タンザニア連合共和国
キリマンジャロ農業開発センター計画
専門家総合報告書(第一分冊)
(根津, 増渕)

昭和61年8月

国際協力事業団

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序　　　文

タンザニア・キリマンジャロ農業開発センター（ＫＡＤＣ）計画は，キリマンジャロ州総合開発計画の一環として，昭和５３年９月１３日に署名された討議議事録（Ｒ／Ｄ）に基づき協力が開始された。

本プロジェクトは，農業生産基盤の整備及び農業技術の確立を通じてキリマンジャロ州における地域開発の促進に資することを目的としており，派遣専門家の尽力とタンザニア側関係者の熱意と努力により成果を上げてきた。昭和６０年１０月に実施された日本・タンザニア合同エバリュエーションによれば，ＫＡＤＣの活動は概ね順調に実施されている旨の報告があり，７年半にわたった協力は昭和６１年３月１２日をもって終了し，第２フェーズのプロジェクトへ引き継がれることとなった。

本報告書は，任期を満了して帰国された根津光也（畑作），増渕清（稲作），難波俊章（かんがい排水），椛木良三（農業機械，保守・整備），大神伸男（農業機械，操作）各専門家のプロジェクトにおける活動をとりまとめたものである。今後，本報告書が，資料，情報の少ないアフリカをはじめとする他の類似地域における農業開発技術協力を推進していく上で参考となれば有意義なことである。

最後に，本報告書の作成にあたりご協力いただいた帰国専門家各位に厚く御礼申し上げるとともに，プロジェクトがより一層発展することを期待するものである。

昭和６１年８月

国際協力事業団
農業開発協力部長
宮　本　和　美

総　目　次

（第一分冊）

Ⅰ　根津光也（畑作）

Ⅱ　増渕　清（稲作）

（第二分冊）

Ⅰ　難波俊章（かんがい排水）

Ⅱ　椛本良三（農業機械，保守・整備）

Ⅲ　大神伸男（農業機械，操作）

Ⅰ　根　津　光　也　（畑作）

任期　５９.２.１５～６１.２.１４

1. 立地条件と目的

Kilimanjaro州は気候も比較的に温暖で，山麓の標高差を利用して，コーヒー豆，バナナ，サイザル麻などの栽培がある。気象的にみて，十分な日照と温度及び湿度較差は各種の作物の栽培に適している。畑作の主力作物はトウモロコシであり，インゲン豆と混作するなどして，雨季を利用した所謂自然依存型の栽培が行なわれている。

しかしながら，畑作を発展さすべき地帯は水利をはじめ問題が多い。したがって，この自然依存型の栽培法を改善するには，かんがい方法のみならず，一般の耕種法全般，すなわち，種子，品種，栽培管理，土壌改良，病害虫防除並びに省力など全体にわたる技術レベルは十分でないことを念頭において，若干高い技術（ feasible technique ）を与えれば，生産が飛躍的に増大する可能性を持っている。したがって，報告者はT.I.P.に基ずき，同州の自給生産を第一に考え，これがひいては農家の収入の増加につながるものとし，適作物の選定及び栽培法の改善を図るべく，各種の試験を行なった。

なお，報告者は，任期中，日常の農作業，研修などあらゆる機会を通じて栽培のポイントを説明し，終始 Counter parts と共に業務を遂行した。その結果，彼等の試験研究に対する意欲と実行力は一層向上し，技術移転の効果は十分にあったものと考えている。

2. 新技術，新作物の導入の必要性

一般の農民は，慣行法の域を脱せず，Needs は弱いながらあったとしても，種子，肥料，農薬などの物資不足，輸送力増強を訴える一方，新技術の経験は全くないと云っても過言でない。すなわち，種子そのものと品種の純度は低く，購入のタイミングからみて，配給乃至は確保するシスティムは未発達である。また，肥料は自国生産するに到っていないので価格も高い。農薬については，D.D.T.などの時代に留まって居り，近代的な農薬の導入は外国に頼っている。特に，輸送力はすべての物資の流通にかかわっていることは極めて厳しい現状である。

結論としては，我々が物資を選択し，彼らに見合った作目を選定し，技術的に生産が向上する可能性を定め，その手段のうち，農耕上の改良方法を手をとって教えてやらねばならない。この点，栽培はあらゆる面を考慮し，農作業の各プロセスの一つでも失敗すれば，収穫は皆無になるとの認識に立って業務を行なわねばならなかった。いいかえれば，日常の栽培管理を intensive に行なうことに尽きるので，報告者は身をもって示し，彼等を厳しく訓練したところである。

新作物の導入の必要性については，上述の状態であるが故に，彼等は考え及ばない。したがって，この新作物の導入の意図と必要性については，今後とも十分に説明し，理解さされねばならない。

3. 作物別の試験結果と Feasible Technique

報告書に添付した成績データーのうち，過去の成績を含めた成績一覧表は，取扱った作物毎，年次別にまとめたものである。特にこの表では作付したほ場，品種，施肥方法，栽培期間，収量と結果を要約して示した。また，今後とも奨励できると考えられる作物については，報告者の判断によって，全データから抜粋し，別扱いとして作物別に載げておく。なお，全データについては，井上淳二リーダー，Counterparts 及び後任者の富高専門家に引継ぎ事項として提出しておいた。したがって，取扱った個々の作物の成績については成績一覧表を参考にして頂きたく，次に主なる作物における試験結果の概要と Feasible Technique は下記のとおりである。

トウモロコシ ― 農家は殆んど無肥料であり，ある政府機関はha当たり，窒素成分で１２０～２００Kgの施用を奨励しているが，データーの信ぴょう性に乏しい。一方，肥料代はかなり高いので，適正な施用量の試験結果が望まれた。２年間のうちで，まともに，データーを処理できる試験を２回実施することが出来た。施用量は窒素成分でha当たり４０～８０Kgが適当と考えられる。すなわち，確かに収量は施用量に比例して増加するが，８０KgＮ／ha以上の施用量では倒伏したからである。統計的に有意な結果を得るには，ほ場の均一性のみならず，栽培が完全に実施されねばならないので，極めて難かしいが，数年間，反復しなくてはならないものであることを明記しておく。但し，試験成績の普及は早い程よいので，我々は，さし当って４０Kg施用を奨励したい。肥料代と収入，作業効率から考えられたところである。なお，施肥時期は８葉期にこだわる必要はなく，むしろ作業効率を考慮すれば，元肥とするべきであろう。

また，トウモロコシに関しては，種子の購入，品種の純度が問題であり，将来は在来品種の純化がＫＡＤＣでは可能である。ハイブリッドは購入と系統維持（採種）に高度の管理が必要であるので，専門の試験場に任せるのがよい。

サツマイモ ― 品種雑ぱくである。純化による収量増が十分期待できるので，サメ地区より苗を購入し，系統選抜を行なった。葉の形と節間の長さに特長がある。これらのうちで栽植密度を高めるには節間の短かい bush型がよいと思われる。実際中耕除草には都合のよい形質であった。また，いもの内部色には，外皮色と関係があり，白色，桃色，赤色，褐色の外皮色に対し，内部は白色，淡桃色の２種類がみられた。Counterparts は白色のものは好まれないと云う。実際食味したところ，白色のものは甘くなく，せんいが多かった。

栽培法は，耐干性のテストも重要であるが，報告者が疑問に思うのは，栽植する苗の状態である。活着と水不足を考慮しての方法のようであるが，葉も先端もすべて除いて植える。そのためか一株に１～１０Kgのいもが１個～２個しか出来ない。この点，今後改善の余地があろう。また，加里肥料の効果の試験も考えられる。系統選抜したものは増殖し，純化しただけでも収量があがるとの認識の上に立って配布されることを望む。

大豆 ― 試作を一回行なった。品種は Indonesia Bogor 産（№29，ＯＲＢＡ）， Egypt産（Clark）及び Korea Agronomical Experiment Station産のアメリカ品種（William '82, Lawrence）の計5品種である。窒素肥料は施用せず，りん酸と加里肥料を施用した。その結果，収量は*ha*当たり1 tonであった。

大豆の試作は，当地において，トウモロコシとインゲンマメの混作が普及していることと，彼等の食生活にマメ類が重要な地位を占めていることで，これらのマメ類に代われる可能性があると考えられたからである。食べ方の問題など残ると思われるが，栽培はかなり容易であろう。将来は種子の寿命が1年と短かいので，自家採種が必要であろう。また，根粒菌は全く着生していなかったので，導入するかどうか課題である。病害虫防除と播種適期（10月が良いとの指摘がある。北海道農試）の検討を望む。

スイカ及びスイートメロン — 2年間の気象観測結果のうち温度については，極めて貴重なデーターであった。（Irrigation Sectionによる。）これを基として，8月より4月までの期間，は種期をかえて，栽培した。スイカの品種は3品種（Sweet Favorite, Sugar Baby，金山）である。結論的に述べると，8月は種で，温度が上昇する，丁度日本に於ける5月初定植7月末までに収獲する作型が最も安全である。12～2月の幹季は余りにも日中の気温が高すぎ，また1～4月の温度下降季は所謂抑制型となり，栽培は難かしい。小規模には雨季に入る3月末までは栽培が可能である。また，畦間かんがいは十分に検討されていない。

将来は，イネわらのマルチングは絶対必要で，時期を失しないよう実行すべきである。また，わらなどの残渣は栽培終了後速やかにすき込み，地力の増強や病害虫の駆除に役立たせるようにする。品種は日本で育成した亜熱帯向け品種である Sweet Favorite 又はこれと同系統の品種がよく，安易な導入はさけた方がよい。日本在来品種は輸送性に乏しく，あらゆる面で現地には適さないからである。野菜の中でスイカは日本に於いてはさほど難しい栽培を要しない。しかし，これとて，Intensive に管理しなければならない例として，別途栽培暦（日誌）を載げておく。

スイートメロンについては，日本産のハウスメロンの試作を行なったが，如何に任地の気象が良いと云っても，元々技術的には無理な品種があった。しかし，露地メロン（マクワ及びこれとの交配品種）のうち，日本でも有名なプリンスメロンは，スイカよりやゝ栽培が難しく，特にウリミバエの被害，収かく直前の病害の進展は早かった。結論的に云って，Counter－parts が出来ないものは農民に普及すべきでない。しかし，若し，望む者が居るならば，スイカの栽培の項で述べた以外に次の事項の実施が必要である。

すなわち，スイートメロンの栽培の要点は，摘芯は絶対必要で，5葉期（第一回）のみならず，14～15節の第二回の摘芯も手まめに行なうこと。ウリミバエは特に初期防除で十分であるが，生育最盛期から収かく初期まで，所謂後半の病害防除とともに油断なく実施せねばならない。なお，試験の結果に示したように，畦巾は2 *m*とし，牛糞5 t／*ha*の施用が収量が最も高かった。

その他の野菜，作物について

キャベツについては窒素施用の効果が大きかった。初期と結球開始期のコナガなどに対する殺虫剤の散布は最小限必要である。ハクサイは7～8月収かくを目途する作型では，大型の極めて良質のものが得られた。これは，報告者の借家の菜園で行なったので，データーとして載せていないが，2年2作の結果である。結球開始直前に尿素を100㎏N/haを追肥し，直ちに土にとけるようなかんがいを行なうのがポイントである。ニンジンは，種子の水浸漬（芽出し）を行なうよう指導した。トマト，ピーマン，ナスについては，T. F. A.（Tanzania Farmer's Association）で取扱っている品種で十分であり，特に栽培上問題がない。慣行の作型を，ことさら替えることはない。以上は，feasible technique であり，現地の菜園でみられるような樹木によるしゃ光は必要である。

パパイヤの雌雄鑑別は，苗では難かしかった。今のところ，間引きを前提として，出来上り本数の約2倍を定植する以外にない。なお，パパイヤの輸出先は日本がトップである。パインアップルでは熱帯で popular な害虫（Diaspis bromeliae）の発生をみた。スミチオン乳剤で防除できるはずである。キャッサバの生育は良かった。加工法が限られている。周年生産を目標にすべきと考えた。

4. 今後とも奨励できる作物と技術目標

今後とは，ローアモシ新プロジェクト地域全体のうち畑作の面積をカバーする作物は何かということである。その点報告者は次のとおり考える。

作物名	技術目標
トウモロコシ	窒素40～80㎏N/ha施用による収量倍増技術の普及。近い将来に地方品種の純化と採種が必要である。
サツマイモ	純化した系統の増殖と普及。
大豆	試作の続行。栽培適期，病害虫防除，土壌管理の試験が必要。
野菜	スイカの栽培普及。その他の野菜については研修による普及を続行し，そのための試作が必要。

5. 耕種全般についてのコメント

試験遂行の過程で得た問題点，経験を基として，各耕種毎に解析したコメントは下記のとおりである。

品種の選択 —— 良質の種子確保が重要。在来品種及びT. F. A. で入手できる品種を重視する。日本品種は一部を除き，現地に適用し難いものがあった。ハイブリッド品種，特に雑種第

一代利用品種は採種の面で，高度の知識（遺伝学の応用）と技術を要するので，時期尚早であろう。

耕うん整地 — 耕うん時期が問題。なお畦間かんがいのためには，かなりのレベリングの修正が必要である。作物残渣のすき込みによる地力増強や乾土効果をねらった耕うんは，燃料不足などで実施し難いが，少なくとも作付1ケ月前には耕うんを終るよう心掛けることである。

施肥 — 窒素施用を優先し，奨励する。ただし肥料代が高いので，収量（収入）に見合う適量の示唆が必要。肥料の種類については，尿素でもよいが，土壌の pH価の修正から考えると硫酸アンモニアを検討すべきであろう。りん酸，加里の効果は確認していないが，早急に検討する必要はない。なお，牛糞は例え少量でも，集中的に施用するよう奨励する。

病害虫防除 — 害虫の種類の同定は服部伊楚子専門家が行ない，かなり特殊なものがある。病害については，報告者が若干判定したところでは，特別なものはなかった。防除薬剤については，D.D.T. が使用されて居り，今のところ止むを得ないが，将来は，供与した安全性の高いマンネブダイセン，D.D.U.P. などの近代的な農薬を最小限使用することが望ましい。また，天敵利用は日本の専門家の指導がなくては全く実施できない技術である。

雑草防除 — 労力面で最大の問題である。作物中心の中耕除草法を考察しなければならない。なお，Trial Farm の農夫の単価と質は問題であり，現地サイドが解決すべき課題である。

ほ場管理 — intensive に行なうよう，あらゆる面から指導する。小農具の管理や栽培資材の準備などの指導にたち帰って実施する以外に道がないよう思われた。

6. Pilot Farm の成績

村当局の計画性と実行とのずれが大きく，その記録を入手，集計するのに多大の労力が必要であった。すなわち，技術の普及以前の問題があり，十分に指導することができなかった。栽培技術面からのみ見ると，ほ場の均一性は極めて悪く，畦間かんがいが十分に出来なかった。しかし，これはレベリングだけの問題ではない。この土質では，畦間かんがいが出来ても，かえってこれにより，土が固結化し，塩類の集積をみることは明らかである。なお，一部，スイカの栽培指導を行なったが，専門家の意見を聴かず，無理な作期の栽培を計画したので，最も安全な8月播種の作型のみが成功した。

7. KADC畑作課における研修とセミナー

研修 — 報告者はKADC畑作部研修について，第2，3，4回を担当した。対象は農業改良普及員主体とし，野菜栽培コースを実施した。1回当たり15名である。第2回の研修生の質は極めて良く，研修の成績を各担当地区に普及しつつあることは，アフターケア調査でもよく観察され，評価された。第3回の研修生の質は劣った。第4回はカリキュラムから実習計画（例えば3000本の苗を育苗準備する）に到るまで，4名の Counterparts が積極的に取

組んだのにもかかわらず，開講出来なかった。現地サイド（普及担当局）などに原因がある。すなわち，畑作部門は取扱う作物が多いので，普及員を対象とするのに異論はないが，研修生の質とその向上を考慮する必要がある。参考のために，第2回のカリキュラムを一例として掲げておく。要は，講義と実習の調和を基とするやり方である。

研修の一環として他州の見学旅行を実施した。報告者は十分効果が上ったものと考えている。しかし，交通に関する諸手配（車の整備，燃料の確保，日程と走行距離等々のプランと実行）については，すべて専門家（各部の専門家，調整員）が行なわねばならない。2回の長距離旅行で，報告者はCounterparts に引卒方法を厳しく教えたので，今後は自力で実施できよう。但し，交通に関しては，今後はなるべく近距離とするのが望まれる。

セミナー — KADC第一回セミナーを開催し，Counterparts の一人である Mr. Sarakikya に畑作課の成績を発表させた。FAOの Dr. Deckersを招待した。課題は「トウモロコシに対する窒素施用の効果」である。Mr. SarakikyaはKADCのスタッフで最も優れた Counterparts と考えられるので，増渕清専門家の協力を得て，統計処理などかなり高度の知識を習得させるようにした。また，このセミナーはKADCの Counterparts 全員のレベルアップも目的としているので，データーのまとめ方，発表の準備，講演方法など全般にわたって，指導した。

8. その他の活動

報告者は，任国主催の農民デー（SABA SABA フェスティバル）にKADCも参加した中で，畑作部門の出品展示を企画指導した。

9. Counterparts の資質の向上と技術伝達の効果

報告者の直接指導並びに日本に於ける研修により，その資質は極めて高められたものと考えられる。Counterparts が習得した技術が効果をあらわすかどうかは，今後の彼らの活躍に期待するところである。Counterparts の氏名は下記のとおりである。

Mr. Zablon Kilenga Sarakikya
Mrs. Grace Mshanga
Mrs. Lucy Manase Chihongo
Mr. Beatus Macha
Mr. William Ndoro

以　上

付属資料

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1. 作目選定／品種

List of Crops in Tanzania

Citrus: sweet orange,limes,grapefruit,lemons,mandarins,pommeloes.

Coconuts: (40,000 ha),coast,Lakes Nyasa,Tangangika and Victoria.

Cocoyams: west shores of Lake Victoria.

Coffee: (Arabica coffee). south and west sides of Mt.Kilimanjaro.
south side of Mt.Meru.
(Robusta). Bukoba.

Cotton: south and east of Lake Victoria (including Mwanza). parts of Mara,Shinyange,Tabora,west Lake Regions,central area and coast. (500,000 - 600,000 ha. 1960).

Cow peas: central province.

Finger Millet: north Mara District.

Groundnuts: coast,lakes in the south.

Maize: Bukoba,Ngara,Kibondo,Mara,Moshi,Arusha,Pare,Lushoto,Morogoro, Iringa,Rungwe,Songea. (600,000 ha).

Mangoes: coast.

Pawpaw: rift wall area to the south of Lake Manyara, southern slopes of Mt.Moru.

Pigeon peas: southorn part of the country.

Pineapple: Korongwe Tanga Reagion.

Potatos: northern Highlands (Moshi,Arusha,Lushoto). southern Highlands (Njombe,Mbeya).

Pyrethrum: western slopes of Mt.Kilimanjaro.

Rice: 60,000 ha. western Tanzania,south of Lake Victoria,Lake Nyasa, Pangani,Ruvu,Rufiji.

Sim sim: Mtwara,Ruvuma,Songea.

Sisal: Tanga-Korogwe,Kilosa-Morogoro,Arusha,Moshi,Lindi,Mtwara. (280,000 ha).

Sorghum: 400,000 ha. dry central part.

Sugar cane: Arusha-Chini (3500 ha),Kilombero (3000 ha),Kagera,Mtibwa, Karangai.

Sunflower: Iringa,Morogoro,Kilimanjaro.

Sweet potato: Kilimanjaro.

Tea: Mufindi,Njombe,Tukyu,Usambara Mts.,Bukoba. 11,000 ha.

Tabacco: Iringa.

Wattle: Njombo.

Wheat: 60,000 ha. Karatu,Oldeani,Mt.Kilimanjaro,Monduli,Babati, Basuto,Uwemba,Njombe(26,000 ha),Mbulu,Mbeya,Mbozi,Usambara, Matengo Highlands,Mwezi Highlands.

Minor Crops

Cereals ---- Oats,Tef.

Essential Oil Crops --- Geranium,Rosemary.

Fibre ---- Flax,Kenaf,New Zealand Flax.

Miscellaneous--Bixa, Gourd, Passion fruits.

Oil seeds--Linseed,Rape,Soya beans.

Pulse--Bambara groundnuts (southern Lake Victoria).Chick peas (southern Lake Victoria),Lima beans,Runner beans,Peas.

Root Crops --- Yam(Kilimanjaro),Tannia.

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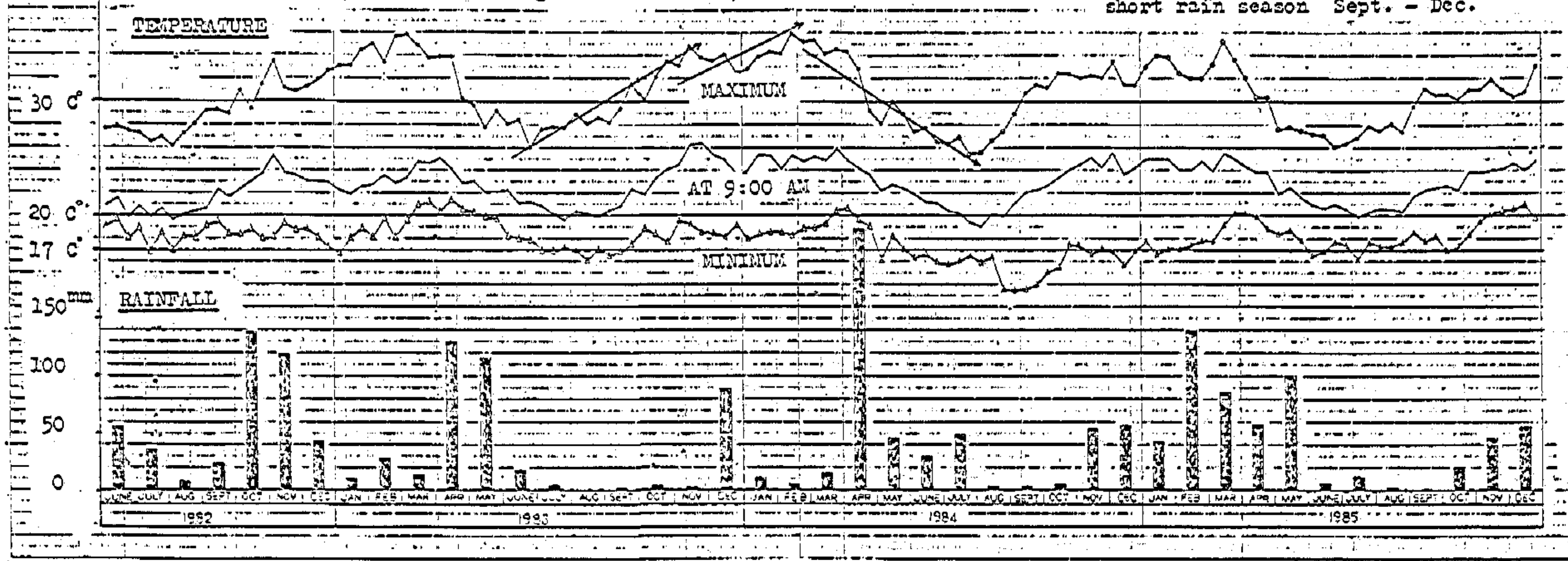
references: East Africa Crops. by J.B.Acland. 1971.
Longman Group Limited,London.により，根津がまとめた。

2 気象表

TEMPERATURE AND RAINFALL MEASUREMENT AT CHEKERENI METEOROGICAL STATION
(K A D C Irrigation Section)

hot/dry season	Jan. – Mar.
rainy season	Mid Mar. – Mid June
cool/dry season	Mid June – Sept.
short rain season	Sept. – Dec.



Location : Latitude 3°28' S, Longitude 37°25' E, Elevation 725m.

気象表

3. KADC 畑作部門試験成績一覧表（１９８１／８２より１９８４／８５）

CROPS	PLOT	VARIETY	PURPOSE	FERTILIZER	DURATION OF CULTIVATION	YIELD	ACHIEVEMENTS/COMMENTS
1981/82							
Maize	C1-6 2.4ha	Katumani H632, UCA, Ilonga	Varietal trial	40kg.N/ha 20kg.P_2O_5/ha.	3 4 5 6 7.8 9 10 11 12 1 2 Sowing Harvesting S----------H 29-31/3/82 - Sept./82	Katumani 740kg./ha. Ilonga 2,305 kg./ha.	Variety Ilonga and UCA showed good yield. But, soil condition was very poor.
Beans	B1-3 1.2ha	Canadian Wonder, Masai Red, Selian Wonder	Variental trial	No fertilizer	S ------H 16-7/6/82 - Oct./82	Very poor yield	The yield could not confirm due to damage by virus and other harmful insects. Serious damage during flowering time.
Alfalfa	A5 - 8	Local variety	Improvement of soil condition	No fertilizer	S-------------H Beginning 3/82 - Oct./82	Observation	Cultivation has been done for soil improvement on watermelon Alfalfa supressed weeds, especially Nut grass (Cyperus escalentus).
82/83							
Melon	B4 - 5 0.8 ha.	Watermelon (KANAYAMA) Sweet melon, (KINTSUYU, TSUTO).	Exploratory checking	Farmyard manure	S-----H 25/8/82 - 11/10/82	Very poor	Heavy infestation of insects and diseases. Special fungus and insects should be indentified. Some sales was done but no record kept.
Sweet potato	A1 0.14 ha.	Chekereni	Vine propagation	No fertilizer	S-------H 13/8/82 - 18/1/83	15.5tons/ha. 2.17tons/0.14ha.	The yield is agreeable, and some kind of beetles (Silas Formicarius, S. puncticollis) damage was not serious.
Sunflower	A1 0.2 ha.	TAN seeds Co.	Exploratory	No fertilizer	S-----H 28/7/82 - 30/10/82	0.67tons/ha (121 kg./0.2 ha.)	Seriously damaged by Sudan Dioch (Quelea Quelea eathiopica) No person was for bird scaring, much was destroyed at milk stage.
Vegetable Beans	A2 0.34 ha	Japanese variety "ALON"	Exploratory, seeds production trial	No fertilizer	S------H 23/8/82 - 9/10/82	No record	Too inmatured pods was not marketable. Seed for propagation should be harvested in the profitable maturing time.

CROPS	PLOT	VARIETY	PURPOSE	FERTILIZER	DURATION OF CULTIVATION	YIELD	ACHIEVEMENTS/COMMENTS
Irish potato	A3 0.34 ha.	Local variety introduced from West Kilimanjaro.	Exploratory,	No fertilizer	3 4 5 6 7 8 9 10 11 12 1 2 S----------H 4/10/82 - no record	Extremely poor	Observed genetical segregation (nearly two different colour of tuber). The lower Moshi area is not profitable for cultivation because too hot this crop.
Brocolli	B6 500 m^2	Japanese variety "green Comet"	Exploratory		S----H 16-18/10/82 - 12/82	38 kg.	Compared with cauliflower, the change of fruit color was fasten and not so popular in market.
Eggy plant	B5 1,500m^2	Japanese Variety "SENRYO No.2"	Exploratory		S-----H	6.6 tons/ha. around 1000kg/plot	Local variety has hard skin. The Japanese variety quality was better than that one, therefore no market due to soft skin caused loss of water thus wilting faster.
Maize	C1-6 2.4 ha.	Ilonga U.C.A.	Productivity	40,60,100kg.N/ha	-H S---- 16 - 18/11/82 - 8/3/83	1.3 tons/ha. (3.1tons/2.4ha.)	No difference has been observed between the two varieties, the variety "Ilonga" matured earlier slightly and more pure on segregation of character.
Beans	B1-3 1.2 ha	1.Canadian Wonder, 2.Masai Red, 3.Selian Wonder	Productivity	No fertilizer	S---------- H 10 - 11/9/82 - Beginning of Feb.1983	1.160 kg./0.4 ha 2.1 02kg./0.4 ha 3.230kg./0.4 ha.	The yield was nearly half due to unexpected strong wind. Selian Wonder was highest yield but low quality of seed. We selected Canadian Wonder as tentative administration.
1983/84 Watermelon	A7,8	KANAYAMA	Exploratory	Farm Yard	-H S--	Water melon	Marketable in watermelon.

CROPS	PLOT	VARIETY	PURPOSE	FERTILIZER	DURATION OF CULTIVATION 3 4 5 6 7 8 9 10 11 12 1 2	YIELD	ACHIEVEMENTS/COMMENTS
and sweet melon	(0.17 ha. + 0.36 ha.)	A - 1 Melon	-do-	manure	5/1/83 - 15/3/83	522p/0.36ha.	It was clarified that melon-fly (Dacus cucurbitae) was main insect attacking the fruit of sweetmelon.
Sweetpotato	A1 0.18ha A3.5 0.36 ha	4 local varieties at Chekereni Collected.	varietal trial	No fertilizer	S————H 9/4/83 -	Failed	Irrigation was stopped due to unexpected out of order of watering pump KADC.
Maize	B1 - 6 2.4 ha.	Ilonga UCA	Preliminary test of urea application	100 kg.N/ha.	19-21/4/83 - 15/8/85	1.3tons/ha. (3.13 tons/ 2.4 ha.	In low yield, could not be judged both varieties for administration.
Sunflower	A1, 2,6 0.9 ha.	TAN Seeds Co.	Yield test in different sowing time	No fertilizer	1.--H S- 7/3/83 - 2.S———H 15/4/83 - 3. S———H 26/2/83 -	Yield per 0.36ha. 1. Non 2. 74 kg. 3.239 kg.	The experiment has carried out to find out minimum damaged month. But we could not, therefore sowing on April or May is diminishing the damage. Originally the bi d flying around the year the plan should be doubtful.
Sunflower	A6 0.36 ha.	TAN Seeds Co.	Survey bird Scaring seasons	No Fertilizer	S———— H 20/everymonth/83	Observation no record	There was 2 months which showed that bird damage was minimum but we couldn't conclude anything because we didn't finish the sowing for the arranged 12 months.
Ordinary beans	C1 0.4 ha	Canadian Wonder	Confirmation on sowing time	No fertilizer	--H S————	Observation	There was some difference for month of April, May and June seemed to have high yield but no conclusion can be given as we didn't sow for the last 3 months.
Cabbage	C4 378 m^2	Japanese Variety "NAGAOKA"	Urea application trial	Nil, 60,80,100, 120, 150 Kgs.N/ ha. 3 replication	S———H Transplanting 5/8/83 - harvesting 20/12/83	9.36tons/ha. (495kg. /378 m^2)	Maximum yield was obtained in 150 kg. N/ha, 41.5kg./21m^2 (19.76 tons/ha). So the yield in no fertilizer showed

CROPS	PLOT	VARIETY	PURPOSE	FERTILIZER	DURATION OF CULTIVATION	YIELD	ACHIEVEMENTS/COMMENTS
					3 4 5 6 7 8 9 10 11 12 1 2		19.66kg./21m^2 that urea application should increase the yield above two times.
1984/85 Maize	B2 - 5 1.6 ha	H 512	Urea application (preliminary test).	Nil, 40,80, 120 120 kgN/ha.	S----------H 28/4/84 - 19/9/84	2.5 tons/ha (5,002tons/2.0 ha.)	The yield increased than former year's. But levelling of the plot was too bad to compare yield of each plot.
Maize	36 0.4 ha	H 512	Urea application (statistic analyisis plot)	Nil, 40,80, 120 kg.N/ha. 4 replication	S----------H 28/4/85 - 19/9/84	No 2.864 kg./ha N40 4.208kg./ha N 80 4.962 kg./ha	Variation in control plot was high. The design should be considered. Therefore some effects of urea was indicated.
Maize	C1 0.4ha	H 512	Cultivation trial in dry Season.	100 kgN/ha	S----------H	2.8 tons/ha (1.12 tons/0.4ha.)	Total duty of water was 2,822m^3 (7.3^{mm}/day). (Irrigation section measured).The yield was satsifactory.
Water Melon	A 13, 14, 3200 m^2	1. sweet favourite 2. Sugar Baby 3. KANAYAMA	Comparison of production in 3 varieties of watermelon in the temperature raising period.	farm yard manure 5 tons/ha 10 tons/ha Nil	S----H 1/9/84 - 28/11/84	1. 12.23 tons/ha 2. 9.59 tons/ha 3. 3.15 tons/ha	The cultivation was carried out nicely, variety Sweet Favourite showed high production and the weight of fruit recorded 10kg. in average.
Sweet Melon	A 15 1800m^2	Prince Melon 1,200m^2	Relation of width of bed and amounts of farm yard manure applied	1.4m. Nil 2.4m 5ton/ha 3.2m Nil 4.2m 5tons/ha.	S----H 1/9/84 - 28/11/84	1. 1.78 tons/ha. 2. 5.26 tons/ha. 3. 4.98 tons/ha. 4. 6.08 tons/ha.	In order to investigate the effects of width of bed, many factors influenced should be considered.(placing of fertilizer covering degree of vine and irrigation/drainage effect etc.) Therefore we have considered that 2m width was stable on production for sweet melon.

CROPS	PLOT	VARIETY	PURPOSE	FERTILIZER	DURATION OF CULTIVATION	YIELD	ACHIEVEMENTS/COMMENTS
					3 4 5 6 7 8 9 10 11 12 1 2		
		MAKUA 200m^2	Collection of performances on cultivation	2m width bed, 5 tons/ha.farm yard manure	S---H 1/9/84 - 28/11/84	6.22 tons/ha.	The production was satsfactory, but we decided to stop the production against the attractive golden skin color because the fruit quickly spoiled within 1 - 2days.
		Net Melon "Nice Melon" "A-1 Melon" "cantalope"	Exploratory	4m width bed, 5 tons/ha.farm yard manure	S---H 1/9/84 - 28/11/84	observation	Skin and special smell was attractive, but they were susceptible against red melonfly. In conclusion on varietal trial, we dicided to choose Prince Melon to be administrated.
Vegetable beans	A 12 0.16 ha	Japanese variety "Alon"	Weeding trial by mini-tractor	50 kgN/ha.	S-----H 24/8/84 - sowing 17/10/84 - 7/11/84 harvest	4.4 tons/ha (708kg/0.16 ha)	Spacing of row to row should be reduced 70cm to 100cm for machinery weeding. Saling was successful.
Carrot	A 12 800 m^2	Nantes (Royal sluis, seeds Co.)	Investigation on Leaf/Root ratio	50 kg n./ha	S--------H 27/8/84 sowing ;1/11/84 - 14/1/85	50 kg,30m in length of row	Irrigation and high temperature were not sufficiently,Ratio Leaf/Root was 73%. It was expected to be 50%.If the ratio could be as expected (50%) we could have high production.
Tomato	A 12 800m^2	Roma VF 2 Manded F1 Manglobe (Royal sluis seeds Co.)	Varietal trial	50 kg./ha	S---H transplantation 2/10/84 harvest 7/11/84	Observation	Irrigation was incomplete due to water shortage. Virus and disorders due to higher tempera- were also observed. No problem about seed quality was investigated.
Sweet pepper	A 11 800m^2	Yolo Wonder B	exploratory	40 kg. N/ha	S---H transplantation 2/10/84 harvest 23/11/84	1.37 tons/ha (110 kg. nice one) (71 kg.reject)	-do- additionally, transplantation method was not profitable even though plastic pots was used in nursery.

CROPS	PLOT	VARIETY	PURPOSE	FERTILIZER	DURATION OF CULTIVATION	YIELD	ACHIEVEMENTS/COMMENTS
1984/85					3 4 5 6 7 8 9 10 11 12 1 2		
Water Melon	A7,8 3200 m^2	Sweet Favourite	Production trial during temperature falling period (water-melon)	Farm yard manure 5tons/ha Urea/T.S.P. 40.80 kg./ha ingredient	---H S- 1/1/85 - 10/4/1985	256 pieces 2.7 tons/3200m^2 (8.4 tons/ha)	Productivity was inferior than the yield of the previous trial during temperature raising period (12.33 tons/ha). It should be cultivated so that is harvested before beginning of April.
	A 9 1600m^2	Prince Melon	Production trial during temperature falling period (sweet melon)	-do-	-H S- 1/1/85 - 22/3/85	649 pieces 373kg./1600m^2 (2.3 tons/ha.)	Mildew disease was services in in the maturity time. Specific fungicide (ex. polyoxyine) should be sprayed in time.
Sweet potato	C2 0.3 ha	Chekereni strain	Production trial	No fertilizer	-H S--------- transplantation 14/9/84 harvest 18/2/85 - 28/3/85	5.6 tons/ha. (1667 kg./0.3ha nice one)	Rejected 481 kg. was due to the bettles attacking, harvesting should have been carried earlier around one month, i.e. within February.
Papaya	C3 0.4 ha	Collected seeds from Aph-odite stocks.	Density and sex-ratio investigation	No fertilizer	------------H S----- transplantation 13/11/84 harvest started Sept.	Fruiting	Fruit bearing tree and male flowering tree (sex ratio) was counted. The ratio was 1:1(even) female trees usually appear at random so, if density is increased we should get the proper density in the orchard, after removing out the males at flowering stage.
Pineapples	C4 0.2 ha	introduced from Mwanga District	exploratory	110 kg.N/ha.	S------------------ 6/3/85 transplanted	not yet	The fertilizer not yet applied. The growth rate of suckers and crown is different. Some kinds of pest (Diaspis bromeliae KERDER) attacking the stocks, so we are using Sumithione to control.

CROPS	PLOT	VARIETY	PURPOSE	FERTILIZER	DURATION OF CULTIVATION 3 4 5 6 7 8 9 10 11 12 1 2	YIELD	ACHIEVEMENTS/COMMENTS
Cassava	C_5 0.1 ha.	Chekereni	Comparison of production in different transplanting time.	No fertilizer	S——H transplantation 27/2/85 " 25/4/85 " 16/5/85	Not yet	The stocks which transplanted on 27/2/85 will be harvested in January, 1986.
Soya bean	C_6 0.1 ha	5 varieties introduced from Korea Egypt and Indonesia	Varietial trial	No nitrogen Lime 50 Kg./10a TSP 7.7 Kg./10a Potassium Sulphate 10 Kg./10a ingredient.	S——H sowing 9/4/85 harvest mid July - mid. Aug. 1985	1.1 tons/ha in average	Korea (William'82 1.14 tons/ha. Lawrence 1.03 tons/ha). Indonesia (ORBA 1.19 tons/ha). Other two varieties were omitted due to low production. Did not apply any nitrogen fertilizer to expect the activity of nitrogen-fixing bacteria. However the formation of the bacteria galls in the roots was not apparent. In order to increase the yield in the successive reason, the introduction of the bacteria stock of application of nitrogen fertilizer in minimum should be considered.
Maize	B1,2,3, 4,6. 2.0 ha B5 0.2 ha	MH·12 H 512	Fertilizer verification trial Fertilizer trial (statistic analysis plot)	Urea 40,80,120 kg. N/ha. RCBD Nil, 40,80,120 kg.N/ha. 4 replication	S——H Sowing 18-20/3/85 harvest Sowing 18-20/3/85 harvest 8/8/85	harvested harvested and analysed	Results was not clear due to poor levelling/another cultivation procedure. Production Kg/ha N 0 1,260 c C.V. 29.7% N40 2,537 bc N80 3,537 ab L.S.D.(0.5) 1,496 Kg/ha N120 4,941 a
Sweet and watermelon	C6 0.1 ha	Sunrise sweet favourite KANAYAMA Sugar Baby	Furrow irrigation	top dressing 4.8 kg/1040m^2 urea, 3.84 Kg/1040m^2 TSP	—H S— Sowing seed in nursery 26/1/85 transplanted on 23/2/85		No fruits harvested due to pest damages, and weeds were not controlled by the method of hand weeding/straw mulching. It indicates that the cultivation should be conducted such that harvesting will be finished before Mid-April when rainy season has started.

CROPS	PLOT	VARIETY	PURPOSE	FERTILIZER	DURATION OF CULTIVATION	YIELD	ACHIEVEMENTS/COMMENTS
Sweet potato	D1 0.2 ha C6 0.4 ha	Chekereni Same Moshi (shanty town)	Selection of hopeful strain and propagation of original stock.	Lime 50kg./ha			Five appreciable strains were selected charactors (Shape of leaf and internode, colour of skin and weight of tuber per plant) and leaf/root ratio should be considered to get high yield. The strains are to be propagated in C6 to test actual yield.

Seeds Vegetable Aviable in T.F.A. (Tanzania Farmers Association), Moshi. on 25th April 1984.

Kinds of vegetable seeds	Variety	Price per Kg. (Tsh)
1. Tomato	Money Maker Maglobe	1,066/- 1,066/-
2. Watermelon	Sugar Baby	500/-
3. Onion	Texas Grano Rod Creole	435/- 510/-
4. Cabbage	Drum Head Grey Hound	373/- 400/-
5. Swisschard	-	260/-
6. Cucumber	-	211/-
7. Chinese Cabbage	-	377/-
8. Hot Pepper	Yellow Wonder Cayunne	969/- 1,366/-
9. Egg Plant	Long Purple Black Beauty	630/- 630/-
10. Carrot	Nantes Chanttegay	377/- 371/-

Others: Beets, Radish, Cauliflower, Green pea, Sweet pepper.

Remarks: All most of the seeds mentioned above were imported from Royal Sluis Seeds Company Ltd.,Holland.

大豆に関する試験データ

Table 1

PERFORMANCES ON CULTIVATION

Plot:	Trial Farm Plot C. No.6
Area:	1,000m^2 (25m x 40m)
Variety:	5 varieities
area/variety;	180m^2/variety
Spacing:	1m ridge, plant to plant distance, 30cm, 2 seeds/Pit. 2 rows.
Land preration:	Level adjustment on 2nd April, 1985 rotary and ridging on 6th April, 1985.
Fertilizer:	Lime 50kg./10a. T.S.P. (46% P_2O_5) 7.7 Kg./10a, Potassium Sulphate (50% K_2O) 10 kg./10a in active ingredient, respectively.
Sowing date:	Direct sowing 9th April, 1985
Plant protection: (pesticides)	D.D.T. in the early growing stage D.D.V.P. and Dithane in flowering stages. 2 times.
Irrigation/ drainage:	Drainage on 4th May, 1985 fullow irrigation weekly
Harvesting:	10th July, 1985 (Williams 82) 15th July, 1985 CLARK, LAWRENCE AND GEBA 20th August, 1985 (No.29)

Table 2

CHARACTERISTICS OF SOY BEANS

VARIETY	NUMBER OF PODS/PLANT	NO. OF GRAINS PER PLANT	WEIGHT OF GRAIN/PLANT	WEIGHT OF PODS/PLANT	NO. OF UNFI-LED PODS	NO. OF UNFERTILI-ZED GRAIN/POD
ORBA	191.25	374.6	52.78	83.03	18.3	26.95
WILLIAM'S 82	105.8	229.0	32.87	82.978	4.0	11.15
LAWRENGE	90.45	209.15	42.94	59.61	3.7	10.6
CLARK B	58.7	106.2	22.20	33.713	2.7	13.35
CLARK A	81.8	172.8	36.925	52.785	1.95	15.4

VARIETY	STEM LENGTH	DIAMETER OF STEM/MM	NO. OF NODES	NO. OF BRA-NCHES MORE THAN 2NODES	WEIGHT OF PLANT (ROOTS)	WEIGHT OF STEM	LENGTH OF INTER-NODES 3rd,4th/MM
ORBA	61.23	6.87	17.35	6.55	94.45	15.93	11.31
WILLIAM'S 82	42.97	9.3	17.45	4.85	101.683	18.68	15.56
LAWRENCE	43.74	7.60	16.0	4.65	50.23	9.37	11.58
CLARK B	33.82	6.375	11.95	4.3	44.449	10.74	12.77
CLARK A	29.35	7.114	13.4	4.15	53.175	6.41	12.95

Table 3

Estimated yield from samples (20 plants sample) of five different Soy beans varieties, and actual yield in $180m^2$.

Variety	Estimated yield		Actual yield	
	$Kg/6.06m^2$	Tons/ha	$Kg/180m^2$	Tons/ha
No. 29	-	-	5.000	0.277
ORBA	1.056	1.743	21.556	1.197
William 82	1.826	3.013	20.576	1.143
Lawrence	0.858	1.416	18.608	1.033
Clark A	0.739	1.219	) (A+B)) 8.183	) (A+B)) 0.454
Clark B	0.444	0.733	)	)

4. サツマイモの系統選抜されたものの形質の記録

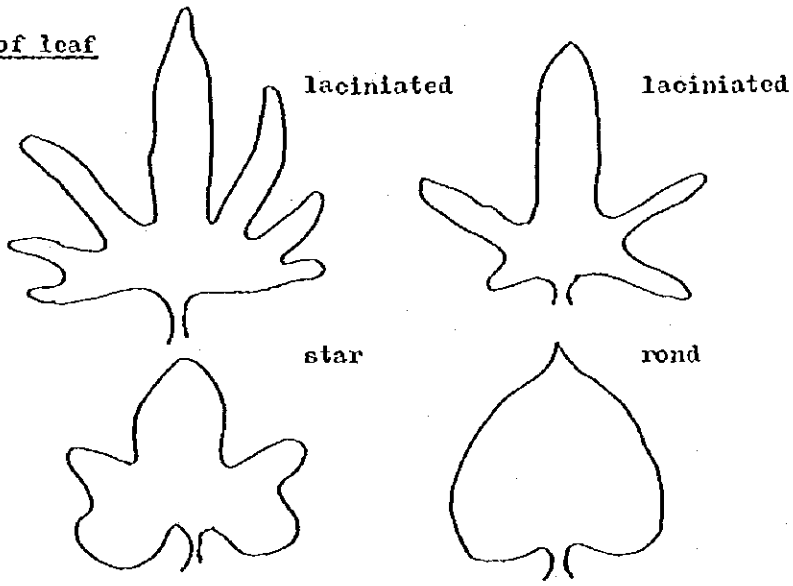
CHARACTERS OF 5 STRAINS (9 SUB-STRAINS) OF SWEET POTATOES

Strain	Shape of leaf	Color of tuber	Length of internode	Tuber weight/ plant
1.Checkereni				
A	laciniated	white	medium long	1.05 Kg*
B	laciniated	white	medium long	-
2.Same I				
A	laciniated	red	short from begining long towards end	6.95 Kg
B	laciniated	red	-do-	7.35 Kg
C	laciniated	red	-do-	9.75 Kg
3.Samo II				
A	star	whitish red	long	9.4 Kg (oval shaped)
B	star	whitish red	long	3.95 Kg (oval shaped)
4.Same III	laciniated	white	very long	4.5 Kg
5.Same IV	rond	white outside inside pinkish	short	6.5 Kg

Remarks: * ; maturity was not yet.
Record on sweet potatoes D1-Plot of Trial Fram (19/11/1985).

We have classified (selected) with four characters, namely, shape of leaf colour of tuber, length of internodes and weight of tuber per plant. These five hopeful strains which we have chosen we hope to get good production because will be propagated in C6-Plot of Trial Farm,KADC.

Shape of leaf



Production of Sweet Potato in Dry Season

Harvesting Date	Nice One (Kg)	Rejected (Kg)	Percentage of Nice One
12 / Feb	58.5	0	100.0
15 / Feb	83	47	63.8
18 / Feb	213	0	100.0
22 / Feb	245	0	100.0
25 / Feb	186	46.	80.1
3 / Mar	212	39	84.4
4 / Mar	161.5	45	78.2
5 / Mar	277	30	90.2
10 / Mar	147.25	20	88.0
20 / Mar	84.5	0	100.0
28 / Mar	0	254	0.0
Total	1,667.75	481	(77.6)

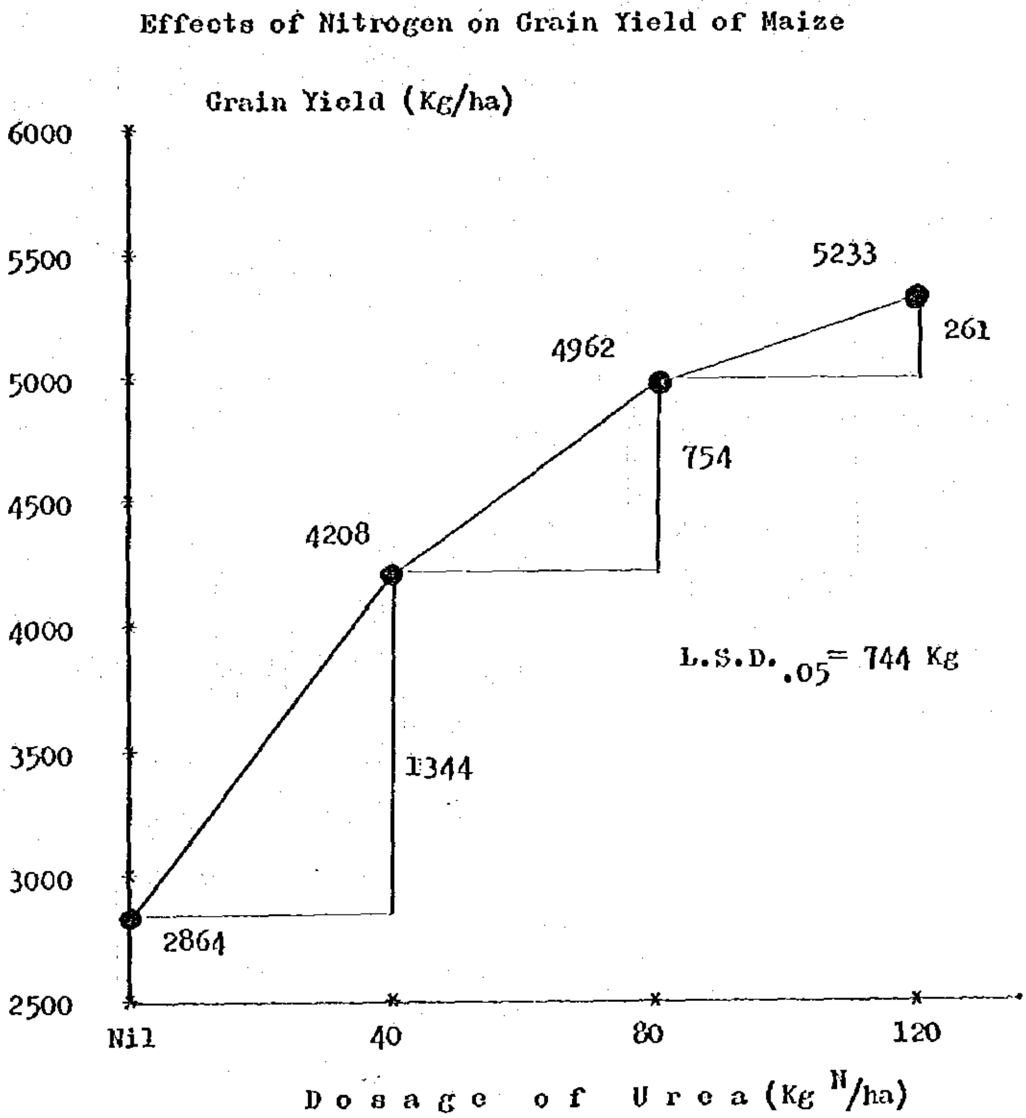
Remarks: Saled 1609.75 Kg (5.36 tons / ha).
Nice 1667.75 Kg (5.55 tons / ha).

Remarks: Transplantation ; Three times (10th, 11th, 12th in September, 18th in September and 26th in Octover) in 10 a.

Plot of Trial Farm ; Plot C - No.2, total 30 a.

Harvesting ; From 12th Feb. to 28th Mar.

トウモロコシに対する窒素施用に関するデータ



5. トウモロコシ窒素施肥

Table 1: Outline of cultivation in the experimental plot and design on fertilizer application.

1.	Name of Crop/variety:	Maize H512
2.	Plot :	Plot B No. 5 Trial Farm
3.	Date of sowing :	18/3/85
4.	Irrigation/duration :	6.8 mm/day, furrow irrigation 7 days interval 25/3/85 - 13/7/85
5.	Harvesting :	8/8/85
6.	Selling/measuring :	6/9/85 - 10/9/85
7.	Experimental design :	RCBD 4 treatments x 4 replications
8.	Area of experimental field :	24.0 m x 16.8 m
9.	Harvested area :	8.64 m^2 in each plot (4.2 m x 6.0 m)
10.	Kinds of fertilizer :	Anmonium Sulphate (21% Nitrogen)
11.	Nitrogen level :	Nil, 40 Kg, 80 kg, 120kg/ha in nitrogen ingredients.
12.	Bed design :	Ridge 90cm width pit to pit distance 40 cm 2 plants per pit.
13.	Method and time of application :	Top dressing 15/4/85

Effects of Nitrogen on Grain Yield, Plant Height, Ear Placement Height and Lodging of Maize (B - Plot, 1985)

Table 1.

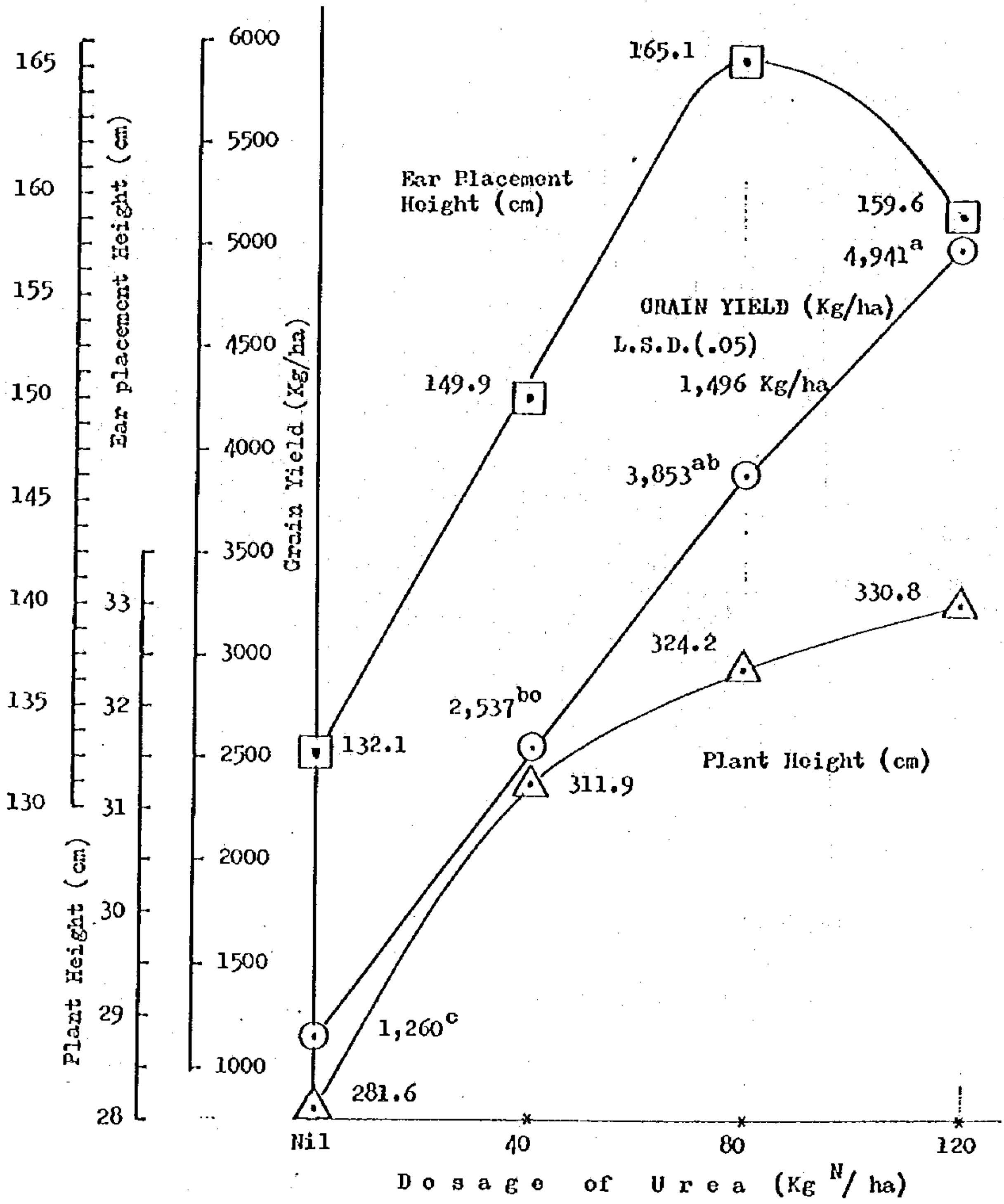
Treatment	Grain yield (Kg/ha)	No. of plant harvested per plot (per ha)	No. of ears harvested per plot (per ha)	No. of rotten ears / plot
N 0	1,260 c	185 (53,241)	104 (30,092)	21
N 40	2,537 bc	192 (55,555)	124 (35,880)	15
N 80	3,853 ab	185 (54,398)	132 (38,194)	11
N 120	4,941 a	176 (50,926)	143 (41,667)	21

Table 2.

Treatment	Plant height (cm)	Percentage root lodging (%)	Percentage stem lodging (%)	Ear height placement (cm)
N 0	281.6	11.9	15.7	132.1
N 40	311.9	5.2	17.2	149.9
N 80	324.2	7.4	15.7	165.1
N 120	330.8	7.9	21.6	159.6

Remarks: Plot area --- 8.64 m^2
C. V = 29.7 %
L. S. D.(.05) = 1,496 Kg/ha

Effects of Nitrogen on Grain Yield, Plant Height and Ear Placement Height of Maize (B-Plot,1985)



スイカ及びスイートメロン栽培に関するデータ

COMPARISON ON YIELD IN THREE WATER MELON VARIETIES

SWEET FAVORITE		Yield/1600 m^2 Number/Weight (Kg)	Production/ha Number/Weight (ton)
Preliminary	P	314 (2,297.5)	1,962 (14.359)
Nice One	N	254 (1,958.0)	1,587 (12.237)
Sales	S	208 (1,570.5)	1,300 (9.815)
Last harvesting	L	314 (1,271.5)	1,962 (7,946)
Over-all Total	P+L	628 (3,569.0)	3,925 (22.306)
SUGAR BABY		Yield/800 m^2	Production/ha
	P	161 (907.5)	2,012 (11,343)
	N	133 (767.5)	1,662 (9,593)
	S	109 (625.0)	625 (7,812)
	L	209 (587.5)	2,612 (7,343)
	P + L	370(1,495.0)	4,625 (18,687)
KANAYANA		Yield/800 m^2	Production/ha
	P	44 (268.5)	550 (3,356)
	N	41 (252.0)	512 (3,150)
	S	15 (88.5)	187 (1,106)
	L	96 (245.0)	1,200 (3,062)
	P + L	140 (513.5)	1,750 (6,418)

Remarks: Variety: Sweet Favourite is F_1 hybrid produced in Japan for sub-tropical region (SAKATA Seed Company).

Sugar Baby is sold in T.F.A. (Tanzania Farmer's Association) produced in Holland (Royal Sluis).

KANAYAMA is produced SAKATA Seed Company for Japan.

KANAYAMA is one of the Japanese varieties which is produced by SAKATA Seed Company for Japan to meet internal needs.

Remarks:
- A: Preliminary harvesting including spoiled ones
- N: Nice ones omitted from spoiled/injured/inmatured etc.
- S: Sold ones after selection
- L: Last harvesting including small fruits in the plot. We harvested all fruits remaining in the plot to estimate the over-all yield if the cultivation will improve in the successive seasons.
- P + L: Over-all total. Estimation of maximum yield when the cultivation will be done perfectly.

CHARACTERISTICS OF THREE VARIETIES OF WATERMELON

Characteristics	Sweet Favourite	Sugar Baby	KANAYAMA
Average weight of soled ones (Kg)	7.48 Kg	5.88 Kg	6.04 Kg.
Average weight in the last harvesting (Kg)	4.04 Kg	2.81 Kg	2.55 Kg
Production per hectare (tons)	14.359 tons	11.343 tons	3.356 tons.
Percentage of edible portion (%)	58.9%	62.6%	55.9%
Skin colour	Light green, dark green stripes	dark green, base yellow	Light green, green stripes
Shape of fruit	pillow	round	round
Hardness of skin	hard	very hard	weak

WATERMELON $A_{7,8}$ (3200m^2) HARVESTING DATES AND PRODUCTION OF "SWEET FAVOURITE"

Harvest-ing Date	Nice		Rejected		Testcut		Submitted		Total	
	No.	wt Kg.	No.	wt. Kg.	No.	wt. Kg.	No.	wt. Kg.	No.	wt. Kg.
10/4/85	15	208	7	91	-	-	15	208	22	299
12/4/85	92	981	29	300,5	2	28	90	953	121	1281
15/4/85	52	569.5	20	192.5	2	23.5	50	546	72	762
22/4/85	97	938.5	76	605.5	3	42	94	896.5	173	1544
Total	256	2,697.0	132	1,189.5	7	93.5	249	2,603.5	388	3886
Product-ion	Nice ones (Testcut plus submitted) 256 pieces (2.697 tons)/3200m^2 800 pieces (8.428 tons)/ha.									

9月播種スイカ・スイートメロンのプロット別の収量差について

Total Harvest for Watermelon (Sweet Favorite) and Sweet Melon (Prince Melon) in Trial Farm, KADC

Sowing Month	Plot	Area m^2	Duration of Harvest	No. of Fruits	Total Weight of Fruits Kg	Production tons/ha.
Watermelon						
September	A-4	1200	4/11/85-19/12/85	58	507.8	4.23
October	A-5	1600	-	0	0	-
November	A-6	1600	going on			
September*	A-14	1600	6/12/85-12/12/85	20	185.3	1.16
Sweetmelon						
September	A-4	400	26/11/85-26/12/85	175	148.5	3.71
September	A-15	400	26/11/85-5/12/85	205	122.7	3.07

Remarks: September* : A-15 (around 1000 m^2) also showed same conditions.

*CLASSIFICATION IN WEIGHT OF THREE TREATMENTS OF SWEET MELON, (Data was collected in November 1984 from the experiment in Sweet Melon)

Class Weight(Kg)	FREQUENCY			
	4 m & Cowduang	4 m & Nil	2 m & Cowduang	2 m & Nil
200	0	1	0	0
250	0	3	3	5
300	0	5	5	7
350	0	21	3	8
400	8	19	9	7
450	10	11	15	13
500	13	12	13	15
550	14	7	19	19
600	14	10	22	12
650	9	6	3	5
700	14	3	3	4
750	8	2	4	1
800	4	0	0	1
850	3	0	0	0
900	1	0	1	1
950	1	0	0	1
1000	1	0	0	1
Total No. examined	100	100	100	100

CLASSIFICATION IN WEIGHT OF THREE VARIETIES OF WATERMELON, (Data was collected on 14th December 1984 in the last harvesting time)

Class Weight (Kg)	Frequency		
	Sweet Favorite	Sugar Baby	KANAYAMA
0.5	1	8	7
1.0	8	22	9
1.5	12	23	8
2.0	24	25	16
2.5	19	26	17
3.0	36	23	14
3.5	42	19	12
4.0	33	16	4
4.5	34	16	4
5.0	37	10	3
5.5	24	14	0
6.0	15	2	1
6.5	13	3	0
7.0	8	0	1
7.5	6	1	0
8.0	1	0	0
8.5	0	1	0
9.0	1	0	0
Total No.	314	209	96
Total Wt.	1,271.5	587.5	245.0
Average Wt.	4.05	2.81	2.55

Number of Sweet Melon (MAKUA Melon) in each three harvest. Collected data on 20th, 22th, and 26th in November 1984. (Checkreni T/F, A).

CLASS (g.)		Number of fruits harvested
150-199	A.	
	B.	B 1
	C.	
200-249	A.	
	B.	BBB 3
	C.	CCCCC 5
250-299	A.	
	B.	BBBBBBBBBB 10
	C.	CCCCCCCCCCCCCCCCC 17
300-349	A.	AA 2
	B.	BBBBBBBBBBBBBBBBBBBBBBBB 24
	C.	CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC 38
350-399	A.	AAAAAAAA 8
	B.	BBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBB 44
	C.	CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC 36
400-449	A.	AAAAAAAAAAAA 12
	B.	BBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBB 45
	C.	CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC 33
450-499	A.	AAAAAAAAAAAAAAAA 16
	B.	BBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBB 41
	C.	CCCCCCCCCCCCCCCCCCCCC 21
500-549	A.	AAAAAAAAAAAAAAAAAAAA 20
	B.	BBBBBBBBBBBBBBBBBBBBBBBBB 25
	C.	CCCCCCCCCCCCCC 14
550-599	A.	AAAAAAAAAAAAA 13
	B.	BBBBBBBBBBBBBBBBB 17
	C.	CCCC 4
600-649	A.	AAA 3
	B.	BBBBBBBBB 9
	C.	CCC 3
650-	A.	AAAAAA 6
	B.	BBB 3
	C.	

A: harvested on 20th/Nov.
B: " 22th/Nov.
C: " 26th/Nov.

Total 473 pieces

I. No. Class $= 2.5 \times \sqrt{473}$
$= 11.65$
11 Class/12 Class

II. Class Interval
min. 150 g
max. 750 g
$750-150/12 = 50$ g

6. スイートメロン

CHARACTERISTICS RELATING TO THE DIFFICULTY ON THE OPEN FIELD CULTIVATION IN WATERMELON/SWEETMELON

Characteristics	Species/varieties bred for open field				Varieties of sweet melon bred in Japan for cultivation in plastic house.	
	Watermelon	Sweetmelon				
	Sweet Favourite	Prince Melon	MAKUA	Cantalope	Nice Melon	A-1 Melon
Susceptibility against melon fly	−	+	++	+	+	+
red melon bettles	−	−	+	++	++	++
Susceptibility against powdery mildew	−	++	+++	+	+	+
other diseases	+	+	+	+++	++	+++
Average weight of the fruits	5 − 10 Kg	500gm	500 g	1 Kg	1 Kg	1 Kg
(number of bearing)	few	many	many	few	few	few
Estimated post* storage ability	2 weeks	1 week	1-2 days	2 weeks	2 weeks	2 weeks
post-maturity** ripening period	short	short	veryshort	long	long	long
Sweetness	sweet	sweet	sweet	verysweet	verysweet	verysweet
Flavour	non	a little	non	much	a little	much
Colour of skin	green stripe	unicoloured bronze	gold	darkgreen whitenetting	white	darkgreen nett
Colour of in side (edible flesh)		green + orange	white	light green	white	light green

Remarks: Susceptibility: − indicates resistant
+ indicates susceptible
++ − +++ very susceptible

Remarks: * The period in which the fruits can be kept without loosing its quality after harvesting.
** The period in which fruits are kept after harvesting in order to ripe well.

Kinds of Injure due to Disease/Insect and disordered
Fruits in Sweet Melon (Prince Melon and MAKUA Melon)

Collected data on 20th/84

	Prince Melon		MAKUA Melon	
Soft rotted(disease)	21	(6.3 %)	11	(3.6 %)
Dry rotted(")	6	(1.8 %)	4	(1.3 %)
Spotted (melon fly)	13	(3.9 %)	17	(5.5 %)
Netting(genetical)	4	(1.2 %)	0	(0.0 %)
Crucked(excess water)	5	(1.5 %)	2	(0.6 %)
Mechanical damage(unknown)	4	(1.2 %)	8	(2.6 %)
Disturbance by vines	0	(0.0 %)	5	(1.6 %)
Abnormal navel(physiological)	2	(0.6 %)	3	(0.9 %)
Total No. of fruits examined	332		304	
Total No. of injured fruits	55	(16.5%)	50	(16.4%)

EFFECTS OF COWDUNG APPLICATION AND WIDTH OF RIDGE TO THE YIELD ON SWEETMELON "PRINCE MELON"

	4m 5 tons/ha	4m Nil	2m 5 tons/ha	2m Nil
	$400m^2$	$400m^2$	$180m^2$	$180m^2$
17th/NOV.	Number of fruit (Kg)	Number of fruit (Kg)	Number of fruit (Kg)	Number of fruit (Kg)
1st Class	2(1.2		1(0.7)	0
2nd Class	0	Nil	2(1.1)	2(1.0
	3(2.1		0	1(0.6)
22nd/NOV.				
1st Class	278(168.0)	27(15.0)	125(68.0)	75(40.5)
2nd Class	68(34.5)	11(5.5)	44(22.0)	21(8.0)
Spoiled	75(43.0)	15(8.5)	46(20.0)	24(11.0)
26th/NOV.				
1st Class	71(41.5)	98(56.5)	71(41.5)	89(47.5)
2nd Class	284(116.5)	268(122.0)	161(62.0)	126(46.5)
Spoiled	61(22.0)	182(74.5)	70(29.5)	83(31.5)
Total				
1st class	351(210.7)	125(71.5)	197(109.5)	164(88.0)
2nd class	352(151.0)	279(127.5)	207(84.0)	149(55.5)
Spoiled	139(67.1)	197(83.0)	116(49.5)	108(43.1)
1st Class only				
Production per hector (tons)	5.267t	1.787t	6.083t	4.888t
Size (average weight)	600 g	572 g	555 g	536 g
Total of 1st and 2nd class				
Production per hectore (tons)	9.042 t	4.975 t	10.750 t	7,972 t
Size (average weight)	514 g	492 g	478 g	458 g

PRINCE MELON A9 (1,600 m^2) HARVESTING TIME AND PRODUCTION

Harvosting	Nice ones piece (Kg)	Tost-cut piece(kg)	Spoiled duo to disease	Spoiled duc to melonfly	Submitted (salo)
22/Mar/85	593(324.5)	58(35.0)	394(172.0)	84(35.0)	535(289,5)
27/Mar/85	114(84.0)	-	146(75.0)		114(84.0)
1/Apr/85	58(44.5)	-	425(225.5)		-
Total	765(453.0)	58(35.0)	965(472.5)		649(373.5)*

Remarks: * submitted 649(373.5) ---- 4,056 (2,334.3 Kg/ha)

7. スイカ・メロンの栽培暦

CALENDAR ON THE CULTIVATION OF SWEETMELON AND WATERMELON
(23th/July/84 - 15th /Dec./84)

Month	Stage/Date and field work	
July	PREPARATION	
	23rd - 28th July -	land preparation (rotary, ridging)
	"	collection of rice straws for mulching.
	"	collection of cowdung (3 tons).
August	PREPARATION	
	1st - 3rd/Aug.	Cowdung application
	8th/Aug.	rotaring to mix cowdung and pit.
	17th - 18th/Aug.	mulching with rice straws on ridges.
	20th/Aug.	sprinkler installation
	31st/Aug.	calculation of seeds to be sown.
	"	field map making.
September	SOWING	
	3th/Sept.	herbicide spray (gramoxone) in the whole plot.
	5th/Sept.	sowing
	6th/Sept.	Sprinkler irrigation (1hr)
	10th/Sept.	" " (1hr)
	14th/Sept.	" " (1hr)
	17th/Sept	" " (3hr.)
	"	germination (one leaf stage)
	19th/Sept.	Sprinkler Irrigation (2hrs.)
	21st/Sept.	" " (")
	23rd/Sept.	weeding by hand (pit only)
	"	insecticide spray (Bysit) by duster.
	24th/Sept.	sprinkler irrigation (2hrs.)
	25th/Sept.	supplimentary sowing (MAKUA).
	26th/Sept.	sprinkler irrigation (2hrs)
	28th/Sept.	" " (")
	29th/Sept.	insecticide spray (EPN, Sweetmelon only).
October	FLOWERING AND FRUIT SETTING	
	1st/Oct.	sprinkler irrigation (2hrs.)
	2nd/Oct.	melon yellow fly appearing and mating on A-/melon, Nice Melon, Cantalope. Nothing in MAKUA, Prince Melon, Watermelon.
	4th/Oct.	sprinkler irrigation (2hrs.)
	5th/Oct.	Pit weeding
	"	insecticide spray (Bysit) by duster
	8th/Oct.	pintching (MAKUA, Prince Melon) continued
	"	Sprinkler irrigation (hrs)
	10th/Oct.	weeding
	10th - 11th/Oct.	pintching (MAKUA, Prince Melon) continued
	12th/Oct.	sprinkler irrigation (2hrs).

Month	Stage/Date and field work	
October (continued)	FLOWERING AND FRUIT SETTING	
	15th/Oct.	Sprinkler irrigation (2hrs)
	16th/Oct.	insecticide spray (Bysit) by duster
	17th/Oct.	first born flowering
	18th/Oct.	weeding
	19th/Oct.	insecticide spray (Bysit) by duster
	20th/Oct.	weeding
	22th/Oct.	sprinkler irrigation (2hrs)
	26th/Oct.	weeding by minitiller
	27th/Oct.	insecticide spray (Formothione) by mist sprayer
	29th/Oct.	sprinkler irrigation (2hrs)
	31st/Oct.	fruit setting.
November	HARVESTING	
	2nd/Nov.	supplimentary mulching with rice straws.
	"	fungicide (Pithane), insecticide (orthoran) mixed spray by mist sprayer.
	4th/Nov.	big birds destroyed water melon (sweet favourite) 2 fruits were injured by breaking.
	5th/Nov.	furrow irrigation 210 t by tank lorry (all)
	8th/Nov.	furrow irrigation 42 t by tank lorry (MAKUA)
	"	sounded gun 1 set installed against birds.
	"	mildew appearing (MAKUA, Prince Melon).
	9th/Nov.	fungicide spray (Polyoxyine) against mildew.
	12th/Nov.	baloon 2 pieces installed against birds.
	13th/Nov.	weeding (big ones only)
	14th/Nov.	fungicide spray (Dithane and Polyoxyine mixed).
	17th/Nov.	Test cutting of fruit
	19th/Nov.	fungicide spray (Dithane, Polyoxyine mixed)
	20th/Nov.	Test harvesting (MAKUA, Prince Melon)
	21st/Nov.	sounded gun and baloon continued
	22nd/Nov.	harvesting of MAKUA and Prince Melon was started.
	23rd/Nov.	fungicide spray (Dithane, Polyoxyine mixed).
	26th/Nov.	harvesting of water melon started, sweet melon continued.
	28th/Nov.	MAKUA Prince Melon harvesting finished.
	29th/Nov.	Water Melon harvesting
	30th/Nov.	Water Melon harvesting.
December	POST-HARVESTING AND SETTLEMENT	
	3rd/Dec.	furrow irrigation
	6th/Dec.	Water Melon harvesting
	12th/Dec.	Water melon harvesting
	14th/Dec.	Water melon harvesting finished
	15th/Dec.	cleaning of plot (abondom spoiled fruits into compost pit, shift of sprinkler.
	17th/Dec.	Harrowing of plot to prevent the disease and melon fruit fly advancement.

8 パイロット・ファーム

Kinds of Crops Cultivated and Yield Assesment in Pilot Fram

Plot No.	Area (ha)	82/83	83/84	84/85
1	3.5	Finger Millet no weeding & irrig. (Maize) no weeding & irrig.	Finger Millet medium (Maize) medium	Cassava good
2	3.5	Sorghum no weeding & irrig. (Maize) no weeding & irrig.	Cotton good	Maize good
3	3.5	Maize under KADC harvested 8 tons	Cotton good	Maize poor **
4	3.5	Maize under KADC harvested 6 tons	Cotton good	Vacant late land preparation
5	3.5	Vegetable good	Cassava good Vegetable good	Vegetable medium *
6	3.5	Maize	Maize medium	Maize medium
7	3.5	Maize	Maize medium	Maize poor
8	3.5	Maize	Maize poor (Maize) poor	Vacant allocated for long rain season
9	3.5	Cotton medium	Maizo good (Maize) medium	Vacant allocated for long rain season
10	3.5	Cotton medium	Maize medium (Sorghum) poor due to bird damage	Vacant allocated for long rain season
11	3.5	Maize	Maize poor	Vacant late land preparation
12	3.5	Maize	Maize very poor	Cotton good
13	3.4	Maize	Vacant problem	Vacant repeat level- ling
14	3.3	still under construction	Maize poor	Vacant repeat level- ling
15	3.1	still under construction	Maize poor	Vacant repeat level- ling

Remarks: 83/84 Maize Production; total 17,822.5 tons average in 9 plots(30.9 ha), average in 4 plots 1,273 Kg/ha.

Remarks: * 84/85 No.5, cultivated maize,onion,tomato,beans and watermelon/sweetmelon. **; due to salinity.

CULTIVATION SEASON IN PILOT FARM, SOWING
AND HARVESTING TIME(82/83 to 84/85)

Plot No.	82/83	83/84	84/85
1	Finger Millet (Maize) Ap/82 -?	Finger Millet (Maize) Ap/83 -?	Cassava
2	Sorgham (Maize) Ap/82 -?	Finger Millet Ap/83 -?	Maize Sept/85*
3	Maize Jan/83-?	Cotton May/83 -?	Maize Oct/85*
4	Maize Feb/83-?	Cotton May/83 -?	Vacant
5	Vegetable	Cassava, Vegetables	Vegetables
6	Maize Ap/82 -?	Maize 26/Dec/83-2/May/84	Maize Oct/85*
7	Maize May/82 -?	Maize 28/Dec/83-6/June/84	Maizo Oct/85*
8	Maize May/82 -?	Maize 9/Jan/84-6/June/84 (Maize) ?	Vacant
9	Cotton May/82 -?	Maize 13/Jan/84-14/Jul/84 (Maize) ?	Vacant
10	Cotton May/82 -?	Maize 24/Ap/84-13/Oct/84 (Sorghum) ?	Vacant
11	Maize May/82 -?	Maize 16/Ap/84-18/Oct/84	Vacant
12	Maize May/82 -?	Maizo 19/Ap/84-18/Oct/84	Cotton
13	Maize May/82 -?	Vacant	Vacant
14	Still under construction	Maize 9/May/84** - ?	Vacant
15	Still under construction	Maize 10/May/84** - ?	Vacant

Remarks: * under harvesting in Feburuary/86.
** first irrigation conducted on 22/May/84,25/May/84.

Remarks: ( ) indicate second cultivation in the same season.

9. 生産物収入

TRIAL FARM INCOME FOR THE YEAR 82/83, 83/84 and 84/85

	1st 82/83	2nd 82/83	3rd 82/83	4th 82/83	Annual Total T.shs.
Total	–	22,621	27,354	62,729	112,705.55
Upland Crops	–	22,621	27,354	55,321	105,289.05
Rice	–	–	0	7,416	7,416.50
Remarks	–	–	(1) Water-melon 24,775 (2) Sweet Potato 1,920 (3) Egg plant 659	(1) Watermelon 41,525 (2) Maize 6,757 (3) Sweet potato 3,089	(1) Watermelon 66,300 (2) Maize 6,757 (3) Sweet Potato 3,089
	1st 83/84	2nd 83/84	3rd 83/84	4th 83/84	Annual Total
Total	5,876	21,526	28,293	–	55,606.30
Upland Crops	1,791	17,438	13,350	–	32,579.70
Rice	3,995	4,087	14,943	–	23,026.60
Remarks	(1) Sweet Potato 1,791	(1) Watermelon 7,992 (2) Maize 6,402 (3) Cabbage 3,044	(1) Maize 13,350		(1) Maize 19,752 (2) Watermelon 7,992 (3) Cabbage 3,044
	1st 84/85	2nd 84/85	3rd 84/85	4th 84/85	Annual Total
Total	20,932	45,403	13,271	22,613	102,221.10
Upland Crops	7,254	43,936	13,146	12,938	77,275.90
Rice	13,678	1,467	125	9,674	24,945.20
Remarks	(1) Sunflower 4,206 (2) Vegetable beans 1,394 (3) Carrot 970	(1) Maize 26,355 (2) Water melon/Sweet 10,260 (3) Sunflower 4,005	(1) Sweet potato 5,265 (2) Maize 4,547 (3) Sweetpotato (3) Sweetpotato 2,959	(1) Watermelon 11,536 (2) cabbage 1,402	(1) maize 30,902 (2) Watermelon/Sweetmelon 27,061 (3) Sunflower 8,211
Remarks:	The selection was done in three categories, namely: (1) Highest (2) Better (3) Good				

10. KADC・畑作課研修に関する記録

CURRICULUM OF UPLAND CROPS
(VEGETABLE CULTIVATION TRAINING COURSE) LECTURE AND PRACTICE,
OTHER ACTIVITY CONCERN FROM / MAY TO th JUNE1985

Upland Crops, Agronomy Section,
KADC

LECTURE

NO.	SUBJECT	DAY	LECTURER (ASSISTANTS)
1.	Environmental condition in Kilimanjaro region. Explanation on weather condition in Chekereni.	0.5	Nezu (Sarakikya)
2.	Urea application in maize	1	Sarakikya (Nezu)
3.	Nursery for vegetables	0.5	Macha (Nezu)
4.	Impression about Vegetable Training Course in Japan	1	Macha (Mshanga)
5.	Storage method in vegetables	0.5	Macha (Nezu)
6.	Necessity of simple measuring method for farmers	1	Nezu (Mshanga)
7.	Knowledge on nutrition of vegetables and related crops	0.5	Nezu (Macha)
8.	Melon cultivation	0.5	Nezu (Macha)
9.	Introduction to statistic analysis for student (Preliminary note)	1	Masubuchi (Sarakikya)
10.	Discussion about agricultural situation in each districts of trainees	1	Sarakikya (all)
11.	Achievements on vegetable cultivation in KADC (Carrot, Vegetable beans etc.)	0.5	Nezu (Mshanga)
12.	Film/slide show (Agriculture in Japan etc.)	1	all

9 days.

PRACTICE

Part I. Practice and Advice

Subject/Contents	day	teacher
1. Nursery.		
1. Nursery bed preparation	1)	
2. Pretreatment of seeds	1)	
3. Construction of nursery house	3) = (7)	Macha
4. Potting and transplantation	1)	Mshanga
5. Nursery care	1)	
2. Fertilizer application		
1. Compost making	0.5)	
2. Calculation of dosage	1) = (2)	Sarakikya
3. Application exercise	0.5)	
3. Plant protection		
1. Calculation of dosage	0.5)	
2. Operation of sprayer	0.5) = (2)	Nezu
3. Detection of pests	1)	

Total 11 days

Part II. Individual plot (Vegetable cultivation exercise)

(1) Kinds of vegetables to be cultivated 12 vegetable crops.
tomato, cauliflower, broccoli, cabbage, chinese cabbage, melon, onion, lettuce, carrot, egg plant, sweet pepper, spinach.

(2) Plot: A_1, 2, 3. Plot, Trial Farm.

(3) Area: 10m^2 x 12 kinds of vegetables x 40 trainees = 4,800 m^2
(120 m^2 / trainee).

(4) Contents of works for trainees
1. Pretreatment of seeds, design of plots.
2. Direct sowing of seeds and plantation
3. Digging by hoe and operation of mini-tractor for weeding.
4. Top-dressing of fertilizer
5. Spraying of pesticide (hand sprayer and duster).
6. Growth regulations (pintching, thin-out etc.)
7. Multching and shadding.
8. Recording of observation and daily activity.
9. Harvesting and treatment for sealing.
10. Discussion and evaluation (between trainees and by teachers).

Total 11 days

SUBJECTS OF TEST FOR STUEDENTS OF UPLAND CROPS TRAINING

Dr. Nezu assignes them to write compositions on the subject of their choosing as follows;

(1) How to teach farmer about linear sowing in vegetables-garden.

(2) My expectation about linear sowing on maize cultivation for big field management.

(3) Simple measuring method on weight, size without any tool in village.

(4) Advantage and weak point on linear sowing method.

(5) any other topic

Remarks:- Give the composition on 12th in May (Sat), and Submit on the morning 9:00 A.M., 14th in May to Mrs.Mshanga.

Table 1. SUBJECT CHOSEN BY STUEDENTS (results).

No. of Subject	No. of stuedents
1	6
2	0
3	5
4	4
5	1
	16 (English 8 stuedents) (SWAHILI 8 ")

BOOKS CONCERNING AGRICULTURE AVAILABLE IN MOSHI KILIMANJARO

NO.	TITLE	NO.	TITLE
1.	Elimu ya Chakula	2.	Kilimo Bora cha Mazao Tanzania
3.	Historical Dictionary of Tanzania	4.	Socialism and Social Acc. in Devel. Nation.
5.	Adult Education and the Dev. of Socialism in Tanzania	6.	Siasa ya Tanzania kuhusu Nchi za Nje
7.	Marketing Board Pricing and Storage Policy	8.	Walowezi Hawana Siri
9.	Geography of Settlements.	10.	The Dev. of a Financial Infrastructures
11.	Economies of Peasant Coffee Production in Tanzania	12.	Miaka 10 ya Azimio la Arusha
13.	Mbotolwa Mwana wa Umma	14.	Sayansi kwa Shule za Msingi
15.	Historia ya Mapambano ya Mtanzania	16.	Historia ya Mapambano ya Mwafrika
17.	Ufugaji wa Kuku	18.	Utajiri Hai
19.	Shamba la Ushirika	20.	Hifadhi ya Wanyama
21.	Nuru ya Nyumbani	22.	Afrika inakwenda Kombo
23.	Cookery for Today	24.	Towards Ujamaa
25.	Elementary Physics	26.	Mashujaa wa Tanzania
27.	Tanzania Food Tables	28.	Nyuki ni Mali
29.	Tanzania Cook Book	30.	Nyarubanja na Sheria
31.	Unyonge wa Mwafrika	32.	Tupike Kitanzania
33.	Protein Energy Malnutrition and	34.	Youth Centre Leaders Handbook
35.	Seth Benjamen Mpaga	36.	Historia kwa Shule za Msingi
37.	Twendeni kwenye Ujamaa	38.	Mapambano ya Ukombozi Zanzibari
39.	A Manual for Investors in Tanzania	40.	A Handbook for the Promot of Industry
41.	Elementary Map Reading	42.	Zamani Mpaka siku hizi
43.	Africa	44.	Nyungu ya Mawe
45.	Advanced Needlework Note Book	46.	How Europe Underdeveloped Africa
47.	The Sale of Goods	48.	Fundamental of Marketing
49.	Jembe ni Mali	50.	Vijiji vya Ujamaa
51.	Island Harvests (The Far East)	52.	Grassland of the Southern Continent.
53.	Biology By Inquiry (Book 1)	54.	New Biology for Tropical Schools
55.	Biology Drawings with Noter	56.	Biology By Inquiry (Book 2)
57.	Misingi ya Sayansi	58.	Biology and Hygiene Tropical Schools
59.	Mazoezi ya Kazi za Mikono kwa Mafundi.	60.	Maarifa Mapya ya Kuelimisha Afya.
61.	Sura ya Dodoma	62.	Chuo cha Ustaarabu Part 1
63.	Organic Chemistry	64.	Care of the New Born Baby in Tanzania
65.	Huduma za Afya na Utunzaji watoto	66.	Dunia ya Mashine
67.	Mwili wa Binadamu	68.	Art Handbook for Schools
69.	Chuo cha Ustaarabu - 2	70.	Refusha Maisha yako
71.	Structured Questions in Physics	72.	The Teaching of Health Training
73.	How Seeds Grow	74.	The Frait
75.	A loaf of Bread	76.	When Dragons Roamed East Africa
77.	Elimu ya Ushirika	78.	Historia ya Jumuia ya Afrika Mashariki
79.	A Packet of Tea	80.	Ati of Butter or Cheese
81.	Safari Yetu Kwenda Rufiji	82.	Uhamiaji wa Ndege na Samaki
83.	Llvingstone Avumbua	84.	Maji na Ardhi
85.	Katika Kutafuta maarifa	86.	Chakula na Maji
87.	Ngorongoro First Visitor	88.	Mabadiliko katika Maisha
89.	Kijana na Kazi	90.	Mwafiki
91.	Kujipatia Mchumba	92.	Magonjwa ya Siri
93.	Pombe na Ulevi	94.	Matendo
95.	Luka	96.	Maisha ya Kijana
97.	Kijana atumieje Pesa na Wakati	98.	Madawa ya kulevya
99.	Tatizo la Kutoa Mimba	100.	Sigara
101.	Mimba kabla ya Ndoa	102.	Usafi wa Maisha ya Ujana
103.	Maombl yangu		

Ⅱ　増　淵　　清　（稲作）

任期　57.2.23～61.3.12

添付資料リスト

1. Verification Trial 1 - 1(seed multiplication)
2. Verification Trial 1 - 2(seed multiplication)
3. Verification Trial 1 - 3(mechnized cultivation)
4. Verification Trial 1 - 4(mechnized cultivation)
5. Verification Trial 1 - 5(Japonica variety)
6. Verification Trial 1 - 6(Japonica variety)
7. Verification Trial 1 - 7(japonica variety)
8. Exploratory observation of bird control method by using plastic balloon
9. Cool temperature injury
10. Exploratory observation(transplanting method)
11. Exploratory observation(irrigation method)
12. Verification Trial 3 - 1(variety investigation)
13. Verification Trial 3 - 2(variety investigation)
14. Verification Trial 3 - 3(variety investigation)
15. Verification Trial 3 - 4(variety investigation)
16. Verification Trial 3 - 5(variety investigation)
17. Verification Trial 3 - 6(variety investigation)
18. Verification Trial 3 - 7(variety investigation)
19. Verification Trial 3 - 8(variety investigation)
20. Verification Trial 3 - 9(variety investigation)
21. Verification Trial 3 - 10(variety investigation)
22. Verification Trial 3 - 11(variety investigation)
23. Verification Trial 3 - 12(variety investigation)
24. Verification Trial 3 - 13(variety investigation)
25. Verification Trial 3 - 14(variety investigation)
26. Verification Trial 3 - 15(variety investigation)
27. Verification Trial 3 - 16(variety investigation)
28. Verification Trial 3 - 17(variety investigation)
29. Verification Trial 3 - 18(variety investigation)
30. Sowing density x Nursery period Expt.
31. Variety Experiment
32. Variety x Density Experiment
33. Fertilizer Experiment
34. Variety x Nitrogen Experiment
35. Nitrogen Application Experiment

36. Production report of Chekereni Pilot farm

37. Training curriculm for rice cultivation course at Kilimanjaro Agricultural Development Centre

38. Time table for Rice cultivation training

39. Summary table of variety verification plot in farmers' field in Rau ya Kati village and Mabogini village.

40. Traditional practices of farmers in Lower Koshi area

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序　　論

タンザニアでは15万haの水田に稲が栽培されていると言われているが，収量は低く，同国の平均収量は1.3 ton/ha程度で，総生産量は20万tonと言われている。タンザニア政府は農業開発計画のなかで，水田開発による面積の増加と面積当りの増収による年率9％の増加を計画し，第3次5ケ年計画の最終年次には315万tonに増産したいとしている。このためタンザニア全土のうち8州を稲作振興地域に指定した。キリマンジャロ州もこのうちの1州に入っている。

キリマンジャロ州では，モシ郡，ローアモシ地域で655haの面積に水稲が栽培されており，州政府関係者も食糧増産，農家収入の増加の点から稲作の振興をいだいている。また米の価格はメイズと比較して極めて高く，農民も稲作には強い関心をいだいている。しかしながら現状は，灌漑水の不足から限られた地域に水稲が栽培されているのみであり，また栽培品種も在来の収量の低い品種である。このような状況下で，灌漑水確保による水稲栽培面積の拡大の計画があり(ローアモシ灌漑プロジェクト)，高収量品種の導入，改良栽培法の確立により，キリマンジャロ州における稲作振興に大きく寄与することが可能である。

このような背景から，昭和53年に農業開発センター暫定実施計画の策定，昭和55年実施計画チームの派遣を経て，昭和54年より工事を開始，昭和56年に関連施設，トライアルファームおよびパイロットファームの工事が終了した。

キリマンジャロ農業開発センターの施設，圃場の工事終了後，水田に水稲栽培が開始されたのは昭和57年であった。水稲栽培の分野では，1.トライアルファームにおける試験研究，2.パイロットファームでの稲作指導，およびトライアルファームで得られた栽培技術の実証，3.ローアモシ地域の農民に対する稲作指導，研修コースの実施を主な業務の内容とし，同地域の稲作振興を目標に活動を行なった。

しかしながら，同地域では稲作の歴史が浅く(現地調査では30年ほど以前に河川の上流で一部実施されていたと言われる)，また水稲栽培の経験がなく，稲作に関する基礎データー，品種特性，気象データーが皆無の状態であった。このような状態から稲作耕種基準を作成し，高収量品種を導入するために，基礎データー，気象データーの収集，慣行栽培技術の調査，収量制限要因の解明等の基礎条件の設定から着手した。次に制限要因の改善，適正水準の決定，検証，耕種基準の作成をトライアルファーム，パイロットファームでの栽培試験，検証栽培をとおして行なった。次のステップとして，作成した耕種基準を，一般の農家のおかれている諸環境条件に適応するかを検討するための現地検証圃を設置し，高収量品種，改良栽培技術に対する農民の意見，反応を検討し，現地適応性品種の選定，耕種基準の改善を行なった。

ローアモシ地域の農民に対する稲作技術の指導は，主に研修コースを通じて実施することとし，本コースは昭和58年より開始した。期間は5ケ月とし，ローアモシ灌漑プロジェクト受益地域の農民およびキリマンジャロ州に配属されている農業普及員を対象として，水稲栽培の基礎を播

種から収穫までの全過程にわたり圃場における実習をとおして行なった。ほとんどの農民が稲作の経験がないか，もしくは在来の栽培法を経験で行なっている程度であるため，本コースでは，基礎的な栽培技術の習得を主な研修内容とした。この他に，5ヶ月コースの修了者でしかも将来指導的立場となり得る農民を対象とし，昭和59年から1年間の長期研修コースを開始し，キリマンジャロ農業開発センターの施設を利用した研修以外に，農家への巡回指導方法及び現地検定圃の設置・管理・運営方法等を主な研修内容とした。

昭和57年から61年までの4年間で水稲栽培全般をカバーする耕種基準を設定するのは困難である。昭和57年の開始当初は，造成後第一作目であるため，圃場条件等の問題で，高い精度の要求される試験は実施できなかった。限られた期間で耕種基準の目安をたてるために，限られた制限要因についてしか試験が組めなかったし，検証試験も十分行なったとは言いがたい。また水稲栽培がトライアルファームやパイロットファームに開始されて以後，期間が短かいため，水田雑草の発生，病害虫の被害等大きな問題とならなかった要因もあり，今後，水稲栽培を継続していく段階で試験の対象となり得る要因についても，4年間の期間では，栽培試験に組み込まなかった。

ここでは昭和57年2月から昭和61年3月の4年間に実施した業務の内容，実施情況，成果そして今後の課題について報告するものとする。限られた期間内に，効果のあがる方法を考慮して栽培試験，検証等の業務を実施したため，試験テーマ，検証回数が十分でなく，ここに報告する水稲栽培の耕種基準についても，今後，検証を継続する必要があり，また4年間の期間にみられなかった制限要因が見つかった場合には，検討，改良されるべきものであると考える。

1. 業務の概要

キリマンジャロ農業開発センター（以後，ＫＡＤＣと記す）稲作分野の主な業務内容は，1.トライアルファームにおける試験研究，2.パイロットファームにおける稲作技術の指導および栽培試験の結果の検証，3.ローアモシ地域，特にローアモシ灌漑プロジェクト受益地域の農民を対象とした稲作コースの実施，稲作技術の指導，4.ローアモシ地域における現地検定圃の設置，周辺の農民に対する展示圃，そして5.ローアモシ灌漑プロジェクトの一部造成工事の終了した圃場（２１３ha）における稲作技術の指導である。同地域における稲作指導は本来の業務ではないがタンザニア側関係機関の強い要請を受けて，技術的指導，助言を行なった。それぞれの業務内容は，年度別，年間業務計画書（Annual Work Plan）に記載し，相手側関係機関に提出した。この年間業務計画書は，トライアルファームにおける栽培試験の項目，パイロットファームにおける指導業務の内容，研修コース年間実施計画を立案し，年度別の業務計画を記載したものである。年間業務計画に基づいて月別の業務計画と，業務日程を決定した。このうちトライアルファームにおける栽培試験，検証栽培については，研究プログラム（図－　）をもとに年度別に試験テーマをカウンターパートとの協議のうえで選択し，実験計画，圃場設計を決定するシステムをとった。

トライアルファームにおける業務は，昭和５７年４月から開始し，６１年３月の任期までに11テーマ，４７の栽培試験，検証栽培を実施した。栽培試験については，収量制限要因の解明，および選別をおこない，各要因の適正水準を決定するための栽培試験を設計し，試験結果をもとに耕種基準の組み立てをおこなった。同時に試験結果を検証し，現地適応性を検討するためにトライアルファーム，パイロットファームおよび一般農家の圃場にて，検証栽培を実施した。この他に収量制限要因の発見のために予備試験（Exploratory Observation）も同時にトライアルファームで実施した。昭和５７年，トライアルファームで水稲栽培を開始した当初は，造成後第一作目であり，圃場の均平度，地力の不均一トラクター，ティーラーによる耕起，代かき作業の問題がしばしばみられた。このため当初は，均一栽培，種子増殖，圃場条件に大きな影響を受けにくい栽培試験を設計し実施した。圃場条件が改良されるにともない，品種，栽培密度，肥料の要因について栽培試験をおこない，耕種基準作成のための目安ができたものと考える。しかしながら４年間という限られた試験期間であったため，収量制限要因すべてについて適正水準決定のための試験を実施した訳でなく，今後とも継続する必要がある。またすでに実施した試験の結果，耕種基準の検証，また新しい制限要因の発見のための予備試験も継続すべきであろう。

パイロットファームでは１８.９haの水田における水稲栽培の演示および同ファームの運営管理に対する指導助言をおこない，将来組織的な灌漑農業をおこなうモデルファームとして機能させることを目標として業務をおこなった。昭和５７年１１月から１０プロット（３.０ha）で水稲栽培の演示，技術指導をおこなった。しかしさまざまな要因により同ファームでは１年間

ほとんど水稲栽培がおこなわれなかった。このような状態を改善するため，昭和５８年１１月から３３プロット（9.9ha）の水田にＫＡＤＣ直接運営方式で水稲栽培を開始した。３３プロットのうち，水管理，施設管理の問題，灌漑水の不足の問題が起こり，水稲は１６プロットに，また残りの１７プロットは代替作物としてシコクビエを栽培した。直接運営以後パイロットファームにおける水稲の作付率が著しく高まった。運営上の問題，ウジャマー形態に起因する問題，栽培技術上の問題など今後，改良されるべき点が多いものの，水稲栽培は一応定着したものと考えられる。しかしながら，年度によっては作付率が低かったり，また籾収量の変動が大きいのが現状である。今後，農場運営上の問題，栽培技術上の問題を解決し同ファームがローアモシ灌漑プロジェクトに対するモデル農場となり得るような指導，助言，また稲収量の安定化，増収の技術指導が強く要求されている。

ローアモシ地域の受益農民に対する研修は，昭和５８年より５ケ月間の研修コースを開始し，６１年までに４回のコースを実施した。また将来のモデル農家を育成するため，昭和５９年より１年間の長期研修コースを開設した。研修開始から昭和６１年の任期終了までに５ケ月コースを４回，長期コースを２回実施し，計１３６名（うち６名は農業普及員）が研修を受けたことになる。コースの内容については，５ケ月コースは稲作の基礎全般について，播種から収穫までの技術を圃場実習を中心に習得させることとした。研修コースの期間は農閑期の8月～12月の5ケ月とし，研修生の営農に障害とならないよう９月１５日～１１月１５日の２ケ月間は休講とした。対象はローアモシ地域の農民２０～４０名とし，４ケ村の村長による選抜とＫＡＤＣスタッフによるインタビューの結果をもって決定した。１年間の長期コースでは，対象を５ケ月コースを終った農民でしかも将来指導的立場となる資質をもった農民を５名とした。研修の内容は，５ケ月コースで十分習得できなかった項目を集中指導し，また各農家の圃場において現地検定圃の設置，管理も指導項目とした。研修コースを終ったもので各村に帰り，改良品種の栽培を試みた農民も多く，特にローアモシ灌漑プロジェクト地域内のマボギニ村，ラウヤカティ村では一般の農民に指導している研修修了者も多かった。またパイロットファームでは営農委員会のメンバーや６ブロックのリーダーに研修を修了した農民が任命され指導業務をおこなっている。１年コースを修了した農民は，ローアモシ灌漑プロジェクト地域で一般の農家の指導をおこない，上記の２ケ村での改良品種の普及に大きな貢献をした。

しかしながら，限られた研修期間で水稲栽培全般にわたる技術を習得することは困難であろう。また研修圃と，農家の圃場では，諸条件も異なり，習得した技術が直接適応できないケースもしばしばみられ，現場での巡回指導の必要性を強く感じた。また研修に際し，教材が十分とはいいがたく，今後，教材を充実させる必要があろう。また稲作ハンドブック，パンフレット等農民を対象として，技術指導書，耕種基準等の出版物の作成も今後，なされるべき項目の１つである。

長期研修コースの指導項目の１つとして，またローアモシ地域における品種，栽培技術の適

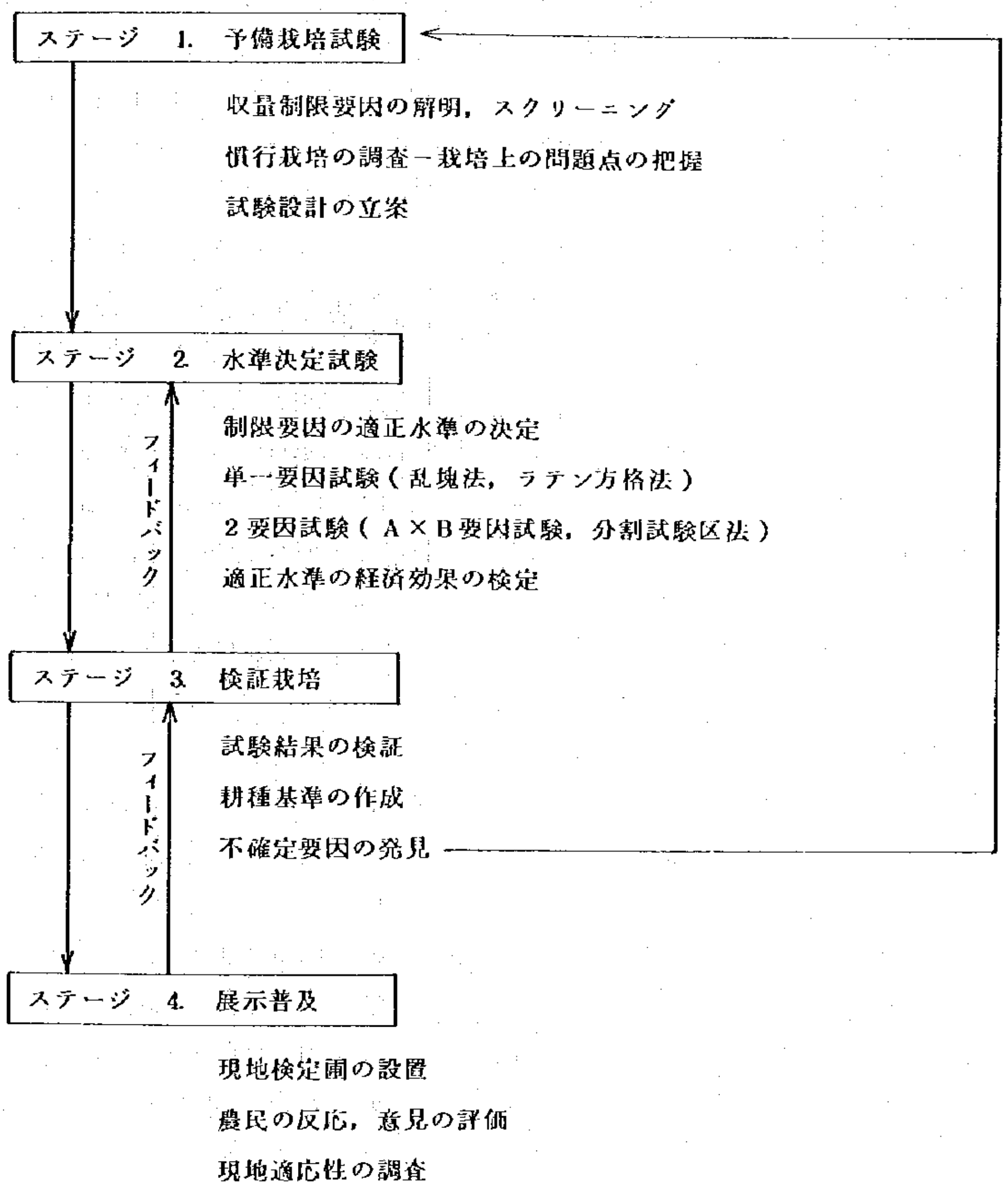
応性の調査のために，農家の圃場において現地検定圃の設置を行なった。これは，ＫＡＤＣで得られた試験結果をもとに，耕種基準を設定し，一般の農民のおかれている諸条件下での適応性の検定，収量制限要因の解明，および改良技術の展示，普及を目的として実施した訳である。現地検定圃はすべて農家の圃場に設置し，具体的内容は，改良品種８，在来種２の計１０品種，栽植密度は１６.７～２５.０株／㎡，Ｎ100^{Kg}/ha，P_2O_5 40^{Kg}/ha を耕種基準の基本とし，試験面積はそれぞれの農家圃場の面積に応じて決定した。上記の耕種基準以外は，農家圃場のおかれている条件下で農民自身の手ですべて行なうかたちとした。昭和５９年に２ケ村，３ケ所に，また昭和６０年には２ケ村５ケ所に検定圃を設置した。このうち６０年度実施した検定圃については任期中に収穫することはできなかった。現地検定圃は，農民に対する現場での巡回指導の素材として，また対象地域に改良品種，栽培技術の適応性の検定，展示，普及の効果が高いものと考えられる。今後は設置ケ所を増加し，また検定のテーマを検討し，実施継続することが望ましいと考える。

ローアモシ灌漑プロジェクトにおける業務は，ＫＡＤＣ本来の業務ではなく（ＫＡＤＣのＲ／Ｄに記載されていない），同プロジェクトタンザニア側関係機関の強い要請にもとづいて昭和６０年より一部工事の終了した圃場で水稲栽培の技術指導をおこなったものである。昭和５９年に工事を終了した７ブロック２１３haの水田で，受益農民から水稲栽培を開始したいとの強い要請が関係機関によせられている。これを受けて，昭和６０年８月にＫＡＤＣのプロジェクトマネージャーを通じて協力の要請があった。これに対しＫＡＤＣ内で検討を重ねた結果２１３haの水田に水稲栽培を開始するに際し，技術的指導助言に関してのみ協力することとした。生産資材の調達，および管理は受益地域の農民の責任でおこなうこととした。具体的な業務内容は２１３ha７ブロックにおける苗代プロットの選定，営農作業計画の作成，月別作業日程の作成，生産資材の見積り，及びチェック（種子の発芽率，肥料の量等のチェック），苗代作り，播種，肥培管理，移植の演示および指導である。しかしながら，造成後第一作のため，圃場の均平作業，水路の管理，トラクターの圃場内の沈下，生産資材の調達がスムーズにできない等の問題のため，当初，作成した計画より大きく遅れることがしばしばあった。しかし，昭和６１年４月には予定の２１３haに移植が終了した。作業の遅れの原因は，さまざまであるが，圃場条件に起因する問題，運営上の問題に分けることができる。圃場条件に起因する問題については造成直後であることを考慮し，除々に圃場の状態を改善する方向で解決されるべきであろう。運営上の問題は，同地域の農民の稲作経験が十分でない，計画的な灌漑農業の経験がないなどの点が原因であると考えられる。広い面積において，限られた水源を最大限に有効利用し水稲を栽培するためには，農民組織の育成が不可決である。ブロック別の水稲栽培を計画的にすすめるための営農組織，灌漑水を有効利用するための水管理組織，施設管理組織，生産資材の調達，トラクターの配分を行なう組織等，農民の組織を育成し，十分に機能させなければ広大な面積に水稲を栽培することは困難であろう。今後ローアモシ灌漑プロジェクトの造

成工事が終了し水稲，畑作物が栽培されるようになるためには，農民の組織づくり，モデル農家，研修修了農民との協力で，一般農民に対する技術指導，展示圃の設置をとおした改良栽培技術の展示，普及等有機的なつながりをもった指導助言が強く要求されるものと考える。

トライアルファームにおける試験実施プログラム

Fig－1



2. トライアルファームにおける業務内容

2－1　業務内容

水稲高収量品種の選択および，改良栽培を確立し水稲栽培の向上，またその向上を目標とする。トライアルファーム10 haのうち2.4 ha（8プロット）の水田において基礎的な栽培試験，検証栽培を実施し，水稲栽培の耕種基準を作成する。

2－2　業務の実施状況

昭和57年4月からトライアルファームで水稲栽培を開始して以来，栽培法確立のため基礎的な栽培試験および検証栽培を実施した。栽培を開始した当初は品種特性に関するデーター，栽培法，気象条件に関する資料も十分ではなかった。また水田造成後の第一作目であったためにさまざまな問題がみられた。このため初年度は均一栽培，種子増殖および基礎的な栽培試験に焦点をしぼって実施した。2年目および3年目では品種，栽培密度肥料の要因について，単一要因試験，2要因試験を実施した。同時に試験結果の実証および耕種基準作成のための検証栽培を実施した。トライアルファームにおける試験検証は試験研究プログラムを設定しこれに基づいて実施した。予備試験ステージでは，収量制限要因の解明，スクリーニングをプライオリティに準じておこない，それぞれの要因に対する試験設計を作成した。ステージ1の試験では，統計分析を前提とした圃場設計は組まずに圃場での観察を基本とした。同ステージで実施した試験は，均一栽培をかねた種子増殖，機械移植，日本稲適応性試験，防鳥対策，灌漑法，移植法の比較，節水栽培，耕起法，輪作体系の諸要因に関するものである。このうち昭和57年～58年では品種，栽植密度，肥料の3要因について適正水準決定のための試験を設計し実施した。ステージ2の段階では品種比較試験（乱塊法），品種と栽植密度に関する試験（分割試験区法），肥料試験（乱塊法4×3要因試験），品種とチッ素施肥量に関する試験（分割試験区法），チッ素施肥時期に関する試験（乱塊法）の試験を昭和57年から59年にわたり実施した。この段階で組み込んだ要因以外にも，耕起法，除草法，病害虫防除，灌漑法など水準決定試験の対象となる要因があるが，試験期間の関係上，任期中に実施することができなかった。

検証栽培は本来，水準決定試験をくり返して実施した後に行う訳であるが，試験期間の関係上，水準決定試験とほぼ同時に実施した。検証栽培は1プロット（0.3 ha）の供試面積とし，改良品種，在来品種の特性を年間を通して，異なる気象条件下で調査するため毎月移殖を基本として実施した。このうち昭和59年3月25日に播種した10品種に低温による障害がみられた。このことにより作期と収量性の関係，稲作安定化のための栽培技術に対する認識が高まった。展示普及の段階では，品種比較試験の供試品種のうち，生育期間，収量性，農民のし好の点から有望な品種を選択し，在来種との比較を通じて農民に展示し，また現地適応性検定のための圃場を昭和59年に2ケ村3ケ所に，昭和60年～61年には2ケ村5ケ所に実施した訳であるが昭和60年および昭和61年に実施した検定圃については任期中に

収穫を終了することはできなかった。

慣行栽培法の調査については，KADCで実施している稲作研修コースに参加した農民に対しアンケート型式で水稲，メイズ，豆，野菜を対象に調査をおこない，同時に水稲については，在来種の収量，特性調査を農家圃場で実施した。

昭和57年から昭和61年までの4年間にトライアルファームで実施した試験，検証のテーマおよび実施年度の概要は下記のとおりである。

Table－1　試験検証の実施状況

試験テーマ	実施年度			
	昭57年	昭58年	昭59年	昭60年
播種量と前代日数	1			
品種比較試験	1	2	1	
品種と栽植密度	1	2		
品種とチッ素施肥料	1	1		
肥料試験（N×P）	1	1	1	
チッ素施肥時期		1		
機械移植	1	2		
種子増殖	3	1		1
品種収量性	3	5	9	5
潅漑法			1	1
移植法			1	
計	12	15	13	7

2－3　試験，検証結果の概要

2－3－1　予備栽培試験

予備栽培試験は収量制限要因の解明，要因のプライオリティーを決定し，適正水準を決定するための試験に組み込む要因を決定し，試験設計を立てるための試験である。特に，統計分析を前提とした圃場設計をおこなわず，圃場における観察を基本として行った試験である。予備試験で対象とした技術要因，試験結果は添付書類－1～29に明細に記載してあるとおり。ここでは予備試験の要約について記載することとする。

a）機械移植

日本製田植機（イセキサナエ2条，4条植）による機械移植および田植機の作業効率の検証を目的とし農業機械分野によって実施された。試験実施期間は，昭和57年11月27日～昭和58年4月16日，昭和58年3月25日～8月29日および昭和59年1月9日～6月13日であった。供試品種および供試面積は第一回目の検証は，Affa Mwanza， 1,296 ㎡(D−2), 第二回目は1R−8で864㎡(D−1), および1R−32, 1967㎡(D−3)であった。

耕種概要は, 1R−8, 1R−32の改良品種では, チッ素100KgN/ha, リン酸 40Kg P_2O_5/haとし, 元肥にチッ素全量の50%およびリン酸全量を施用, 分ケツ期, 幼穂形成期にそれぞれチッ素の追肥を行った。

収量についてみると1R−8で6.48 ton/ha(籾), 1R−32で5.15 ton/haの収量となり, Affa Mwanzaでは2.35 ton/ha〜4.11 ton/haの収量が得られた。3回の機械移植の検証で観察された点は, 1.圃場準備, 特に代かき後の均平作業が欠株の発生を大きく左右する。このため代かき, 均平作業を入念におこなう必要がある。2.育苗技術が通常の方法と比較して複雑であり, 特殊な育苗箱が必要である。3.在来種を用いて検証した場合, 登熟期に極めて高い倒伏が認められた。などである。現在タンザニアの経済状態や農民のおかれている環境をみても, 田植機の購入や維持管理は困難であり, 農民レベルへ展示普及する段階ではないとの結論に達した。今後, 圃場の状態が改良され, 高い均平度が得られる状態となれば, 機械移植による増収の可能性を検討する必要があるだろう。手移植と比較して, 単位面積当りの個体数を高める, 稚苗移植により旺盛な初期生育を期待できるなどの点が考えられるが, タンザニアの経済状態や農民のおかれている条件が改善されなければ機械移植を農民レベルにまで普及することは困難であろう。3回の検証からみて機械移植という栽培技術要因のプライオリティーは低いとの判定から水準決定試験には組み込まなかった。

ｂ) 日本稲導入試験

日本稲の収量性, 現地適応性を検定し, 低温乾期の日本稲の導入の可能性を調査する目的で昭和57年〜60年の期間に3回の導入試験を実施した。第1回目, 2回目の試験では7〜8品種を供試し3回目では2品種に限定した。

第1回目の導入試験は昭和57年9月11日〜昭和58年2月3日の期間であった。供試品種は7品種で「あきしももち」「あさひもち」「うずしお」「れいほう」「はっさくもち」「しらぬい」「ありあけ」であった。種子量は極めて少なく10g〜30g程度であったため, 供試面積405㎡で, 種子の量で各品種ごとの供試面積を決定した。耕種概要は, チッ素75Kg/ha, リン酸40Kg P_2O_5/haとし元肥にチッ素全量の50%およびリン酸全量を施肥し, 分ケツ期, 幼穂形成期にそれぞれチッ素の追肥を行った。昭和57年9月11日の播種後, 50日程度で不時出穂が認められた。草丈が20cm程度まで生育した時点で一時生育が停止し, 移植後も40〜50cm程度まで生育がみられたが, 不時出穂が観察された。(添付書類−5にあるとおり)

以後, 無効分ケツの発生が観察され, 一株分ケツ数が著しく増加した。これにより穂長の短小化もみられ籾収量は著しく減少した。不時出穂以外にもクイリークイリー

（Quelca Quelea）と呼ばれるハタオリドリの一種による被害も減収の原因であった。第1回目の検証では，生育期間の高温，これによる水温の上昇による生育が促進されたために不時出穂が起った。苗代時期が長くなったため（代かきが適期に終らなかったため移植が遅れた。）に不時出穂が観察されたものと推定した。日長については導入試験をおこなった場所は南緯3°28′で日長の影響はさほど大きくないと考えられるが，日長の観測は行なっていなかったので，不時出穂と日長との関係は不明である。クイリークイリーの被害については，以前からみられていたが，今回の導入試験では周囲に摂食の対象となる作物雑草がない場合，水稲に被害が集中することが認められた。鳥害の防除の対策としてフラッシュテープ，フラッシュパネル，爆音機の設置を試みたが効果的に防除することができなかった。同じD−3プロットで実施したAffa Mwanza の検証栽培もクイリークイリーの被害のため収量皆無の状態となった。このことにより防鳥対策の重要性の認識が高まり，後述するように防鳥対策の検証を実施するきっかけとなった。

第2回目の導入試験は，昭和59年5月4日から開始し，9月21日に収穫を終了した。供試品種は，「はっさくもち」「こしひかり」「大空」「日本晴」「あきしももち」「あきひもち」「うずしお」「れいほう」の8品種であった。供試面積は2,619㎡（D−8）を品種別に分け，25株／㎡の栽植密度で1株1〜2本植えとした。耕種概要は前回と同様でチッ素100KgN／ha，リン酸40KgP_2O_5／haとし，チッ素全量の50％とリン酸全量を元肥に施肥し，チッ素は分ケツ期，幼穂形成期に施用した。

籾収量は「れいほう」の868Kg／haから「うずしお」の2.1 ton／haと品種間に大きなばらつきが認められた。8品種の平均収量は1.29 ton／haと低い結果となった。減収の原因は7月中〜下旬の低温による障害が考えられる。（低温の障害については添付書類−9のレポートに記載してあるとおり）。また品種間の収量のばらつきは障害の程度の違いによるものと考えられる。昭和59年度の低温によって，供試品種のほとんどが障害を受け空籾の多発がみられた。このうち特に障害が著しかったのは「日本晴」「あさひもち」で1株穂数のうち不稔穂が55〜53％となった。空籾の発生により登熟粒数が著しく減少し，登熟粒の割合は「日本晴」で19.2％，「あさひもち」で21.6％と極めて低い結果となった。この他の品種の籾収量，収量構成要素の調査結果は添付書類−9に記載してあるとおり。

第3回目の導入試験は昭和60年7月5日に開始し，11月5日に収穫を終了した。供試品種は低温障害の程度，生育過程の草丈，分ケツ数，一穂えい花数等を考慮して2品種「こしひかり」と「大空」を選択した。供試面積は2,619㎡（D−2）に2品種を栽培し，耕種概要はチッ素150KgN／ha，リン酸80KgP_2O_5／haとし元肥にチッ素全量の30％およびリン酸全量を施用し，分ケツ期，幼穂形成期にそれぞれチッ素の追肥をおこなった。栽植密度は25.0株／㎡，1株3本植とした。

「こしひかり」は4.25 ton／haの籾収量が得られた。7月5日播種，8月6日移植後播種後77日の9月21日に出穂期を観察した。「大空」は「こしひかり」と比較して，出穂が多少遅れ出穂後81日に出穂期を観察した。「大空」の籾収量は4.0 ton／haであった。2品種とも出穂揃いが悪く，均一な出穂はみられなかった。「こしひかり」の生育日数は109日で一株穂数は27.2，一穂粒数54.5，千粒重24.0gであった。「大空」については生育日数が117日，一株穂数26.1，一穂粒数は58.2で千粒重が25.1gであった。生育の特徴は草丈が低いこと（「こしひかり」稈長54.6 cm，「大空」46.8 cm），一株穂数が高いこと，穂数増加による穂の短化がみられたことである。3回の日本稲導入試験を実施した結果では，日本稲も4 ton／ha前後の籾収量が得られたが，他の1R系統の品種と比較して決して収量が著しく高いとは言えない。苗代期間が長くなることで不時出穂の可能性が高くなったり，栽培期間によっては気温，水温の上昇により生育が促進され十分な栄養生長期間を経過せず出穂したり，また不時出穂の可能性も高くなる。このため日本稲の栽培時期を注意して選択する必要がある。などの点がみられた。品種特性でみると，草丈が他の品種と比較して低いこと，脱粒性が低く，慣行の脱穀法では十分に脱穀できない。などの点が明らかとなった。これらの点からみて1R系統の品種と比較して著しく高い日本稲の利点はみられないとの結論にいたった。しかしながら7～8月の低温期に低温による障害が観察された年度もあり，低温乾期の稲作の対策の一つとして日本稲の栽培も今後検討する必要もあるだろう。

今任期中は上記の点から考えて，日本稲の導入試験は3回にとどめ水準決定試験の段階には組み入れなかった。

c）鳥害防除対策

KADCトライアルファームに水稲栽培が開始されて以来，しばしば野生の鳥による被害がみられたがこのうち特に被害の観察されたものは，①クイリークイリー（Quelea Quelea）と呼ばれるハタオリドリの食害，②野生のガチョウの一種でEgyptian Goose（学名は不明）による苗代の被害と移植後の水田に飛来して，苗を切ったり，欠株を発生させる害，③白サギの一種（学名）が移植後の株に飛来して生育初期の稲体が折る害などであるが被害の最も高いものはクイリークイリーによる食害である。トライアルファームではD−8プロットに実施した試験のうちAffa Mwanzaの品種が収量皆無となった。D−3プロットでおこなった検証栽培（Affa Mwanza）および日本稲の導入試験，D−4プロットでおこなった1R-品種の増殖圃に著しい被害が観察された。Quelea対策として，フラッシュテープ，フラッシュパネル，かかし，爆音機の設置を試みたが一定の期間（2−3週間）が経過すると効果がみられなくなった。日本製の「鳥おい風船」による対策も試み，Queleaの被害および「風船」の効果について簡単なレポートを作成した。（添付書類−8）。ここではトライアルファームで試みたQuelea 防除対策について報告する。

Quelea Quelea と呼ばれるハタオリドリの一種はアフリカ16ケ国で大きな被害を与えていると言われている。この種は半乾燥地帯の降雨に依存して大集団の移動をおこない穀物をおそう。集中性が強く100－1,000の群で摂食し最長50㎞の遠方まで摂食に出かけ夜の巣にもどるというパターンの行動をとっている。夜の巣では個体数が100万羽にも達するとの報告もあり，夜の巣の他に昼間の移動径路に昼の巣をつくるともいわれている。Queleaの群は餌のある場所では到達後3時間の間に摂食が集中する。摂食の対象となるものは草の種子，穀物の種子が主で，乾期には草原の地表におちている種子を主に摂食するが，灌漑施設の整った耕地等に栽培された作物も加害の対象となる。雨期の開始で食餌がなくなると300㎞から1,200㎞もの距離に移動がおこなわれると言われている。繁殖は雨期開始後まもなくおこなわれ，繁殖のための巣をつくり大きにコロニーを形成すると言われている。

KADCのトライアルファームでみられたQueleaの被害については季節的な変化があり，10月～11月にかけて飛来する鳥の数が多くなることが観察された。トライアルファーム周辺には7.5～10㎞の距離に森林やサトウキビ畑などQueleaの昼の巣となっている地域がある。KADCのある地域に飛来する鳥はケニア南部の自然公園内で繁殖し，雨期の終った8～9月にタンザニア北部へ移動してくるとのことであった。（FAO Bird control unit）。トライアルファームやパイロットファームはQueleaの食餌が不足する時期に水稲，シコクビエ，ヒマワリ等食害の対象となる作物が栽培されると鳥害が著しく高まることがみられた。通常鳥の個体数が少ない時には150～200羽程度が1つの群を形成し水稲に被害を加える。この時，周囲に人間がいると3～4つの小さな群に分かれて，飛行をくりかえし摂食を継続する。また大きな群が飛来した場合，2,000羽程度が1群となって被害を加え，この時には人間が近づいても，ほとんど移動せずに摂食を継続し，Queleaが飛び去った後1粒のモミも認められない程に被害を受ける。

摂食の対象となる作物は水稲，ヒマワリ，シコクビエ，ソルガムメイズの雄種と禾本科の雑草の種子であった。タンザニア種子生産公社（NAFCO・MBARALI RICE FARM）の報告では，1羽のQueleaが1日に摂食で75gのモミをとると言われている。水稲が出穂後乳熟期の段階になった時からQueleaの食害が始まり，十分な対策が講じられなければ登熟粒がなくなるまで継続する。

Quelea対策の検証の1つとして，「鳥おい風船」を使用した場合の防鳥効果を調査するために，D－6（1R－54）の検証圃に風船を設置し調査を昭和59年5月から開始し，以後，D－7（1R－56検証圃），D－2（Affa Mwanza検証圃），D－8（日本稲導入），D－7（RD－10，Sen-glutinous検証圃）で4プロット59年11月まで継続し，効果

を調査した。D−6プロットで行った設置方法は風船を2個1組，1個づつ，風船と同じ模様をプラスティックの円板にかいたものをそれぞれ設置した区と無処理区（カスミアミを設置し個体数の調査区とした）の4つの異なる区をプロット内につくり風船とプラスティック板の効果について調査した。設置方法，調査結果，捕獲した鳥の数等は添付のレポートにあるとおり。

5月3日にカスミアミを設置し，23日間，1日当りの捕獲数および種類を調査した結果によると，設置後2−4日の間に捕獲した数は16〜22／日と高く，5日目以後は徐々に減少した。また13日目から再び捕獲数が10〜5／日と増加し，18日目から減少し23日目には0となった。捕獲したQueleaのなかに3つの異った個体が認められた。赤いクチバシをもったもの，胸部に赤色の羽毛をもったもの，クチバシが茶かっ色で赤色の羽毛のないもののうち，最も捕獲数の高かったものは3番目の茶かっ色のQueleaであった。このような個体の違いは年令，繁殖期，性別などの要因によるものと考えられる，各処理区で1㎡の面積で3ケ所から食害を受けた穂のある株／1㎡の株数（被害株率）と被害株のうち鳥害を受けた穂／1株穂数（被害穂率）について調査した結果無処理区とプラスティック板を設置した区に高い被害率が認められた。風船を設置した区についても被害は認められたが，無処理区より少ないことが観察された。以後，D−7，D−2およびD−8で同じ調査を継続したが，低温による障害のため空籾が多発したこと，鳥の個体数が少なかったことにより風船の効果を判定するまでにはいたらなかった。D−7プロットで行なった調査では風船を設置したにもかかわらず著しい被害を受けた。D−7プロット内8ケ所に1㎡の調査スポットをもうけて被害株を調査したところ100％の被害率であった。風船を設置した点を中心とした半径5m程度の円形の範囲ではほとんど被害がみられなかったが，これ以外の範囲では高い被害率となっていることが観察された。このことからQueleaの大群が飛来した場合には「鳥追い風せん」の効果範囲は極めて限られたものになることが明らかになった。被害を受けたところと風船の近くのところから10個体をサンプリングし被害の程度を調査した結果，風せんの近くのサンプルでは10個体の総モミ数の33.7％が登熟が終了していないモミで，このうちの4.6％がQueleaにより乳熟期に被害を受けたモミであった。これに対して，被害の激しかったところでは不完全登熟モミのうち68.9％がQueleaによる被害を受けたことが明らかになった。激しい被害を受けた結果，RD−10の収量は1.62 ton／haと極めて低い結果となった。

Quelea対策の検証を行った結果次のような結論にいたった。①Queleaの個体数は季節によりまた餌の有無，周辺に摂食対象となる作物の栽培の有無により異なり被害の集中する時期を正確に判定することは困難である。②フラッシュテープ，フラッシュパネル，かかし，爆音機等の設置を試みたが鳥が慣れてくるにつれて効果がうすれる。③

「鳥おい風船」については鳥の個体数が少ない場合には効果があるようであるが，大群が飛来するような場合には，風船の効果範囲は半径5mm程度の円形面積となるようで，大きな効果は期待できない。④風船は風にゆられて動いている場合には効果があるが風船と同じ模様をかいたプラスティック板のように風による動きがない場合には効果が期待できない。この結果から効果的な方法は慣行防除法の鳴子（小石を入れたアキカンを圃場に設置し，鳥が飛来した時に鳴らす），防鳥ネットの設置と考えられる。

上記の方法は，根本的に防除するというより，鳥を追い払い被害を集中させない方法である。根本的な防除法としてタンザニアで行われている方法は，FAO Bird control unitによるセスナ機を用いてQueleaの夜の巣に薬剤を散布し殺す方法，ドラム缶を使って爆殺する方法である。この他には鳥の移動時期，摂食対象となる作物の栽培時期との関連から，被害の集中する時期を作期を変える，あるいは生育期間の異なる品種を栽培するなどの方法により回避する方法が考えられる。このような作期の調整の方法を実施するには鳥の移動時期，繁殖地，Queleaの生活範囲等，広範囲にわたる調査が必要となりKADCが独自に取り組むのは困難である。

Quelea以外の鳥による被害は発生するケースも少なく現在は大きな問題にはなっていない。しかしながらEgyptian gooseの苗代，移植後の圃場における被害は徐々にみられるようになって来た。Egyption gooseは通常夕方飛来し，早朝飛び去っていく行動パターンのため，人間による夕方から夜間にかけて防除する方法が被害を最少限におさえる妥当な方法かと考えられる。爆音機の設置もEgyptian gooseについては効果がみられる。

d) 間断日数と収量の関係

間断日数を変えて，同量の水を灌漑した場合に水稲の生育および籾収量に及ぼす影響について調査する目的で実施した。間断日数は0日，4日，7日の3区をもうけD−7プロットをそれぞれ1区819㎡の区に分け畦を作り，灌漑水が他の区に流入しないようにした。灌漑水量は20㎜/日を基本とし，0日間断区では毎日20㎜を灌漑した。4日間断区では80㎜を毎4日に，また7日間断では140㎜/7日を灌漑した。総灌漑水量は，105日の灌漑期間で1,984.2㎥(0日間断)，1,719.0㎥(4日間断)，1,797.8㎥(7日間断)となった。総灌漑水量の差は圃場に給水する際の誤差として処理し，3プロットに対する灌漑水量は同量と考えることとした。耕種概要はチッ素75㎏N/ha，リン酸40㎏P_2O_5/haとし，元肥にチッ素の全量の30%およびリン酸全量を施肥し，分ケツ期，幼穂形成期にそれぞれチッ素の追肥をおこなった。試験期間は昭和60年1月17日〜6月12日であった。試験結果は添付書類−11に記載してあるとおり。

籾収量についてみると，4日間断，7日間断の区で4.4 ton/ha，4.6 ton/haの収量が得られた。0日間断の区では2.5 ton/haの収量で4日間断区と比較して1.9ton/haの

減収となった。減収の原因は，単位面積当りのえい花数の減少と考えられる。0日間断では，一株穂数は4日間断区と比較して大きな差はみられないが，一穂えい花数が減少していることがみられた。また7日間断区では，一株穂数，一穂えい花数とも0日間断，4日間断区より高い。1,000粒重についても同様の傾向が観察された。予備試験であるため，収量および収量構成要素に間断日数の及ぼした影響の有意差検定を行うことはできない。しかしながら間断日数のちがいによる灌漑水の温度が影響を及ぼしているものと考えられる。トライアルファームの灌漑水の温度は9：00 AM吐出口で測定され結果は図－24にあるとおりである。この水温は水田内の温度でなく吐出口の灌漑水の温度である。測定結果からみると，26℃をピークとして5月から6月にかけては23～24℃まで低下していることが解る。

試験を実施したD－7プロットは水もちが良く，7日間断の区でも田面が乾燥するようなことは観察されなかった。このような状態で，4日間断，7日間断の区では日中の太陽により水温が上昇したのに対し，0日間断では26℃～23℃の水が毎日灌漑され，十分な水温の上昇がなかったものと考えられる。結果として籾収量，水稲の生育に差がみられたのは，圃場内の水温によるものと推定することができる。間断日数の影響は水田の水もちの状態により異なり，また間断日数は要水量設計に基づいて決定されたものであるため，簡単に変更できないものであるが，水温と稲の生育の点から検討されるべき項目であろうと考える。水準決定試験では，分割試験区法で間断日数と品種を組み合わせた相互効果の調査も興味があるだろう。任期中に水準決定のための試験は実施しなかった。

c）移植法

通常の手移植と株まきポット（丸井加工KK A型）を使用した投げ植え移植の2つの方法に関して，水稲の生育，収量に及ぼす影響，移植に要するコストを比較する目的で行なった。

供試品種はIR－8，処理区は手移植，投げ植とし供試面積は1,026 m²/区とした。試験設計反復は特にもうけず，圃場観察を主とした予備試験として実施した。耕種概要はチッ素150Kg/ha，リン酸80Kg P_2O_5/haとし，チッ素全量の50％及びリン酸100％を元肥に，また残りのチッ素50％を分ケツ期，幼穂形成期に追肥した。栽植密度は25株/m²とし，手移植区では20cm×20cmの栽植密度とし，投げ植区では，株まきポット数（A型43枚/0.1ha）で調整した。

害虫防除については必要に応じて行った。除草は水もちの良い水田であったため1回の手除草を行っただけであった。

育苗方法は，手移植区では通常の方法で育苗し移植した。投げ植区では株まきポット1枚当り4 litの床土を用意し，催芽種子80g/枚を播種した。播種後，発芽そろいが

確認された後３－４日して通常の苗代へ移し，以後は手植え区と同様に育苗した。水稲の生育では手移植区と比較して投げ植区は５日早い出穂始が観察され，登熟も投げ植え区の方が７日早かった。投げ植区では活着が手移植と比べてはやく，４～５日後には苗が直立した。以後最高分ケツ期以後，有効茎数が高く，投げ苗区では植えいたみが少ないため，分ケツ発生節が手植え区より低い位置になったものと推定できる。試験結果（添付書類－１０のとおり）をみると，投げ植区に高い一株穂数が認められた。

籾収量についてみると，手植え区と比較して投げ植区では，約1.0ton/ha の増収となっており，この原因は一株穂数の増加によるものと考えられる。移植に要したコストを時間と人で比較すると，手移植では苗取りから移植まで0.1ha当り６０時間・人を要したのに対し，投げ植え区では１８時間・人を要し，約1/3 で移植作業が終了したことになる。この結果から，籾収量の差が処理区の違いにより生じたのか，処理外の要因により生じたのか解析することはできないが，投げ植は移植に要するコストも低く，増収の可能性も高い方法であるとの結論にいたった。しかしながら投げ植を農民レベルまで普及させる栽培技術の対象とするかどうかは，次のような問題点を考慮する必要があるだろう。
1.育苗法では特殊な株まきポットが必要であり，また床土の水分調整覆土を適正に行わないと播種穴鎮圧作業の低下や，また苗の根がからまり苗取りがスムーズにいかない。
2.本田内に均一に苗を投げる必要があり，適正密度を得るためには訓練が必要である。
3.水田の均平度，代かきを十分に行う必要がある。均一でないところび苗，うき苗が増える。4.除草法でタンザニアでは除草剤の入手が困難であるため，投げ植区では除草が問題となる可能性が高い。このように投げ植え移植法はさまざまな問題があり，一般農家のレベルで実施するには，栽培試験，検証をくり返す必要があるだろう。移植法と品種を組み合せた試験や投げ植とすじ投げ植の比較も今後の課題と考える。

f) その他

任期中に開始したものの収穫できなかった予備試験は耕種法に関するものと節水栽培に関するものである。耕起法については，従来ロータリー耕起を主に行って来た訳であるが，ロータリー以外のボトムプラウやディスクプラウによる耕起について，その効果を調査する目的で予備試験を実施した訳である。水田作が開始されて以来４年が経過しており，水田の土壌も安定しつつあるところで，ボトムプラウ，ディスクプラウを使用して耕起した場合の作業効率，耕起深度，水稲の生育に及ぼす影響について調査するために行った。供試面積は2,619 ㎡（D－4 プロット）でロータリー耕起とボトムプラウ耕起の２区とし，供試品種はＩＲ－32，ＩＲ－42 Affa Mwanza，Taiwan－14，在来種２品種（Mdundiko，Matandiko）の計６品種とし，反復はもうけず圃場での観察を重点におこなった。任期終了時に移植が終了した状態であったため，生育調査はできなかった。今後ローアモシ地域で水稲栽培が大面積に開始された場合，耕起深度，作業効率は

検証されるべき項目であろうと考える。

節水栽培については，乾田直播（すじ播き）で節水栽培を行った場合の水稲の生育および収量に及ぼす影響について調査する目的で実施した訳である。キリマンジャロ州でもしばしば畑地状態で稲作を行っているケースがみられ，節水可能な程度と収量の品種間の差異の調査も試験目的の1つである。供試品種は30（改良種，在来種，ITA－品種，系統を供試した。）供試面積は44㎡（8m×5.5m）/品種とし，畦間40cm，株間20cmとした。昭和60年10月17日に播種，以後灌漑を行い，10月30日に出芽の悪い品種について再度播種を行った。任期中に収穫ができなかったが，節水の影響が品種間に認められた。生育期間についても差が認められ，供試品種のなかには著しい節水の影響を受け，減収となるような品種もいくつか認められた。この予備試験の結果から，耐旱性の高い品種を選択し，さらに明細な品種特性調査を継続していく必要性があるように考える。

2－3－2　水準決定試験

a）苗代播種量及び苗代日数に関する試験

目的：栽培基礎技術の設定のための試験とし，育苗法に関する要因のうち，苗代の播種量，育苗日数が苗の発根力および移植後の生育，籾収量に及ぼす影響について調査することを目的として実施した。試験設計および結果については添付書類－30に記載のとおり。

試験設計：苗代播種量を50g/㎡，100g/㎡および200g/㎡とし，苗代日数を20日，30日，40日および50日とし，乱塊法2反復で播種量と苗代日数を3×4要因試験12処理区とした。供試品種はIR－8とAffa Mwanzaの2品種としたがAffa Mwanzaの試験はクイリーの被害により調査個体を得ることができなかったために，解析は行わなかった。

結果の要約：苗代播種量および苗代日数の及ぼす影響が，苗の乾物重，発根数，発根長にみられた。乾物重についてみると，50g/㎡の場合が最も高く，播種量が増加するにつれて乾物重が減少した。苗代日数の影響についてみると，苗代日数が20日から30日，40日と苗代日数が増加するにつれ乾物重の増加が認められたが，苗代日数が40日以上になると減少する傾向が認められた。発根長についてみると，50g/㎡の播種量の苗が高く，30日～40日で最も高い発根長がみられた。40日以上の苗では発根長が減少することが解った。発根数では50g/㎡の播種量で30～40日の苗の発根数が高く，20日苗，50日苗では播種量に関係なく著しく低下することが認められた。30日～40日の苗代期間では100gおよび200g/㎡の間に有意差は認められなかった。次に籾収量に及ぼす影響をみると50g/㎡の播種量が高く，苗代における播種量が高くなるにつれ，籾収量が減少する傾向がみられた。苗代日数の影響についてみると，播種量が50

g/m²－100g/m²で20日－30日の苗代日数の場合に増収の可能性が高いようで，苗代日数が40日以上になると，播種量に関係なく収量が減少する傾向が認められた。籾収量の違いが生じた原因は単位面積当りの穂数が変化するためと考えられる。単位面積当りの穂数は苗代での播種量が増加し，また苗代日数が増えると減少する傾向が認められた。苗の発根力，乾物重と単位面積当りの穂数が似た傾向を示すことが理解できた。この結果から，苗の発根力，籾収量を考慮すると，苗代における播種量は100g/m²までとし，100g/m²以上の播種量では苗の発根力が低下し，移植後の分ケツに影響を及ぼし，穂数が減少する可能性がある。また苗代日数は20～30日が発根力の点からすぐれていると考えられるが20日苗では草丈も短かく，苗取り，手植え作業による苗いたみなどの点で20日苗を移植することはむずかしいように思える。また草丈が短かいため，本田の均平度も要求されることを考慮して，現時点では実用的でないとの結論にいたった。苗代日数が40日以上になると苗の発根力が低下し，籾収量にも影響を及ぼすだろうと考えられる。この結果から，苗代播種量は80～100g/m²とし，苗代日数は25日～35日が適正であろうとの結論にたっした。50g/m²の播種量では質の高い苗を得ることができるが苗代面積が大きくなりすぎる。以後，栽培試験，検証栽培では80－100g/m²で25日～35日苗を基準としているが，現在まで問題がみられず適正水準と認められるだろう。

b) 品種比較試験

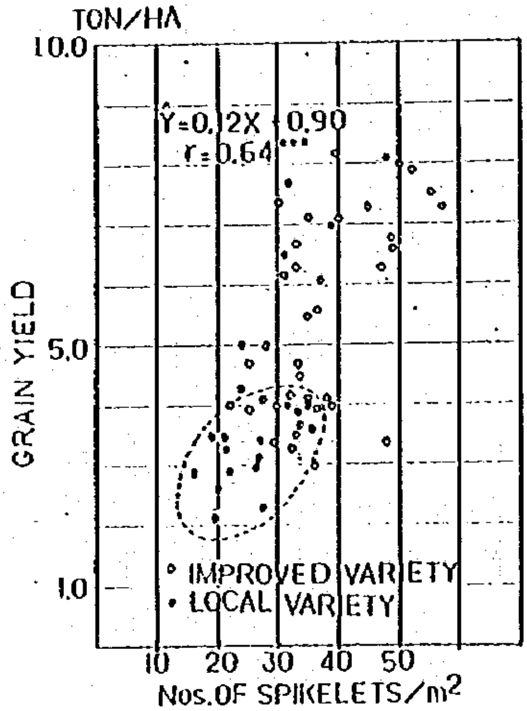
目的：品種特性，収量性の比較，調査をおこないローアモシ地域における適正品種の選択を行う目的で実施した。

試験設計：乱塊法4反復とし，供試品種は試験実施年により異なるが，IR－8，IR－20，IR－32，IR－36，IR－42，IR－54，IR－56，Affa Mwanza，Taiwan-14，Kilombero，Surinan，Matandikoの12品種であった。供試面積，耕種概要，試験結果の明細については添付書類－31にあるとおり。

この試験は昭和57年から3年にわたり実施した。このうち昭和58年に行った試験では，試験圃場の水もちが悪化し，水管理上の問題がみられた。同プロットでは，通常の規定補給水では水田を湛水状態にたもつことができなかった。水もちが悪くなった原因については，灌漑セクションによる調査が行なわれたが明らかになっていない。以後同プロットは畑作物の栽培に利用されている状態である。また昭和59年実施の試験については，揚水ポンプの故障による水不足がみられた。移植後10日に揚水ポンプが急激な電圧変動のため故障し，代替の水源として上水道から試験圃場への灌漑を行ったが，水量は十分でなく試験プロットの一部では枯死する個体もみられた。したがってこの試験では，3年間で実施した試験結果に加えて，農家圃場で実施した現地検定圃の結果（3ケ所）も品種特性の検討の対象とした。

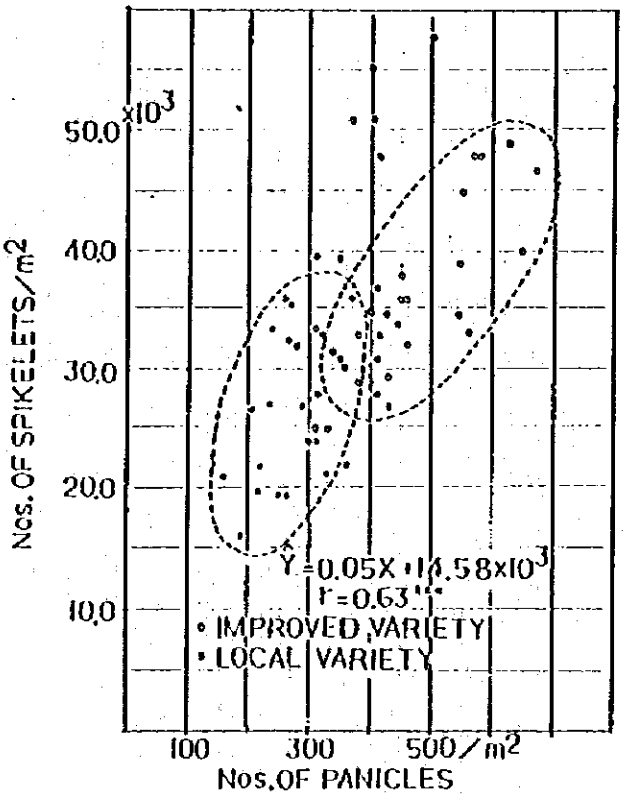
結果の要約：在来種の籾収量は改良品種と比較して著しく低い。これは単位面積当り
のえい花数が低いことが原因と考えられる。単位面積当りのえい花数と籾収量に強い正

Fig 2



の相関が認められ（r＝0.64***），単位面積当りのえい花数が収量を決定する１つの因子となっていることが理解できる。次に改良品種と在来品種の単位面積当りのえい花数を比較すると，改良品種の方が明らかに高いことが解る。一般的には在来種の方が１株えい花数がいい訳であるが，単位面積当りの穂数が改良種より少ないため，えい花数が低い数値になっているものと考えられる。改良種のえい花数が25×10³〜50×10³／㎡の範囲に分散しているのに対し，在来種の場合では15×10³〜35×10³／㎡と なっている。１穂えい花数と単位面積当りのえい花数に相関が認められなかった（r＝0.25^{ns}）ことから，穂の大きさはえい花数に強い影響を及ぼさないものと考えることができる。このことから，在来種の単位面積当りのえい花数が低い原因は，分ケツ力の低いことと推定することができる。次に単位面積当りの穂数をみると，改良品種の方が在来種よりも高いことが解る。在来種の穂数が150〜300／㎡であったのに対し，改良種の場合は300〜500／㎡の穂数がみられた。在来種は分ケツ力が低く，チッ素の肥効が低く，チッ素の施肥による無効分ケツの増加により，有効茎数が低下する傾向がしばしばみられる。在来種のうちAffa MwanzaとSurinamの１株穂数は他の在来種より高く，チッ素の施肥により単位面積当りの穂数の増加を期待することもできるだろう。一方，改良種の間にも穂数の差がみられ，１R−8，１R−36，１R−56の穂数／㎡は他の品種よりも

Fig 3



高い，逆に1R－20，1R－54が低く1R－32，1R－42が中間型と推定することができる。

1穂えい花数についてみると，Taiwan－14，Kilomberoが著しく多い以外，在来種と改良種に大きな差はみられなかった。改良種のなかでは，1R－8，1R－20，1R－42，1R－54の1穂えい花数が高く，逆に分ケツ力の高い1R－36，1R－56は1穂えい花数が低いことが解った。

次に品種間の籾生産効率を比較するために，調査個体の乾物重に占める籾の重量の割合をみると，在来種の籾生産効率が著しく低いことが明らかになった。Taiwan－14，MatandikoおよびKilomberoでは，全乾物重の30％が籾であったのに対し，改良品種では50％となっている。このように著しく効率の低い品種ではチッ素肥料の施用による無効分ケツの発生，倒伏の可能性が高く，明らかな増収は期待できないであろう。

生育期間の差は明らかにみられた。供試品種のうち早生の品種は1R－36と1R－56で118～132日で登熟終了している。在来種のなかではSurinamの生育期間が短かく118～120日であった。改良品種のうち比較的生育期間の短かい品種は，1R－20（133～139日），1R－54（131～138日）で晩生の品種は1R－5，1R－8および1R－32であった。在来種は改良種と比較して生育期間が長く，Kilombero，Affa Mwanza，Taiwan－14，Matandikoでは137～157日となっている。その他の品種特性は，別

添の資料であるが，この特性のうち収量性，生育期間，現地適応性また農民の意見，市場性，慣行栽培法との適応性を考慮し，1R−20，1R−36，1R−54，1R−56と生育期間は長いが，収量性の高いとみられる1R−42を選択した。また在来種では増収の可能性のみられるAffa Mwanzaを選択した。Surinamは品種特性のばらつきが高く異品種や系統の混入が著しく選択の対象とはしなかった。改良品種については，1R−54，1R−20の評判が高く，農民が好む品種特性を有している。1R−36，1R−56については脱粒性が低いため脱穀作業に時間がかかりすぎるとの意見もあるが，食味，現地の調料法に適しており，農民に好まれて栽培されている。現在，農民は天水田で水稲を栽培し，11〜12月播種，5〜6月収穫の作期となっているが，生育期間の短かい品種を導入することで雨期開始前の収穫が可能となるため農民は生育期間の短かい品種を好む傾向が強い。

限られた試験現地検定圃の結果から選択した訳であり，今後とも品種特性，現地適応性の調査を継続していく必要があるだろう。現在までの結果からみると，先に述べた4品種（1R−20，1R−36，1R−54，1R−56）が適応性の高い品種と考えられる。また農民の栽培技術，経済状態を考慮すると穂重型の品種の方が適応性が高いと考えるがこの点についても検討する必要があるだろう。

c）品種と栽植密度に関する試験

目的：品種特性の違いによる栽植密度に対する反応性を調査し，適正な栽植密度を決定するために実施した。

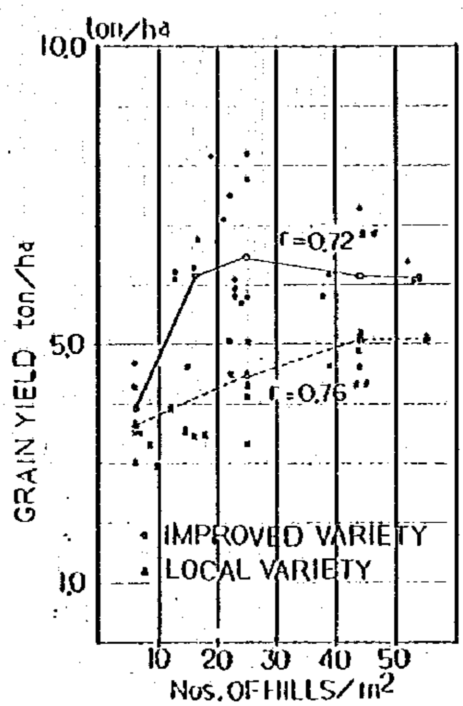
試験設計：分割試験区法，4反復としメインプロットに品種，サブプロットに栽植密度の処理区とした。供試品種は昭和57年度実施の試験では，Surinam, Kilombero, Affa Mwanza，Taiwan−14，1R−8の5品種とし，栽植密度は44.4株／㎡，25.0株／㎡，6.25株／㎡とした。昭和59年度に実施した試験では，1R−36，Taiwan−14，Surinam，Affa Mwanzaを供試し，栽植密度は66.7株／㎡，44.4株／㎡，25.0株／㎡とした。第一回目の試験で，栽植密度を高めることで収量の増加傾向が認められたため，第二回目の試験では収量が横ばい状態となる限界密度を調査するために栽植密度を高めた。品種の選択については，短稈穂数型，長稈穂重型の異なる草型の品種特性に基づき，周辺農家で栽培されている品種の特性をもつ品種の点を考慮して行った。供試面積，耕種概要，試験結果は添付書類−32に記載してあるとおり。

結果の要約：昭和59年に実施した試験では収量調査の時点で，収穫個体数を調査したところ，設計栽植密度と比較して，著しく低い数になっていることが明らかになった。この傾向は栽植密度が高い区ほど顕著にみられた。これは，極端に栽植密度が高くなることにより欠株，植えわすれ，人夫の手ぬき等の原因によるものと考えられる。25.0株／㎡に対し，23.1株／㎡が収穫時の調査で得られた密度であり，一方，66.7株／㎡の

密度に対して52.9株／㎡が実際の密度であった。

品種により栽植密度に対する反応が異なることが認められた。籾収量についてみると在来種は改良種より低いことが明らかになった。特にTaiwan−14，Kilombero は在来種のなかでも低収量であった。IR−36，Surinamは分ケツが高く，高い収量性を有することが解った。次に品種間の差異についてみると，10株／㎡以下の栽植密度では，改良種と在来種の間に収量の差は認められないが，40株／㎡以上の栽植密度では約1ton／haの収量差がみられた。改良種，在来種とも栽植密度を高めることで収量が増加することが認められたが，収量が横ばい状態となる限界栽植密度が異なることが解った。改良品種では栽植密度を高めることで籾収量が明らかに増加することが認められたものの，30株／㎡以上の栽植密度では横ばい状態になる傾向がみられた。一方在来種では収量

Fig 4



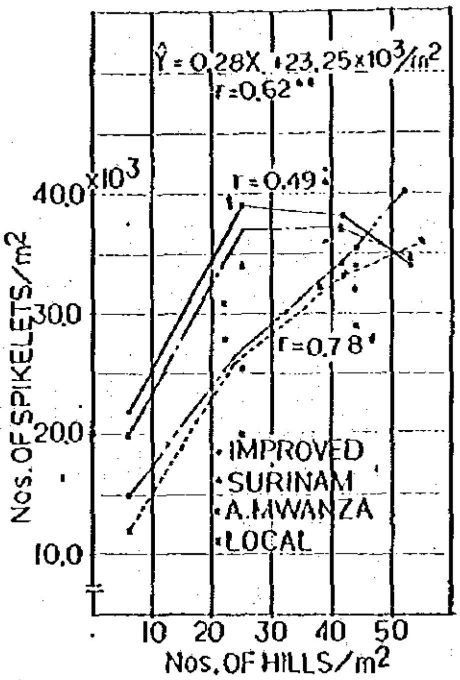
の横ばい状態がみられたのは40株／㎡であった。在来種の籾収量は改良種よりも低く，また栽植密度に対する反応が低いようにみえた。

次に，単位面積当りのえい花数についてみると，改良種，在来種とも栽植密度を高めることで単位面積当りのえい花数が増加することが認められた（$r=0.62^{**}$）。しかし，改良種では25株／㎡〜30株／㎡の栽植密度でえい花数／㎡は横ばい状態から減少する傾向もみられた。一方在来種では，えい花数／㎡が横ばいとなる限界栽植密度は，改良品種よりも高いようにみえる。改良種が高い栽植密度でえい花／㎡が低下するのは穂の短小化が1つの原因と考えられる。一方，在来品種では分ケツ力が低いため栽植密度を高

めることで，単位面積当りのえい花数が増加したものと考えられる。

単位面積当りの穂数についても，えい花／㎡と同様な傾向が認められた。改良種では，25株／㎡～30株／㎡の栽植密度で，単位面積当りの穂数は横ばいの状態となり，40株

Fig 5



／㎡以上の栽植密度では減少する傾向がみられた。在来種では，栽植密度が高くなるにつれ穂数／㎡が増加するがAffa Mwanzaでは，穂数の増加傾向は40株／㎡でも認められたが，他の在来種（Taiwan－14，Kilombero）では40株／㎡以上の栽植密度では減少する傾向がみられた。

籾収量と単位面積当りのえい花数の間に正の相関が認められた。えい花／㎡が収量決定因子の1つであることが解る。しかし，改良種と在来種の収量に差がみられるのは単位面積当りのえい花数の他にも登熟歩合によるものと考えられる。改良種と在来種の登熟歩合を比較してみると30×10³／㎡のえい花数の場合で10％程度の登熟歩合の差がみられた。次に単位面積当りのえい花数と単位面積当りの穂数の関係をみると，改良種SurinamおよびAffa Mwanzaに正の相関が認められ，穂数／㎡が単位面積当りのえい花数を決定する要因であることが解る。栽植密度を高めることで単位面積当りの穂数が増加し，この結果単位面積当りのえい花数が増加する訳であるが，改良種の場合では，30株／㎡以上ではえい花／㎡の増加傾向がみられなかった。これは穂数／㎡が増えることで逆に1穂えい花数の減少，穂の短小化が起こるためによるものであろう。逆に在来種の場合には，栽植密度を高めることでえい花／㎡の増加を期待することができるであろう。

この結果から適正栽植密度を推定すると，改良種では25－30株/㎡，在来種ではさらに高い栽植密度となるであろう。しかしながら，栽植密度を極端に高めることでメイ虫の被害，倒伏の負の要因による減収の可能性も高まることが十分に考えられる。昭和59年度に行った試験では，Taiwan－14，Affa Mwanza，Surinam の3品種にメイ虫の被害が観察された。

Table－2

品種＼栽植密度	25株/㎡	44.4株/㎡	66.7株/㎡
IR－36	0	0	0
Taiwan－14	18	13	13
Surinam	22	16	0
Affa Mwanza	7	14	10

注）各プロット6㎡のサンプル面積のなかでメイ虫の被害の白穂の観察された株数

実際の移植作業をみると，25株/㎡以上の栽植密度では，植えわすれや人夫の手ぬき等による欠株が増える傾向がみられ，また移植に要する時間が増えるし，また44.4株/㎡(15cm×15cm)以上の栽植密度では作業効率が著しく低下する。このような点を考慮し，改良種では25株/㎡(20cm×30cm)とし，在来種では20株/㎡(20cm×25cm)を乾期作に，また16.7株/㎡(20cm×30cm)を雨期作に適正栽植密度として，現在も検証を継続している。

d) 肥料試験

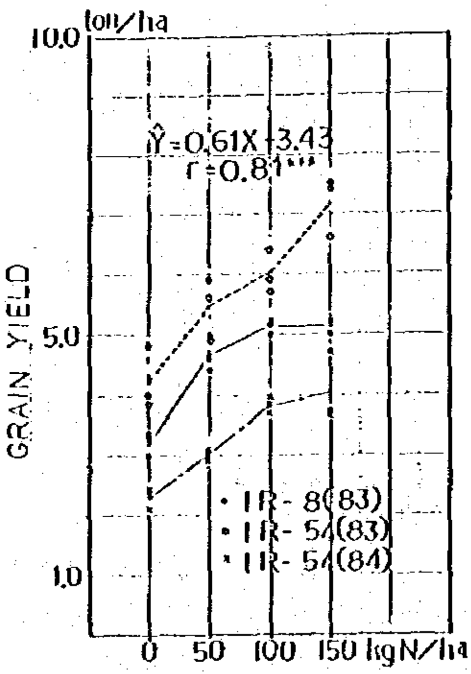
目的：チッ素およびリン酸の収量に及ぼす影響を調査し，適正施肥基準を決定する目的で実施した。

試験設計：乱塊法4反復とし，チッ素の施肥量を4水準（0－50KgN/ha－100KgN/ha－150KgN/ha）とし，またリン酸の施肥量を3水準（0－40KgP_2O_5/ha－80KgP_2O_5/ha）として2要因を4×3要因試験とし，チッ素リン酸の主効果と要因間相互効果の検定を行った。供試品種は昭和58年度の第一回目の試験ではIR－8，同年二回目の試験と昭和59年に実施した三回目の試験ではIR－54とした。この2品種を選択した理由は，IR－8は現在でもタンザニアで最も広い面積に栽培されている改良種であること，またIR－54は品種比較，現地検定を実施する過程で収量性の高い，また適応性の高い品種であろうと推定したためである。IR－54は粒の型状，脱粒性，市場価格の点でローアモシ地域の農民のあいだで好んで栽培されている品種の1つである。供試面積，

耕種概要，試験結果は添付書類－33に記載のとおり。

結果の要約：昭和58年～59年に3回にわたり実施した結果，チッ素に対する反応が1R－8と1R－54で異なることが認められた。3回目に実施した試験では昭和59年10月に水源である揚水ポンプが故障したために十分な水管理ができず，12処理区の平均収

Fig 6

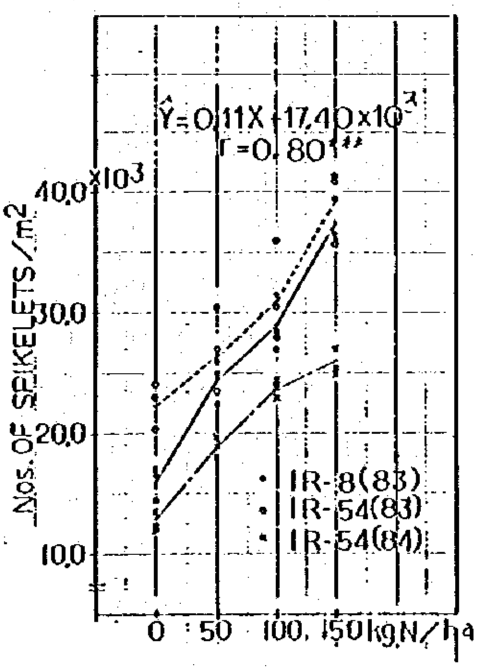


量が低い結果となった。揚水ポンプが故障したために上水道を水源とした灌漑を行った訳であるが，試験圃場の一部では田面が乾燥する区もみられ，適正な肥培管理ができなかった。

籾収量についてみると，1R－8，1R－54ともチッ素施肥の効果に有意差が認められ，明らかに収量が増加することが認められた。1R－8の場合では，N_0からN_{50}へ施肥量をあげることで著しい増加がみられたがN_{50}，N_{100}，N_{150}の施肥水準の間に有意差は見られなかった。この原因については単位面積当りのえい花数が増加したことによる登熟歩合が低下したためと考えられる。1R－54については昭和58年，59年の結果をみると，58年実施の試験ではチッ素の施肥する増収の傾向が認められ，施肥量4水準の間に有意差が認められた。1R－8の場合ではN_{100}の施肥量以上では収量増加の傾向はみられなかったが1R－54ではN_{150}で明らかに収量の増加が認められた。昭和59年の結果では平均収量が4.02 ton／haと低い結果となっているものの，チッ素施肥の効果が認められた。チッ素施肥にする増収の傾向がみられたがN_{100}とN_{150}の間には差がみられなかった。リン酸の肥効については，昭和58年の結果に認められたが他の試験ではリン酸施肥の収量に及ぼす影響は認められなかった。

チッ素の施肥による単位面積当りのえい花数の増加は3つの試験で認められ，チッ素施肥量とえい花／㎡の間に強い相関（$r=0.8006^{***}$）が認められた。1R−8，1R−54ともに150kgN／haを施用した区に最も高いえい花数が得られ，N_{50}，N_{100}，N_{150}の施肥量の間にも有意差が認められた。えい花／㎡の明らかな増加は，単位面積当りの穂数が増加したためと考えられる。チッ素肥量の施肥で1穂えい花数の増加する傾向がN_{50}，N_{100}，N_{150}の3水準間にみられらかったことから，えい花／㎡の増加は穂数の増加によるものと推定した訳である。

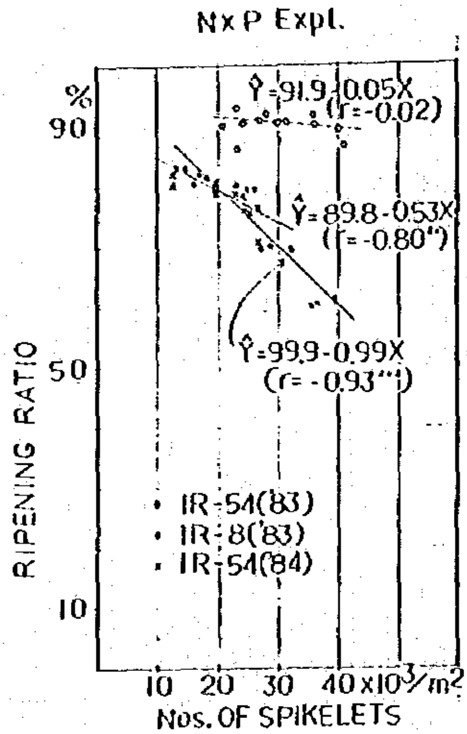
Fig 7



次に単位面積当りの穂数とチッ素の施肥量についてみると，正の相関がみられ，チッ素の施肥水準をあげることで穂数が増加することが解った。昭和58年の1R−8の場合では$N_0-N_{50}-N_{150}$の間に有意差が認められ，1R−54（昭和58年）の場合でも同様であった。これは，チッ素肥料の施用により1株穂数が著しく増加したためである。単位面積当りの穂数，そしてえい花数がチッ素の施肥により増加することが明らかになったが収量は横ばい状態になる施肥量の水準がある。籾収量と単位面積当りのえい花数の間に強い正の相関が認められ，えい花数／㎡が収量を決定する1つの要因であることが解った。しかし，単位面積当りのえい花数と登熟歩合の間に負の相関が認められ，登熟歩合の減少が収量の横ばい状態のあらわれる原因となっていることが解る。1R−54（昭和58年）では有意差はみられなかったもの，1R−54（昭和59年）では$r=-0.80^{**}$および1R−8では$r=-0.93^{***}$と強い負の相関が認められた。

1R−8の場合では，えい花数が20×10³／㎡以上になると，登熟歩合の低下がみられ，

Fig 8



40×10³/㎡では60%に低下した。IR−54(昭和58年)では，えい花数が増えることで登熟歩合が減少する傾向はみられたものの30×10³−40×10³/㎡のえい花数が得られた場合でも著しい登熟歩合の減少は認められなかった。昭和59年のIR−54では，灌漑水不足などの問題のため，登熟歩合が減少することが認められた。試験数が少ないため，登熟歩合の著しい減少をひきおこす単位面積当りのえい花数の限界を明確に把握することは困難であるが，IR−8では25×10³〜30×10³/㎡また IR−54では40×10³/㎡程度と考えられる。

次にチッ素，リン酸の施肥の経済効果について検討すると，チッ素の経済効果は高いものの，リン酸の効果はみられず，リン酸を施肥することで高い収益率を期待することはむずかしいものと考える。チッ素肥料の施肥量を0から50KgN/haへ高めることで，IR−8の場合で21.18，またIR−54(昭和58年)で8.88，またIR−54(昭和59年)の場合で5.05の限界収益率が認められた。チッ素の施肥量をさらに50KgN/haから100KgN/haへ高めた場合でも，高い限界収益率がみられた。しかし，施肥量をN100からN150へ増加した場合，IR−54(昭和58年)以外では収益率が低下した。このことからみて，経済的に妥当なチッ素の施肥量は100KgN/haと推定することができる。リン酸の効果についてはIR−54(昭和58年)にみられたがリン酸肥料だけを施肥しても効果は期待できないであろう。リン酸はチッ素肥料と組み合せて施肥された場合に，その経済効果を期待することができるであろう。しかしながら限られた試験数であるた

め，今後も検証を継続する必要があり，また，施肥の経済効果についてもより多くの試験結果をもとに検討する必要があるだろう。

ここで得られた結果をもとに，施肥の適正水準はチッ素で100〜150Kg/ha，リン酸40Kg P_2O_5/haと推定した。また，ローアモシ地域の農民の経済状態，栽培技術，作期を考慮し，次のような施肥基準を設定した。

改良種では，$N_{100}P_{40}$，$N_{150}P_{40}$を基準とし，この場合適切な水管理，除草，病害虫防除が強く要求される。リン酸肥料が入手困難であったり，農民に十分な資本力がない場合には，リン酸施肥をせず$N_{100}P_0$，$N_{150}P_0$を基準とするか，3－4年に1回はリン酸を施肥するという基準も可能であろう。しかし，農民の圃場でしばしば水不足がみられたり，その他栽培上の問題がみられる場合，チッ素100〜150KgN/haの施肥基準は危険率が高すぎる。十分な資本力を持たない農民にとっては$N_{50}P_0$の施肥基準も妥当であろう。チッ素50Kg/haの施肥でも高い経済効果を期待することができる。また，作期についても考慮する必要があるだろう。現在までは，試験，検証回数が少なく，病害虫の大きな被害は観察されていないが，今後病害虫が制限要因となることも十分予想できる。従って，害虫の被害の可能性の高い雨期では，チッ素の施肥量をN_{150}からN_{100}へ変えることも必要となるだろう。

c) 品種とチッ素施肥量に関する試験

目的：品種特性のチッ素肥料に対する反応性を調査し，各品種の適正施肥基準を決定する目的で実施した。

試験設計：分割試験区法，4反復とし，メインプロットにチッ素施肥量とし，サブプロットに品種とした。昭和58年に実施した試験は，チッ素施肥量3水準(N_0－N_{50}－N_{100})とし3品種，また昭和59年に実施した試験では，チッ素施肥量3水準(N_{50}－N_{100}－N_{150})4品種とした。昭和58年に行った結果から，チッ素施肥量を上げることで増収がみられたため，昭和59年の試験では，施肥水準をN_{50}－N_{100}－N_{150}とした。品種についても，同様に第一回目の試験で品種間差異が認めなれたため，昭和59年度では短稈分ケツ型の穂数型，穂重型の品種間のチッ素の肥効の違いを調査するために4品種を選択した。供試品種，供試面積，耕種概要，試験結果は添付書類－34に記載してあるとおり。

結果の要約：チッ素の施肥量に対する品種間の差異が認められた。供試品種の籾収量は，チッ素の施肥量を高めることで増加することが認められた。しかしIR－54，IR－8の場合，チッ素の施肥量を100Kg/haから150Kg/haへ変えても増収の傾向が認められたが，在来品種の場合には籾収量が減少する傾向がみられた。チッ素の施肥量が高くなることで，単位面積当りのえい花数が増加することが認められたが，収量と同様に品種間の差異がみられた。IR－54，IR－8が100KgN/haから150KgN/haのレベルでもえい花数が増加するのに対し，在来種 Affa Mwanzaでは減少か横ばいの状態となること

が解った。

次に単位面積当りのえい花数と収量の関係についてみると正の相関が認められたが，供試品種の間で，えい花数が異なり，改良種では25×10³～40×10³/㎡の範囲でえい花数/㎡がみられたが，在来種では12×10³～25×10³/㎡にとどまっている。このことから改良種と在来種の収量の差は，えい花数/㎡によるものであり，チッ素の施肥量に対する収量が異なる傾向を示す原因と推定することができる。

次に単位面積当りのえい花数を決定する因子として，1穂当りのえい花数と1株当りの穂数についてみると，1穂えい花数は，品種により明らかに異なり，Taiwan−14，Kilomberoが他の品種と比較して高いことが解った。以外の1R−54，1R−8および

Fig 9

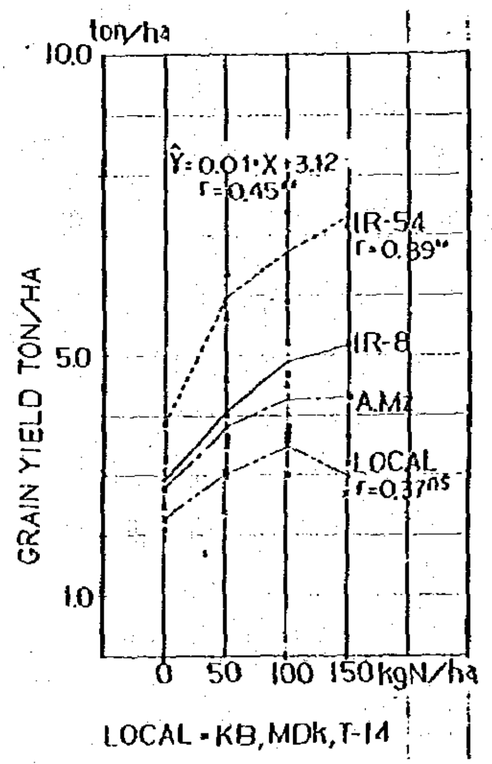
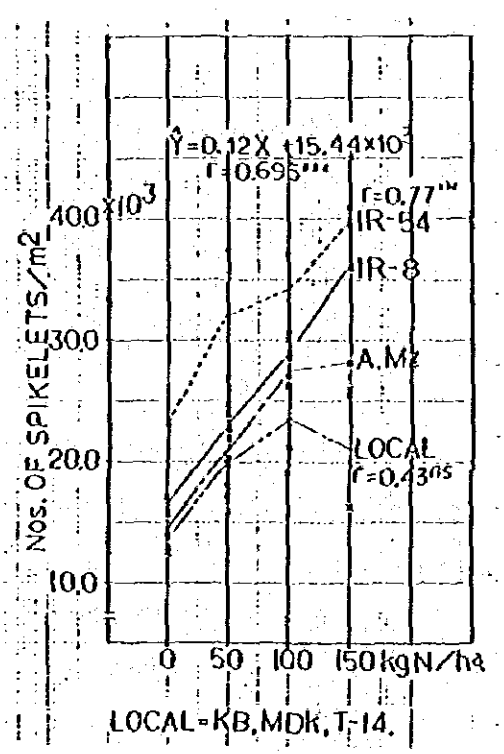


Fig 10

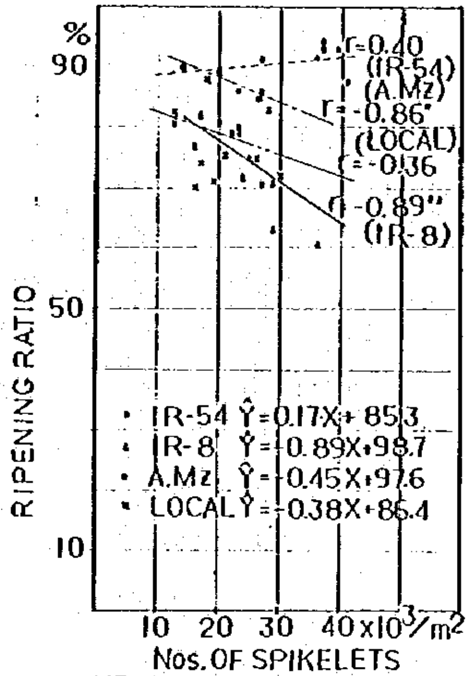


Affa Mwanza，Matandikoの品種間には1穂えい花の大きな差がみられなかった。チッ素施肥量の1穂えい花数に及ぼす影響は明らかに認められなかったが1R−54，Affa Mwanzaでは増加の傾向がみられ，Matandikoでは減少する傾向が認められた。次に1株穂数についてみると1R−54，1R−8の改良種ではチッ素施肥量を高めることで，増加することがみられたが，施肥水準がN_{100}以上に高められると，横ばいかわずかに増加する傾向がみられた。一方，他の供試品種では，N_{100}以上の施肥量では1株穂数が減少し，特にKilombero，Matandikoではこの減少が著しく，N_{50}の施肥水準から，減少傾向がみられた。在来種の1株穂数の減少は無効分ケツの発生に起因するものと考えられる。このように籾収量を決定する要因である単位面積当りのえい花数は品種間に差異がみら

れ，改良種ではチッ素の施肥に高い反応を示し，えい花／㎡が増加するのに対し，在来種ではN_{100}の水準以上ではえい花の増加が期待できないことが解った。

次に単位面積当りの穂数についてみると，品種間に有意差が認められ，在来種のMatandiko，Kilombero は改良種と比較して著しく低いことが解った。チッ素の施肥に対する反応は，品種間の差異に有意差は認められなかったものの，1R−8，1R−54ではN_{100}以上では横ばい状態となり，一方在来種では減少する傾向がみられた。次に単位面積当りの穂数と単位面積当りのえい花数の間に正の相関が改良品種，在来種に認められ，穂数／㎡が単位面積当りのえい花数を決定する因子であることが解った。単位面積当り

Fig 11



NB. LOCAL=K.B,MDk,T-14

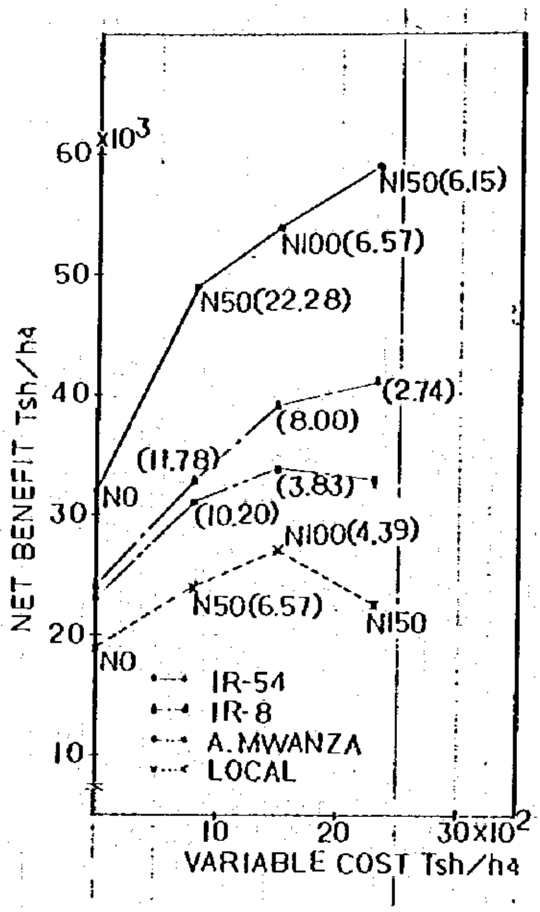
のえい花数を増加するためには，有効茎の確保，ならびに単位面積当りの穂数を増加させることがキーポイントになっていることが解った。在来種の低収性の要因は，単位面積当りの穂数が低いことであろう。

次にえい花数／㎡と登熟歩合の関係をみると，1R−54以外の品種では負の相関がみられ，特に1R−8とAffa Mwanzaの登熟歩合の低下が著しい。登熟歩合の品種間差異についてみると，1R−8，Taiwan−14，Matandikoが他の品種と比較して低いことが認められた。1R−54では，えい花数が40×10^3／㎡のレベルにおいても，登熟歩合の低下はみられなかったが1R−8の場合にはえい花数が30×10^3／㎡以上になると著しく登熟歩合が低下した。

在来種については有意差は認められなかったものの（$r=-0.36$）20×10^3〜25×10^3

／㎡がえい花数の限界かと考えられる。分ケツ力の低い品種ではチッ素肥料の施肥を行っても，無効分ケツの発生，チッ素効率の低下により，単位面積当りのえい花数の著しい増加は期待できないであろう。

Fig 12



このような品種特性の違いから適正施肥基準を推定すると，IR−54については150㎏N／ha，IR−8 Affa Mwanzaのように著しい登熟歩合の低下がみられる品種では，100㎏N／ha以上の施肥量による増収は期待できないであろう。在来種については，50㎏N／haが適正水準と推定した。

次に，チッ素施肥量の経済効果について検討すると，図−12にあるとおり，IR−54の場合，施肥量をN_0からN_{50}に高めた場合，22.28と高い限界収益率が得られ，さらに施肥量をN_{100}，N_{150}と高めることで6.57および6.15の限界収益率が得られた。IR−8の場合では，N_{100}，N_{150}の施肥量では8.00から2.74と限界収益率が低下していることが解る。一方在来種の場合N_{50}の施肥量で6.57の限界収益率が得られたものの，施肥量をさらに高めた場合，負の収益率がみられた。このことから考えても，在来種の施肥水準は経済的効果の点からも50㎏N／haが妥当であろう。

本試験についても，他の栽培試験と同様に，試験くり返し数がかならずしも十分とは言えず，場所を変え検証を継続する必要があるだろう。

f) チッ素施肥時期に関する試験

目的：チッ素の施肥時期の収量に及ぼす影響を調査し，適正施肥追肥時期を調査することを目的として行った。

試験設計：乱塊法，4反復として処理区は元肥分ケツ期，幼穂形成期の施肥時期に全量の100%，50%および25%の施肥量を組み合せた7処理区に無肥料区を加えた8処理区とした。供試品種はIR-54，昭和58年12月から開始し，59年4月に終了した。試験設計，供試面積，耕種概要結果は添付書類－35に記載のとおり。

結果の要約：8処理区の籾収量を比較すると，無処理区と全量幼穂形成期施肥の区の差はみられず，他の処理区と比較して明らかに収量が低い。この減収の原因は単位面積当りのえい花によるものと推定することができる。元肥を施用しない場合には，えい花／㎡が元肥を施肥した区と比較して低いことが解る。チッ素肥料の全量を元肥，分ケツ期，幼穂形成期に施用した場合のえい花／㎡を比較してみると，元肥の重要性が認められた。単位面積当りの穂数をみると，元肥を施用しなかった区の穂数／㎡が低いことが解った。1穂えい花数，登熟歩合に及ぼす影響については，有意差が認められなかった。1回の試験結果から結論を出すことは極めて困難であるが，今回の試験では元肥の効果が高く，元肥50%－分ケツ期25%－幼穂形成期25%の施肥方法が籾収量にとって効果的と考えられる。しかしながら地力，肥培管理等，チッ素の施肥時期に及ぼす影響を考慮する必要もあり，今後，施肥時期の効果の検証は継続する必要があるだろう。

2－3－3　検証栽培

品種特性，収量性の調査および耕種基準の検証を目的として実施し，また同時に検証をおこなう過程で，新たな制限要因の発見と解明も検証栽培の目的として実施した。

検証栽培の目的，供試面積，耕種概要，結果については添付書類－12～29にあるとおりである。ここでは要約について記載することとする。昭和57年9月から61年1月までの間に18の検証栽培を実施した。この検証栽培は季節の変化，作期を変えることで供試品種の収量性に及ぼす影響を調査するために毎月播種を行った訳である。

18の検証結果の要約は下記のとおりで，灌漑水，低温の障害，quelca birdによる被害のため，収量に大きなばらつきが認められた。品種特性外要因の影響が大きく品種の収量性については正確に検証できなかった。

検証栽培の概要

	品　種	作　期	収　量	備　考
1	Affa Mwanza	3/9/82 － 25/2/83	0	quelea queleaの被害により収量皆無の状態となった。
2	IR－8	11/2/83 － 14/7/83	5.76ton/ha	出穂が不揃いで穂数/㎡が低いようであった。
3	IR－8	4/3/83 － 13/8/83	770Kg/ha	デーゼル油不足のため，灌漑水の供給が停止し一部枯死がみられた。
4	IR－36	7/9/83 － 18/1/83	5.77 ton/ha	最高分ケツ期，上位葉先端の黄化現象がみられた。土壌条件に起因する問題か不明である。
5	IR－20	2/9/83 － 8/2/84	8.26 ton/ha	プロットの水もちが良かった。耕起深度を高くした。試験を実施したプロットで長期間圃場が湛水状態であったため，雑草の発生が著しく，深い耕起を行った。 上位先端葉の黄化現象が最高分ケツ期にみられた。
6	IR－42	13/1/84 － 15/6/84	4.72 ton/ha	出穂不揃，穂数/㎡が低いことがみられた。
7	IR－54	10/2/84 － 30/6/84	4.60 ton/ha	コンバインハーベスターの収穫によるロスが高かった。IR－54は脱粒性が高い。鳥おい風船を設置したがqueleaの被害を受け減収した。
8	IR－56	9/3/84 － 25/8/84	31Kg/ha	低温被害による不稔粒が多発した。
9	Affa Mwanza	13/4/84 － 5/10/84	218Kg/ha	同　上
10	RD－10	14/6/84 － 6/11/84	1.62 ton/ha	queleaの被害100% 鳥おい風船の効果は認められなかった。著しい数のqueleaの飛来がみられた。
11	IR－42	13/7/84 － 21/12/84	528Kg/ha	揚水ポンプの故障により水不足が生じた，また同圃場の水もちが著しく悪く他の試験圃の灌漑を優先するために，給水を停止した。
12	IR－56	10/8/84 － 26/12/84	2.78 ton/ha	揚水ポンプの故障のため十分な灌漑ができず，圃場全体の約30%の面積が強度に乾燥して枯死した個体がみられた。

13	ＩＲ－３６	10/8/84 － 26/12/84	2.2６ ton/*ha*	揚水ポンプ故障のための水不足により，登熟歩合が著しく低下した。
14	ＩＲ－２０	14/2/85 － 1/7/85	2.1８ ton/*ha*	圃場の水もちが著しく悪化し，規定補給水では十分ではなかった。不稔粒が多くみられた。
15	ＩＲ－３２	28/2/85 － 20/8/85	３７０Kg/*ha*	低温による障害のため，登熟歩合が著しく低下した。
16	ＩＲ－４２	22/3/85 － 4/9/85	３２６Kg/*ha*	低温による障害のため登熟歩合が著しく低下した。また穂の先端えい花の白色化退化がみられた。えい花／㎡は高かったが登熟粒はわずか７.３%であった。
17	ＩＲ－３６	9/8/85 － 24/12/85	6.0３ ton/*ha*	水もち良好で特記すべき問題はみられなかった。収量解析はできなかったため，明細については記述できない。
18	ＩＲ－５４	12/9/85 － 28/1/86	2.7４ ton/*ha*	圃場の水もちが悪く，規定補給水では十分な水管理ができなかった。このため雑草の発生が著しく，減収したものと考えられる。収量解析はできなかった。

quelca queleaによる被害は，３回の検証圃で認められ，壊滅的な被害を受けた圃場では収量皆無となった。queleaについては別添のレポートに記載してあるとおりで，quelea の被害は季節により異なり，鳥の集中する時期に変化があること，また鳥追い風船の効果もみられなかった。quelea対策としては，人間による鳥の分散，被害を集中させないこと，防鳥ネットを使用するなどの方法が考えられる。

次に灌漑水不足による問題が４件の検証栽培に認められた。特に昭和５８年に実施した検証圃では，籾収量が著しく低下し５２８Kg/*ha*となった。30.18 ×１０³/㎡のえい花数が認められたが，登熟歩合が４２.６％と低下し，千粒重も低いことが認められた。灌漑水が不足した場合，共通して認められた現象は，登熟歩合，千粒重の低下であった。

低温の障害により不稔が多発し，著しい減収は４件の検証栽培に認められた。特に著しい減収は，昭和５８年３月播種のＩＲ－５６にみられ，収量は３１Kg/*ha*であった。えい花/㎡は極端に高かったが不稔粒が多発した。また遅れ穂が多発した。不稔粒の多発による著しい収量の減少が共通してみられた現象であった。２－３月播種で７－８月の低温期に減数分裂期が重なった場合に低温による障害がみられた。

この他に，圃場の水もちが不安定で，前年は水もちが良好であったのに，次の年では著

しく水もちが悪化し，規定の補給水では不十分となり水不足が原因で減収となった検証栽培がみられた。この原因については，不明確な点が多い。圃場が強度に乾燥し，亀裂が深いところまで到したためと考えることができる。

このようにして気象要因，queleaの被害，灌漑水，圃場の水もちなどの制限因子が明らかになった。特に気象要因については，今後の検証が強く望まれるところである。年間の気温の変化をみると，7－8月の低温期，2－3月の高温期があるが，温度の変動，期間の変動も年度により認められ，低温による障害や高温期の障害による稔実の低下の可能性も考えられる。稲作の安定化を考えるに際し，年間の温度変化，水温の変化と作期の関係を決定することが最重要項目と考えられる。

水田の水もちが年度により異なる現象が観察されたが，原因については不明な点が多い。このため，原因の解明とその対策を早急にたてる必要があるだろう。現状では，収穫後水田が強度に乾燥する前に土壌表面の構造破壊をロータリー耕で行い，深いところまで亀裂が入るのを防ぐ方法をとっている。結果的には品種特性，収量性の検定は，これらの諸要因の障害のため十分にできなかった。しかし一方，これらの不確定要因の収量に及ぼす影響が明らかになった訳で，今後，収量の安定化のためにこれらの諸問題の解決法を予備試験，栽培試験の段階で解明する必要がある。

最後に，トライアルファームで行った試験，検証の結果を考慮し耕種基準の概要をまとめると下記のとおりである。

耕種基準の概要

栽培技術	適正水準	備考
苗代播種量 苗代面積	80～100g/㎡ 7.5～9.0Kg/0.3ha 90--120㎡/0.3ha	播種量が100g/㎡以上になると苗の乾物重，発根力が低下する傾向がある。このことから1プロット（0.3ha）を基準とすると，7.5～9.0Kgの播種量とし，苗代面積は90－120㎡となる。KADCでは現行の苗代は1.5m×26.0mの苗代に2.5～3.0Kgの播種量とし，0.3haのプロットには3つの苗代を基準としている。発芽率は85％以上とし，鳥害，灌漑水の問題による苗の損失を考慮し，播種量を調整する。
苗代形態	水苗代	除草，水管理の点を考慮し，水苗代（ねり苗代）とした。播種後，2葉期程度まで苗代灌水を行い，芽ぼしも適期におこない，ころび苗の防止につとめる。以後は苗代を湛水状態に保ち，雑草の発生を抑制する。
苗代日数	25－35日	播種後，25日－35日に移植を終了することとし，35日以上40日となると発根力が低下する。IR－36，IR－56などの早生品種では老熟苗を移植した場合，不時出穂の

		可能性が高くなる。
品種	改良品種 1R−20, 1R−36 1R−54, 1R−56 1R−42 在来品種 Affa Mwanza	生育期間，収量性，慣行栽培，適応性また農民の意見を考慮して選択した。このうち1R−54は広く栽培されている。 在来種ではローアモシ地域では12品種がみられるがチッ素反応性が低く，千粒重，1穂えい花数は高いが収量性は低い。改良品種のうち穂重型の品種が農民の評判が高い。
栽植密度	改良品種 25.0株/㎡ 1株3本植 在来品種 16.7～20.0株/㎡ 1株3本植	改良品種，在来品種とも栽植密度を高めることで，えい花/㎡および籾収量が増加する傾向がみられた。しかし，在来品種ではメイ虫の被害が認められた。
施肥量	改良品種 チッ素100−150 Kg/ha リン酸40Kg/ha 在来品種 チッ素50Kg/ha リン酸0−40Kg/ha	作期および農民の資本力に応じて，施肥量の調整が必要となる。リン酸の肥効，経済効果は低い。肥料を購入する資金のない農民では，チッ素50Kg/ha，リン酸0Kg/haとすることも可能である。
施肥時期	元肥全量50% 分ケツ期，幼穂形成期各25%	元肥の施用効果が高い。
耕起	移植前1ケ月に耕起終る。 ロータリー耕起	移植前1ケ月には耕起を終了し，雑草のコントロールを行う。耕起はロータリー耕起としたが，ボトムプラウ耕起も検討中である。ディスクプラウの耕起は圃場の均平度を悪化する可能性がある。耕起深度は15−20cm。長期間圃場を未耕起の状態を放置すると亀裂が生じ，水もちが悪くなる可能性がある。収穫後，表面を浅くロータリー耕起し，土壌の乾燥を防ぐ方法を現在行っている。
灌漑法	20mm/日 4日間断	代かき用水200mm 中干しは栽培上の効果はみられない。中干しを行うと，中干後の水田も水もちが悪くなり20mm/日，4日間断の補給水では水不足となる場合もみられた。水もちの良い水田では7日間断も可能であり，増収の傾向がみられた。
害虫防除	ダイアジノン，タイオダン，苗代期，分ケツ期に散布	よく観察された害虫は次のとおり。 1. stalk−eyed shoot fly 2. Pink stalk borer 3. White rice borer

		4. Rice hopper 5. Rice bug
病　　害		現在までは，病害の被害は認められなかった。ゴマ葉枯病，モンガレ病が一部にみられた。 分ケツ期に上位葉の先端が黄化する現象がみられた。
除　　草	代かきによる除草 分ケツ期の手除草	代かき時に除草，分ケツ期に手除草，回転除草機による除草。除草剤は使用しない。除草剤は入手が困難であり高価で，農民の現状では除草剤の使用には問題がある。
収　　穫	適期収穫	穂全体の85％程度が登熟し，穂首近くが黄化する時期を登熟期とし，適期収穫とする。収穫が遅れ，立毛状態で乾燥すると砕け米が増える傾向がみられた。農民は適期をのがし，収穫が遅れる傾向がみられた。落水は収穫の2週間前程度とする。
作　　期	1. 雨期作 2月〜7月 2. 乾期作 10月〜3月 3. 乾期作 8月〜1月	雨期作は1〜2月播種し，収穫は6〜7月とする。乾期作は2期作の場合，7〜8月播種，12〜1月収穫とする。2.の乾期作は慣行の作期に改良品種を栽培した場合の作期。慣行栽培法では水稲の収穫後，トマト，インゲン豆が栽培される。

2－4　今後の課題

4年間に実施した栽培試験，検証では精度の高い耕種基準を決定するには十分と言えない。したがって，今後も耕種基準の検証を継続する必要があることは言うまでもないことである。また4年間でみられなかった病害虫，雑草耕起法に関する試験は実施しなかった。特に害虫や雑草は今後制限要因となることは十分考えられる。また稲作の安定化，増収技術の開発の点からも，気象要因と栽培期間の検討も今後重要な課題となるであろう。4年間で実施できなかった項目，今後検討すべき項目，技術要因，対応策を次のように要約することができる。

今後の課題と対応策

技術要因	検　討　項　目	対　応　策
品　　種	1. 品種特性（改良種，在来種）	検証栽培
	2. 現地適応性	現地検定圃
	3. 病害虫抵抗性	
栽植密度	1. 栽植密度の品種間差異	水準決定試験
	2. 限界栽植密度と収量性	分割試験区法
	3. 病害虫の発生と栽植密度	検証栽培

	4. 移植効率と経済性	
施肥量	1. 適正施肥量の検討	水準決定試験
	2. チッ素施肥量の品種間差異	乱塊法要因試験
	3. 施肥時期の検討	分割試験区法
	4. 施肥量と病害虫の発生	検証栽培
	5. 経済効果の検討	
耕起	1. 耕起法と作業効率の検討	予備試験
	2. 耕起時期の検討	水準決定試験
	3. 耕起深度の収量に及ぼす影響	分割試験区法
	4. 耕起時期と水田水もちの関係	
灌漑法	1. 間断日数の収量に及ぼす影響	予備試験
	2. 間断日数と水温の変化	水準決定試験
	3. 中干しの効果	分割試験区法
	4. 中干しと灌漑効率の検討	
病害虫	1. 病害虫の分類同定	予備試験
	2. 病害虫の被害発生時期の解明	圃場調査
	3. 適正防除法の確立	検証栽培
除草	1. 水田雑草の同定	予備試験
	2. 発生生態の解明	圃場調査
	3. 適正防除法の確立	検証栽培
収穫	1. 収穫時期と砕け米の発生状況	予備試験
	2. 収穫時期と圃場における収穫ロスの関係	
移植法	1. 手植え，投げ苗，機械移植の収量に及ぼす影響	予備試験
	2. 移植作業効率と経済性	水準決定試験
		分割試験区法
日本稲導入	1. 品種特性	予備試験
	2. 作期と収量性の検討	水準決定試験
		乱塊法
作期	1. 気象要因と作期の検討	予備試験
	2. 低温障害，高温障害の解明	周年栽培
	3. 適正作期の確立	
	4. 抵抗性品種の検定	
節水栽培	1. 節水効果，収量に及ぼす影響	予備試験
	2. 乾田直播陸稲栽培の検討	

	3. 適正品種の検定	
輪 作 体 系	1. 田畑輪作の水稲収量に及ぼす影響	予備試験
	2. 水田裏作畑作物の導入の可能性	
	3. 適正作物の検討	
防 鳥 対 策	1. Queleaの被害の発生時期	予備試験
	2. Quelea生態の解明	
	3. 適正防除法の検討	
水田の水もち	1. 水もち状態悪化の原因解明	予備試験
	2. 代かき回数と水もちの関係	
	3. 耕起時期との関係	
	4. 適正対策の確立	

3. パイロットファームにおける業務

3－1　業務内容

パイロットファームにおける水稲栽培の導入，チェケレニ農民に対し水稲栽培の技術指導を行い，パイロットファームを組織的かつ計画的灌漑農業を実践するモデル農場に育成することを目標とする。また同時にトライアルファームでの試験結果を検証をおこない，耕種基準作成のための基礎データーの収集も目標の1つである。

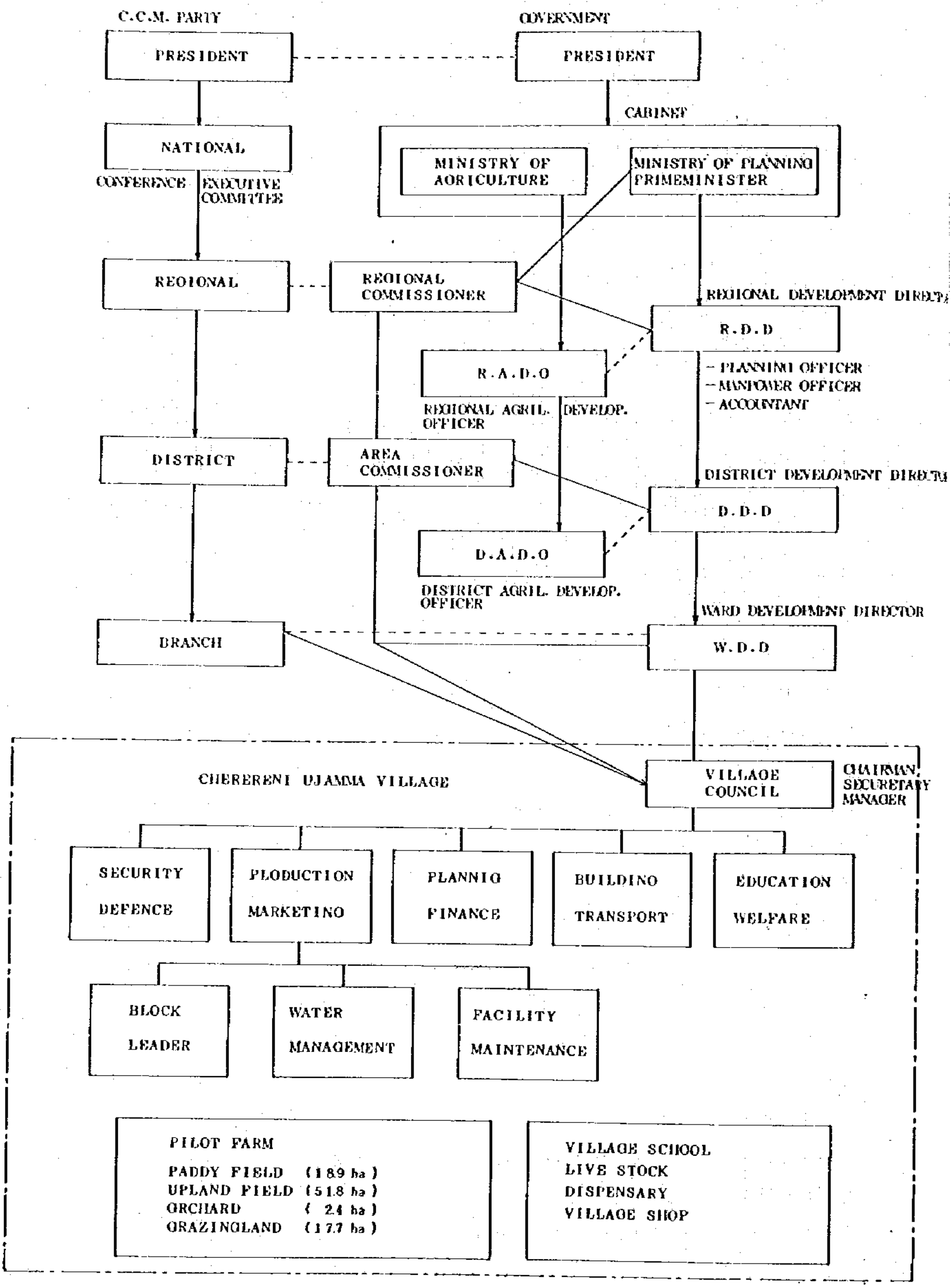
3－2　チェケレニウジヤマー村について

パイロットファームの運営について理解するためには，当農場の運営形態の基本である「ウジヤマー」について語らなければならないであろう。ウジヤマーとはスワヒリ語で「家族」，「同胞」を意味する言葉で，1961年の独立以来，社会主義を標榜する，タンザニアでの農村開発の基本理念となっている。ウジヤマー精神とは，植民地以前の伝統的アフリカ社会における「無階級」，「平等分配」，「保障と歓待」の原理を賞揚をし，伝統的アフリカ社会への復帰の基本理念となっている。1967年ニエレレ大統領による「アルーシヤ宣言」で農業開発に基礎をおき，外国の援助に依存しない。自助努力をタンザニアの政策の中心としてうち出された。以後タンザニアの農業開発は，ウジヤマーの精神にもとづいた，農業協同組織体，ウジヤマー村の建設を中心に行われている。ウジヤマーの村長，書記およびマネージャーは，タンザニア革命党（CCM）より任命され，事業の計画，運営は合議制によりおこなわれ，所有の分配では，私有は否定され，原則として共産制を基本として運営されている。

パイロットファームを運営するチエケレニウジヤマー村と政府，CCM（政党）との関係およびチエケレニ村の組織図は添付の図－13にあるとおりである。チエケレニウジヤマー村は5つの委員会により構成され，パイロットファームをはじめ，教育，医療，商店等の業務が運営されている。構成家族は約500とされ，3500名がチエケレニウジヤマー村の構成員となっている。このうち，パイロットファームに関する業務を担当する構成員は330名，同ファーム以外の業務を担当する構成員は170名とされている（昭和59年調査）。通常は週2日，7：00Am～12：00Amの3時間の共同農場で労働提供をおこない，農作業の集中する期間は，週3日の共同作業，あるいは作業時間の延長で対応している。1日当りの労働提供に対する報酬は，収穫物を平等配分し，調査時では1日当り3～5タンザニアシリングで，普通，日雇い人夫の日当が17～20シリングであるのに比較して著しく低い金額であった。またチエケレニウジヤマー村では，原則として共産制を基本としているものの，構成員1人当り3acの所有地が認められている。この私有地と1日当りの労働報酬の低さが，パイロットファームでの共同作業に対する意欲を著しく低下させた原因の1つであろう。

パイロットファームの運営に直接関係するのは，5つの委員会のうち，営農委員会であ

Fig.－13　タンザニア政府，CCM党と村の関係図



り，この下に，6ブロックをそれぞれ担当するブロックリーダーが配属され，また，パイロットファームの水管理施設管理を行う小委員会が設置されている。これらの委員会，小委員会の下にある水管理，施設管理小委員会は昭和６０年にＫＡＯＣ灌漑セクションの指導により創設された組織である。

3－3　業務の実施状況

昭和５７年３月に８１.８ ha（うち水田9.0 ha）の引き渡しが終り，また昭和５８年１月に２６.７ ha（うち水田9.9 ha）の引き渡が終り，パイロットファームはチエケレニ村にすべて引き継がれた。パイロットファームにおける業務の主な内容は展示圃の設置，チエケレニ村民に対する水稲栽培の演示，技術指導および農場運営に関する助言である。

昭和５７年１１月に１０プロット（3.0 ha）で水稲栽培の演示を開始した。以後は，農民の自主性にもとずいて，パイロットファームでの水稲栽培が継続されるべきであるとの観点から，１０プロットでの演示以外，すでに農民にまかせるかたちとなった。しかし，共同農場における農民の勤労意欲が低く，わずか１０プロットに栽培されたにすぎなかった。昭和５８年に引き渡された水田についても同様に，まったく水稲が栽培されないまま放置された。このため，水田はブッシュと化し，水路の通水能力も雑草のため著しく低下した状態のまま放置された。このようなパイロットファームの状態を改善し，モデル農場と機能するように，昭和５８年１２月より３３プロット（9.9 ha）で，ＫＡＤＣが直接参加するかたちで，水稲栽培を開始した。昭和５８年１２月２７日より水稲の播種を開始し，１６プロットに水稲を，また，１７プロットにはシコクビエを栽培した。この直接参加の栽培については添付書類－３６の「Production Report of cnekereni Pilot Farm－１９８４」に記載してあるとおり。水稲のかわりに，シコクビエを栽培したのは，水稲を栽培していく過程で灌漑水が不足したためで，水稲に変る需要の高い作物との観点から選択したためである。

水稲の収量についてみると，作付面積が拡大するにつれ収量が低くなる傾向がみられる。昭和５８年１２月に播種を開始して以来，１月下旬から田植が始まった訳であるが，田植が進むにつれ，代かき用水と補給水のバランスがくずれ，代かき用水の不足，代かきの遅れがみられ，４０－４８日苗を移植せざるおえなかったプロットもいくつかみられた。老熟苗の移植（代かきの遅れのため），補給水の不足が収量の低下をもたらした原因と考えられる。

３３プロットでの直接参加を実施した後，チエケレニ農民の勤労意欲が高まり，水稲栽培面積が著しく拡大した。この理由はいろいろと考えられるが，水稲栽培のプロット担当制，収穫物の分益制を導入したことが，農民の勤労意欲を高めたものと考えられる。パイロットファームの水田での労働の報酬として１日当りの賃金で支払うのではなく，各農民の担当したプロットの収穫物を５０％がウジヤマー村への供出，のこりの５０％を農民の

取り分という制度を導入し，それぞれのプロットでもウジヤマー村民が共同で耕作する方法をとらずに，1プロットに1～2家族に割り当てる制度をとり入れた訳である。4年間の作付状況の推移は下記のとおりである。

パイロットファーム作付状況の推移

年度 ブロック	作付面積（ha）			
	1982	1983	1984	1985
A　3.0 ha	3.0	0	6.0	6.0
B　3.0 ha	0	3.0	3.9	6.0
C　3.0 ha	0	0.3	3.0	6.0
D　3.2 ha	0	3.2	3.2	6.4
E　3.3 ha	0	0	3.3*	6.6
F　3.4 ha	0	0	4.0*	6.8
計	3.0	6.5	23.4	37.8

＊シコクビコの栽培

このように昭和58年，当初農民の労働意欲が低く，また水稲栽培の経験不足などの要因のため10プロットで栽培されていた程度であるが，KADCがパイロットファームの水稲栽培に直接参加した後，著しい作付率の増加がみられた訳である。パイロットファームにおける水稲栽培の推移の明細については添付書類－36にあるとおり。

昭和57年から61年までの4年間でパイロットファームで実施した業務の経過，指導助言を要約すると次のようになる。

パイロットファームにおける業務の推移

年度	実施状況	備考
57年11月	10プロット（3.0ha）での演示，展示圃の設置	チエケレニ村農民の水稲栽培の経験不足と，共同農場における労働意欲が低かったため，水稲，作付面積は拡大しなかった。
58年 7月	10プロット（3.0ha）にIR－8が栽培された。	10プロット以外の水田は，放置状態で，水田はブッシュ化し，水路は雑草のため，著しく通水能力を低下した。
58年 9月	チエケレニウジヤマーのリーダーとの協議，パイ	次のような問題点が明らかになった。 1. 農民の労働意欲が低い。

	ロットファームの運営改善と作付率改善のため。	2. 構成員の一部はチエクレニ村に住んでいない。 3. 稲作経験の不足。 4. 灌漑水不足。 5. 水管理，施設管理の組織がない。 6. 農機，トラクターが不足。 7. 生産資材の調達がむずかしい。
58年12月	33プロット（D.E.F.の3ブロック）にKADO直接運営方式で水稲栽培を開始	水稲16プロット，シコクビエ17プロットを栽培 KADOがパイロットファームに対して行った業務 1. 営農計画の作成 2. 水配分計画の作成 3. 農機の貸し出し 4. 生産資材の一時貸付 また明らかになった問題点は 1. 水管理，水配分が設計どおり実施できない。 2. 施設（水路等）の維持管理が十分でない。
59年　5月	作付率の増加 運営改善に関する指導および助言	農民が自主的に水稲栽培を開始し，作付率が高まった。 指導，助言の内容は下記のとおり。 1. 作付計画の作成 2. プロット別，担当制の導入 3. プロット収穫物分益制の導入（農民1／3，村2／3） 4. ブロックリーダーの任命 各ブロック別に作業内容，収量を記録し，また担当農民に対する指導，助言をブロックリーダーの業務とした。
59年10月	33プロットをチエクレニ村へ返還した。	農機の貸付料金，生産資材の貸付け分等，KADOが一時立て替した分を収穫物から差し引き，収益はウジヤマー

		村へ返還し，農場運営資金としてプールするよう助言した。
５９年１１月	現地検定圃の設置	改良品種８，在来種２の計１０品種の品種比較。 以後，改良種の栽培が著しく増加した。
６０年　５月	水管理，施設管理，小委員会の創設	ＫＡＤＣ，灌漑セクションにより水管理の組織が作られ，計画的灌漑農業の実践のため，パイロットファームでの訓練が開始された。
６０年　７月	現地検討会 ウジヤマー村，指導組織営農委員会，農業，普及員が参加した。	作付面積が増加したもののプロット当りの収量が低下したことについて，農民から問題提起があった。ここで明らかになった低収の原因は 1. 適期移植がなされていない。 2. 適正栽植密度が守られていない。 単位面積当りの株数が低すぎる。 3. 適正肥培管理がなされていない。 特に元肥はまったく施肥されていなかった。
６０年１２月	計画的灌漑農業，設計にもとづいた水稲栽培の開始	灌漑セクションの指導のもと設計にもとづいた水管理を開始した。同セクション作成の灌漑計画にもとづいて作付計画を作成し，計画的な水稲栽培が開始された。

３－４　成　果

４年間にわたりパイロットファームにおいて行った水稲栽培の技術指導および，営農改善のための助言をとおして，得られた成果を次のとおり要約することができる。

a) 水稲栽培の定着

昭和５９年よりチエケレニ農民の水稲栽培に対する熱意も高まり，開始当初の５８年と比較して，作付率も著しく高まり，基礎的な水稲栽培技術は習得したものと考えられる。また各プロットの担当制度を導入したこと，収穫物の分益制を導入したことも作付率が高まった理由である。しかし，図－５６，５７の作付面積とプロット当りの収量の関係にもみられるとおり，作付面積が拡大するにつれ，収量が減少する傾向がみられた。昭和５９年３月以後，７月までの間に作付されたプロット数は２０－２３プロット／月

と急激に増加したのに対し，プロット当りの平均収量は4 ton／ha～3 ton／ha と逆に減少している。この原因は，管理が粗雑になったためである。適正肥培管理がなされず，元肥も施肥されなかった。また，十分な水管理もなされず，粗雑な肥培管理が原因で収量が減少した訳である。この時期に作付されたプロットは，造成後2作目であり地力が原因して減収となったとは考えられない。

b) 農民の意欲の向上

ウジヤマー本来の共産制から，水田各プロットの担当耕作の制度が導入され，個々の農民が1プロットの水稲栽培を受けもち，またプロットの収穫物を1／3（農民）：2／3（村）の割合で分益する制度が導入されたことで，チエケレニ農民の勤労意欲が著しく高まった。分益率は，以後，作付面積が増えるにつれ1／2（農民）：1／2（村）の割合となった。しかし，農民達はウジヤマー村への供出量を一律に固定したいとの意向が強い。この点について， 1. 生産資料（肥料，農薬）を村が一括購入し，各プロット担当の農家に配分する。2. トラクター耕起にかかる経費，水管理，施設管理に必要な経費を算出し，水管理費として一律にする。これらの経費を1プロット当りの生産経費として算出し，またウジヤマー村の取り分を加えて，1プロット当りの供出量を決定するよう助言した。ロークーモシ地域では，1 ac の小作料は2,000～3,000シリングか籾200kgとなっており，チエケレニ村の農民も，供出量を一律に固定することを強く望んでいる。この点についてはチエケレニ村の運営にかかわる委員会，リーダーの間で検討されている。

c) 農民からの問題提起

昭和57年開初当初，平均収量は5.0 ton／ha であった。 以後，58年に実施した33プロット（KADC直接運営）では，プロット当りの平均収量は6.3 ton／ha となったが，昭和59年以後，作付面積が拡大するにつれ，平均収量は3.0 ton／ha 程度に低下した。この現象について，チエケレニ農民側から疑問が発せられ，収量が低下したことについて，現地検討会がおこなわれた。このように農民の意識が，ただ単に水稲を栽培することから，高収量をあげることへと高まったものと考えられる。高収量品種に対する認識が高まり，パイロットファームで改良品種が広い面積に栽培されるようになった。これは，昭和59年11月に現地検定圃を設置したことにより，改良品種の収量性に対する認識が高まったためと考えられる。以後，検定圃の供試品種のうち，1R－20，1R－36，1R－54および1R－56が主に栽培されるようになった。

d) 計画的作付の開始

以前は，パイロットファームにおける水稲栽培は計画性がなく，水稲の作期，生産資材の調達，63プロットの作付計画を考慮せず，場当り的な栽培をおこなっていた。しかし，将来パイロットファームがモデル農場となるように，そして計画的かつ組織的な

灌漑農業を実践する農場とするため，営農，水管理，施設管理組織が育成された。KADC灌漑セクションにより作成された灌漑計画に基づいてプロット別の作業計画を作成し営農委員会をつうじて各農民に伝達する組織をつくりあげた。これにより昭和61年からの作付は灌漑計画にもとづいた作業計画にそって，トラクター耕起，播種，代かき，移植が計画的に実践されるようになった。しかしながら，このような計画的な作付を開始したのは，昭和61年であり，農民の経験が十分とはいいがたく，さまざまな問題がみられる。今後，農民が計画的な営農を継続するためには，KADCの指導助言が強く望まれるところである。

3－5　今後の課題

水稲栽培がほぼ定着し，作付面積が拡大したものの，まだ栽培技術，パイロットファーム，ウジヤマー村の運営から起因するさまざま問題がみられる。収量の高いばらつきがみられること，作付面積の増加に対する，プロットの平均収量の低下は，今だパイロットファームの水稲栽培が安定期にいたっていないことを意味するものであろう。ここでは，これらの諸問題の解決する方法，今後の課題を下記のとおり要約することができるであろう。栽培技術上の問題パイロットファーム運営上の問題について記載することにした。

a）栽培技術上の問題

技術要因	問　題　点	対　　策
肥培管理	肥料の購入が適期になされない，適量が購入されないなどの問題によりしばしば，元肥，追肥の施用，適期肥培がなされない。	展示圃，検討会をつうじて適正肥培管理の収量に及ぼす影響，及び重要性を認識させる。パンフレットの配布
栽植密度	25株／㎡を基準としているが，この栽植密度が守られていない場合がしばしばみられる。この原因の1つが雇用した人夫の作業効率を高めるために，畦間隔を30－40㎝に広げるためと考えられる。	展示圃，現地検定圃および検討会をつうじて適正栽植密度の重要性を認識させる。パンフレット等の配布で重要性を認識させる。
播種量	適正播種量が守られていない。このため苗不足が生じ，栽植密度が守られていない原因の1つである。	耕種基準（括種量）の徹底。
適期移植	灌漑水の不足，水管理上の問題，	計画的作付の指導。

	トラクターの不足，計画性の欠落のため，代かきが遅れ，適期に移植がされていない。２５－３５日（播種後）の移植を基準としているが，４０日以上の老熟苗を移植している場合がしばしばみられた。	計画的水管理の徹底。 トラクターの貸し出し。
収量の安定化	プロット当りの平均収量のばらつきがみられる。上に述べた栽培要因の他に気象要因も考えられる。昭和５９年のD－1（1R－５６），また昭和６０年EおよびFブロックの1R－36，1R－４２に低温によるものとみられる障害がみられた。	低温，高温の障害の解明。 気象要因と作期の検討。

b）運営上の問題

運営上の要因	問　題　点	対　　策
生産資材の調達	肥料，農薬の調達が適期に，また適量おこなわれないため，適期，肥培管理ができない。	耕作費の一律化。 ウジヤマー村での一括購入。 予算行為の迅速化
計画的作付	作付に計画性がないため，栽培上の問題点の原因となっている。	作付計画の作成。 営農委員会の機能を強化し，作付計画の徹底をおこなう。 ブロックリーダー組織の育成
計画的水管理	作付計画と同様に栽培上の問題の原因となっている。	小管理，施設管理組織の機能を強化する。 水管理費として，水管理あるいは施設管理に要する経費を一括して担当農民から徴収する。あるいは収穫物から差し引く制度を確立する。
収穫物の配分	パイロットファームでの勤労意欲の低さは同農場運営にかかわ	プロット当りの村に対する供出割合を現行の１／２（村）：１／２

	る根本的な阻害要因である。	(農民)から1/3(村):2/3(農民)に改めるか，供出量，全プロット一律とする。 ローアモシ地域での小作料は1ac当り籾200kg(2グニア)であり，これと比較してもパイロットファームでの供出量は極めて高い。

4. 研修に関する業務

4－1 業務内容

ローアモシ灌漑プロジェクト受益地域の農民，およびキリマンジャロ州の農業普及員に対し水稲の改良栽培法を指導普及し，同地域における水稲栽培の向上と安定化をめざし，将来，指導的立場となりうるモデル農家を育成することを目的として研修を実施した。

4－2 業務の実施状況

昭和58年2月から5ヶ月の研修コースを開始し，昭和60年までに4コースを終了した。コース対象者はローアモシ地域の農民および農業普及員であった。5ヶ月のコース期間を1.5ヶ月づつの前期と後期に分け，2ヶ月は休講とした。これは対象者のほとんどが農民であることを考慮したためである。また昭和59年8月から，5ヶ月コース修了者でしかも指導的立場にある農民を対象に1年間の長期コースを開始し，昭和61年までに2回終了している。

2つのコースの対象者，期間，研修内容を要約すると次のとおりである。

a) 一般コース

内容：水稲栽培の基礎的項目全般にわたり播種から収穫までを圃場実習をとおして習得する。

期間：5ヶ月

1.5ヶ月づつの前後期に分け，2ヶ月間の休講をもうけ農家の仕事に研修が障害とならないよう考慮した。

対象：ローアモシ地域4ヶ村の農民およびキリマンジャロ州に配属の農業普及員

b) 長期コース

内容：5ヶ月コースで十分習得できなかった項目についてトライアルファームで集中訓練する。各農民の圃場で現地検定圃の設置，管理，巡回指導，トライアルファーム，パイロットファームでの業務の助手をつとめさまざまな技術を習得する。

期間：1年間

対象：一般コースの修了者で，将来指導的立場となり得る農民

研修内容の明細，および研修日程については，添付書類－37，38に記載してあるとおり。

研修コースは，8：30AM開始，1時間30分を単位とし2：00PMまでとし，土曜日はその週の研修内容のまとめおよびテストを実施し，研修生の理解度のチェックを行った。研修用テキストとしては「Kitabu cha Kilimo cha Mpunga」（スワヒリ語）を作成し，教材として使用した。

研修コースの実施状況は下記のとおり。

Table－4　研修コース実施状況

期間 / コース	昭和５８年 2月1日～6月30日	昭和５８年 9月1日～1月31日	昭和５９年 8月1日～12月31日	昭和６０年 8月1日～12月31日
５ケ月コース	２８名*	２４名	３２名	４２名
１年コース	０	０	５名**	５名
計	２８名	２４名	３７名	４７名

＊２８名のうち６名はキリマンジャロ州配属の普及員

＊＊長期コースは８月１日開始の７月３０日終了とした。

c）現地検定圃

長期研修コースの研修内容の１つとして各農家の圃場で検定圃を実施した。昭和５９年には２ケ村３ケ所に，また６０年には２ケ村５ケ所に実施した。６０年に実施した検定圃については，任期終了までに収穫できなかった。

現地検定圃の目的は，改良品種の適応性の検討，農民のおかれている環境下に改良品種を栽培した場合にみられる問題，改良品種の収量性，品種特性の展示農民の改良品種に対する意見を調査することである。供試品種は改良品種８，在来品種２の計１０品種とした。

耕種概要は，チッ素１００kg／ha，リン酸４０kg／ha とし元肥５０％，分ケッ期２５％，幼穂形成期２５％とした。栽培密度は１6.7～２5.0株／㎡を基準とし，これ以外の耕種基準，水管理，除草はすべて農民自身によりおこなわれた。

実施期間，供試面積は次のとおり

1. ラウヤカティ村（M. Furia）
   供試面積：９２０㎡
   播　　種：５９年　９月１３日
   移　　植：５９年１０月１６日
   収　　穫：６０年　１月２１日～２月２５日
2. ラウヤカティ村（F. Silayo）
   供試面積：１２８０㎡
   播　　種：５９年１１月２１日
   移　　種：５９年１２月２４日
   収　　穫：６０年　３月２７日～４月２２日
3. チエケレニ村（J. Ngowi）
   供試面積：２６７３㎡
   播　　種：５９年１０月１５日

移　植：59年11月15日

収　穫：60年　2月25日～4月1日

ラウヤカティ村（M. Furia）の場合では同地域の主作期より2ケ月ほど早く播種したため，早生種の幼穂形成期～出穂期が，主作期の代かき時期と重なったため，灌漑水が確保できず，12月24日では，田面に亀裂が入るほど乾燥し，10日間ほど乾燥状態が続いた。このため別添の試験結果にあるとおり，全品種とも著しく収量が低い結果となった。このことから，主作期から2ケ月もずれると，灌漑水の問題が制限要因となることが理解できた。次にチェケレニ村（J. Ngowi）の例でみると，適正密度が守られていないことが明らかになった。株間は比較的守られているのに対し，うる間が40cm以上の間隔で移植されている場合がしばしばみられた。ラウヤカティ村（F. Silayo）では栽植密度を25.0株／㎡とし，特に栽培上の問題もみられず，比較的高い収量が得られた。なおこれらの検定圃の結果は，品種比較試験の項目に記載したとおり，品種選択の参考資料とした。

4－3　成　果

4年間に一般研修コースを4，また長期1年コースを2回実施し，136名の農民，普及員が研修に参加したことになる。研修の効果，成果について評価することは容易ではないが，研修の成果はある程度あがったものと考える。特に長期コースには高い効果がみられた。ここでは，研修後の受講生の活動状況について記載し，研修の効果について評価することとする。

a）パイロットファームにおける研修生の役割

パイロットファームの営農委員会のメンバー，ブロックリーダーはＫＡＤＣの研修コースを終了した農民で，このうち2名は長期コースを終了しており，パイロットファームでの水稲栽培に関する業務のほとんどが研修生によりおこなわれている。営農委員会における研修修了生の役割りは多く，ＫＡＤＣとパイロットファームを継ぐパイプ役として，またＫＡＤＣが行う指導助言の業務の対象として重要な役割を果している。

b）ローアモシ地域における研修生の役割

5ケ月の期間では十分な研修期間とは言えないものの，水稲栽培の経験が皆無に近い農民たちでも5ケ月コースである程度，水稲栽培の基礎は習得したようである。

ローアモシ地域では，昭和60年8月から213 ha に水稲栽培が開始された際に，ＫＡＤＣのスタッフといっしょになり一般農家に対する演示，技術指導を研修生が中心となって行った。研修効果は，特に一年間の長期コース修了者に高くみられ，これは，研修生が各村の中堅の自作農であり，年令的にみても，一般農家に対して指導的な立場にあることもその理由の1つであろう。各村で実施した検定圃の周囲の一般農家に及ぼした影響は高く，特にラウヤカティ村を中心として改良品種の栽培面積が著しく拡大し

た。一般農民の改良品種に対する認識が高まったのも，栽培面積が拡大した理由の1つであるが，長期研修生の果した指導的役割が大きいのもその理由の1つである。

c) 農業普及員の役割

普及員に対する研修の効果は，農民，特に長期コースの研修効果よりも劣るようである。これはタンザニアにおける普及員の業務にも起因することであるが，普及員自身が水稲栽培の演示をする機会が少ないためと考えられる。しかしながら，第1回のコースを修了した6名の普及員のうちモシ郡に配属されている普及員は，パイロットファームで指導的役割を果し，またローアモシ地域においても普及員グループの中心として，一般農家に対する指導業務を行っている。この他ハイ郡では郡長官の指示により2acの圃場で改良品種（1R－20）の展示栽培を行った。

d) 現地検定圃の効果

現地検定圃の結果をみると，3ケ所の検定圃を設置した圃場が異なったこと，実施した時期が違ったことによる，収量の違いがみられた。この収量の違いは，先に述べたとおり灌漑水の問題，栽植密度の問題によるものであり，改良品種を農家の圃場で栽培した場合に，起こると考えられる問題の一部が明らかになった訳である。

これらの検定圃をとおして，一般農家の改良品種に対する認識が高まったことも，現地検定圃の効果と考えることができる。改良品種，在来品種を比較栽培することで品種特性，収量性，生育期間の差が明確に展示された訳で，施肥の効果も同様に農民に理解されたものと考えられる。ラウヤカティ村，チエクレニパイロットファームで改良品種の作付面積が著しく広まったことをみても現地検定圃の展示の効果は高いものと考えられる。

4－4　今後の課題

改良品種の栽培がローアモシ地域で大きく広まったものの，さまざまな問題がみられるのも現状である。施肥量，施肥時期をまちがえたために，苗が枯死した，在来種に多量のチッ素肥料を施用したために倒伏し著しい減収となった，適正肥培管理がなされていない，苗代播種量の基準が守られておらず，質の悪い苗が移植されている，などの問題を巡回指導中にしばしばみることができた。このように5ケ月間の研修コースを修了しても，実際の圃場で改良品種を栽培するための十分な技術を習得したとはいいがたい。研修修了後の巡回指導，現場での指導が，おこなわれなければ，研修の効果も期待できないだろう。このような点を考慮し，研修に関する今後の課題を次のとおり要約することができる。

項目	問題点	対策
研修生の質	研修に参加する農民の年令，稲作経験などが均一でなく，研修に対する熱意や研修効果に差がしばしばみられる。	研修生の選択に際して，インタビューを行い，なるべく質が均一になるようつとめる。短期研修コースの開設。
研修効果	5ケ月コースでは十分に習得できない項目があり，特に肥培管理に関する問題がしばしばみられる。	巡回指導の強化。 農家圃場を現場にした技術指導で研修コースの不足を補う。 現地検定圃の設置。 短期研修コース（重要な項目に限って）と巡回指導の組み合せで研修効果を高める。
展示普及	研修終了後に，各自の圃場で改良種の栽培を開始できるよう，種子，肥料，スプレーヤー等の資材を支給するが，実際に栽培する農家は少ない。	巡回指導の強化。 現地検定圃の増設。これは，今までは品種比較以外の項目，栽植密度，施肥に関する検定圃を必要に応じて設置することである。 「稲作手引書」等簡単な水稲栽培技術をまとめたパンフレットの配布をとおして，技術指導をおこなう。
教材	研修用教材が十分でない。スワヒリ語のテキストを作成したが内容の充実が必要である。	現場のデーターを加えたテキストの作成。 栽培試験，検証栽培の結果をまとめたテキストの作成。 スライド，オーバーヘッドプロジェクター，ビデオ等，視聴覚機器の教材の充実。

5. ローアモシプロジェクトに関する業務

ローアモシ灌漑プロジェクト工事（2300ha の圃場整備）はキリマンジャロ州の食糧増産を目的として，昭和59年から開始され，現在まで頭首工，幹線水路，支線用水路および圃場整備工事の一部が完成した。ローアモシプロジェクト地域内での業務は本来KADCの業務内容に含まれていない（R／Dに記載されていない），本来のトライアルファーム，パイ

ロットファームにおける業務がおろそかになるなどの意見があったが，タンザニア政府関係機関からの強い要請で昭和６０年８月から工事完了の２１３ha について協力業務を開始した。

5－1　協力にいたった経緯

一部工事終了した地域２１３ha に水稲栽培を開始したいのでＫＡＤＣに協力してほしいとの要請が同プロジェクトマネージャからよせられた。昭和６０年８月７日，ＫＡＤＣスタッフの合同会議がもたれ，協力内容について討議した。しかしこの時点で協力要請を受けたものの，同プロジェクトに関する資料はまったくない状態で，圃場マップ，協力内容を決めるための圃場面積，灌漑計画もない状態であった。この時点でローアモシプロジェクトでは，３－４品種が混入した種子とは言いがたい１Ｒ－８の種子をすでに購入していた。また圃場の状態，水路の通水試験も実施していたり段階であり１Ｒ－８の生育期間を考慮し，６１年３月から始まる主作期との重度の可能性があったため，要請があった時点では，水路の通水試験，圃場の均平度のチェックを当初おこない，６１年３月開始のための準備期間とすべきであるとの意見もあった。昭和５９年８月１３日，再度合同会議がもたれ，強い要請があり，ＫＡＤＣとして，技術指導に限って協力するとの合意にいたり，協力できる範囲，協力内容を明記し，ＫＡＤＣプロジェクトマネージャーに文書で提出した。以後，ローアモシ灌漑プロジェクト地域における協力活動が開始され，昭和６０年１２月１０日に，同プロジェクトのＯ＆ＭがＫＡＤＣの業務となるとの通告をRDDより受け，トラクターハイヤーサービス（ＴＨＳ）の３５台のトラクターもＫＡＤＣの敷地に移動され，ＫＡＤＣの管轄下におかれ，本格的に協力活動を行う体制がととのった訳である。

5－2　業務内容

協力要請を受けた面積２１３ha ７ブロック（ＭＳ１－１，ＭＳ２－１，ＭＳ２－２，ＭＳ－２－３，ＭＳ５－１，ＭＳ７－１，ＭＳ７－２）において水稲栽培を開始するために，苗代プロットの選定から播種苗代管理，代かき，移植の一連の技術指導，演示および７ブロックにおける作業計画の作成が主な業務の内容である。ＫＡＤＣの協力活動は指導助言に限定し，生産資材の調達，購入，配分，農民の動員に関する業務には参加しなかった。このように協力業務を指導助言に限った理由は，ＫＡＤＣスタッフが十分でない。本来の業務であるトライアルファーム，パイロットの業務を停止することができないためである。

5－3　実施状況

昭和６０年８月２６日から協力活動を開始した。当初は４ブロック（ＭＳ１－１，ＭＳ２－１，ＭＳ２－２，ＭＳ２－３）９３ha の作業計画を作成し，苗代プロットの選定を行った。苗代つくり，播種は６０年９月上旬から開始した。しかしながら水路のろう水が激しく，激しい箇所では決壊する所もあり，苗代つくり，播種も遅れた。当初作成した作

業計画より1週間ほど遅れて苗代作りが開始され，本田への移植は9月26日から始まった。作業計画では10月9日に移植終了の予定であったが，約1ヶ月ほど遅れて移植が終了した。この他，MS5－1，MS7－1，MS7－2，3ブロック120 ha については，昭和61年1月から播種が開始され本田移植が2月から始まった。栽培面積も広く，また造成後の一作目のため圃場の均平度，水路の決壊，トラクターの圃場内での沈下等の問題のため，作業計画どおり進展しない地域がほとんどであった。しかしながら昭和61年3月の任期終了時はMS5－1，MS7－1，MS7－2，3ブロックでの移植が行なわれ，4月に終了した。当初協力要請を受けた213 ha の移植が終了した訳である。当初栽培を開始した4ブロック（IR－8）は昭和60年12月より収穫が開始し，予想以上の収量が得られたことで同地域の農民の水稲栽培の意欲が高まった。次にMS5－1，MS7－1，MS7－2、120ha の圃場ではIR－8にかわってIR－54が栽培品種となった。一般農家に対する指導助言はKADCスタッフとともに研修を終了した農民，特に長期研修コースを修了した農民が中心になって行われた。ローアモシ灌漑プロジェクトにおける農民の指導には，このような中堅農家の役割が極めて重要であることが解った。

昭和60年8月から開始した協力は，213 ha の面積について一応移植が終了した訳であるが，同プロジェクトの面積からみるとわずか10％にすぎず，今後円滑に水稲栽培を継続するためには，解決されるべき問題が多い。特に農民の組織作りが最も重要なポイントである。

5－4　今後の課題

ローアモシプロジェクトの一部213 ha での協力活動をおこなうなかで，問題となった点は次の4項目であった。

a）KADCの業務とプロジェクト側の業務が明確に調整されていない。このためスタッフの配属，栽培品種の選択，協力活動の方針が不明確であった。 b）農民の組織化が十分でない。営農，水管理をブロック別，用水系統別に行う組織がないため，共同苗代の管理，移植，本田の補給水の管理がなされていない場合がしばしばみられた。また一部の地域では，耕作権を有する農民のほとんどが，プロジェクト地域内の村に住んでいないため，共同作業の苗代つくり，水路の整備に人がでてこない等の問題がみられた。この不在耕作者（耕作権をもっているが，モシ市やキリマンジャロ山間に住む者，その他政府機関で働く政府職員，権力者が同プロジェクト内の圃場を獲得している）の問題は，今後，広い面積に水稲が栽培された場合に，共同作業の効率に影響を及ぼすものと考えられる。 c）生産資材，トラクター燃料の調達。特に肥料の調達が適期におこなわれないため無肥料のプロットがいくつかみられた。トラクター用デーゼルが調達できず，耕起，代かきが一時，中断したことがあった。 d）指導する側の問題。KADCスタッフ，

同プロジェクトに配属されている普及員との連絡調整が十分でなく，またスタッフの数も少ない。ＫＡＤＣ水稲栽培の研修コースを修了した農民の効果的活用が必要となるだろう。

このような状態から，今後，ローアモシ灌漑プロジェクトを円滑に運営するためには，農民の組織づくりがまず必要である。限られた水を有効利用し，水稲，畑作物を栽培するには，水管理，施設の維持管理の組織がなければ極めて困難なものとなるだろう。営農に関しては，ブロックを最小単位とし，ブロック内の耕作者名簿の作成，共同作業の耕作者間の連絡調整を行う組織が必要となろう。ローアモシ灌漑プロジェクトはこの最小単位の集合体と考えることができる訳であり，ブロック間，用水系統別の区域間，さらにこの区域が集まったスキーム，そして村の間の調整を行う機関として，生産資材の調達，トラクター耕起，代かき，および水稲栽培に関する指導助言を行う営農組織の創設が望まれる。そして，さらに重要な機関として，生産資材の調達，トラクター耕起，代かき，水管理，施設維持管理に要する経費に関する業務を行う会計組織が必要となる。生産資材の調達，分配，水路の維持管理を各耕作者の共同でブロック単位で行うのか，村レベルで行うのか，あるいは全プロジェットを統轄する機関でおこなうのか，管理，経費の取り扱い方法も考慮されねばならない。このような項目：組織の役割を次のとおり要約することができる。

水管理に関する業務	灌漑計画 ブロック別，用水系統別の代かき 補給水の配分計画	1. ブロック別，用水系統別の水管理委員会のの水管理委員会の組織づくり。
	水管理業務	1. ブロックリーダーを最小単位としブロックリーダー間，用水系統別の地域間の調整。
	施設管理業務，水路の整備補修業務の制度化	1. 耕作者の共同作業方式 2. 施設管理費，あるいは水管理費を決定し，耕作者からプロット数に応じて徴収する方式。
生産資材，耕起に関する業務	生産資材の調達，分配方法の制度化およびトラクター耕起に関する業務の制度化	1. 各個の農民（耕作者）が調達する方法。 2. 生産資材，およびトラクター耕起に関する経費を耕作費としてプロット数に応じ耕作者から徴収し，ブロック別，あるいは村別に一括購入を行う方法。 プロジェクトを統轄する組織が一括して行う場合には，ブロック間の調整を行う組

		織が必要となる。
栽培技術指導に関する業務	営農計画。 ブロック別，用水系統別の営農計画の作成	1. 灌漑計画にもとづいて，ブロック別の代かき，移植予定日を決定する。 2. ブロック別営農委員会（ブロックリーダー，サブリーダー等）の組織化による耕作者への作業計画の徹底。
	演示，指導組織の育成	1. ＫＡＤＣスタッフ，普及員およびKADCの研修を修了した農民を組織化する。 2. 各ブロック単位に研修修了者を配属し，一般耕作者の指導を行う。 3. ブロックリーダーを責任者として共同作業（共同苗代管理等）の管理を行い，またブロックリーダーとの共同作業で演示，指導を行う。
	展示圃の設置	1. ブロック別に展示圃を設置し，適正栽培技術の指導を行う。 2. ＫＡＤＣスタッフの指導のもとに一般耕作者との共同管理とし，ブロックに配属されたＫＡＤＣ研修コース修了者が管理する。
	ＫＡＤＣと耕作者の連絡業務	1. ブロックリーダー，サブリーダーをメンバーとしてブロック別営農委員会の組織化 2. 各ブロックでの栽培上，運営上の問題点を検討する会議を定期的におこない，ブロックリーダー，ＫＡＤＣ各ブロック配属の指導農民普及員の間で情報交換，業務の進捗状況の把握を行う。

6. 慣行栽培法の調査

ＫＡＤＣの研修コースに参加した農民，巡回指導の対象とした週辺の農民を対象としたトウモロコシ，水稲，菜豆（マハラゲ）および野菜の栽培法の調査を実施した。７３名の農民の解答を得た。６０年度のコースに参加した農民に対するアンケートは任期中に翻訳が終了できなかったため７３名となった訳である。７３名の農民のうち７０名がトウモロコシの栽培をし，ほとんどの農民がトウモロコシを栽培していることが解る。水稲は５２名が栽培し，ローアモシ地域の４ケ所ラウヤカティ村，マボギニ村，チエケレニ村，オリア村では比較的水稲が栽

培されていることが解る。タンザニアで主食作物の1つである菜豆(マハラゲ)は45名の農民が栽培している。しかし栽培面積はトウモロコシ，水稲と比較すると少ないことが明らかになった。野菜についてみると，トマト，玉ねぎ比較的多くの農民により栽培されており，農民の現金収入源となっている。この他に，キャベツ，オクラ，ナス，ムチチア等が栽培されているが自家消費の傾向が強い。野菜についてはキリマンジャロ山の高地1000～1200m標高で多く栽培されている。ここでは，トウモロコシ，水稲，菜豆，野菜のローアモシ地域における慣行栽培法の概要について記載する。詳細は，添付書類－40にあるとおり。

6－1 トウモロコシ

技術要因	耕種基準	備考
栽培面積	2－3ac	2－3ac／農家が最も多いようであり，70%の農民のトウモロコシ作付面積は4a未満小数ではあるが10ac以上のトウモロコシ栽培を行う農民もみられた。
品種	Ilonga Composite	4品種のトウモロコシが栽培されているようであるが，Ilonga Compositeが一般的である。しかし種子を購入する農民はほとんどなく，自家採種の種子を用いて栽培している。このため品種特性の著しい分離がしばしばみられた。
作期	3月播取－8月収穫	年一作が一般的である。2月～3月にかけて雨期の始まりにある降雨をまって，耕起が開始される。従って雨期の始まりにより作期は変化する。ごくまれに灌漑水のあるところでは乾期作(9月～2月)がみられる。
播種量	9～18kg／ac	播種量については，調査対象の農民の解答に大きなばらつきがみられた。
栽植密度	1.2～1.9株／㎡ 2－4粒／株	比較的ライン播種が行なわれている(政府指導が昭60年より始まった)。しかしながら，栽植間隔がまちまちである。播種後の間引きは通常しない。

施　　肥	無 肥 量	無肥量 硫安，堆肥の施肥がみられたが施肥量は明らかでない。施肥をしない理由は， 1. 肥料の使い方が解らない 2. 肥料は高価すぎる。など
除　　草	12−20日・人/ac	年間の農作業のうち最も農家の多忙な時期である。4−5月，雨期の除草でありこの時期，人夫の雇用は困難である。
虫　　害	無 防 除	多くの農民は害虫の被害を認めるが対策は構じていない。DDT Thiodan の散布もみられた。 チエケレニ周辺でみられた害虫は， 1. Maize stalk boren 2. Spoted stalk borer 3. Pink stalk borer 4. Rice weevil (storap)
収　　量	1.8〜2.3 ton/ha	トウモロコシは収穫が一時期に終らないため正確な収量は把握できない。農民は，穂を収穫し，脱粒前の穂の山で収量をみたり穂を家のなかにつみあげ，その高さで収量をみる。農民は必要に応じて，消費のために収穫する。

6−2　水　稲

技術要因	耕種基準	備　　考
栽培面積	1〜2 ac	ほとんどの農家の水稲作付面積は 2ac 以下であり，3 ac 以上の作付面積はほとんどいない。
品　　種	Matandiko Manikora Shingo ya Mwali	12品種の在来種がロークーモシ地域で栽培されている。品種特性は草丈が高く，穂重型でありチッ素反応性は低い。 品種の命名は，その品種を同地域に導入した農家の名前をつける例がある

		例：Matandiko Silayo（1R－20）
作期	雨期作 11～12月－5～6月 乾期作 5～6月－12月	ほとんどの農家は年1作で11～12月に播種し，5～6月に収穫する。ごくまれに灌漑水の得られる場合，乾期に栽培されるがQuelea Quelea の集中，灌漑水の供給不安定等の問題がある。通常，雨期作後はトマト，菜豆の栽培が裏作としておこなわれる。
圃場準備	トラクター耕起 人力による代かき	ほとんどの農家は耕起はトラクター，代かきは人力で行う。短期間に耕起が集中するため，トラクターの供給に問題がみられる。代かきは，1ac当り800－1200シリングで人夫を雇用して行う。
苗代	畑苗代 スジ播き	催芽せず，畑苗代にスジ状に播種する。発芽率が悪く，雑草の発生も多い。苗代面積は一定ではないが80～160㎡／ac とみられる。
播種量	13－26kg／ac	播種量のばらつきが多い。農民は経験から，本田の一部に苗代を造り，播種する。苗代播種量が高く，著しい厚播きになり，苗の質は極めて低い。
移植	21～28日人／ac 乱植，下り植	1acのプロットを7のサブプロットに区切り，移植する。1サブプロットを3－4日で1日で移植するという慣行の見積りがみられた。
栽植密度	30～40株／㎡ 7～8本／株	乱植であるため，栽植密度は17株／㎡～57株／㎡のばらつきが，農家の圃場調査を行った場合にみられた。苗の質が悪いため1株苗数を増し，深植の傾向がみられる。移植後30～40日に移植を開始する。本田の面積に関係なく，同時に播種するため，耕作面

		積が大きい場合，老熟苗の移植がしばしばみられる。
施　　肥	無肥料	少数の農民は硫安，尿素25－38kgN／ha（成分量）を分ケツ期，開花期に施用しているが，ほとんどの農民は無肥料で栽培している。無施肥の理由は肥料の使用法を知らない，肥料は高価で購入できないなどである。
水　管　理	深　水	灌漑水量の調整はない。水のある時期に深水にし放置する。多くの農民は移植後，灌漑水の不足があるとの解答をした。村では水配分を行う組織があり，灌漑水のコントロールを行っている。
除　　草	手除草 20～48日・人／ac	除草剤の使用はない。移植後10～30日に除草を行い，人夫を雇用した場合700～1500シリング／ac を支払う。
虫　　害	無防除	ほとんどの農民は，害虫の被害を認めるが，減収の原因とはなっていない。またほとんどの農民は虫の名も知らない。チエクレニ周辺でみられた害虫は， 1. stalkeyed shoot fly 2. pink stalk borer 3. white stalk borer 4. rice hopper 5. rice bug
鳥　　害	空カン鳴子	ほとんどの農民は，Quelea Quelea の被害による減収を観察している。空カンに小石を入れた鳴子，土のボールを投げるなどの方法で鳥を追い払う防除を行っている。
収　　穫	土際より刈取り 打ち脱穀 16～30日・人／ac	土際より刈取り，圃場に野ずみ，打ち脱穀。人夫を雇用した場合，支払いは収穫物で収穫高の1／6。刈取り，脱

収　　量	1.4〜2.1 ton／ha	穀，風選，袋づめの全行程を終り，1グニアにつき1ティンの支給となる。この収穫物の支給は，水稲に限られる。収穫後は籾貯蔵され，必要に応じて精白される。販売も籾でおこなわれる。収量については，ばらつきが高い。不作の年では1.1〜1.8 ton/ha と言われる。多くの農民は消費より販売に重点をおいている。政府供出の場合1袋（75kg）当り686シリンダーに対し，ヤミ価格で1200〜1800シリング／1袋であり，農民の水稲栽培の関心は高い，

6－3　菜豆（マハラゲ）

技術要因	耕種基準	備　　考
栽培面積	1／4〜1.0 ac	73名のうち43名の農家が栽培しているが，作付面積は小さい。
品　　種	Canadian Wonder	4品種が同地域では栽培されているがCanadian Wonder が比較的多くの農民に栽培されている。他には在来種といわれる農家が自家採種した品種がある。
作　　期	6〜7月－9〜10月	乾期作としては6〜7月播種9〜10月収穫。マハラゲは水田裏作として，水稲収穫後に栽培される場合が多い。ごくまれに9月播種〜2月収穫の作付がみられるが，灌漑水の得られる場合に限られる。
播　種　量	20－30kg／ac	播種量は8.0kg〜30kgのばらつきがみられた。まれに菜豆とトウモロコシの混植がみられるが，ほとんどは菜豆のみを栽培される。

播　　　種	乱　植 ４５～９０cm×３０cm ２－３粒／株	栽植密度は正確ではなく，慣行の" Hatua " の単位を用いて，うね間，株間を決定する。通常，うね間は1/2－1 Hatua　とされている。
施　　　肥	無肥料	施肥しない理由は，肥料の使い方を知らない。肥料が入手できない，などである。
水　管　理	フラッド灌漑	乾期作であるため，しばしば灌漑水不足がみられる。播種後１週間から灌漑を始める。
除　　　草	２０～３０日・人／ａｃ	除草剤の使用はない。 １ａｃ 当り７日程度で除草を終了。人夫を雇用した場合，４００～９００シリング／ac を支払う。
虫　　　害	無防除	大半の農家は虫害を観察しているが，対策はとられていない。まれに草木灰，Thiodan の散布がみられる。チエケレ二周辺でみられた菜豆の害虫は， 1.　Bean　Leaf　beetle 2.　Thrips 3.　Bean　aphis である。
ネズミの害	バナナ葉中肋	収穫適期時にしばしばみられる。圃場の周囲にバナナ葉の中肋をおいてネズミ対策としている。効果については不明。
収　　　量	0.5～1.0 ton/ha	収量についてもばらつきがみられたが，1.0 ton／ha　以下と考えられる。ほとんどの農民が自家消費のために栽培している。

6－4　野　　菜

種　　　類	トマト 玉ねぎ オクラ	ローアモシ地域では，この野菜のうちトマト，玉ねぎが多くの農民に栽培されている。特にタンザニア慣行調料

	キャベツ ナス ムチテヤ	法にはトマト，玉ねぎおよびキャベツが重要である。
作期	乾期	ほとんどの野菜は乾期で，水稲刈取り後に栽培される。6月～9月が主な野菜の作期である。
栽培面積	1 ac 以下	トマト，玉ねぎは比較的大きい面積で栽培されるが，以外の野菜は家の周辺に自家消費用に小さい面積に栽培される。 野菜は農民にとって貴重な現金収入源であり，トマトや玉ねぎでは端境期には精白米のヤミ価格よりも高くなる。 野菜の栽培はハイ郡，キリマンジャロ山高地で栽培されている。

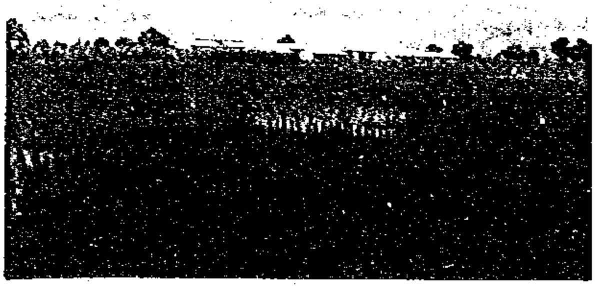
7. 総合評価および課題提起

昭和57年4月からトライアルファームに水稲栽培が始まってから4年間に11テーマ，47の栽培試験，検証栽培が実施された。4年間の限られた期間ではあるが地域耕種基準の目安が確立されたと考える。しかしながら耕種基準の今後の検証は継続されなければならない。パイロットファームおよびローアモシ灌漑プロジェクト地域の農民に対する水稲栽培の指導についてみると，農民はある程度の技術を習得したものと考えられる。パイロットファームおよびローアモシ地域の一部では，改良品種の導入定着の段階にいたったと考えられる。しかしながら，籾収量のばらつきが高く，安定期にはいたっていない。この原因については，営農に起因するもの，栽培技術に起因するものが考えられる。原因の究明・稲作の安定化，また増収技術の開発が今後の課題であろう。ローアモシ灌漑プロジェクトに関しては，業務開始以来8ヶ月が経過したにすぎず，今後の推移をみまもる必要がある。特に2300 ha のプロジェクト地域のうちわずか10％程度（213ha）に水稲が栽培されたにすぎない訳で，今後，作付面積が拡大するにつれ，さまざまな問題がでてくるだろう。

最後に，今後，KADCの業務を発展し，またローアモシ灌漑プロジェクトを円滑に推進するに際し，必要と考えられる課題を提起し本報告書の終りとする。

業務分野	課　　題	備　　考
トライアルファーム	1. 栽培試験，検証栽培の継続 2. 新しい制限要因の解明 3. 収量の安定化 4. 灌漑水供給の安定化 5. カウンターパートの増員および技術指導 6. 外部研究機関との情報交換	耕種基準の精度を高める。稔実歩合と収量の関係および気象要因と収量の解明。 トライアルファームの水源は，揚水ポンプであるが，電圧変動などの問題により故障した場合，トライアルファームの機能は完全に停止する。将来は代替の灌漑水供給を考える必要がある。 現在配属されているカウンターパートは，稲作の基礎を習得したものと考えられるが，試験設計，試験項目の設定については，理解度が不足している。 今後，ローアモシプロジェクト地域での指導により多くのカウンターパートの増員が望まれる。 FAO，TARO(Tanzania Agrilo Research Organijation) 等の研究機関との情報交換を行い，KADCの活動を外部機関にも発表する。
パイロットファーム	1. 計画的作付，灌漑農業の実践。 2. 耕種基準の徹底。 3. 運営改善。	営農委員会，水管理委員会の機能強化水管理費の制度化 生産資材の適期調達，一括購入，プロット当りの耕作費の一律化。 収穫物分益割の改善および供出量の一律化。
研　　修	1. 巡回指導の強化 2. 現地検定圃の設置 3. 短期コースの開設 4. 「手引書」の配布 5. 教材の充実	ローアモシ地域で指導者となる中堅農家の育成は急務である。 現地検定圃を活用した現場での指導と，短期研修コースの組み合せで高い研修効果を期待することができる。 研修内容を限定し，重要度の高い内容を選び，短期間の研修コースを開設し，巡回指導で補強する方法で，多くの農

		民に効果的研修を行う。 現地検定圃のテーマを品種比較に限らず，栽植密度，施肥等のテーマで実施する。
ローアモシ灌漑プロジェクト	1. 農民組織の育成 2. 中堅農家の育成と指導体制の強化 3. 営農計画の作成 4. 展示圃の設置	水管理，施設維持管理組織の育成による，水管理がプロジェクト運営の基本である。 営農計画の作成と耕作者への徹底。 ブロックリーダー，サブリーダー等ブロックを最小単位とした営農組織の育成。 KADC，普及員，中堅農家による指導体制の強化，展示圃の設置，管理をブロックリーダー，中堅農家の指導のもとに一般耕作者と行い，適正技術の指導を行う。

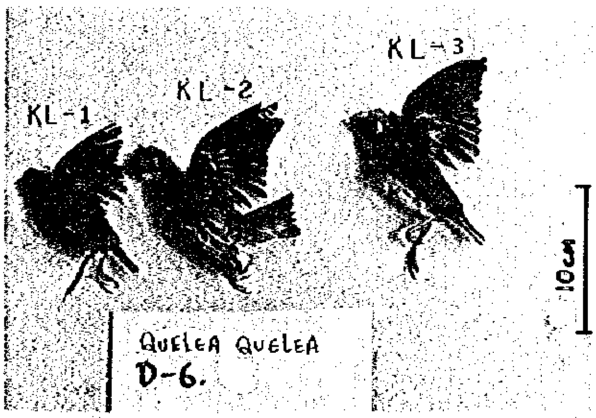


トライアルファーム水不足　1984年

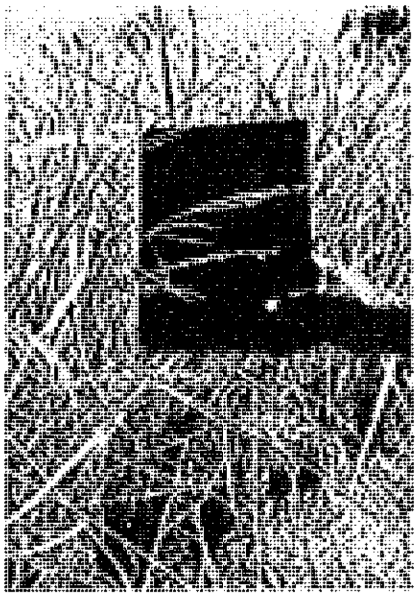
SURINAM異品種混入の状況
（トライアルファーム）

トライアルファーム水不足　1983年

日本稲 不時出穂（トライアルファーム）

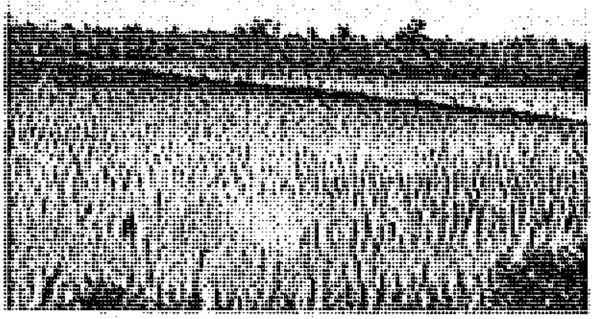


Quelea Quelea（トライアルファーム）

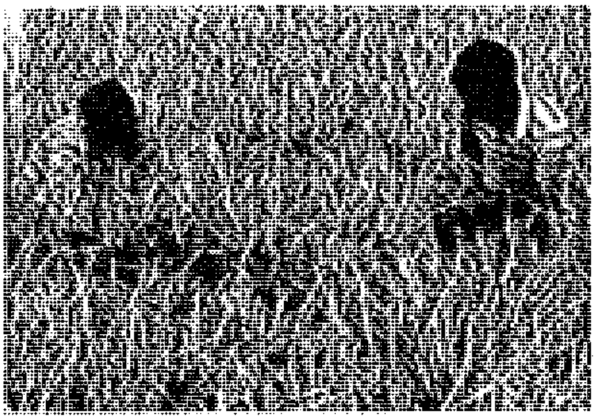


Quelea Queleaの被害状況
（トライアルファーム）

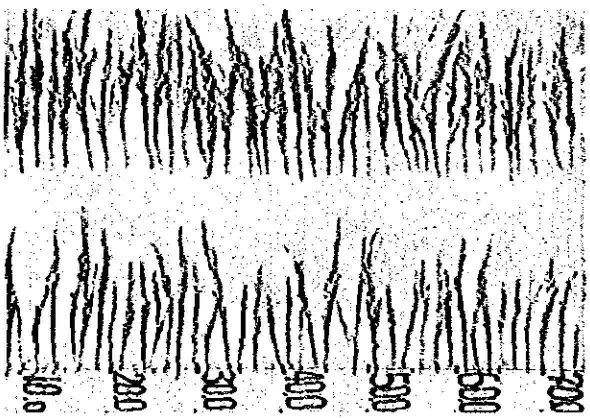
Quelea Queleaの群の被害状況
（トライアルファーム）



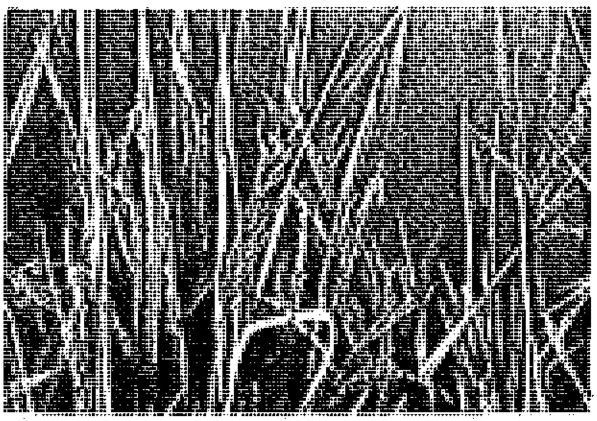
エジプシャングースの被害状況（パイロットファーム）



低温被害を受けた圃場　1984（1R－56）



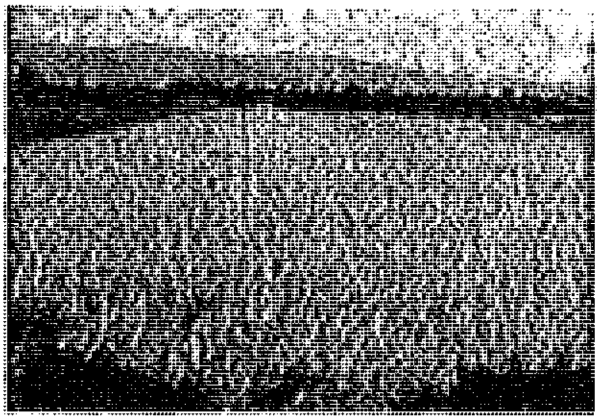
1株当り不稔穂　1R－56（1984）



低温による先端えい花の　仕　1R－42（1985）

コンバインハーベスターによる脱
粒状況　1R－54

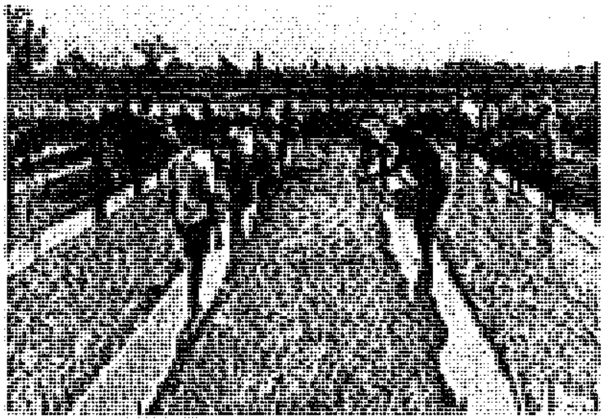
パイロットファームの状況 1982-1983



パイロットファームの状況 1983

シコクエビの栽培パイロットファーム 1984

パイロットファームの状況 1984～1985

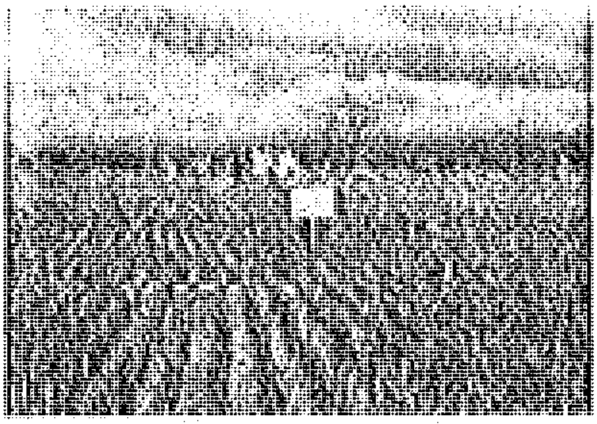


トライアルファームでの研修風景－1

トライアルファームでの研修風景－2

トライアルファームでの研修風景－３

現地検定圃の播種　ラウヤカティ村　１９８４

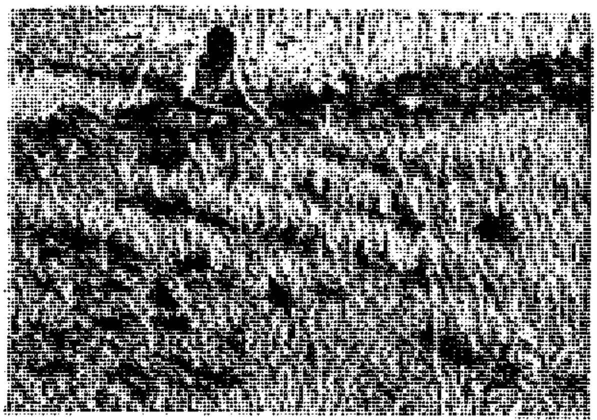


現地検定圃　ラウヤカティ村

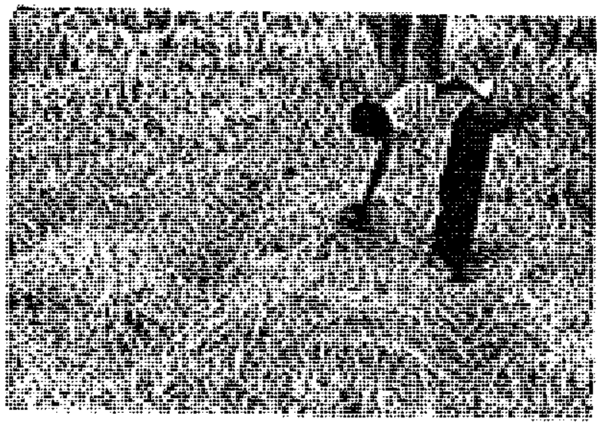
現地検定圃　ラウヤカティ村

現地検定圃収穫風景

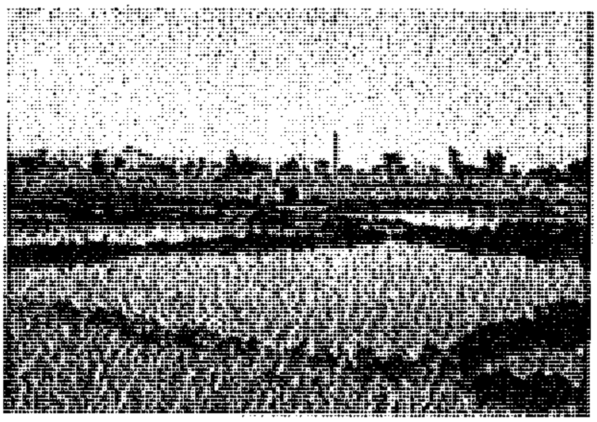
一般農民の圃場　マボギニ村



在来の苗代　キリマンジャロ州ハイ郡



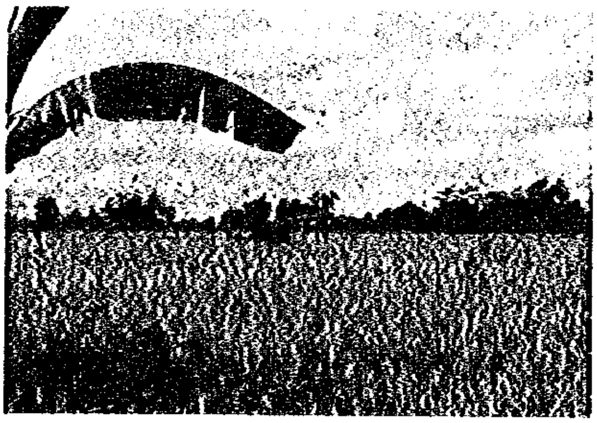
在来の苗代　マボギニ村



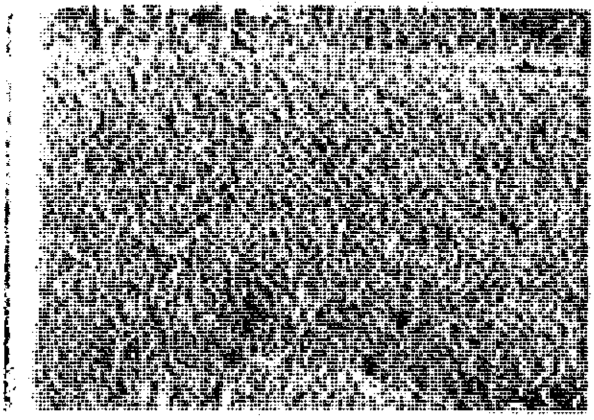
本田移植後の状態　ハイ郡

在来の灌漑水路　マボギニ村

出穂期の防鳥対策（アキカン鳴子）



登熟期鳥よけ小屋　マボギニ村



水田裏作トマト　ウラヤカティ村

水田裏作菜豆　ウラヤカティ村

ロークーモシMS－1ブロック　水入れ開始

ロークーモシMS－1ブロック 共同苗代

ロークーモシ MS－1　耕起，代かき

ロークーモシ MS－2　本田移植

現地検定圃苗代 ロークーモシ MS－5

移植後の本田 ロークーモシ MS－7

添付書類－ 1

Verification Trial -1-1

Seed multiplication

Objectives:

To increase five varieties of seed obtained from Tan Seed(Tanzania Seed Corporation) and to carry out uniform cultivation.

Variety:

V1. IR - 8
V2. Taiwan - 14
V3. Surinam
V4. Affa Mwanza
V5. Kilombero

Plot size:

27.0 m x 30.0 m(810 m^2) per variety in D-6 and D-7

Cultural practices:

Fertilizer: Nitrogen 100 kg/ha(improved variety)
50 kg/ha(local variety)

Phosphorus 40 kg P_2O_5/ha(both variety)

Due to poor condition of paddy field, agricultural machinery could not be used for puddling. 50 % of total amount of nitrogen and 40 kg of P_2O_5(TSP) were applied as basic fertilizer, however fertilizers were not mixed properly. Remaining 50 % of nitrogen was applied at tillering and panicle initiation stages.

Density:

30 cm x 30 cm
3 seedlings per hill

Sowing date:

22 April 1982

Transplanting date:

19 May 1982

Harvesting date:

29 Oct. 1982

Insect control:

Diazinin 40E of 1/1000 solution was sprayed at nursery and tillering stages to control stem borer.

Weed control:

Weed control was done properly by hand and any herbicide was not sprayed. Serious weed infestation was not observed.

Grain yield:

Variety	ton/ha
IR - 8	5.07
Taiwan - 14	4.31
Surinam	3.67
Affa Mwanza	3.83
Kilombero	2.54

Remarks:

Before first cultivation was started, paddy field was plowed several times by disc plow to control weed. As a result of it, level of the field was destroyed completely. Soil was accumulated at center portion of the field and center portion was higher than other portions of the field. Puddling and leveling were done by man power because agricultural machinery could not be used.

Tremendous number of off-type plants were observed in Surinam. Grain type and plant height of off-type were same as that of Surinam, however maturity day and color of leaf sheath were completely different. Even in Kilombero, off-type plants were observed.

Early maturing of Surinam was observed. Approximately 100 days after sowing, heading of Surinam was observed.

Seed multiplication

Objectives:

To increase new variety seeds obtained from IRRI and Thailand and also to observe varietal characteristics of 9 varieties.

Variety:

V1.	IR - 5	V6.	IR - 42
V2.	IR - 8	V7.	IR - 54
V3.	IR - 20	V8.	IR - 56
V4.	IR - 32	V9.	RD - 10
V5.	IR - 36		

500 g each of these varieties were obtained in 1982.

Plot size:

26.0 m x 9.0 m(234 m^2) per variety in plot D-4

Cultural practices:

Fertilizer: Nitrogen 100 kg N/ha

Phosphorus 40 kg P_2O_5/ha

50 % of total amount of nitrogen and 100 % of phosphorus were applied at the time of puddling. Remaining 50 % of nitrogen was applied at tillering and panicle initiation stages.

Density:

20cm x 30cm(16.7 hills/m^2)
1 - 2 seedlings/hill

Sowing date:

24 July 1982

Transplanting date:

31 Aug. 1982

Harvesting date:

27 Dec. 1982

Insect control:

Diazinon 40E, 1/1000 solution was sprayed at nursery and tillering stages to control stem borer. Serious insect damage was not observed.

Weed control:

Weed control was done properly by hand. No herbicide was sprayed. Weed infestation was not observed.

Summary Table:

Variety	Grain yield ton/ha	Days to heading days	Number of panicles per hill	Number of spikelets per panicle
IR - 5	3.61	118	22.8	75.9
IR - 8	6.77	110	20.5	92.8
IR - 20	3.63	104	32.0	99.5
IR - 32	6.94	124	24.0	87.9
IR - 36	5.75	93	35.0	66.9
IR - 42	5.56	120	33.5	94.3
IR - 54	6.84	104	23.8	98.7
IR - 56	3.06	90	32.8	43.1*
RD - 10	3.12	87	17.7	71.1*

Variety	1000 grain weight g	Ripening ratio %	Grain/total production
IR - 5	22.8	74.2	30.5**
IR - 8	29.2	78.2	45.5
IR - 20	23.2	77.9	44.0
IR - 32	23.7	74.5	39.3
IR - 36	23.1	74.8	46.1
IR - 42	21.3	73.7	38.5
IR - 54	25.3	80.7	43.9
IR - 56	24.6	61.4	35.4
RD - 10	28.3	73.7	39.0

* Spikelets were seriously damaged by quelea quelea at milk ripe stage.
** Grain/total production percentage was low because of quelea damage.

Remarks:

Large variation of grain yield was observed among 9 varieties, however it was not due to characteristics of these varieties. Major cause of yield difference was quelea quelea damage. At maturity stage,high concentration of quelea birds was observed in the trial farm but bird scaring was not carried out properly.

Early heading was observed in IR -36, IR -56 and RD - 10. Next to these varieties, early heading was also observed in

IR - 20 and IR -54. Concerning maturity days, IR -36, IR -56, IR -20 and IR -54 matured earlier than other varieties. IR -42 was later than these varieties, however matured earlier than IR -32. Among 9 varieties, IR - 20 and IR -54 were large panicle varieties. Large grain type was observed in IR -8 and RD - 10(glutinous rice). IR -54 and IR - 56 were also relatively large grain varieties.

Detail investigation of yield components should be carried out. Early maturing is one of criteria of variety selection. Spikelet production of variety is also important factors to be considered. High tillering with small panicle or less tillering with large panicle varieties may cause large number of spikelets per unit area, however performance of varieties should be verified also in a farmers field.

Mechnized rice cultivation

Objectives:

To verify working performance of rice transplanter and also to demonstrate mechnized transplanting.

Variety:

Affa Mwanza (D-2)
IR - 8 (D-1)

Plot size:

27.0 m x 32.0 m(864 m^2) in D-1

27.0 m x 96.0 m(1592 m^2) in D-2

Cultural practices:

Machinery used:

Rice transplanter, ISEKI SANAE of 2 rows and 4 rows, was used for machinery transplanting.

Fertilizer:	Nitrogen	75 kg N/ha(Affa Mwanza)
		100 kg N/ha(IR - 8)
	Phosphorus	40 kg P_2O_5/ha

50 % of total amount of nitrogen and 40 kg P_2O_5/ha were applied at the time of puddling. And remaining 50 % of nitrogen was applied at tillering and panicle initiation stages.

Density:

All operation of machinery transplanting were carried out by Agricultural Machinery section. Detail row to row and hill to hill distances were not available.

Sowing date:

Affa Mwanza	27 Nov. 1982
IR - 8	25 March 1983

Transplanting date:

Affa Mwanza	17 Dec. 1982
IR - 8	13 April 1983

Harvesting date:

Affa Mwanza	16 April 1983
IR - 8	29 Aug. 1983

Insect control:

Diazinon 40E of 1/1000 solution was sprayed at nursery and tillering stages to control stem borer. Serious insect damage was not observed.

Weed control:

Weed control was done properly by hand and any herbicide was not sprayed. Serious weed infestation was not observed.

Grain yield:

Variety	ton/ha	lodging %
Affa Mwanza	2.35	80%
Affa Mwanza*	4.11	60%
IR - 8	6.48	-

* Plot D-2 was splited into two subplots of 27m x 48 m because of arrangement of seedlings.

Remarks:

Transplanting and harvesting were done by machinery section to examine working performance of rice transplanter and combine harvestor. Results of the test were presented in final report of Mr. T Tsujimoto. Except these two operations, all required management like weeding, fertilizer application and insect control were carried out by paddy section.

Machinery transplanting seemed to be not adoptable to the present situation of farmers because of following reasons. 1. Fine leveling of paddy field is required to transplant by machine. Poor leveling of the field causes tremendous number of missing hills. 2. Raising seedlings in box is not easy for farmers. Preparation of soil, water management and other required management to grow seedlings seems to be too complicated to farmers. 3. Farmers can not afford to purchase transplanter and to maintain it properly.

60 - 80 % of lodging of Affa Mwanza in D-2 was observed. Main cause of lodging seemed to be vigrous vegetative growth of Affa Mwanza especially when young seedling was transplanted. High grain production might be expected by machinery transplanting if improved variety is cultivated in properly leveled field.

Machinery transplanting should be examined more detail in proper experimental plot. The effect of transplanting young seedling is to be analized properly.

In remaining portion of plot D-1, IR - 8 was cultivated but due to shortage of irrigation water, rice plants were dried up before maturity. Sample plants were collected from plot D-1. Data obtained from sample analysis was as follows.

plant height	91.0 cm
panicles/hill	19.5
tillers/hill	26.5
spikelets/panicle	86.1
ripened grain/panicle	3.4
ripening ratio	3.8 %

添付書類－ 4
Verification Trial 1-4

Mechnized cultivation

Objectives:

To examine the working efficiency and performance of rice transplanter and also to observe effect of mechnized transplanting on grain production

Variety:

IR - 32

Plot size:

1967 m^2 in plot D-3

In plot D-3, nitrogen application experiment was also conducted. Remaining area was for verification trial.

Cultural practices:

Fertilizer:	Nitrogen	100 kg N/ha
	Phosphorus	40 kg P_2O_5/ha

50 % of nitrogen and 100 % of phoshporus were applied at the time of puddling. Remaining nitrogen was applied at tillering and panicle initiation stages.

Density:

Iseki transplanter 2 rows was used for the verification. All operation of transplanting was carried out by agricultural machinery section and detail density was not available.

Sowing date:

9 Jan. 1984

Transplanting date:

28 Jan. 1984

Harvesting date:

13 June 1984

4 days after sowing in boxes, seedlings were taken to nursery in the field for greening seedlings.

Insect control:

Diazinon 40E, 1/1000 solution was sprayed for prevention of stem borer at nursery stage and at the time of nitrogen top-dressing. Stem borer damage was not observed in the plot.

Weed control:

Weed control was carried out properly by hand. No herbicide was sprayed and weed infestation was not observed.

Summary table:

1.	Sowing date	9 Jan. 1984
2.	Transplanting date	28 Jan. 1984
3.	Max. tillering	---
4.	Effective tillering	---
5.	Panicle initiation	17 April 1984
6.	Heading	2 May 1984
7.	Maturity	10 June 1984
8.	Maturity days	147 days
9.	Panicles/hill	22.7
10.	Spikelets/panicle	71.9
11.	Panicles/m^2	378.3
12.	Spikelets/m^2	27.05×10^3
13.	Effective tiller	83.7 %
14.	Ripening ratio	81.2 %
15.	1000 grain weight	24.4 g
16.	Grain/total production	50.0 %
17.	Grain yield/plot	1138 kg
18.	Grain yield/ha	5146 kg

Remarks:

Due to poor leveling of the field, many missing hills were observed after mechanical tranplanting was completed. Poor level of the field and high water stand caused floating seedlings. Gap filling was repeated 3 times. Finally seedlings for gap filling were not enough so seedling of same variety from the pilot farm was used for gap filling of missing hills. Because of mixture of different seedlings, max. tillering stage and effective tillering stage were not observed clearly.

Heading initiation was observed on 25 April 1984 and heading was completed on 8 May 1984. Heading was very irregular even considering difference of seedling age. Irregular heading might be a varietal characterisrics of IR - 32.

Plant growth of IR -32

Sowing: 9 Jan. 1984
Transplanting: 28 Jan. 1984

Date	plant height	tillers/hill
21 Feb. 1984	31.8 cm	4.6
29 Feb. 1984	40.0	8.6
6 March 1984	45.3	12.2
13 March 1984	51.1	16.0
20 March 1984	52.1	16.2
27 March 1984	58.5	16.6
3 April 1984	61.9	18.0
10 April 1984	70.0	19.4
17 April 1984	72.4	19.0
24 April 1984	73.7	19.0
4 May 1984	65.3	18.6

Verification Trial 1 - 5

Seed multiplication

Objectives:

To investigate adaptability of Japonica varieties in Chekereni environment and to increase seeds of Japonica varieties.

Variety:

V1. Akishimo mochi
V2. Asahi mochi
V3. Uzushio
V4. Reihoo
V5. Hatsusaku mochi
V6. Shiranui
V7. Ariake

All these Japonica varieties were brought from Japan and quantity of seeds were very small. Seeds obtained was around 10 -30 g.

Plot size:

15.0 m x 27.0 m(405 m^2) in plot D-3

In this area, 7 varieties of Japonica rice were cultivated. Area for each variety was decided by quantity of seed. Some varieties were cultivated only in 2 rows of 15 m length and other in 9 - 19 rows.

Cultivation practices:

Fertilizer: Nitrogen 75 kg N/ha
Phosphorus 40 kg P_2O_5/ha

50 % of total amount of nitrogen and 100 % of phosphorus were applied at the time of puddling. Remaining amount of nitrogen was applied at tillering and panicle initiation stages. Same plot of D-3 for Affa Mwanza was used for Japonica variety. Fertilizer application for Japonica varieties was same as that of Affa Mwanza.

Density:

30 cm x 30 cm
1 seedling per hill

Sowing date:

11 Sept. 1982

Transplanting date:

8 Nov. 1982

Harvesting date:

3 Feb. 1983

Insect control:

Diazinon 40 E 1/1000 solution was sprayed to control stem borer and insect damage was not observed.

Weed control:

Weeds were controlled properly by hand. No herbicide was sprayed and weed infestation in the plot was not observed.

Grain yield:

Variety	g/variety
Akishimo mochi	398
Asahi mochi	339
Uzushio	322
Reihoo	218
Hatsusaku mochi	31
Shiranui	59
Ariake	22

Remarks:

Premature heading of all varieties was obsrved approximately 50 days after sowing. After sowing in nursry, all varieties grew upto 15 - 20 cm in height, then stopped growing. Even after transplanting, plant height was not increased very much. When premature heading was observed in the field, plant height of 7 varieties was approximately 40 - 50 cm. After premature heading, tremendous number of tillers were produced. However most of tillers were uneffective ones and size of panicle was very small.

Major causes of premature heading could be 1. high temperature during vegetative growth pahse 2. long duration of nursery period and 3. day length. Due to problems of puddling in D-3, seedlings were not transplanted on time and seedlings were left in nursry for long time. That might be a cause of premature heading.

Quelea quelea damage was also observed in the plot. During milk ripe to maturity stage, Japonica varieties were seriously damaged by quclea birds. Proper sample analysis was not done because damage-free plants were not available in the plot.

添付書類－ 6
Verification Trial 1 - 6

Variety investigation

Objectives:

To observe varietal characteristics of Japonica varieties and also to examine adaptability of Japonica varieties in Chekereni enviornment. Seed increase of varieties is also one of the objectives.

Variety:

1. Hatsusaku mochi
2. Koshihikari
3. Oozora
4. Nihinbare
5. Akishimo mochi
6. Asahi mochi
7. Uzushio
8. Reihoo

500 g seeds of Koshihikari, Oozora and Nihonbare were brought from Japan and other varieties were increased in previous verification trial.

Plot size:

27.0 m x 97.0 m(2619 m^2) in plot D-8

Plot D-8 was splited into 10 subplots according to the quantity of seedlings available. Area for each variety were 27m x 12m(V1 - V4), 27m x 7m(V5 and V6), 27m x 6m(V7) and 27m x 3m(V8).

Cultivation practices:

Fertilizer:	Nitrogen	100 kg N/ha
	Phosphorus	40 kg P_2O_5/ha

30 % of nitrogen and 100 % of phosphorus were applied at the time of puddling. Remaining nitrogen was applied at tillering and panicle initiation stages.

Density:

20 cm x 20 cm(25 hills/m^2)
1 - 2 seedlings/hill

Sowing date:

4 May 1984

Transplanting date:

6 June 1984

Harvesting date:

21 Sept. 1984

Insect control:

Diazinon 40E, 1/1000 solution was sprayed at nursery stage and at the time of nitrogen top-dressing to control stem borer. No insect damage was observed.

Weed control:

Weed control was carried out properly by hand. No herbicide was sprayed and weed infestation was not observed.

Summary table:

Variety	Grain yield kg/ha	Number of panicles per hill	Number of spikelets per panicle	Ripening ratio
V1	1197	16.6	99.6	65.4
V2	1071	26.5	50.1	47.5
V3	1339	15.3	57.2	50.6
V4	1049	45.4	52.2	19.2
V5	1296	18.8	69.0	50.0
V6	1377	38.0	58.5	28.7
V7	2109	48.1	46.6	35.4
V8	868	46.3	64.4	21.6

Variety	1000 grain weight g	percent of unpollinated panicle	plant height	panicle length
V1	25.3	41.0	83.5	17.4
V2	24.1	33.2	82.1	16.5
V3	24.4	2.0	76.3	16.2
V4	25.7	55.0	72.5	17.6
V5	23.3	18.6	84.7	20.0
V6	25.2	53.4	80.8	18.0
V7	25.4	32.0	-	-
V8	25.6	35.0	74.1	18.9

Unpollinated panicle: Panicle which did not produce even one of filled grain is called unpollinated panicle.

Variety	culm length cm	Number of tillers per hill	Number of unpollinated panicle/hill
V1	66.0	21.2	6.8
V2	65.7	33.3	8.8
V3	60.1	16.8	0.3
V4	54.9	57.8	25.2
V5	64.7	31.0	3.5
V6	62.8	44.5	20.3
V7	-	-	15.3
V8	55.2	56.8	16.5

Remarks:

Cool temperature injury was observed in 8 Japonica varieties , however there was difference in damage of cool temperature. Field observation and heading observation of Japonica varieties were also carried out.

Hatsusaku mochi:

Heading initiation was observed on 30 July 1984 and heading was completed on 6 Aug. 1984. Panicles were excerted from the leaf sheath of flag leaf. Number of unpollinated panicles was relatively low. Late emerged panicles from high node of main stem were observed.

Koshihikari:

Heading initiation of Koshihikari was observed on 11 July 1984 and heading was completed on 19 July. However pre-mature heading was observed. Panicles were exserted completely from the sheath of flag leaf and late emerged panicles from high node were not observed.

Oozora:

Heading initiation of Oozora was observed on 11 July and heading was completed on 19 July. Same as Koshihikari, pre-matured heafing was observed. Panicles were exserted completely from the sheath of flag leaf and late emerged panicles were not observed. Number of unpollinated panicles was the lowest among 8 varieties.

Nihonbare:

Heading initiation was observed on 4 July 1984 but it was very irregular. Heading was completed on 27 July. Panicles were exserted completely from the sheath of flag leaf. Late emerged panicle from higher node of main stem was observed. Number of unpollinated panicles per hill was the largest.

Akishimo mochi:

Heading initiation was observed on 14 July 1984 and heading was completed on 16 Aug. Heading was very irregular and prematured heading was observed. Panicles were exserted completely from the sheath of flag leaf. Panicle development from higher node was not observed.

Asahi mochi:

Heading initiation was observed on 14 July 1984, however it was very irregular and many plants were at booting stage. Heading was completed on 13 Aug and prematured heading was observed. Panicles were partly enclosed by the sheath of flag leaf. Late emerged panicles from higher node of main stem were observed.

Uzushio:

Heading initiation was observed on 14 July 1984 and heading was completed on 11 Aug. Heading was uniform. Panicles were exserted completely from the sheath of flag leaf. Panicle development from higher node of main stem was not observed. Number of unpollinated panicles per hill was relatively high.

Reihoo:

Heading initiation was observed on 20 July 1984 and heading was completed on 13 Aug. Heading was irregular and prematured heading was also observed. Panicles were exserted completely from the sheath of flag leaf. Panicle development from higher node of main stem was observed.

Details of cool temperature injury was presented in the report.

添付書類- 7
Verification Trial 1 - 7

Variety investigation

Objectives:

To observe varietal characteristics of Japonica varieties in different growing season and also to investigate productivity of grain.

Variety:

Koshihikari
Oozora

Plot size:

27.0 m x 97.0 m(2619 m^2) in plot D-2
The plot was splited into two subplots of 1296 m^2

Cultivation practices:

Fertilizer: Nitrogen 150 kg N/ha
Phosphorus 80 kg P_2O_5/ha

30 % of total amount of nitrogen and 100 % of phosphorus were applied at the time of puddling. Remaining nitrogen was applied at tillering and panicle initiation stages.

Density:

20 cm x 20 cm(25.0 hills/m^2)
3 seedlings/hill

Sowing date:

5 July 1985

Transplanting date:

6 Aug. 1985

Harvesting date:

5 Nov. 1985

Insect control:

Diazinon 40E, 1/1000 solution was sprayed to control stem borer at nursery stage and at the time of 1st nitrogen top-dressing. No insect damage was observed.

Weed control:

Weed control by hand was carried out properly. No herbicide was sprayed and weed infestation was not observed.

Summary table:

1. Koshihikari

1. Sowing date	5 July 1985
2. Transplanting date	6 Aug. 1985
3. Max. tillering	17 Sept. 1985
4. Effective tillering	24 Sept. 1985
5. Panicle initiation	---
6. Heading	21 Sept. 1985
7. Maturity	22 Oct. 1985
8. Effective tiller	95.6 %
9. Maturity days	109 days
10. Panicles/hill	27.2
11. Spikelets/panicle	54.5
12. Panicles/m^2	473.3
13. Spikelets/m^2	25.18×10^3
14. Ripening ratio	75.9 %
15. 1000 grains weight	24.0 g
16. Grain/total production	45.4 %
17. Grain yield/plot	582.5 kg
18. Grain yield/ha	4250 kg
19. Panicle length	16.4 cm
20 Culum length	54.6 cm

Plant growth:

Date	Plant height	Tillers/hill
26 Aug. 1985	51.8	9.6
3 Sept. 1985	61.4	17.0
10 Sept. 1985	69.4	22.8
17 Sept. 1985	70.9	26.6
24 Sept. 1985	75.8	27.0
1 Oct. 1985	71.6	27.4
9 Oct. 1985	72.2	27.6
15 Oct. 1985	72.2	27.0
22 Oct. 1985	71.0	26.4*

* Number of panicles/hill

Summary table:

2. Oozora

1.	Sowing date	5 July 1985
2.	Transplanting date	6 Aug. 1985
3.	Max. tillering	17 Sept. 1985
4.	Effective tillering	24 Sept. 1985
5.	Panicle initiation	----
6.	Heading	25 Sept. 1985
7.	Maturity	30 Oct. 1985
8.	Effective tiller	87.8 %
9.	Maturity days	117 days
10.	Panicles/hill	26.1
11.	Spikelets/panicle	58.2
12.	Panicles/m^2	468.9
13.	Spikelets/m^2	27.28 x 10^3
14.	Ripening ratio	71.7 %
15.	1000 grains weight	25.1 g
16.	Grain/total production	50.4 %
17.	Grain yield/plot	545.0 kg
18.	Grain yield/ha	3999 kg
19.	Panicle length	15.5 cm
20.	Culum length	46.8 cm

Plant growth:

Date	Plant height	Tillers/hill
26 Aug. 1985	45.6	7.4
3 Sept. 1985	50.0	16.8
10 Sept. 1985	56.4	24.8
17 Sept. 1985	59.6	30.6
24 Sept. 1985	69.0	27.0
1 Oct. 1985	69.4	26.4
9 Oct. 1985	69.2	27.1
15 Oct. 1985	69.2	27.1
22 Oct. 1985	68.3	24.2 *

* Number of panicles/hill

Remarks:

Heading initiation of Koshihikari was observed on 4 Sept. 1985 and heading was completed on 25 Sept. 1985. Heading of Koshihikari was irregular. 77 days after sowing, heading of Koshihikari was observed.

Heading initiation of Oozora was observed on 17 Sept. 1985 and heading was completed on 30 Sept. 1985. Heading of Oozora was also irregular. 81 days after sowing, heading of Oozora was observed. Due to irregular heading, maturity days was not clearly observed, however maturity of two varieties was decided by the appearance of panicles in the plot.

The tendency of early heading and dwarf plant height were observed. The relation between plant development of Japonica rice and accumulated temperature should be analized.

添付書類－ 8

Exploratory observation of birds (quelea Quelea) control method by using plastic ballon.

Introduction:

Since rice cultivation was initiated at KADC Chekereni Centre, approximately three years have passed. During these three years, several problems of rice cultivation were observed. One of the most serious problems is birds damage. Birds (called Quelea Quelea) suddenly increases their number and destroy almost all grains of panicles unless paddy field is protected properly. Several bird control methods were applied to protect field, however most of the controlling methods were effective only for 2 - 3 weeks after installation of control methods. Flash tape were installed over the field and the tape created flashing lights of reflected sun light and strange sound of wind, however, this method was no longer effective after 7 - 10 days. Explosive sound control method was also applied but it was effective only for 1 - 2 weeks. Scare crow installation was not effective. It was observed that birds get accustomed to these control method. Among different birds of bird control method, empty tin method seems to be more effective to be compared with other methods. Empty tins with small stones inside were connected with sisal rope and hung over the paddy field. When birds are coming to destroy panicles, empty tins create strange sound when sisal rope is pulled strongly. However, for this method, always at least 1 - 2 labourers must stay around paddy field. The performance of this control method, normaly depends on working performance of labourers. If bird control was not done properly, no grain yield can be expected. Even at KADC trial farm, only 4.0 Kg. of grain yied was obtained from 0.3 ha of area due to poor bird control in 1983.

Plastic ballons painted eye-shaped spots on them were offered from Japan to investigate effect of the ballon on bird control. Ten ballons were installed in the paddy field in different ways to observe whether these ballons were effective to control birds. As first stage of this trial with the ballons, objective was to investigate effectiveness of the ballons.

This report is prepared to present the results of ballon control method and Kwelea Kwelea damage to rice plant.

Kwelea damage on rice:

Kwelea feeds on different types of crops. Rice, sunflower, finger millet, wheat are normarlly their favorite crops. Sometimes Quelea feeds on maize tassel, gramineous weeds seed and flower of sugar cane. So far as has been observed at KADC trial farm, normarlly quelea cause serious damage especially to rice and sunflower. It was reported from Mbarali rice farm, Mbeya that single quelea eats 75g of rice grains per day. Number of quelea observed at trial farm vary with season of crops cultivation. When rice is grown in a low area e.g. at pilot farm located near KADC trial farm or at farmers field, less number of quelea were observed. On the contrary, when rice was cultivated only at trial farm, tremendous number of quelea were observed. 150 to 200 numbers of quelea quelea make one group and it was a large group of them so far as been observed. However they always change numbers in a group. They easily split into smaller number of groups and 40 - 60 number of quelea make one group. When quelea were concentrated especially at trial farm, two to three groups of 150 - 200 numbers of kwelea were always flying over paddy fieldto feed on rice. When sunflower is cultivated at trial farm, less quelea damage to rice was observed. When paddy field is protected, kwelea stay in sunflower field or maize field to feed themselves on gramineous weed seeds or sunflower seeds.

Seasonal variation in numbers of quelea observed at trial farm might be because of crop cultivation at surrounding area of KADC Chekereni centre. Tanzanian farmers and staff of KADC say that kwelea drift in all Kilimanjaro region. They also say that quelea shift from West Kilimanjaro to T.P.C. sugar cane estates located near by KADC at Chekereni and then from T.P.C. sugar cane estates, kwelea shift to Chekereni. However, life cycle and ecological status of kwelea was not explained.

Kwelea make their roost on certain trees and sometimes also make roost on maize plants. Many roost prepared on one tree was at KADC trial farm. It seems that quelea quelea make their roosts at forest and they normally stay in certain areas. Because many roosts are also observed at Kahe forest. There are a few places where kwelea kwelea may stay. T.P.C. suga cane estates located approximately 10 Km. far from KADC Chekereni centre is one of the places. Always some of small groups (30 - 40 number of quelea) are observed at T.P.C. sugarcane fields. Kahe forest approximately 6.5 Km. far from KADC and Rau forest around 7.5 Km. far from Chekereni can be considered as an area where kwelea stay.

Birds are normally called as kwelea kwelea in Swahili however, there are three different species of quolea quelea. Quelea that has red bill is reffered as KL-3 as shown in Fig. . Others are quelea with red feathers on chest (KL-1) and ordinary quelea (KL-2). Number of these different kweleas in a group is not yet explained, however, it seems that ordinary quelea (KL-2) are majority in their group. Invisible bird net was installed in paddy field to investigate kwelea kwelea. Number of quelea quelea caught were presented in Fig-14.

Damage to rice:

Kwelea kwelea start damaging rice plant when rice plants are at ripening stage. Serious kwelea damage was observed especially at milk ripe and drough ripe stages. It is also observed that elea suck stored starch from spikelets and damage the spikelets at milk ripe stage stopped growing totaly. When there are no other crops except rice, kwelea continue to feed on rice even at drough stage.

Significant defference of quelea was not observed, however it was observed that quelea damaged local varieties more than improved short plant-type varieties. When two different types of rice were grown at trial farm, higher degree of quelea damage was observed in tall plant-type varieties. Tall plant-type varieties extract panicle above flag leaf because these types of varieties have dropy flag leaf. Short plant type variety with erected flag leaf seems protect panicle against quelea. quelea stop on panicle and they eat grains while they stay on panicles. Sometimes panicles are broken from neck node due to kwelea and broken panicle totaly stop ripening.

As mentioned before, quelea also damage other crops. So far as observed at trial farm, KADC, sunflower seems to be more susceptible to quelea atack then rice. When sunflower and rice were cultivated at the same time, quelea concentration in sunflower field was higher than in paddy field.

Damage of quelea quelea observed at KADC trial farm can be summarized as mentioned below.

1. Number of kwelea in one group is 150 - 200 in large group and 40 - 60 in small group. Number of quelea vary with season of crop cultivation in surrounding area.
2. Severity of quelea damage to rice depends on cultivation of other alternative food crops.
3. Quelea start damaging rice when rice plants are at milk ripe to drough ripening stage.

4. Quelea seems to make their roost in a forest area and stay there when enough food is available.

Exploratory observation of the ballon control method:

Exploratory observation Trial was conducted in one of KADC paddy field to examine effect of the ballon installation on bird (kwelea) control. Specially designed balloons for bird control were installed over the field when heading of rice plants was completed. On 3rd May balloons were installed and field observation was continued for 23 days. Field plan for observation trial and balloon installation method are presented in Fig-15. Three spots of $1m^2$ per plot were selected for investigation of Quelea damage to rice.

Balloon installation method:

1. Double balloon installation plot. Two ballons were tightened together with sisal ropes and hung over paddy field as shown in Fig.-15.
2. Single balloon installation plot.
   One balloon was installed with sisal rope in such a way that a balloon could move along with rope.
3. Plastic board installation plot.
   Plastic board of 50 cm. diameter, 3mm. thickness was installed over paddy field as shown in Fig.-15.
4. Control plot:
   No objective was installed except bird trap net which was invisible from certain near distance.

After installation of balloons and plastic board, field observation was continued for about 2 weeks. It was observed that irregular movement of balloons scared kwolea away. When movement of balloons was large and irregular due to wind, effect of balloon scaring was more effective. Significant difference in scaring kwelea between double balloons and single balloon plots. Plastic board was heavy as compered to balloon so that movement was less than balloons. It was observed that plastic board was not effective as balloons because of less irregular movement. However, even balloons were installed over paddy field, certain extent of quelea damage was observed. Serious kwelea damage was observed especially around the edge of paddy field.

Result:

3 spots of $1m^2$ already were selected in each plot to investigate quelea damage to rice. Number of damaged hill i.e. hills which was damaged by elea was counted per unit area and percentage of damaged hill was obtained. Even if one panicle of one hill was damaged, that hill was counted as damaged hill. For damaged panicle per centage, number of damaged panicles were counted in each damaged hill and damaged panicle per centage per hill was obtained. When kwelea damage was less than 20%, that panicle was not counted as damaged panicle. Damaged hill count and damaged panicle count were presents in table - 5.

Discussion:

Higher percentage of damaged hill was observed in control and plastic board plots than balloon plots.

In double balloon plot, 7 hills were damaged out of 16 hills and 8 hills were damaged in single balloon plot, while 9.7 hills and 11.7 hills were damaged in plastic board plot and control plot respectively. Larger number of panicles were damaged in control plot. 105.7 panicles were damaged by kwelea in $1m^2$ in control plot. In plastic board plot, 65.3 panicles were damaged per $1m^2$ while less number of panicles damaged was observed in balloon plots. 22.3 panicles $1m^2$ and 34.3 panicles $1m^2$ were damaged in double balloon and single balloon plots. Same tendency of kwelea damaged panicles per hill was also observed. 9.1 panicles/hill was damaged in control plot and 3.2 panicles/hill which was the lowest among 4 plots were damaged in double balloon plot.

It is quite difficult to discuss about balloon effect on kwelea control from only one results of observation trial. More over seasonal variation in number of kwelea and ecology are not clearly explained. Same observation trial is still continued even now. Very less quelea damage was deserved in June, however very serious damage was observed in July under same treatment of the trial (field plan is presented in Fig.16). Several observations are necessary to be carried out to obtain precise data, however, it can be assumed from this first trial that balloon installation is some how effective to protect rice from kwelea damage. More significant difference was observed in number of the damaged panicles per unit area. It can also be assumed that double balloon and single balloon installations would not be much different in scaring effect.

Future observation trial:

Only one trial is not enough to discuss about effect of balloon on bird control. Trials should be conducted through a year so that data of kwelea damage can be obtained every month. Seasonal variation of kwelea damage can also be examined through the Trials. Balloon installation of field plan - 2 (shown in Fig.16) is conducted continuously every month.

Different control method like empty tin method (local method), scare crow method or other method which can be prepared from available materials in Tanzania also should be examined. Balloons seems to be effective but are not available. More over when large number of balloons are installed in paddy field, balloon robbery will be a problem. Even in KADC trial farm, 5 balloons were already stollen from the field, only 1 - 2 month after installation.

Duration of scaring effect of balloon method also should be examined. elea are normally get used to control method in a short period. There are many factors to be considered for investigating bird control method. Seasonal variation in number of birds, life cycle, feeding crops and duration of control method are factors to be examined.

FIG - 14

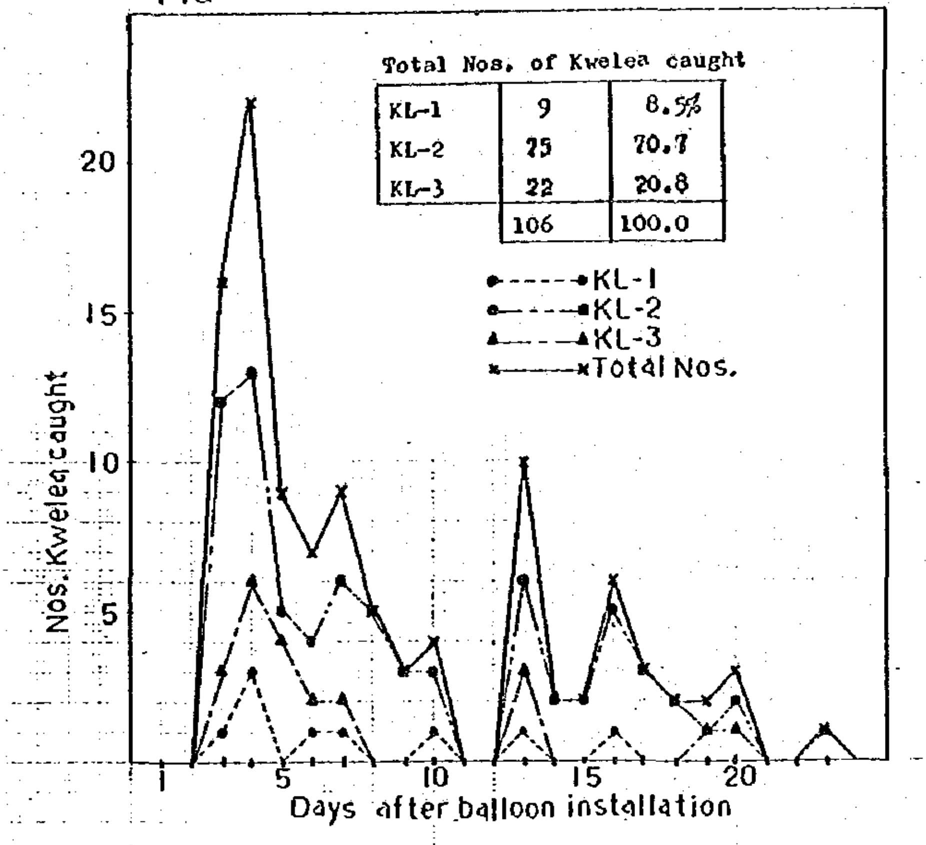


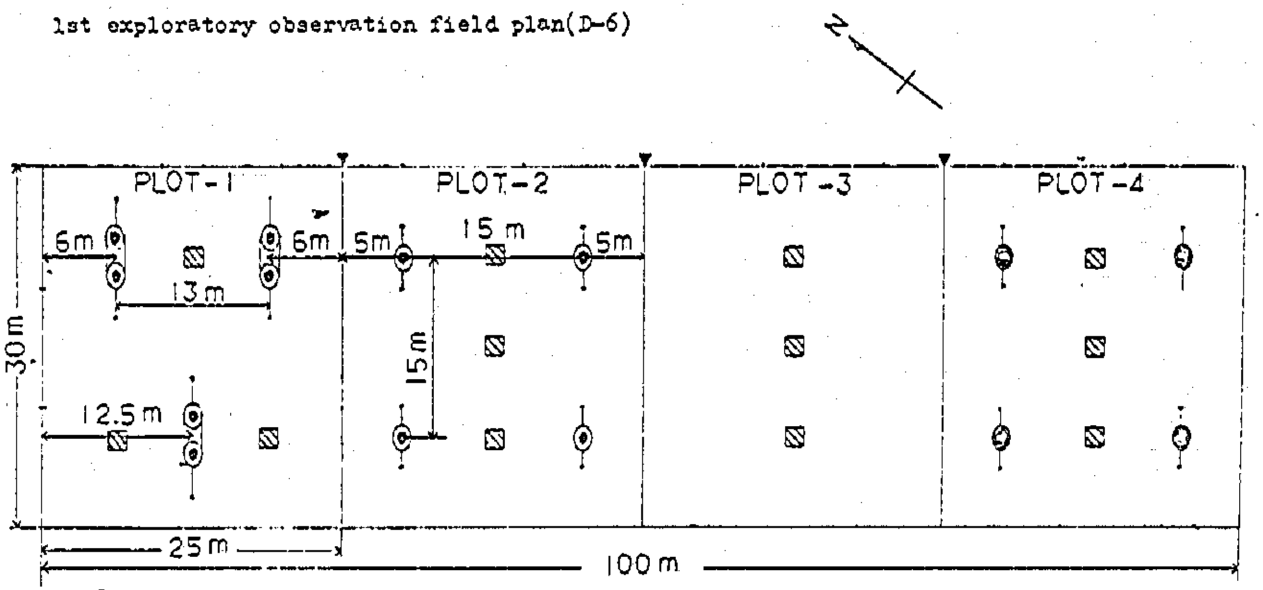
TABLE - 5

plot	damaged hills/m^2	damaged hills %	damaged panicles/m^2	damaged panicles %	damaged panicles/hill
double	7.0	43.8	22.3	15.8	3.2
single	8.0	50.0	34.3	20.7	4.3
control	9.7	72.9	105.7	42.6	9.1
plastic	11.7	60.5	65.3	31.3	6.8

Nos. of hills/m^2 : 16.7(20 cm x 30 cm)

FIG-15

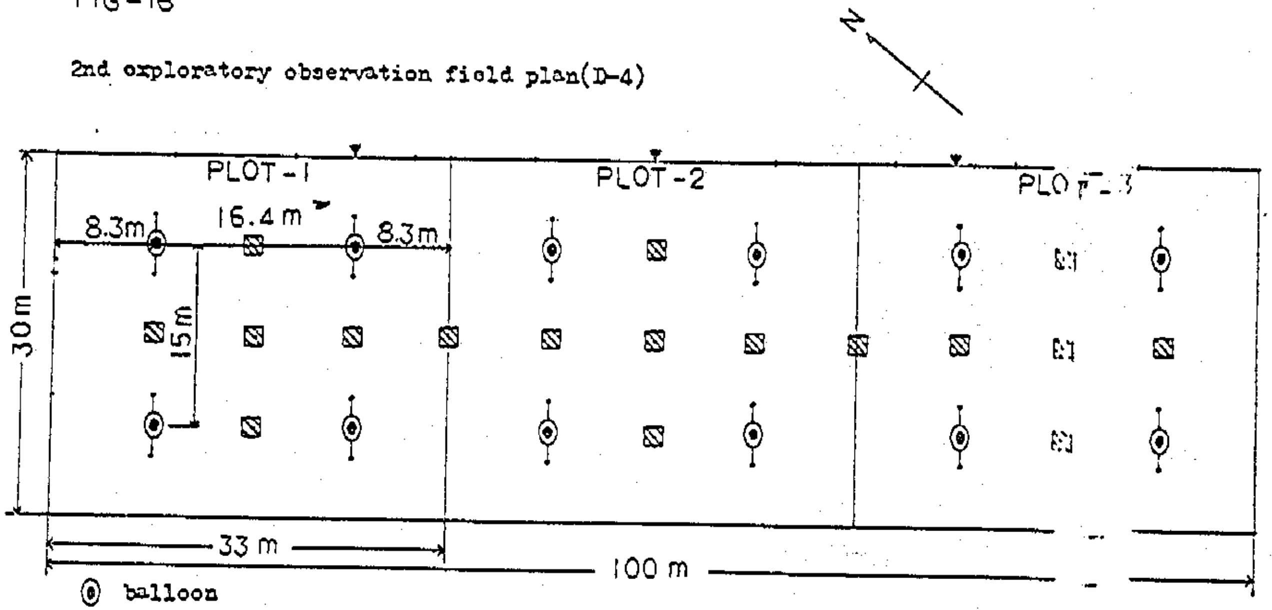
1st exploratory observation field plan(D-6)



balloon
plastic board
sample area for damage investigation

FIG-16

2nd exploratory observation field plan(D-4)



◎ balloon
▨ sample area for damage investigation

1. Introduction

More than 3 years have been passed since the first rice cultivation was started at Chekereni trial farm in 1982. In this year, 5th - 6th crops of rice cultivation are carried on the trial farm. Since 1982 several types of experiments have been conducted to investigate basic technological factors of rice cultivation and to identify limiting factors. Verification trials were also conducted simultaneously to verify the factors which were screened at the experiment stage. Objectives of verification trial are to examine technological factors and level of the factors such as variety, optimum plant population, optimum fertilizer rate and time of nitrogen application in a large scale of field. Field observation(exploratory observation) of bird control methods,the damage of bird, performance of variety, insect and disease outbreak are also other objectives of verification trial. The trials are normally conducted every month at the trial farm.

In 1984 cool temperature injury was observed in three plots of verification trial. The most severe sterility of spikelets was observed in IR-56 which was sown in March 1984. Grain production of IR-56 was almost nothing. High sterility was also observed in Affa Mwanza of April sowing. Sterility of spikelets of Affa Mwanza was not severe as IR-56, however remarkable yield reduction was observed. Spikelet sterility and yield reduction was also observed in 8 Japonica varieties which were sown in May. Among 8 varieties, difference in sterility of spikelet was observed.

It might sound strange that cool temperature injury to rice plant was occured at Chekereni. But cool temperature injury in South East Asia has been reported. In South and South East Asia alone, morden rice varieties(IRRI varieties) can not be planted in about 7 million hecteres because they will not grow in low temperatures. The area includes some regions in India, Nepal, Pakistan, Indonesia, Burma, Vietnam and the Philippines(IRRI Report). It is quite possible that cool temperature at certain stage can be a limiting factor when rice is grown at higher elevation in tropical area. It is also reported that rice grown in about 500,000 ha at elevation of more than 500 m in Indonesia and only one rice crop is usually grown. Many farmers tried growing the morden rice varieties(IR-5, IR-8 and CU-63) at high elevations, however at best the yields were poor at elevations between 700 m and 1000 m, primarly because of sterility due to low temperature during booting and flowering stage.(IRRI Rice Cold Tolerance Workshop 1979)

Once sterility due to cool temperature was observed in the verification plots of IR-56, Affa Mwanza and 8 Japonica varieties in 1984, monthly temperature pattern through the years, influence of cool temperature to rice plant and cause of sterility was investigated so that the damage of cool temperature on rice production could be minimized. The effect of cool temperature, yield reduction due to sterility and degeneration of panicle tips, was also observed in Chekereni pilot farm. IR-20 grown in 5 plots of the pilot farm(block E plot1 to plot5) was sown in April 1984. Sterility of spikelets of IR-20 was observed and degenerated panicle tips showed whitish and frail branches. IR-56 in plot 11 of block-D of March sowing showed exactly same symptom of IR-56 which was cultivated in the trial farm. Degeneration of panicle tips of IR-56 was not observed but almost all spikelets were empty. Extemely high sterility of one of local varieties, Super, was also observed in Rau ya Kati village. Panicles of Super were erected and spikelets were almost empty. The farmer did not get grain production from Super and he discarded his field.

2. Cool temperature injury at KADC trial farm

Sterility of spikelets was observed in 10 varieties which were cultivated in the trial farm. There was difference in severity of sterility among varieties. Largest yield reduction was observed in IR-56. 10 varieties were IR-56, Affa Mwanza, Hatsusaku mochi, Koshihikari, Oozora, Nihonbare, Akishimo mochi, Asahi mochi, Uzushio and Reiho.

2-1 IR-56

IR-56 was sown on 9 March 1984 and one month later seedlings were transplanted in the field(D-5). At early stage of tillering, stem borer outbreak was observed. As a prevention measure, Diazinon was sprayed in the field. On 17 May plants seemed stop growing and seemed as if plants were stunted. Abnormal increase of tiller was observed on the same day. Nos. of tillers per hill was 47.2 at 33 days after transplanting(68 days after sowing). Tiller production was conrinued and 71.6 nos. of tillors per hill was observed on 26 June(109 days after sowing).

Heading initiation was observed on 11 June and heading was completed on 22 June 1984. However heading was very irregular and tremendous number of late-emerging panicles from higher node were observed. It was difficult to determino exact heading date because of irrogular heading. Panicles wero not exserted completely from the sheath of flag leaf and most of panicles remained partly covered by the sheath of flag leaf. Black spots on empty spikelets were observed. After heading stage, grain filling was not occured. Degeneration of panicle tips was not observed and panicles did not show whitish frail branches. Due to irregular heading, it was difficult to decide exact maturity date. After some panicles turned yellowish, still many late-emerged panicles remained greenish without any pollinated spikelets. First it was not known that high storility of IR-56 was caused by cool temperature. Harvest was delayed because of waiting till grains to be filled. But no improvement of grain filling was not observed since flowering. On 14 Aug. harvest was completed. Grain production from the plot(actual area is 2619 m^2) was 8.0 kg which was equivalent to 30.5 kg per ha. Results of yield componets analysis is presented in Table-6.

2-2 Affa Mwanza

Affa Mwanza was sown on 13 April 1984 and transplanted in plot D-2 on 17 May. Abnormal growth of plants like IR-56 at early stage was not observed. Aftor transplanting, Maximum nos. of tillers per hill was obtained 101 days after sowing.

Heading initiation was started on 14 Aug. and heading was completed on 24 Aug. 1984. Heading of Affa Mwanza was not very much irregular, however late-emerging panicles from higher node of stem were observed. Degeneration of panicle tips was not observed however remarkable number of empty spikelets were observed. Panicles were exserted from the sheath of flag leaf. But unpollinated panicles and late-emerging panicles were not exserted completely from the sheath of falg leaf. Black spot on spikelets were observed. After harvesting was completed on 13 Oct. 1984, 57.0 kg of grain yield was obtained from the plot. Grain yield of Affa Mwanza in plot D-2 was equivalent to 217.6 kg per ha. Result of yield components analysis was presented in Table-6.

2-3 Japonica varieties

Japonica varieties cultivated in plot D-8 were Hatsusaku mochi, Koshihikari, Oozora, Nihonbare, Akishimo mochi, Asahi mochi, Uzushio and Reiho. Sowing of 8 varieties was completed on 30 April and transplanting was completed on 2nd June 1984. At early growth stage, diazinon was sprayed twice to control stalk-eyed shoot fly. On 14 July, heading of Hatsusaku mochi was not yet initiated. Number of tillers on the same day was 9.4 per hill. In a few plants of Koshihikari, panicle emergence was observed, however most of plants were at booting stage. Number of tillers of Koshihikari was 15.8 per hill. Panicle emergece of Oozora was same as Koshihikari and number of tillers was 15.8 per hill. Heading initiation of Nihonbare was observed on 14 July. But heading of this variety was very irregular. Number of tillers was 15.4 per hill.Relatively large number of tillers, 30.4 per hill was observed in Akishimo mochi. In a few plants of the same variety, panicle emergece was observed but most of plants were at booting stage. Panicle emergence of Akishimo mochi was different from that of Hatsusaku mochi and Koshihikari. Emergece of a few panicles was observed in Asahi mochi on 14 July and number of tillers was 32.8 per hill. Panicle emergece of Uzushio and Reiho was almost same as Asahi mochi. Numbers of tillers of these two varieties were 19.6 per hill(Uzushio) and 21.6 per hill

(Reiho). On 14 July, heading initiation of Koshihikari and Oozora was observed. At this stage visible effect of cool temperature was not observed. Heading observation of all varieties was carried out. Heading of Hatsusaku mochi was initiated on 30 July and was completed on 6 Aug. Heading initiation of Koshihikari was observed on 11 July and heading was completed on 19 July. heading of Oozora was same as Koshihikari. Heading of Nihonbare was initiated on 14 July and completed on 27 July. Heading of Akishimo mochi was initiated on 26 July and completed on 16 Aug. Heading initiation of Asahi mochi was observed on 14 July and heading was completed on 13 Aug. Heading of Uzushio was initiated on 14 July and was completed on 11 Aug. Heading of Reiho was initiated on 20 July and was completed on 13 Aug. Among 8 varieties, difference in heading date was observed. While heading of Hatsusaku mochi,Koshihikari and Oozora was completed within 1 - 2 weeks Akishimo mochi, Asahi mochi, Uzushio and Reiho took approximately 3 - 4 weeks to complete heading. Difference in heading period might be caused by premature heading. Maturity of varieties was not observed clearly due to irregular heading. Harvest of Japonica varieties was completed on 21 Sept. 1984. Grain yield and yield components analysis of varieties was presented in Table-1.

Whitish tips of panicles was not observed in 8 varieties. Relatively large number of unpollinated panicles was observed in Nihonbare and Asahi mochi. Late-emerged panicles form higher node was observed in Hatsusaku mochi, however panicles were exserted completely from the sheath of flag leaf. Panicle development from higher node of Koshihikari was not observed and panicles were exserted completely. Late-emerged panicles was not observed in Oozora and panicles were exserted completely. Very small number of unpollinated panicles was observed in Oozora as compared to other varieties. Panicle development from higher node was observed in Nihonbare and panicle was exserted completely. Panicle development from higher node was not observed in Akishimo mochi and panicles were exserted from the sheath of flag leaf. Panicle development from higher node was observed in Asahi mochi and panicles were partly enclosed. Panicle development from higher node of Uzushio was not observed and panicles were partly enclosed. In Reiho, panicle development from higher node was observed and panicles were exserted completely.

2-4 Cool temperature damage to grain yield

Grain yield and yield components analysis of 10 varieties was presented in Table-1. There was variation in yield reduction among varieties. The most seriously damaged variety was IR-56.

When harvest and sample plants collection of IR-56 was completed, number of tillers, including late-emerged panicles, was 115.2 per hill. Tremendous number of panicle emergence was continued even after field was dried and they remained greenish without any filled grains(Photo-17). Number of panicles was 79.3 per hill. Number of unpollinated panicles which did not produce even a single filled grain was 40.2 per hill. Approximately 50 % of total panicles did not produce filled grain at all. Total number of spikelets of sample plants was 11983 and only 83 spikelets were filled out of 11983. 99.3 % of spikelets were not filled and average number of filled grain per panicle was only 0.4. 1000 grains' weight was 20.5 g which was relatively lower than that of IR-56 grown under normal condition. 1000 grains' weight of this variety cultivated in Rau ya Kati village was 23.6 g. Grain production of IR-56 was 30.5 kg per ha.

Grain yield of Affa Mwanza was 217.6 kg per ha. Average number of tillers was 34.0 per hill and number of panicles was 21.9 per hill. Number of unpollinated panicles was 6.1 per hill out of 21.9. Approximately 72 % of panicles produced pollinated and filled grains. However filled spikelets per panicle were very small in number. Total number of spikelets produced from sample plants was 14609 and only 2961 of spikelets were filled out of 14609. Approximately 80 % of spikelets were not filled. Number of spikelets per panicle was 115.9 and 23.1 of spikelets were filled per panicle. 1000 grains' weight of Affa Mwanza was 27.0 g which was relatively low as compared to that of Affa Mwanza grown in Rau ya Kati village(28.5 g).

Among 8 Japonica varieties, the highest percentage of unpollinated panicles was observed in Nihonbaro. Total number of panicles produced per hill was 45.5 and 25.2 panicles were unpollinated. Approximately 56% of panicles were not pollinated. Asahi mochi also produced relatively large number of unpollinated panicles. 53.4 % of total panicles were unpollinated. Percentage of unpollinated panicles of other varieties were 41.0 % in Hatsusaku mochi, 35.6 % in Reiho and 32.0 % in Uzushio. The lowest percentage of unpollinated panicles was observed in Oozora.

Variation of sterility of spikelets was also observed among varieties. Number of spikelets per panicle of Nihonbare was 52.5 and only 10.1 of spikelets were filled out of 52.5. Number of filled grain of Reiho was also low. 64.4 number of spikelets were produced and 21.6 % of spikelets were filled. Relatively high percentage of filled grain was observed in Oozora and Hatsusaku mochi. Spikelets production of Oozora was 57.2 per panicle and 29.0 of spikelets, approximately 50 % of total spikelets were filled. Percentage of unpollinated spikelets of Hatsusaku mochi was 34.6 %. Considering percentage of unpollinated panicles and spikelets, it seemed that less cool temperature injury was observed in Oozora and Hatsusaku mochi and severe cool temperature injury was observed in Nihonbare, Asahi mochi and Reiho.

3. Mechanism of cool temperature injury

It is mentioned that there are two types of cool temperature injury, Sterile type(destructive type) and delayed growth type. In the sterile-type, severe decrease in yield results from sterility caused by unseasonable cool temperature at the booting stage or at anthesis. In the delayed-growth type, low yield results from grain immaturation caused by cool temperature during maturing period. It is well known that low temperature at panicle initiation stage(booting stage) causes severe yield reduction due to increased spikelets sterility in the high elevation of tropical countries(IRRI Report).

For many years, it has generally been assumed that sterility resulted from cool temperature at anthesis. It has also reported that sterility of rice plants could be induced by cool temperature at the meiotic stage. Typical symptoms of cool temperature damage at productive phase are; Delayed heading results from low temperature during both the pre-tillering and reproductive phases. Low temperature prolong the vegetative phase and delay heading. Delayed heading results in spikelets sterility and immature grains. Partial panicle exsertion also results from low temperature. Low temperature prevents the normal elongation of internodes and panicle emergence. Panicles may emerge partially and remain partly covered by the sheath of flag leaf. Incomplete exsertion of panicles increases the incidence of sheath rot. Degeneration of panicle tips is also typical symptom of cool temperature injury and is most common at higher elevations. Degenerated panicle tips show whitish and frail branches. Sterility of spikelets is a factor for yield loss and it is caused by abnormalities of the pollen. Irregular maturity of panicles is a feature of cool damage. Lower temperature at maturity results in decreased kernel weight, increased immature grains and chaffines.

Cool temperature injury observed at KADC Chekereni in 1984 was mainly induced due to sterility of spikelets.

3-1 Mechanism of sterility

The organs susceptible to cool temperature is spikelets. It is known that sterility is caused due to floral impotency. The growth of paleas(a part of spikelet) was not damaged by cooling treatment. It was considered that organs of spikelet causing sterility might be the pistil or the stamen or both.

In the severe cool-damaged year of 1941 in Hokkaido, many male abnormality were observed and it was considered that sterility might be caused by abnormality in the stamen. However a spikelet has six anthers, producing $5 \times 10^3 - 7 \times 10^3$ of pollen grains and it is known that fertilization is expected to taken place when 10 pollen grains or more germinate on stigma. After conducting several experiments to find out main cause of sterility , it was found that sterility resulted from abnormality of the pollen. Cooling treatmont at roduotion division stage delayed the growth of palea in length but did not affect the final length. On the other hand,it shortened anther length at heading by 10 - 20 percent. Even when rice plants were grown under favorable conditions, after fairly cooling treatment was applied at the reduotion division stage, considerable high sterility always occured. All these physiological abnormality appeared 4 - 6 days after oooling(IRRI).

It is reported that main cause of abnormality of pollon is due to tapetal hypertrophy. Nutrients required for the dovelopment of microspore is supplied through tapetal cells. Abnormal development of microspore means that nutrient movement is suppressed through tapetal cell to miorospores. Tapetal pypertrophy inhabits transport of sugar from surrounding tissues to miorospores and that is main cause of sterility of pollen grain.

3-2 Critical temperature for sterility

Remarkable high sterility was induced by cooling at 17°C for 6 days and low sterility at 20°C for 10 days. It was reported that abnormality of meiotio division and hypertrophy of tapetal cells oocured below 15°C. It is generally assumed that critical cool temperature for induoing sterility is 15 - 17°C in the highly cool tolerant varieties and 17 - 19°C in the cool sensitive varieties. These critical temperatures for sterility were obtained from the studies which had been conduoted under constant day and night temperatures during cooling period. Constant temperature do not occur under natural climatic conditions. The effect of temperature on sterility at meiotio division stage was investigated by using a combination of controlled different day and hight temperature. High sterility occured at continous cool temperature while low sterility occured when warm temperature during the day was combined with cool temperature at night. Severity of sterility seemed to be determined by both of night temperature(minimum temperature) and day temperature(maximum temperature).

It was reported that cool temperature for certain period induced sterility. Serious sterility was reported when low temperature of 17°C was continued for 2 - 3 days and when rice plants were at booting stage. The relation between yield reduction and average minimum temperature was studied in 1972. When average minimum temperature was 17°C for 5 days(10 - 14 days before heading) yield reduction was 4 %, however 15 % of reduction was reported when average minimum temperature was 16°C. When average minimum temperature was 15°C for 5 days 40 % of yield reduction was observed. Variety used for this study was highly cool tolerant Japonica variety. Higher percentage of yield reduction could be expected in case of indica varieties.

Critical temperature for sterility inducement can not be explained only by minimum temperaturo. When cool temperature was continued for 6 - 9 days, percentage of sterility varied with the night and day temperatures. When average temperature for 6 - 9 days was 16°C, 10 - 25 % of sterility was reported when minimum temperature was 12°C. While 10 % of sterility was report ed when maximum temperature was 20°C and minimum temperature was 18°C.

The relation between yield reduction and average minimum temperature for 5 days(10 - 15 days before heading) was studied. In cool sensitive varieties, more than 10 % of yield reduction was observed when average minimum temperature was 16.5°C. When average minimum temperature for 5 days was 15.0°C, approximately 40 % of yield reduction was reported. 40 % of yield reduction was equivalent to 60 % of sterility(relation between yield reduction and sterility 1964). The same effect of cool temperature on yield reduction was reported at flowering stage. When average of minimum temperature of 5 days at flowering stage was below 21°C, yield reduction was more than 10 %.

According to the studies on cool temperature and cropping season of rice in Japan(Tsuboi 1974), lowest limit of minimum temperature during panicle initiation to booting was 17.0°C. Crroping season for rice should be decided in such a way that susceptible period for cool temperature could fall in certain period when minimum temperature is more than 17.0 C(Tsuboi 1974). Critical period for sterility is assumed when minimum temperature of 17.0°C is observed in more than 3 days for each 10 days of a month. The period when 17.0°C of minimum temperature is observed in more than 3 days for each 10 days of a month could be assumed as dangerous period for sterile-type cool injury when rice plant is at booting stage.

3-3 Critical stage to cool temperature

Major cause of sterility is abnoramlity of pollen. In the several research on cool temperature and sterility, it was found that the most sensitive stage to cool temperature was young microspore stage. Practically a few days period of 10 days before heading was also considered as critical stage. However period of cool injury occured under natural condition can not be estimated precisely by heading date. Heading date could be delayed when temperature is low. Several studies on cool temperature indicated that booting stage(10 - 14 days before heading) was most susceptible stage to cool temperature. Flowering stage is also susceptible stage to cool temperature. 35 % of yield reduction was reported when average of maximum temperature for 5 days after flowering was 20.0°C. It is generally accepted that total 20 days from 14 days before heading to 5 days after heading are critical period to cool temperature.

The effect of cool temperature at ripening stage was also reported. Proper ripening of grains could be obtained when accumulated average temperature for 15 days after heading is 350°C (23.3°C/day). The lower limit of accumulated temperature for 45 days after heading is 880°C(17.8°C/day). It is mentioned that heading to ripening should be completed before lower limit of accumulated temperature(880°C for 45 days). Finally it could be assumed that critical stages to cool temperature are young microspore stage(10 - 11 days before heading), reduction division stage(10 - 14 days before heading) and flowering stage(5 days after heading).

4. Cool injury and olimatio condition in Chekereni

Sowing date of IR-56 was 9 Maroh 1984and transplanting was completed on 13 April. Heading initiation was observed on 11 June and completed on 22 June. Temperatures for 20 days, 14 days boforo heading to 5 days after heading, were low as compared to that of 1983 and 1982. In 1984 number of days whiohi minimum temperature was below 17°C was 11 out of 20 days. While the number of days in 1983 and 1982 were 3 and 1 respeotively. Minimum temporatures of 4 days at susceptible stage of 10 - 11 days before heading in 1984 were 18.0°C, 15.5°C, 15.5 C and 15.0°C. In 1983, minimum-temperatures of tho same period were 19.8°C, 18.4 C, 18.0°C and 17.3°C and also 17.8°C, 20.0 C, 19.3 C and 20.5 C in 1982. It is not easy to estimate cool temperature injury occured under natural condition just by comparing minimum temperatures of susceptible stage, however, remarkable low temperature in 1984 might be a cause of cold injury in IR-56. Minimum temperatures of 5 days after heading were 16.0°C, 16.8°C, 15.5°C, 15.5°C and 16.5°C.

Affa Mwanza was sown on 13 April 1984 and was transplanted on 17 May. Heading was initiated on 14 Aug. and completed on 24 Aug. 1984. Minimum temporatures of 4 days at susoeptible stage of 10 - 11 days before heading were 16.2°C, 15.5°C, 15.5°C and 16.5°C. Average of minimum temperature of these 4 days was 15.9°C. While in 1983 and 1982 average of minimum temperature of the same period were 16.0°C and 18.7°C. Average of daily mean temperature for 4 days were 20.9°C in 1984, 23.2°C in 1983 and 22.0°C in 1982. Average of minimum temperature for 20 days(14 days before heading to 5 days after heading) was 15.5°C in 1984 while 16.3°C and 22.5°C of average of minimum temperatures were observed in 1983 and 1982. Number of days whioh minimum temperature was below 17.0°C during the 20 days in 1983 and 1982 were 12 days and 3 days respeotively. While whole period of these 20 days, minimum temporatures woro below 17.0°C in 1984.

Among 8 varieties of Japonica rioe, variation in cool temperature injury was observed. Nihonbare seemed to be damaged the most seriously than other varieties. Sowing date of Nihonbare was 30 April 1984 and transplanting was complated on 2 June. Heading initiation of Nihonbare was observed on 14 July and heading was completed on 27 July 1984. Minimum temperatures of 4 days at susceptible stage of 10 - 11 days before heading were 15.0°C, 15.5°C, 15.5°C and 17.0°C in 1984. Averago of minimum temperature for these 4 days was 15.8°C and average of maximum temperature was 26.7°C. Average of minimum temperature of the same period in 1983 and 1982 wore 17.7°C and 18.8°C, respectively. Average of minimum temperature for 20 days(14 days before heading to 5 days after heading) was 16.0°C in 1984, while 16.7°C and 18.0°C of average minimum temperatures were observed in 1983 and 1982. Number of the days which minimum temperature was below 17.0°C during those 20 days was 18 in 1984. In 1983 and 1982, the number of the days were 11 and 4 respectively. Comparing maximum and minimum temperatures during susceptible period to cool temperature and varieties damaged by cool temperature in 1984, it was observed that exteremely cool temperature was couured. These cool temperatures in June July and Aug. in 1984 might be a major cause of high sterility of varieties observed in Chekereni.

5. Meteorological conditions in Chekereni

Since 1982 meteorologioal observation was startod at KADC Chekereni, records for about 3 years and six months have been accumulated. Meteorological observation made for such period is not adequate to charactorize the precise monthly pattern of weather change through the year. Moreover it is impossible to decide wheather cool temperature ocoured in 1984 is irregular or not from limited observation records. However monthly change of weather could be characterized somehow as follows;

5-1 Monthly pattern of temperature

Monthly pattern of maximum and minimum temperatures are presented in Fig-17 and 18. Large variation in maximum temperature among years was not observed. Peak of maximum temperature was observed twice through year. First peak was observed in Feb. (35.0°C average temperature of maximum) - March(35.1°C). Maximum temperature starts falling after March and reaches cool season in June(27.4°C) - July(26.9°C) - Aug.(27.4°C). Then maximum temperature starts rising again and reaches 2nd peak in Nov.(32.6°C). There is variation of maximum temperature among three years however variation is large as minimum temperature.

Peak of minimum temperature was obsrved in March - April. Average of minimum temperature for these two months was approximately 20 - 21 °C. Minimum temperature starts falling after April and reaches cool season in July - Aug.(17.0°C of average minimum temperature). 2nd peak of minimum temperature was observed in Nov.(18.0°C). Variation of minimum temperature among 3 years was very large and it was difficult to characterize monthly pattern of minimum temperature precisely. In 1982 and 1983, cool period which minimum temperature was below 17.0 C was observed in 1st-10 days of Aug.(1982) and in whole July upto 2nd-10 days of Aug. (1983). While the cool period started from the end of May and continued upto 2nd-10 days of Oct. in 1984. Monthly average of minimum temperature during these period was 16.3°C(June), 16.1 °C(July), 15.1°C(Aug.), 13.6°C(Sept.) and 16.0°C(Oct.). While monthly average of minimum temperature during same period in 1983 was 18.0°C(June), 17.1°C(July), 16.7°C(Aug.), 16.9°C(Sept.) and 18.2°C(Oct.). In 1982 monthly average of minimum temperature was 18.9°C(June), 18.1°C(July), 17.4°C(Aug.), 18.9°C(Sept.) and 18.3°C(Oct.). It seemed that cool temperature period was expanded in 1984.

Fig-20 indicates the number of days which minimum temperature is below 17.0°C for every 10 days of a month through years. Considering the period which cool day(minimum temperature is below 17.0°C) continues more than 3 days in a 10 days of a month as critical cool period, critical period started from 2nd-10 days of May and continued upto the end of Dec. in 1984. In 1983 from 1st-10 days of July upto the end of Sept., number of cool days was more than 3 days in each 10 days of a month. In 1982 cool period was reduced. Critical period was observed in 3rd-10 days.

of June, 2nd-10 days of July and 1st-10days of Aug. in 1982. From the meteorological observations for three years, it might be considered that there is relatively high probability of occurring cool temperature during July to Sept. However cool temperature starts earlier like in 1984, it will be difficult to estimate critical cool period precisely.

Daily temperature pattern seemed different in seasons. In case of 7 June 1985, maximum temperature of 27.5°C was observed at 3:00 pm then temperature started falling to 20.0°C at 8:00 pm. After 9:00 pm temperature fell below 17.0°C and decrease of 3.0 °C per hour was observed. Minimum temperature of 11.5°C was observed at 7:00 am of 8 June 1985 and two hours later temperature reached at 20.0°C. Highest peak of daily temperature was observed at 3:00 pm then after sunset temperature started falling rapidly and reached lowest peak just before sunrise. In 7 June 1985, 11 hour, from 9:30 pm to 8:30 am, temperature was below 17.0°C. In hot period, the change of temperature in a day seemed different from that of cool period. In 4 April 1985, maximum temperature of 32.0°C was observed at 3:00 pm. After 3:00 pm temperature started falling and minimum temperature was observed around 3:00 am to 7:00 am of the next day. After 7:00 am temperature started rising again. Temperature fell near minimum temperature of the day at 11:00 pm, then after 11:00 pm temperature did not change rapidly and kept falling gradually untill sunrise. Rapid change of temperature during night like cool season was not observed in case of 4 April 1985.

5-2 Monthly pattern of rainfall

Variation of anual rainfall was observed in 1982, 1983 and 1984. Total rainfall of the year was 501.9mm in 1984, 416.8 mm in 1983 and 793.3 mm in 1982. Effective precipitation of each year was 406.6 mm(23 days) in 1984, 345.2 mm(22 days) in 1983 and 691.9 mm(35 days) in 1982. There are two rain seasons called main rain season and short rain season. Main rain season normally starts from early April and continues untill the end of May.

Approximately 40 - 60 % of total anual rainfall was availablo in main rain season. Rainfall in short rain season varied with years. In 1982, 20 - 25 % of anual rainfall was observed in Oot. and Nov.. In 1983, 20 - 25 % of anual rainfall was observed in Deo. In 1984, approximately 22 % of anual rainfall was observed in Deo. Rainfall in main rain season did not vary very much with years, while rainfall and priod of short rain season varied with years. Preoipitation pattern could be oharacterized as main rain season(mid April - end of May), short rain season(Oct. - Deo.) and dry season(July - Sept.).

5-3 Sunshine hours

Observation records of daily sunshine hours were obtained from Moshi Meteorological Station and monthly pattern of sunshine hours was ploted in Fig-22. Remarkable variation of sunshine hours was observed among 5 years(1980-1984). In Jan. - Feb., approximately 10 hours of sunshine hours was observed. As rain season started, sun shine hours deoreased to approximately 6 hours per day. Short sunshine hours continued untill Aug.. During short rain season, sunshine hours was not decreased. Sunshine hours might coincide with number of rainy days in seasons. During Jan. to Feb., number of rainy days was 2 - 4 days per month, while in April to May 13 - 18 days per month were rainy days. When cool season started, coll and cloudy days continued upto Aug.. Through the year, monthly pattern of sunshine hours might be characterized as period of short sunshine hours to bo main rain season and cool temperature season(April - Aug.) and as period of long sunshine hours to be Jan. - March and Sept. - Deo.

6. Conolusion

. First of all, it is quite difficult to estimate damage of oool temperature occured under natural conditions and critical temperature caused cool temperature injury. Observation records of temperature at KADC Chekereni are not sufficient to estimate frequency of inducement of cool temperature injury in future.

Under cool temperature, plant growth of rice is normally delayed and that makes difficult to investigate sterility of spikelets and minimum temperature which caused sterility basing on the date of heading. Heading can be also delayed by cool temperature. However it can be assumed that serious yield reduction of IR-56, Affa Mwanza and some of Japonica varieties was caused by remarkable low temperature during June, July and Aug. in 1984.

Meteorological observations for three years is not enough to discuss about monthly pattern of temperatures, even though it can be assumed that there is a probablity of occuring of cool temperature during July - Sept. But minimum temperatures during these months can not be predicted precisely and probability of cold injury inducement can not be estimated. Accumulation of more observations is strongly required to make precise estimate of cool temperature season and cool temperature injury.

It can be considered that critical stages to cool temperature are young microspore stage to flowering stage, i.e. 14 days before heading to 5 days after heading. Practically it is also considered that booting stage(approximately 25 days before flowering) and flowering stage are susceptible to cool temperature.

Critical temperature to cool injury vary with cold tolerance of variety. Moreover cool injury can not be estimated only by minimum temperature. Combination of maximum and minimum temperatures causes different cool injury.

Cool temperature period is one of the most important factors when cropping pattern of rice cultivation is to be decided. When cool days(minimum temperature of the days is below 17.0°C) continue more than 3 days in each 10 days of a month is practically considered as critical period for panicle initiation to booting stages. Panicle initiation should be completed before or after critical cool period occurs. Cropping season of rice would be better to be decided in such a way that overlapping of susceptible stages and cool temperature period can be avoided.

Most of farmers in Lower Moshi area start sowing seeds in Nov. - Dec. and complete harvest in May - June. After rice cultivation, bean and vegetables(mainly tomato) are cultivated in paddy field. At Chekereni trial farm rice is cultivated every month through the year for verification of varietal performance in different seasons. Cool temperature injury of several varieties was observed when these varieties were cultivated in off-season in 1984. It is not easy to decide suitable season of rice cultivation. More meteorological observations are required and cold tolerance of different varieties also should be investigated. Moreover effects of climatic environment on rice such as temperature, solar radiation, rainfall and sunshine hours are required to be examined to establish ideal cropping pattern of rice cultivation.

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TABLE -6 **Summarised table of grain yield and yield components**

Variety	Grain yield kg/ha	Total nos. of panicles/hill	Nos. of unpollinated panicles/hill	Percentage of unpollinated panicles	Nos. of spikelets per panicle
IR - 56	31	79.3	40.2	50.6	51.0
Affa Kwanza	218	21.9	6.1	27.9	115.9
Hatsusaku mochi	1197	16.6	6.8	41.0	90.6
Koshihikari	1071	26.5	8.8	33.2	50.1
Oozora	1339	15.3	0.3	2.0	57.2
Nihonbare	1049	45.4	25.2	55.0	52.5
Akishimo mochi	1296	18.8	3.5	18.6	69.0
Asahi mochi	1377	38.0	20.3	53.4	58.5
Uzushio	2109	48.1	15.3	32.0	46.6
Reiho	868	46.3	16.5	35.6	64.4

Variety	Percentage of unpollinated spikelets	Nos. of filled grains per panicle	Ripened grain ratio %	1000 grains' weight g
IR - 56	99.3	0.4	0.7	20.5
Affa Mwanza	80.0	23.1	20.0	27.0
Hatsusaku mochi	34.5	59.3	65.4	25.3
Koshihikari	52.5	23.8	47.5	24.1
Oozora	49.4	29.0	50.6	24.4
Nihonbare	80.8	10.1	19.2	25.7
Akishimo mochi	50.0	34.5	50.0	23.3
Asabi mochi	71.3	16.8	28.7	25.2
Uzushio	64.6	16.5	35.4	25.4
Reiho	78.5	13.9	21.6	25.6

FIG.-17

Monthly temperature pattern at Chekereni

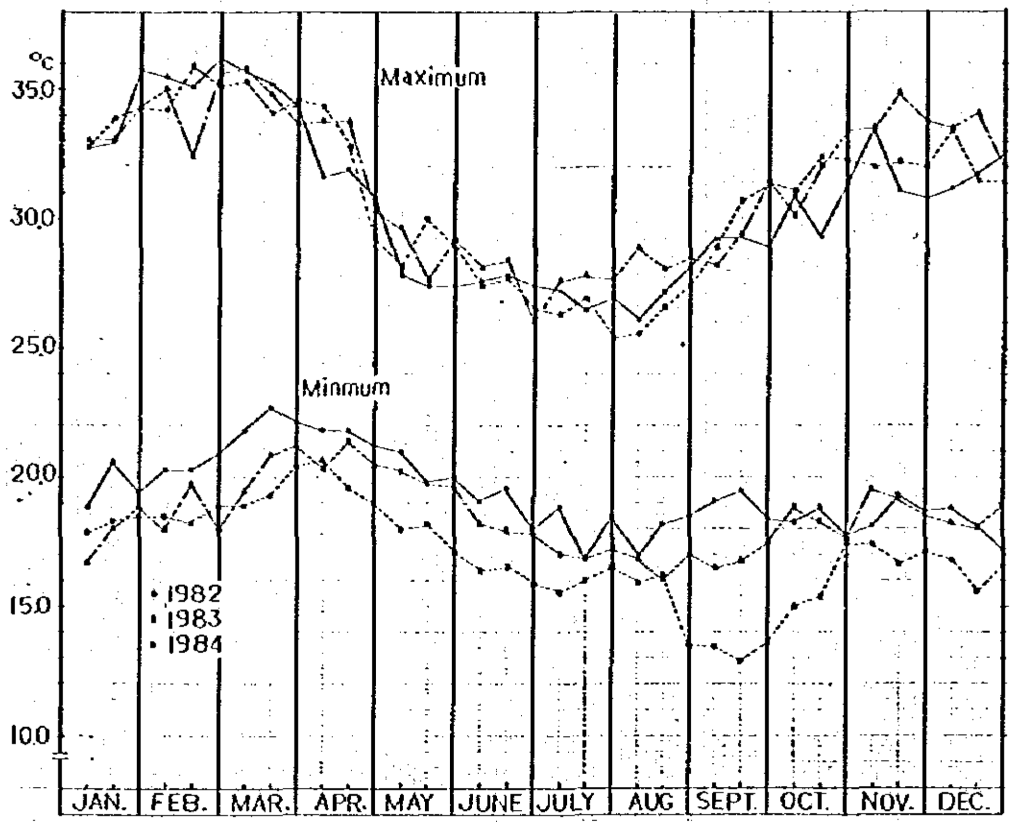


FIG.-18

Monthly temperature pattern at Chekereni

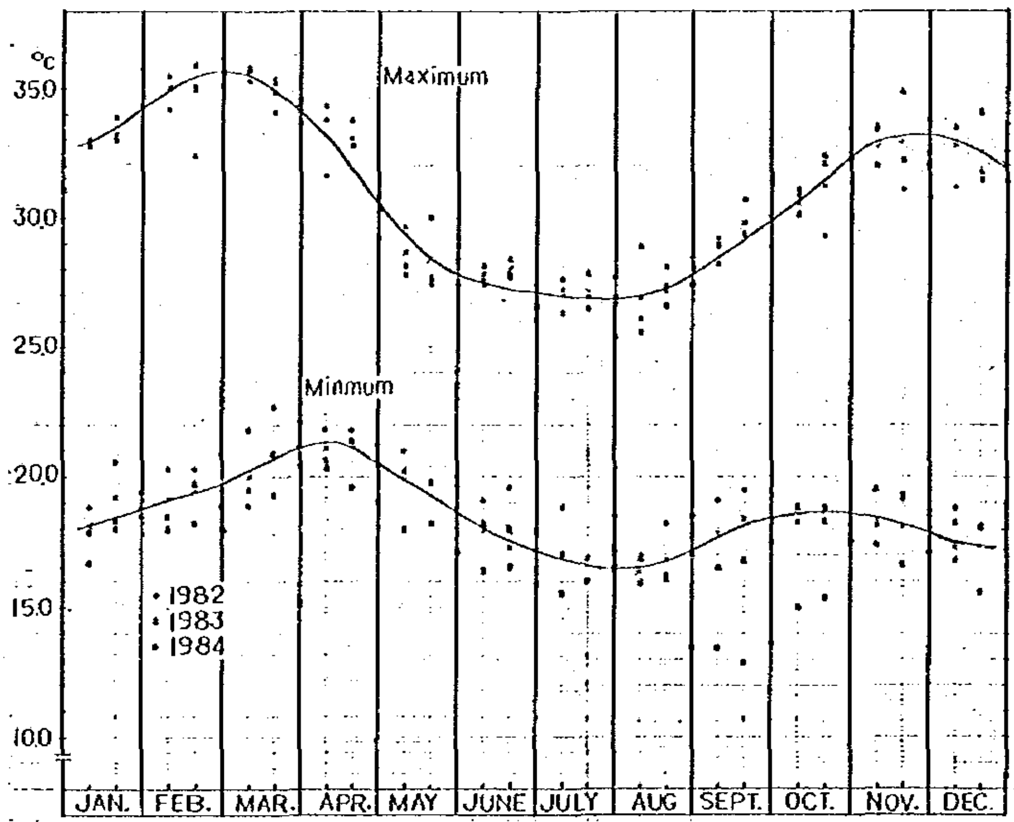
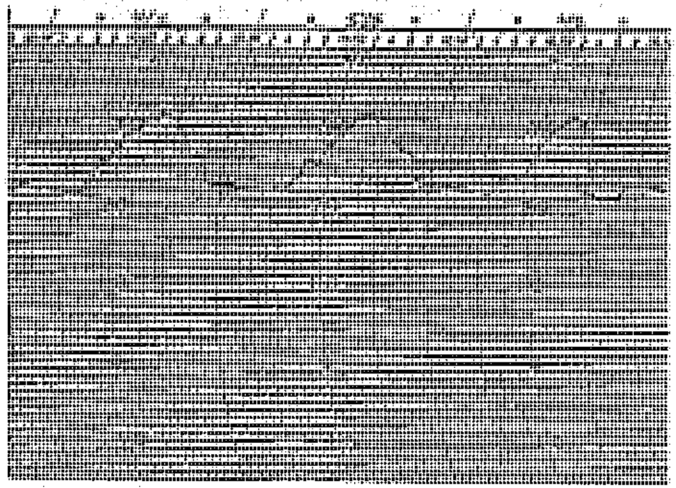


FIG.- 19

Daily temperature pattern on 4 April to 6 April 1985



Daily temperature pattern on 6 June to 8 June 1985

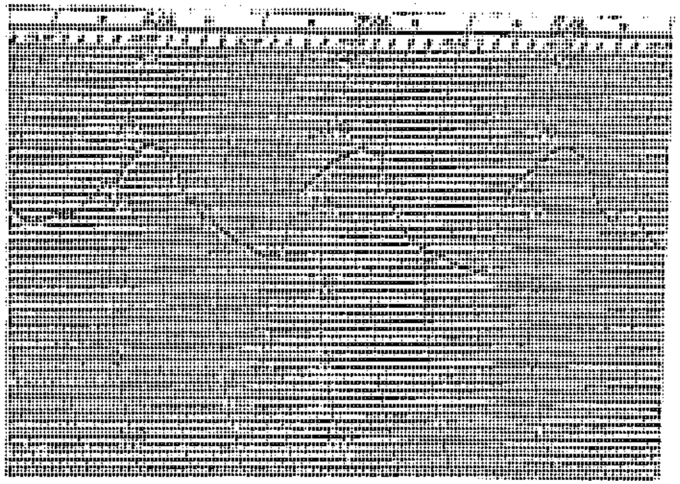


FIG.- 20

Nos. of days which minimum temperature is below 17°C for every 10 days.

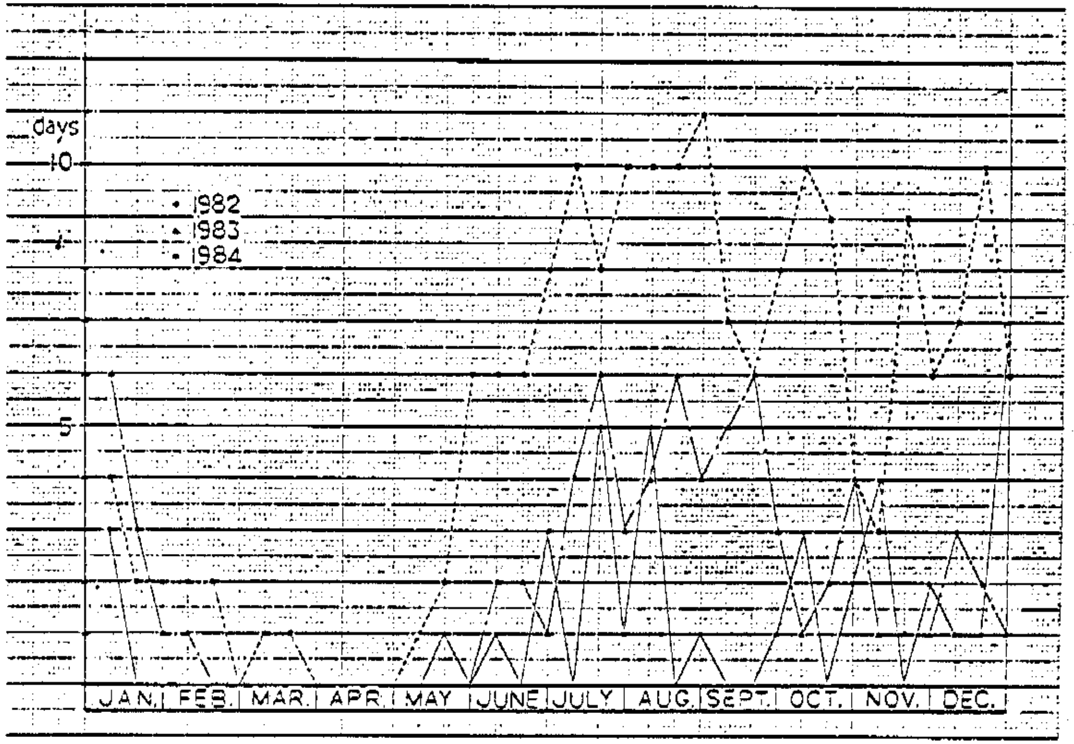


FIG.-21

Monthly precipitation pattern at Chekereni

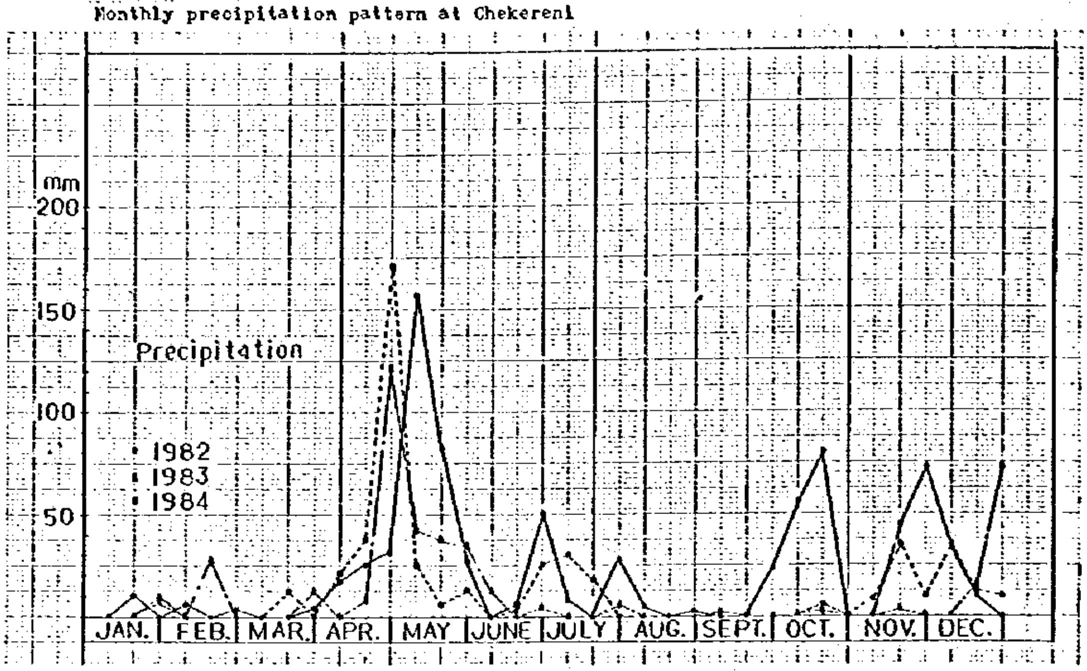
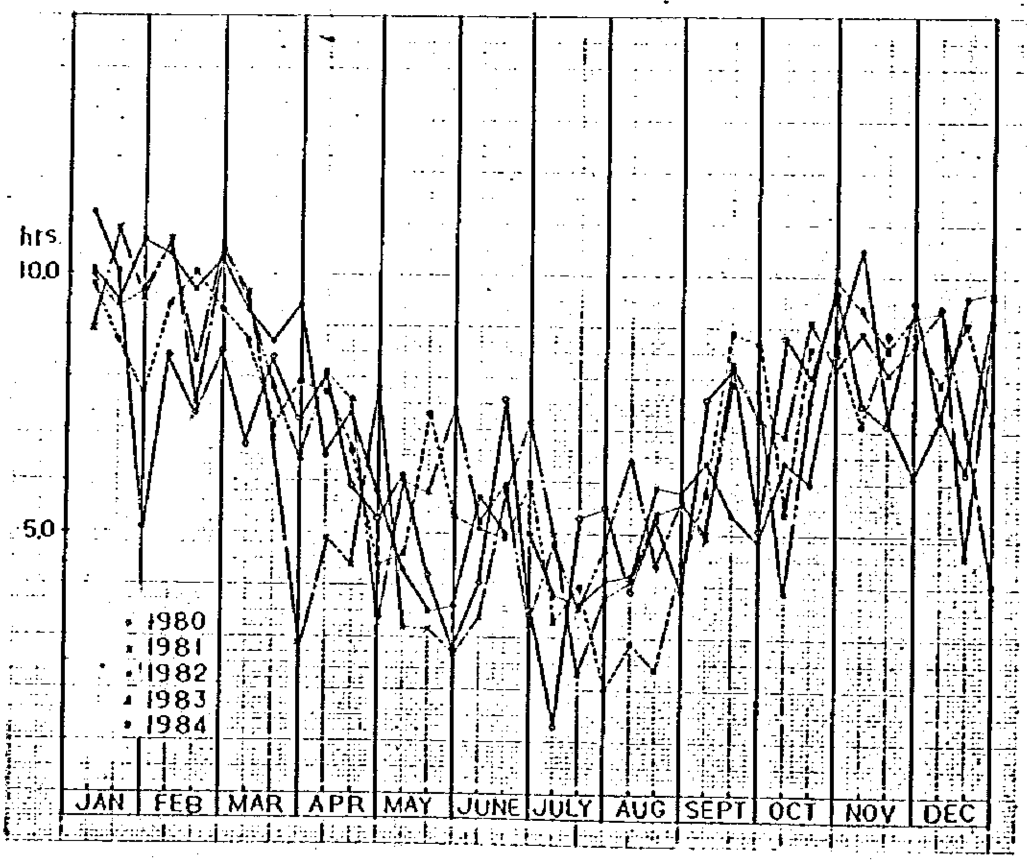


FIG.-22

Monthly sunshine hour at Moshi meteorological station



添付書類－10
Verification Trial 2 - 1

Exploratory observation

Objectives:

To compare two different methods of transplanting from agronimical and economic aspects and to investigate grain productivity of variety.

Variety:

IR - 8

Plot size:

27.0 m x 38.0 m(1026 m^2) per transplanting method
Plot D-8 was splited into subplots of 1026 m^2. Remaining area of the plot was for nursery.

Cultivation practices:

Fertilizer: Nitrogen 150 kg N/ha
Phosphorus 80 kg P_2O_5/ha

The rate of fertilizer application was increased from the year of 1985 to investigate grain yield at higher fertilizer rate. 30 % of nitrogen and 100 % of phosphorus were applied at the time of puddling. Remaining nitrogen was applied at tillering and panicle initiation stages.

Sowing date:

15 Jan. 1985(line transplanting)
11 Jan. 1985(broadcasting method)

Transplanting date:

15 Feb. 1985(line transplanting)
13 Feb. 1985(broadcasting method)

Harvesting date:

18 June 1985

Insect control:

Diazinon 40E, 1/1000 solution was sprayed to control stem borer at nursery satge and at the time of 1st nitrogen top-dressing. No insect damage was observed in the plot.

Weed control:

Weed control was carried out properly by hand. No herbicide was sprayed. No weed infestation was observed in the plot.

Seedling raising for broadcasting method:

Specially designed plastic tray for broadcasting method was used to grow seedlings. 578 numbers of soil cubes with 1 - 2 seedlings were obtained from one tray. 4 lit. of soil was filled in the tray and pressed to make hole for sowing in each room of the tray. 8 kg of seeds were sown in a tray. After sowing, seeds were covered by soil and irrigated carefully. To obtain 25 hills/m^2 of density in the main plot 43 Nos. of trays were prepared. 4 days after sowing, trays were taken to nursery which was prepared in the field. Seedlings were kept for about 30 days in nursery. Water management and insect control were done same as ordinal method.

Density:

20 cm x 20 cm(25.0 hills/m^2) for line transplanting
25.0 hills/m^2 for broadcasting method adjusted by the number of trays.

Summary table:

1. Line transplanting:

1.	Sowing date	15 Jan. 1985
2.	Transplanting date	15 Feb. 1985
3.	Max. tillering	26 March 1985
4.	Effective tillering	23 April 1985
5.	Panicle initiation	---
6.	Heading	14 May 1985
7.	Maturity	13 June 1985
8.	Effective tiller	64.0 %
9.	Maturity days	149 days
10.	Panicles/hill	12.8
11.	Spikelets/panicle	95.4
12.	Panicles/m^2	268.8
13.	Spikelets/m^2	25.63 x 10^3
14.	Ripening ratio	82.4 %
15.	1000 grains weight	29.5
16.	Grain/total production	50.5 %
17.	Grain yield/plot	709.5 kg
18.	Grain yield/ha	6125 kg

2. Broadcasting method:

1. Sowing date	11 Jan. 1985
2. Transplanting date	13 Feb. 1985
3. Max. tillering	26 March 1985
4. Effective tillering	23 April 1985
5. Panicle initiation	---
6. Heading	8 May 1985
7. Maturity	6 June 1985
8. Effective tiller	85.0 %
9. Maturity days	146 days
10. Panicles/hill	21.6
11. Spikelets/panicle	99.1
12. Panicles/m^2	410.4
13. Spikelets/m^2	40.69×10^3
14. Ripening ratio	77.4 %
15. 1000 grains weight	29.9 g
16. Grain/total production	50.4 %
17. Grain yield/plot	807.5 kg
18. Grain yield/ha	7053 kg

Remarks:

Different growth of rice plant was observed between two methods. In broadcasting method, quick recovery of seedling was observed after transplanting. Approximately 4 - 5 days after transplanting, broadcasted seedlings were well established and erected. Subplot for broadcasting mehtod was splited into 6 plots by sisal rope so that proper plant population can be obtained. However it seemed that several practices of throwing seedlings was necessary to obtain proper density in main field.

Max. tillering of both methods was observed on 25 - 26 March. After max. tillering stage, number of tillers per hill of both methods was reduced gradually, however reduction was more distinct in line transplanting.

Heading initiation of ordinal method(transplanting in line by hand) was observed on 11 May and approximately 5 days earlier than ordinal method, heading initiation of broadcasting method was observed. Heading date of broadcasting method was also approximately 5 days earlier than ordinal method. Difference in maturity days was 7 days. The different effect of transplanting methods on grain yield was observed.

Panicle production of broadcasting method was higher than that of ordinal method. It might be due to less injury of root during transplanting and also quick recovery of broadcasting method. As a result of higher panicle production in broadcasting method, number of panicles per 1 m^2 was also higher even number of hills harveted/m^2 was lower than that of ordinal method. The number of hills/m^2 was measured in 6 spots of both plots. Very large variation in plant population was observed in broadcasting method. It was caused by uneven distribution of seedlingsduring transplanting.

Number of spikelets per panicle was almost samr but number of spikelets/m^2 of broadcasting method was higher than that of ordinal method. High production of spikelets/m^2 of broadcasting seemed to be due to high panicle production. Yield difference of 900 kg/ha was observed between two methods.

Man·hour required for transplanting was measured for both methods. In ordinal method, it took 6 hours to transplant including uprooting in 0.1 ha with 10 labours. In case of broadcasting method, it took 3 hours with 6 labours.

Broadcasting method could be very easy, quick and less in cost of transplanting however it will be difficult to obtain proper plant population. There is probability of high yielding in broadcasting method. Larger number of panicles/m^2 can be expected because of quick recovery of seedlings. But weed control can be a limiting factor for broadcasting method. In this trial, serious weed infestation was not observed because proper weeding was carried out and water level in the field was kept. But serious weed infestation was common in farmer field.

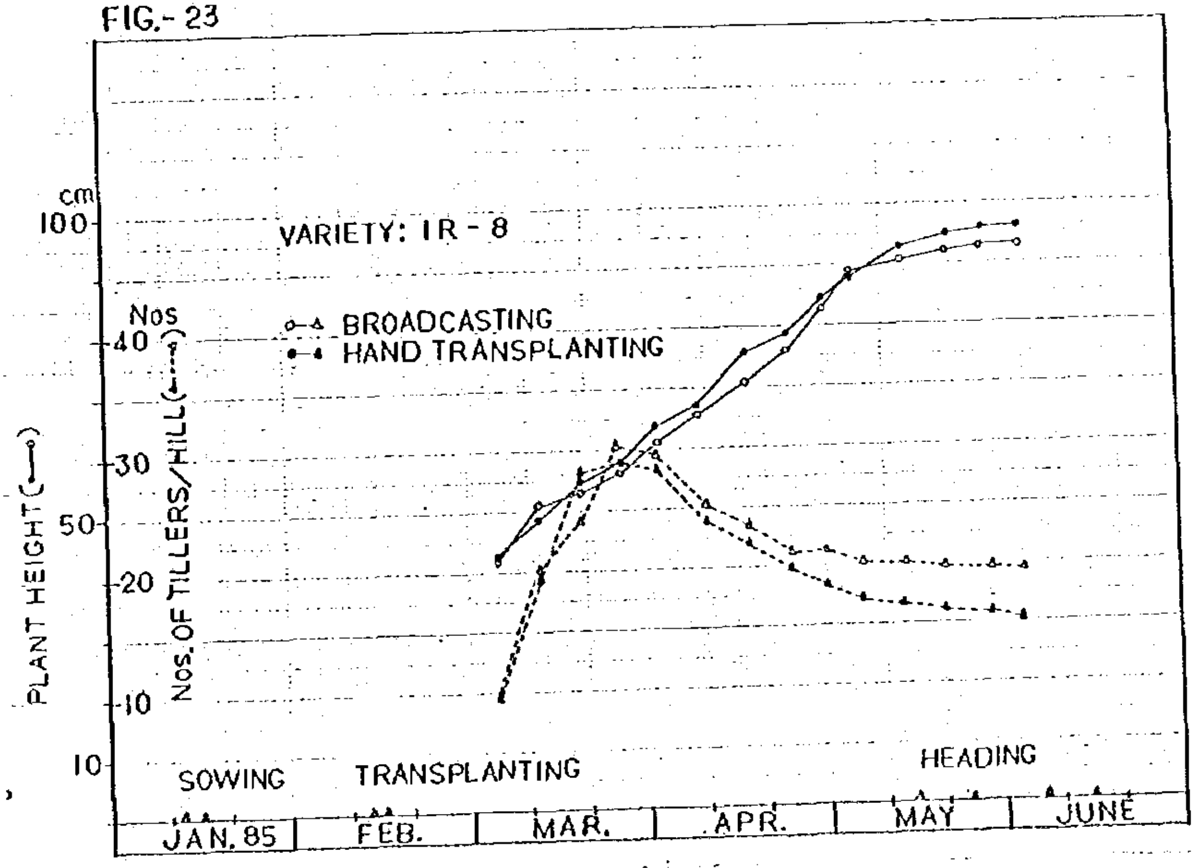
It was observed that there was probability of high yielding in broadcasting method. But there are many factors to be investigated. Weed control, even distribution of seedling and lodging are to be investigated in experimental plot so that the effect of broadcasting method on grain yield and other factors can be nalized statistically.

TABLE-7

	Ordinal method	Broadcasting method
Grain yield	6125 kg/ha	7053 kg/ha
Nos. of spikelets per panicle	95.4	99.1
Nos. of panicles per hill	12.8	21.6
Ripening ratio	82.4 %	77.4 %
1000 grain weight	29.5 g	29.9 g
Nos. of panicles per 1 m2	268.8	410.4
Nos. of spikelets per 1 m2	25.63 x10^3	40.69 x10^3
Grain/total production	50.5 %	50.4 %
Nos. of hills per 1 m^2(harvested)	21.0	19.0
M.H.* required for transplanting	60/0.1 ha	18/0.1 ha

Required Man x Hours for up-rooting seedlings and transplanting was measured to compare different transplanting mthods.

FIG.- 23



添付書類－11
Verificarion Trial 2-2

Exploratory observation

Objectives:

To observe the effect of irrigation interval on grain production of rice and also to examine varietal characteristics of Affa Mwanza in different growing season.

Variety:

Affa Mwanza

Plot size:

26.0 m x 31.5 m(819 m^2) for each irrigation interval

Plot D-7 of 27.0 m x 97.0 m was splited into 3 sub plots of 819 $m^2$by small alleys.

Treatment:

irrigation intervals:

1. 0 day interval
2. 4 days interval
3. 7 days interval

20 mm/day of irrigation water was supplied to each subplot. For 0 day interval, 20 mm of water was supplied every day. For 4 days interval treatment, 80 mm of water was supplied every 4 days and 140 mm of water for 7 days interval treatment.

Water stand of each subplot was very stable. Even in 7 days interval treatment, field was never dried. Temporary irrigation canal was constructed in the field so that irrigation water can be supplied to 3 subplots.

3 different irrigation intervals were compared without any replication. The trial was conducted as exploratory observation plot. 3 subplots were splited by small alley to avoid water movement between two adjacent plots.

Cultivation practices:

Fertilizer:	Nitrogen	75 kg N/ha
	Phosphorus	40 kg P_2O_5/ha

30 % of total amount of nitrogen and 100 % of phosphorus were applied at the time of puddling. Remaining 70 % of nitrogen was applied at tillering and panicle initiation stages.

Sowing date:

17 Jan. 1985

Transplanting date:

21 Feb. 1985

Harvesting date:

12 June 1985

Insect control:

Diazinon 40E, 1/1000 solution was sprayed to control stem-borer at nursery stage ans at the time of 1st nitrogen top-dressing. No insect damage was observed.

Weed control:

Weed control was carried out properly by hand. No hericide was sprayed and weed infestation was not observed.

Summary Table:

1.	Sowing date	17 Jan. 1985
2.	Transplanting date	21 Feb. 1985
3.	Max. tillering	2 April 1985
4.	Effective tillering	17 April 1985
5.	Panicle initiation	24 April 1985
6.	Heading	9 May 1985
7.	Maturity	12 June 1985
8.	Effective tiller	--- *
9.	Maturity days	152 days
10.	Panicles/hill	---
11.	Spikelets/panicle	---
12.	Panicles/m^2	---
13.	Spikelets/m2	---
14.	Ripening ratio	---
15.	1000 grains weight	---
16.	Grain/total production	---
17.	grain yield/plot	---
18.	Grain yield/ha	---

* Results of yield component analysis are presented in Table-1. Heading initiation was observed on 2 may 1985 and heading was completed on 16 May 1985.

Plant growth of Affa Mwanza from 12 March to 28 May was presented in Fig.-1.

Remarks:

The highest grain yield was obtained in treatment-3 where water was supplied every 7 days. Grain yield of treatment-2 was almost same as that of treatment-1. However grain yield of 0 day intervalplot was quite low as compared to other treatment. Grain yield of treatment-1 was almost 55 % of that of treatment-3 where water was supplied every 7 days.

Panicle production/m^2 of treatment-3 was the highest while that of treatment-1 and 2 was almost same. Spikelets/panicle of treatment-3 was the highest among 3 treatments. Number of spikelets per panicle of treatment-2 was almost same as that of treatment-3. The lowest spikelet production was observed in treatment-1. Due to low production of panicle/hill and spikelets/panicle of treatment-1,spikelets production/m^2 was the lowest among 3 treatments. In case of treatment-2, panicles/hill was same as treatment-1 but spikelets/panicle was higher than treatment-1. Eventually spikelet production/m^2 of treatment-2 was higher than treatment-1.

Larger difference of ripening ratio was not observed among 3 treatments. The lowest grain weight was observed in treatment -1. The highest grain weight of 28.? g was observed in treatment-3.

Causes of yield difference among 3 treatments might be irrigation interval. Nitrogen movement due to irrigation water can not be a reason of yield difference because borders were constructed between two adjacent plots so that irrigation water can not be overflooded. Total amount of water supplied to each plot was measured by irrigation section. Total amount of water supplied was almost same. Water stand of 3 plots was stable and plots were always flooded even in 7 days interval plot.

During growing period, temperature of irrigation water was measured and variation in water temperature was observed. The highest temperature was aroud 25.5 - 26.0°C and the lowest was 23.0 - 23.5°C. These were temperature measured at the entrance to the field everyday at 9:00 am. But water temperature in the field was not measured. Water temperature could be a reason of grain yield difference. Optimum temperature at several growth stages are 30 - 35°C(recovery stage), 32 - 34°C(tillering stage), and 28 - 30 °C(panicle initiation to ripening). In treatment-1, 20 mm of water was supplied everyday while 140 mm of water was supplied every 7 days in treatment-3. It might be possible that water temperature in the plot of treatment-3 was higher than that of treatment-1. Because water in treatment-3 was kept for 7 days in the plot and water stand was stable, while irrigation water was supplied every day in treatment-1. Water temperature in the field was not measured so that it was difficult to mention that water temperature caused grain yield difference of 3 treatments. However, considering optimum temperature during growin stage, temperature of irrigation water fell after transplanting and reached around 25.5 °C at tillering stage and fell to 24.8 °C when heading initiation was observed. The same tendency of air temperature was also observed. Water temperature in the plot can be a reason of difference in grain yield.

Same experiment of irrigation method should be conducted under proper experimental design(split-plot) with replications so that the effect of irrigation interval on grain yield can be analized statistically. At the same time, water temperature in the field is also to be measured every day so that the change of water temperature of different treatments and yield components can be compared.

TABLE- 8

	0 day interval	4 days interval	7 days interval
Grain yield	2534 kg/ha	4416 kg/ha	4608 kg/ha
Nos. of panicles per hill	11.0	11.6	14.7
Nos. of spikelets per panicle	78.9	87.4	89.3
Nos. of panicles per 1 m^2	225.5	237.8	301.4
Nos. of spikelets per 1 m^2	17.80 $x10^3$	20.78 $x10^3$	26.90 $x10^3$
Ripening ratio	82.5 %	87.4 %	89.4 %
1000 grain weight	26.6g	27.9g	28.2g
Grain/total production	39.5 %	42.5 %	42.9 %
Total duty of water	1984.2 m^3	1719.0 m^3	1797.8 m^3

Total duty of water: Total amount of water supplied to each plot for 105 days of irrigation

FIG.-24

IRRIGATION WATER TEMPERATURE RECORD AT TRIAL FARM

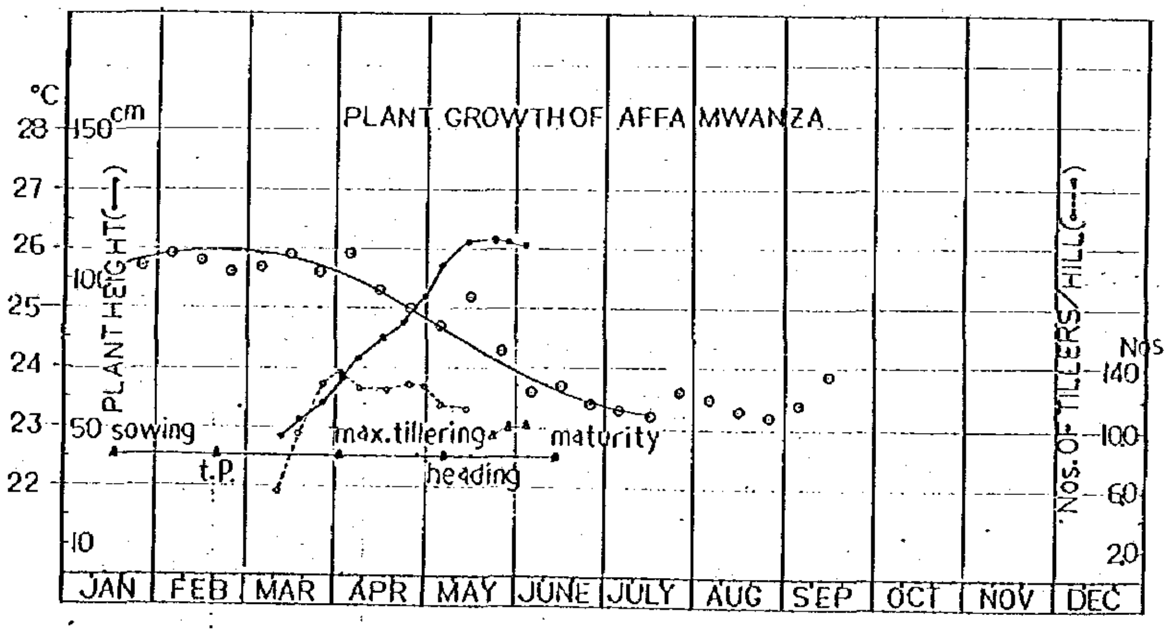
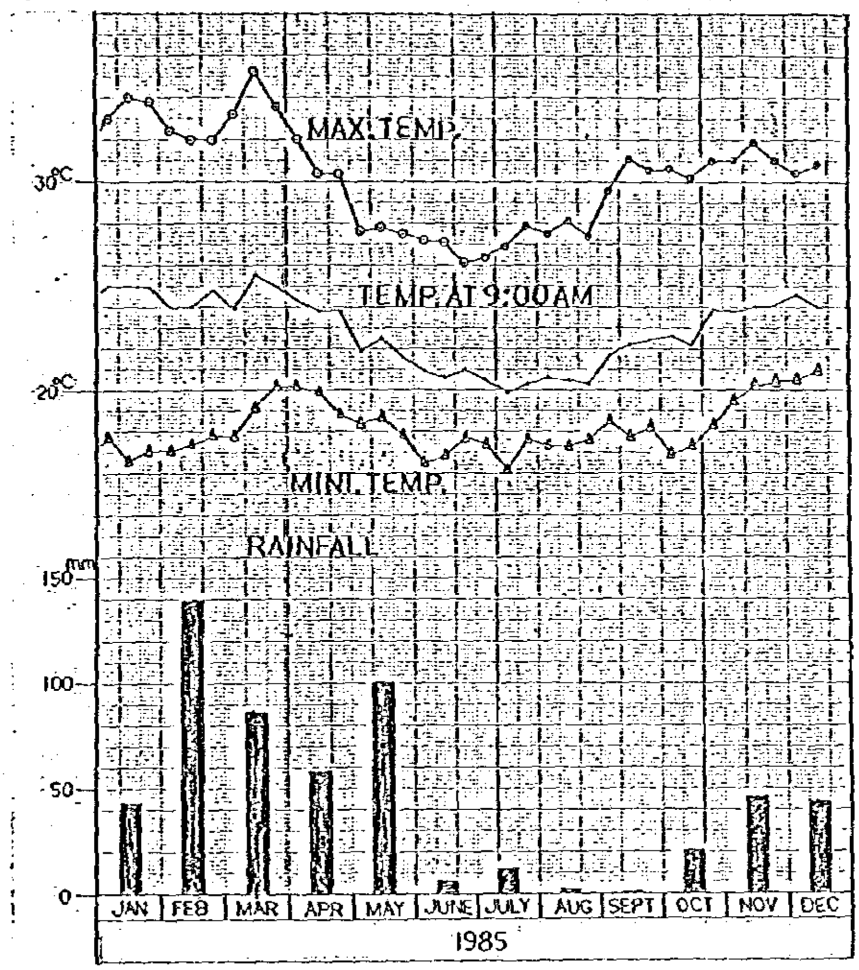


FIG. - 25

Temperature and rainfall measurment at Chekereni



添付書類－12
Verification Trial 3－1

Variety investigation

Objectives:

To investigate varietal characteristics of Affa Mwanza and to verify grain productivity.

Variety:

Affa Mwanza

Affa Mwanza was selected for investigation trial because other variety was not available. And Affa Mwanza was one of the common variety cultivated in Tanzania. For the begining of rice cultivation in the trial farm, Affa mwanza was cultivated for uniform cultivation.

Plot size:

87.0 m x 27.0 m(2349 m^2) in D-3

Cultivation practices:

Fertilizer: Nitrogen 75 kg N/ha
Phosphorus 40 kg P_2O_5/ha

50 % of total amount of nitrogen and 100 % of phosphorus were applied at the time of puddling. Remaining 50 % of nitrogen was applied at tillering and panicle initiation stages.

Density:

20 cm x 30 cm(16.7 hills/m^2)
3 seedlings/hill

Sowing date:

3 Sept. 1982

Transplanting date:

5 Nov. 1982

Harvesting date:

25 Feb. 1983

Insect control:

Diazinon 40E 1/1000 solution was sprayed to control stem borer at nursery and tillering stages,however serious insect damage was not observed.

Weed control:

Weeds were controled by hand properly. No herbicide was was sprayed and weed infestation was not observed.

Grain yield:

No grain yield was obtained from the plot because rice plants were seriously damaged by quelea quelea birds.

Remarks:

During heading to maturity, high concentration of quelea quelea birds was observed in the plot. More than 90% of whole plot was damamged by birds. Almost all grains on panicles were empty and destroyed at milk ripe stage. To protect rice plants from birds, 1. bird scaring by labours, 2. explosive gun, 3. scare crow installation, 4. flash tapes and flash panels which create strange sound and reflecting light were tried, however any means of protection was not effective.

High concentration of quelea quelea birds was observed early in the morning and late evening before sunset. Variation of quelea concentration was observed. When rice or cereal crops were cultivated in other places nearby, less number of quelea birds was observed. From the verification trial of Affa Mwanza, the importance of bird control was realized. Different methods for scaring quelea quelea should be investigated otherwise quelea damage could be a limiting factor of rice cultivation.

Verification Trial 3-2

Variety investigation

Objectives:

To investigate grain productivity of IR - 8 and also to provide field practices for trainees from 4 villages.

Variety:

IR - 8

Plot size:

27.0 m x 97.0 m(2619 m^2) in plot D-7

Plot was splited into 4 subplots for a group of trainees from same village. 22 farmers from 4 villages and 6 extension agents from 3 districts were participants for the 1st- training course.

Cultivation practices:

Fertilizer:	Nitrogen	100 kg N/ha
	Phosphorus	40 kg P_2O_5/ha

50 % of total amount of nitrogen and 100 % of phosphorus were applied at the time of puddling. Remaining nitrogen was applied at tillering and panicle initiation stages.

Density:

20 cm x 30 cm 16.7 hills/m^2
3 seedlings/hill

Sowing date:

11 Feb. 1983

Transplanting date:

8 March 1983

Harvesting date:

14 July 1983

Insect control:

Diazinon 40E 1/1000 solution was sprayed in nursery and at the time of 1st topdressing for the prevention of stem borer. Stem borer damage was not observed.

Weed control:

Weeds were controled properly by hand. No herbicide was sprayed. As water stand in the plot was stable, weed infestation was not observed.

Grain yield:

Subplot	kg/plot	kg/ha
1.	375	5789
2.	392	6049
3.	424	6543
4.	303	4676
X	373.5	5764

Area of subplot: 24.0 m x 27.0 m(648 m^2)

Yield variation among 4 subplots was observed. Grain yield was obtained after harvesting whole area of subplot. Sample analysis was not carried out.

Remarks:

Maturity of IR - 8 was not completed before the training course was closed. Maturity was observed on 12 July 1983. From the field observeation, it was observed that panicle production was not very high. The reason why panicle production of IR -8 was low was not known because sample analysis was not carried out. Variety verification at higher density should be tried to investigate productivity of panicle per unit area and grain yield.

Verification Trial 3-3

Variety investigation

Objectives:

To observe the possibility of bean cultivation between two crops of rice and also to examine the residual effect of bean cultivation on rice cultivation.

Variety:

Rice	IR -8
Bean	Maharage Selian rounder
	Soya bean ST - 5

Plot Size:

27.0 m x 97.0 m(2619 m^2) in plot D-5

Plot D-5 was splited into 3 subplots of 31.5 m x 27.0 m for beans cultivation. Maharage and soya bean were cultivated in subplot separately and one subplot was left without bean.

Cultivation practices:

Bean cultivation:

After harvesting variety experiment, the field was ploved by tractor and furrows of 70 cm apart were prepared for irrigation. Sowing of beans was completed on 1 Dec. 1983. No fertilizer was applied. Density for Maharage and soya bean was 70cm row to row and 30 cm hill to hill.

Rice cultivation:

Fertilizer:	Nitrogen	100 kg N/ha
	Phosphorus	40 kg P_2O_5/ha

50 % of nitrogen and 100 % of phosphorus were applied at the time of puddling. Remaining nitrogen was applied at tillering and panicle initiation stages.

Density:

20 cm x 30 cm, 16.7 hills/m^2
3 seedlinga/hill

Sowing date:

4 March 1983

Transplanting date:

11 April 1983

Harvesting date:

13 July 1983

Insect control:

Diazinon 40E 1/1000 solution was sprayed in nursery and at the time of 1st topdressing to control stem borer.

Weed control:

Weeds were controlled properly by hand. No herbicide was sprayed and weed infestation in the field was not observed.

Grain yield:

Rice	771 kg/ha
Bean	no harvest

3.2 kg of soya bean was obtained from the plot.

Remarks:

Beans:

56 days after sowing of Maharage and soya bean, plant growth of maharage was stunted. After repeating furrow irrigation many times, white substance was accumulated on the surface of soil. Soil analysis was done by simple equipment, however accurate reading was not obtained. Later leaves of Maharage were dried and leaf color turned yellow. Eventually no yield of Maharage was obtained.

Same growth tendency of soya bean was observed. Very small yield of 3.2 kg per plot was obtained after selecting inmatured beans. Leaves of soya bean plant were turned yellow.

Causes of the problem observed were not known. Strong and hot wind during Jan. to Feb. might be a cause of high evaporation of soil moisture. Moisture stress and white substance on soil surface might be another cause of problem. Disease also can be a cause of problem.

Rice:

Due to shortage of irrigation weter at late growth stage, grain yield of rice was very low. On 1st July, leaves of rice plant especially upper leaves turned yellow. In some portion of the field, rice plants were dried completely. After heading was completed, flag leaves and upper leaves were dried completely and fertilization was not completed.

Problem of irrigation water was caused by shortage of disel fuel. Water pump was operated by generator because electricity was not available at this time. Enough disel was not supplied because of national problem of Tanzania.

Verification Trial 3 - 4

Variety investigation

Objectives:

To investigate grain productivity of IR - 36 under different crop season. The trial in plot D-3 was also utilized for field practice of 2nd training course.

Variety:

IR - 36

Plot size:

27.0 m x 97.0 m(2619 m^2) in plot D-3

Cultivation practices:

Fertilizer:	Nitrogen	100 kg N/ha
	Phosphorus	40 kg P_2O_5/ha

50 % of nitrogen and 100 % of phsphorus were applied at the time of puddling. Remaining nitrogen was applied at tillering and panicle initiation stages.

Density:

20 cm x 30 cm 16.7 hills/m^2
3 seedlings/hill

Sowing date:

7 Sept. 1983

Transplanting date:

7 Oct. 1983

Harvesting date:

18 Jan. 1984

Insect control:

Diazinon 40E 1/1000 solution was sprayed for prevention of stem borer at nursery and at the time of 1st top-dressing. Stem borer damage was not observed.

Weed control:

Weed control was carried out properly by hand. No herbicide was sprayed and weed infestation was not observed.

Grain yield:

5774 kg/ha

Other informations were collected from sample analysis of 10 plants.

1.	Sowing date	7 Sept. 1983
2.	Transplanting date	7 Oct. 1983
3.	Max. tillering	8 Nov. 1983
4.	Effective tillering	12 Nov. 1983
5.	Panicle initiation	15 Nov. 1983
6.	Heading initiation	29 Nov. 1983
7.	Heading	4 Dec. 1983
8.	Maturity	10 Jan. 1984
9.	Maturity days	123 days
10.	Panicles/hill	18.3
11.	Effectice tiller	60.6 %
12.	Panicles/m^2	305.0
13.	Spikelets/m^2	31.86×10^3
14.	Ripening ratio	89.1 %
15.	Grain yield/plot	1496.5 kg
16.	Moisture content	13.1 %
17.	Grain yield/ha	5774 kg
18.	Spikelets/panicle	102.4
19.	1000 grain weight	20.1 g

Remarks:

At tillering to max. tillering stage, color of leaves turned yellow. The reason of yellowing was not known. Water was drained and field was dried for 4 days, however yellowing of leaf color was not changed.

Plowing was done by rotary plow but plowing depth was very shallow because the field was very hard. Crop residure was not incorporated to soil.

From the field observation, less tillering was observed when 1st top-dressing was applied. Effective tillering percent was also low.

Method of plowing and plowing depth should be examined.

Incorporation of crop residure could be an important factor to inprove soil condition of paddy field.

Time of 1st nitrogen top-dressing also to be examined. Low tillering percent might be due to late top-dressing. Nitrogen top-dressing at max. tillering stage could be a cause of increase in uneffective tillers.

添付書類－16
Verification Trial 3-5

Variety investigation

Objectives:

To investigate grain productivity of IR - 20 and to observe performance of variety in different growing season.

Variety:

IR - 20

Plot size:

27.0 m x 97.0 m(2619 m^2) in plot D-8

Cultivation Practices:

Fertilizer: Nitrogen 100 kg N/ha
Phosphorus 40 kg P_2O_5/ha

50 % of nitrogen and 100 % of phosphorus were applied at the time of puddling. Remaining nitrogen was applied at tillering and panicle initiation stages.

Density:

20 cm x 30 cm, 16.7 hills/m^2
3 seedlings/hill

Sowing date:

21 Sept. 1983

Transplanting date:

21 Oct. 1983

Harvesting date:

8 Feb. 1984

Insect control:

Diazinon 40E, 1/1000 solution was sprayed for prevention of stem borer at nursery stage and at the time of 1st nitrogen top-dressing. Stem borer damage was not observed.

Weed control:

Weed control was carried out properly by hand. No herbicide was sprayed and weed infestation was not observed.

NB. At the time of transplanting, seedlings were transplanted too deep. Recovery stage was delayed and many seedlings were died. Gap filling was completed on 26 Oct. 1983.

Summary table:

1.	Sowing date	21 Sept. 1983
2.	Transplanting date	21 Oct. 1983
3.	Max. tillering	28 Nov. 1983
4.	Effective tillering	6 Dec. 1983
5.	Panicle initiation	16 Dec. 1983
6.	Heading initiation	26 Dec. 1983
7.	Heading	10 Jan. 1984
8.	Maturity	3 Feb. 1984
9.	Maturity days	134 days
10.	Panicles/hill	23.6
11.	Effecitve tiller	77.8 %
12.	Spikelets/panicle	117.1
13.	Panicles/m^2	417.7
14.	Spikelets/m^2	46.98×10^3
15.	Ripening ratio	89.7 %
16.	1000 grain weight	20.0 g
17.	Grain yield/plot	2262.8 kg
18.	Moisture content	17.8 %
19.	Grain yield/ha	8258 kg

Remarks:

During tillering stage to max. tillering stage, yellowing of upper leaves was observed. After max. tillering stage, field was left without irrigation and dried for 5 days. Irrigation was started again on 6 Dec. 1983. However leaf color was not improved very nuch. After 2nd nitrogen top-dressing leaf color was improved a bit.

Relatively high yield was obtained from the plot. Major cause of high yield seemed to be large number of spikelets production per unit area. High panicle production might be another reason of high yield.

Plot D-8 was used for sowing time experiment so that field was flooded for long time. Tremendous weed infestation was observed in the field. To control weed field was ploved deeply by subsoiler. High production of grain might be due to deep plowing and incorporation of weed and crop residure.

添付書類－17
Verification Trial 3 - 6

Variety investigation

Objectives:

To observe performance of IR - 42 in different growing season and to examine grain productivity of the variety.

Variety:

IR - 42

Plot size:

27.0 m x 97.0 m(2619 m^2) in plot D-6

Cultivation practices:

Fertilizer: Nitrogen 100 kg N/ha
Phosphorus 40 kg P_2O_5/ha

30 % of total amount of nitrogen and 100 % of phosphorus were applied at the time of puddling. Remaining 70 % of nitrogen was applied at tillering and panicle initiation stages.
From this year, nitrogen application method was changed to 30 % - 35 % - 35 % instead of 50 % - 25 % - 25 % to observe the effect of nitrogen top-dressing on grain yield.

Density:

20 cm x 30 cm, 16.7 hills/m^2
3 seedlings/hill

Sowing date:

13 Jan. 1984

Transplanting date:

16 Feb. 1984

Harvesting date:

15 June 1984

Insect control:

Diazinon 40E, 1/1000 solution was sprayed for prevention of stem borer at nursery stage and at the time of 1st nitrogen top-dressing. Stem borer damage was not observed.

Weed contro:

Weed control was carried out properly by hand. No herbicide was sprayed, however weed infestation was not observed.

Summary table:

1.	Sowing date	13 Jan. 1984
2.	Transplanting date	16 Feb. 1984
3.	Max. tillering	10 April 1984
4.	Effective tillering	---
5.	Panicle initiation	17 April 1984
6.	Heading	24 April 1984
7.	Maturity	5 June 1984
8.	Maturity days	139 days
9.	Effective tiller	84.5 %
10.	Panicles/hill	24.0
11.	Spikelets/panicle	96.0
12.	Panicles/m^2	400.0
13.	Spikelets/m^2	38.37×10^3
14.	Ripening ratio	80.9 %
15.	1000 grains weight	20.1 g
16.	Grain/total production	53.0 %
17.	Grain yield/plot	1336 kg
18.	Grain yield/ha	4718 kg

Plant growth:

Date	plant height	tillers/hill
21 Feb. 1984	20.2 cm	3.6
29 Feb. 1984	30.2	7.0
6 March 1984	38.4	14.2
13 March 1984	44.0	26.8
20 March 1984	48.9	34.2
27 March 1984	55.2	36.0
3 April 1984	55.3	36.4
10 April 1984	62.2	37.0
17 April 1984	69.3	30.8
24 April 1984	-	-
4 May 1984	80.1	29.6

Harvest: 16 June 1984

Remarks:

Heading initiation was observed on 19 April 1984 and it was completed on 30 April 1984. Heading was not uniform even at initiation and 50 % heading. Irregular heading might be varietal characteristics of IR - 42. Less panicle production was observed in the field at ripening stage. 1000 grain weight seemed to be very low while number of spikelets was not very high. The cause of low grain weight should be analized.

添付書類－18
Verification Trial 3 - 7

Variety investigation

Objectives:

To observe performance of IR -54 in different growing season and to investigate grain productivity.

Variety:

IR -54

Plot size:

27.0 m x 97.0 m(2619 m^2) in plot D-4

Cultivation practices:

Fertilizer:	Nitrogen	100 kg N/ha
	Phosphorus	40 kg P_2O_5/ha

30 % of nitrogen and 100 % of phosphorus were applied at the time of puddling. Remaining 70 % of nitrogen was applied at tillering and panicle initiation stages.

Density:

20 cm x 30 cm(16.7 hills/m^2)
3 seedlings/hill

Sowing date:

10 Feb. 1984

Transplanting date:

13 March 1984

Harvesting date:

30 June 1984

Insect control:

Diazinon 40E, 1/1000 solution was sprayed to control stem borer at nursery stage and at the time of 1st nitrogen top-dressing. However white head of 13 Nos. were observed in 132 panicles of sample hills.

Weed control:

Weed control was carried out properly by hand. No herbicide was sprayed however weed infestation in the plot was not observed.

Summary table:

1.	Sowing date	10 Feb. 1984
2.	Transplanting date	13 March 1984
3.	Max. tillering	24 April 1984
4.	Effecitve tillering	22 May 1984
5.	Panicle initiation	4 May 1984
6.	Heading	13 May 1984
7.	Maturity	22 June 1984
8.	Effective tiller	82.1 %
9.	Maturity days	132 days
10.	Panicles/hill	22.0
11.	Spikelets/panicle	119.5
12.	Panicles/m^2	366.7
13.	Spikelets/panicle	43.82×10^3
14.	Ripening ratio	82.4 %
15.	1000 grains weight	24.9 g
16.	Grain/total production	51.0 %
17.	Grain yield/plot	1298 kg
18.	Grain yield/ha	4598 kg

Plant growth:

Date	plant height	tillers/hill
27 March 1984	37.2 cm	7.4
3 April 1984	44.6	17.4
10 April 1984	51.9	26.4
17 April 1984	60.8	28.6
24 April 1984	63.6	29.4
4 May 1984	68.2	26.4
16 May 1984	78.3	24.8
22 May 1984	84.0	20.4
30 May 1984	83.7	19.2
6 June 1984	84.4	19.6
12 June 1984	84.4	19.2
19 June 1984	84.1	19.2

Harvest: 10 July 1984

Remarks:

Heading initiation was observed on 8 May 1984 and heading was completed on 21 May. Heading of IR - 54 was very uniform.

Harvesting was done by combine harvester on 10 July. When harvest was started, grain on panicle was overmatured. Very high shattering of IR -54 resulted into high percentage of grain loss. Combine harvester beat panicles when they were sent to threshing drum after cutting by machine. After harvesting was completed, many grains dropped in the field. Sample of shattered grains were collected from 6 spots of 60 cm^2 in the plot. Estimated grain loss was 338 g/m^2 and 13647 grains/m^2 which was equivalent to 18 % of grain loss during harvest.

After sample plants were collected from the field, 13 Nos. of " white head " was observed from 132 sample panicles. It was not known wheather IR -54 was susceptible to stem borer or not.

To protect rice plants from quelea quelea birds and to observe the effect of plastic balloons, balloons were installed over the field. Investigation on quelea damage was carried out in the field. 16 spots of 1 m^2 were selected randomly and damaged hills/m^2 and damaged panicles/hill were counted. Estimated quelea damage in the field was less than 10 %. Out of 16 spots, damaged hill was observed in 6 spots. Damage of quelea was presented as follows.

1. 2 hills damaged/20 hills
   2 panicles damaged/18 panicles
   1 panicle damaged/15 panicles
2. 1 hill damaged/17 hills
   2 panicles damaged/18 panicles
3. 6 hills damaged/16 hills
   2 panicles damaged/18 panicles
   3 panicles damaged/24 panicles
   2 panicles damaged/20 panicles
   4 panicles damaged/18 panicles
   6 panicles damaged/22 panicles
   1 panicle damaged/16 panicles
4. 1 hill damaged/16 hills
   4 panicles damaged/24 panicles
5. 2 hills damaged/17 hills
   3 panicles damaged/15 panicles
   1 panicle damaged/10 panicles
6. 3 hills damaged/19 hills
   2 panicles damaged/27 panicles
   3 panicles damaged/21 panicles
   1 panicle damaged/18 panicles

Estimated grain yield from spot harvest was relatively high but actual yield obtained was not much as estimated yield. Grain loss during harvest might be one of reasons. However density and nitrogen rate should be examined in other verification trial. Insect resistance of IR - 54 also should be investigated. White head observed in sample plants might be due to insect resistance of the variety or due to growing season.

Quelea damage could be also a limiting factor. Once quelea birds are not controlled properly during maturity stage, grain loss will be very high. Different control methods should be verified in the field.

Verification Trial 3 - 8

Variety investigation

Objectives:

To observe varietal characteristics of IR -56 in different growing season and to investigate grain productivity of the variety.

Variety:

IR - 56

Plot size:

27.0 m x 97.0 m(2619 m^2) in plot D-5

Cultivation practices:

Fertilizer: Nitrogen 100 kg N/ha
Phosphorus 40 kg P_2O_5/ha

30 % of total amount of nitrogen and 100 % of phosphorus were applied at the time of puddling. Remaining 70 % of nitrogen was applied at tillering and panicle initiation stages.

Density:

20 cm x 30 cm(16.7 hills/m^2)
3 seedlings/hill

Sowing date:

9 March 1984

Transplanting:

13 April 1984

Harvesting date:

25 Aug. 1984

Due to cold injury, maturity and harvest were delayed.

Insect control:

Diazinon 40E, 1/1000 solution was sprayed to control stem borer at nursery stage and at the time of 1st nitrogen top-dressing. Serious attack of stem borer was observed on 17 May 1984.

Weed control:

Weed control was carried out properly by hand. No herbicide was sprayed and weed infestation was not observed.

Summary table:

1.	Sowing date	9 March 1984
2.	Transplanting date	13 April 1984
3.	Max. tillering	16 May 1984
4.	Effective tillering	---
5.	Panicle initiation	---
6.	Heading	16 June 1984
7.	Maturity	---
8.	Effective tiller	54.6 %
9.	Maturity days	---
10.	Panicles/hill	79.3
11.	Spikelets/panicle	51.0
12.	Panicles/m^2	1326.7
13.	Spikelets/m^2	67.54×10^3
14.	Ripening ratio	0.7 %
15.	1000 grains weight	20.5 g
16.	Grain/total production	---
17.	Grain yield/plot	8.0 kg
18.	Grain yield/ha	31.0 kg

Plant growth:

Date	plant height	tillers/hill
4 May 1984	49.6	23.0
16 May 1984	59.5	57.2
22 May 1984	61.2	47.6
30 May 1984	65.1	48.6
6 June 1984	71.7	71.4
12 June 1984	73.1	70.2
19 June 1984	73.2	71.4
26 June 1984	73.9	71.6

Remarks:

Approximately one month after transplanting, stem borer attack was observed and plants stopped growing. Plants seemed to be stunted on 17 May 1984. Heading was initiated on 11 June 1984 and was completed on 22 June. However heading was very irregular and tremendous number of late-emerging panicles from high node of main stem were produced. Panicles were not exserted from the leaf sheath of flag leaf. Black spots on empty spikelets were also observed. After heading was completed, filling of grain was not occured. It was difficult to decide exact date of maturity.

Very abnormal growth of plant was observed. Tremendous number of late panicles were produced even after heading was completed and no filling of grains was observed. Even by pressing milky starch was not found. It seemed that pollination of spikelets did not occur. Finally it was known that low grain yield and abnormal plant growth of IR - 56 were caused by cool temperature injury. Detail of cool temperature injury was also presented in the report prepared by KADC paddy section.

添付書類－20
Verification Trial 3-9

Variety investigation

Objectives:

To observe varietal characteristics of Affa Mwanza in different growing season and to investigate grain productivity of the variety.

Variety:

Affa Mwanza

Plot size:

27.0 m x 97.0 m(2619 m^2) in plot D-2

Cultivation practices:

Fertilizer:	Nitrogen	75 kg N/ha
	Phosphorus	40 kg P_2O_5/ha

30 % of total amount of nitrogen and 100 % of phosphorus were applied at the time of puddling. Remaining 70 % of nitrogen was applied at tillering and panicle initiation stages.

Density:

20 cm x 30 cm(16.7 hills/m^2)
3 seedlings/hill

Sowing date:

13 April 1984

Transplanting date:

14 May 1984

Harvesting date:

5 Oct. 1984

Insect control:

Diazinon 40E, 1/1000 solution was sprayed to control stem borer at nursery stage and at the time of 1st nitrogen top-dressing. Serious insect damage was not observed.

Weed control:

Weed control was carried out properly by hand. No herbicide was sprayed and weed infestation was not observed.

Summary table:

1.	Sowing date	13 April 1984
2.	Transplanting date	14 May 1984
3.	Max. tillering	23 July 1984
4.	Effective tillering	14 Aug. 1984
5.	Panicle initiation	23 July 1984
6.	Heading	19 Aug. 1984
7.	Maturity	25 Sept. 1984
8.	Effective tiller	67.0 %
9.	Maturity days	165 days
10.	Panicles/hill	21.9
11.	Spikelets/panicle	115.9
12.	Panicles/m^2	365.7
13.	Spikelets/m^2	42.39×10^3
14.	Ripening ratio	20.0 %
15.	1000 grain weight	27.0 g
16.	Grain/total production	---
17.	Grain yield/plot	57.0 kg
18.	Grain yield/ha	218 kg

Plant growth:

Date	plant height	tillers/hill
30 May 1984	31.3 cm	3.8
6 June 1984	41.7	7.4
12 June 1984	48.2	11.2
19 June 1984	55.1	17.2
26 June 1984	60.2	27.0
23 July 1984	75.2	31.0
1 Aug. 1984	88.4	31.4
14 Aug. 1984	107.6	28.8
22 Aug. 1984	112.5	31.6
28 Aug. 1984	112.5	33.2
7 Sept. 1984	104.4	33.2
11 Sept. 1984	103.9	33.2
25 Sept. 1984	103.9	37.0
		25.4*

* Number of panicles per hill

Remarks:

Heading initiation was observed on 14 Aug. 1984 and heading was completed on 24 Aug. 1984. Heading of Affa Mwanza was not very much irregular, however late panicles emerged from higher node of main stem were observed. No symptom of cold injury was observed except high percentage of sterelity. Degeneration of panicle tip and whitish frail branches were not observed. Panicles were exserted completely from the sheath of flag leaf. Detail analysis of yield components were presented in the report.

Abnormal plant growth of Affa Mwanza was not observed. Number of tillers per hill was 34.0 and 21.9 Nos. of panicles were produced per hill. Approximately 72 % of total panicles were pollinated. However filled grains per panicle was very small in number. Total spikelets produced from 10 sample plants was 14609 and only 2961 were filled grains. Low grain yield of Affa Mwanza was caused by cool temperature injury, however symptom of cool temperature on Affa Mwanza was different from that on IR - 56.

Verification Trial 3 - 10

Variety investigation

Objectives:

To observe varietal characteristics of RD - 10 and Taiwan glutinous rice in different grwoing season and to examine grain productivity.

Variety:

RD - 10
Sen - glutinous(Taiwan)

Plot size:

27.0 m x 97.0 m(2619 m^2) in plot D-7

Plot D-7 was splited into two subplots for each variety.

Cultural practices:

Fertilizer:	Nitrogen	100 kg N/ha
	Phosphorus	40 kg P_2O_5/ha

30 % of nitrogen and 100 % of phosphorus were applied at the time of puddling. Remaining nitrogen was applied at tillering and panicle initiation stages.

Density:

30 cm x 30 cm
2 seedlings/hill

Due to shortage of seedlings density was changed to 30 cm x 30 cm instead of 20 cm x 30 cm.

Sowing date:

14 June 1984

Transplanting date:

19 July 1984

Harvesting date:

6 Nov. 1984

Insect control:

Diazinon 40E, 1/1000 solution was sprayed to control stem borer at nursery stage and at the time of nitrogen top-dressing. No insect damage was not observed.

Weed control:

Weed control was carried out properly by hand. No herbicide was sprayed but weed infestation was not observed.

Summary Table:

RD - 10:

1.	Sowing date	14 June 1984
2.	Transplanting date	19 July 1984
3.	Max. tillering	28 Aug. 1984
4.	Effective tillering	7 Sept. 1984
5.	Panicle initiation	3 Sept. 1984
6.	Heading	28 Sept. 1984
7.	Maturity	30 Oct. 1984
8.	Effective tiller	61.3 %
9.	Maturity days	138 days
10.	Panicles/hill	22.5
11.	Spikelets/panicle	114.4
12.	Panicles/m^2	249.8
13.	Spikelets/m^2	28.57×10^3
14.	Ripening ratio	---
15.	1000 grains weight	30.2 g
16.	Grain/total production	---
17.	Grain yield/plot	205.3 kg
18.	Grain yield/ha	1618 kg

Plant growth:

Date	Plant height	Tillers/hill
14 Aug. 1984	50.4	6.8
22 Aug. 1984	64.5	14.4
28 Aug. 1984	68.7	22.2
7 Sept. 1984	71.6	18.6
11 Sept. 1984	72.8	19.5
25 Sept. 1984	81.0	11.4

Yield components were calculated by two sample spots. Ripening ratio and grain/total production of sample plant were not obtained because spikelets were seriously damaged by quela quela.

Summary Table:

Sen - glutinous(Taiwan)

1. Sowing date	14 June 1984
2. Transplanting	19 July 1984
3. Max. tillering	7 Sept. 1984
4. Effective tillering	11 Sept. 1984
5. Panicle initiation	18 Sept. 1984
6. Heading	5 Oct. 1984
7. Maturity	5 Nov. 1984
8. Effective tiller	61.5 %
9. Maturity days	144 days
10. Panicles/hill	10.7
11. Spikelets/panicle	105.7
12. Panicles/m^2	118.8
13. Spikelets/m^2	12.56×10^3
14. Ripening ratio	---
15. 1000 grains weight	26.7 g
16. Grain/total production	---
17. Grain yield/plot	400.5 kg
18. Grain yield/ha	3048 kg

Plant growth:

Date	Plant height	Tillers/hill
14 Aug. 1984	51.0	5.2
22 Aug. 1984	65.5	9.8
28 Aug. 1984	69.3	11.4
7 Sept. 1984	75.1	12.6
11 Sept. 1984	76.5	13.2
18 Sept. 1984	77.3	18.3
25 Sept. 1984	78.5	17.8
2 Oct. 1984	87.8	16.8
9 Oct. 1984	96.8	15.6
16 Oct. 1984	95.8	9.6

Remarks:

Both of RD - 10 and Sen - glutinous were seriously damaged by quelea quelea birds. Plastic balloons were installed over the field to observe the effect of balloons on scaring birds. No other means of scaring birds were taken. 8 spots in each variety were selected randomly to investigate damage of quelea quelea on grain yield.

Almost 100 % of quela damage was observed. 100 % of hills per unit area(1 m^2) was damaged by quelea and also 100 % of panicles per hill in the spots was damaged. Only circle of 5 m diameter near plastic balloon was free from bird damage. To compare the bird damage on grain yield, sample hills were collected from two different spots. As shown in sample analysis, less damage of quelea was observed near balloon, however effective area of the balloon was very small. It can be mentioned that plastic balloon alone might not be effective to protect rice plants against quelea birds. As result of serious bird damage, grain yield of two varieties was very low.

RD - 10:

1. from seriously damaged spot

Number of filled grains	2203
Number of unfilled grains	7647
Number of spikelets/panicle	85.7
Number of damaged spikelts	5269
Number of empty spikelets	2378
Damaged spikelets %	68.9
Number of panicles/hill	19.2

2. from near the balloon

Number of filled grains	14587
Number of unfilled grains	7431
Number of spikelets/panicle	143.0
Number of damaged spikelets	342
Number of empty spikelets	7089
Damaged spikelets %	4.6
Number of panicles/hill	25.7

Sen - glutinous:

1. from seriously damaged spot

Number of filled grains	4461
Number of unfilled grains	4821
Number of spikelets/panicle	90.1
Number of damaged spikelets	3055
Number of empty spikelets	1757
Damaged spikelets %	63.5
Number of panicles/hill	10.3

2. from near the balloon

Number of filled grains	10128
Number of unfilled grains	3212
Number of spikelets/panicle	121.3
Number of damaged spikelets	96.0
Number of empty spikelets	3116
Damaged spikelets %	3.0
Number of panicles/hill	11.0

6 samples were collected from two different spots to investigate damage of birds on yield components.

添付書類－22
Verification Trial 3－11

Variety investigation

Objectives:

To observe varietal characteristics of IR – 42 in different growing season and to examine grain productivity.

Variety:

IR – 42

Plot size:

27.0 m x 65.0 m(1755 m^2) in plot D-1.
Variety experiment was also conducted in plot D-1.

Cultivation practices:

Fertilizer: Nitrogen 100 kg N/ha
Phosphorus 40 kg P_2O_5/ha

30 % of total amount of nitrogen and 100 % of phosphorus were applied at the time of puddling. Remaining nitrogen was applied at tillering and panicle initiation stages.

Density:

20 cm x 30 cm(16.7 hills/m^2)
3 seedlings/hill

Sowing date:

13 July 1984

Transplanting date:

23 Aug. 1984

Harvesting date:

21 Dec. 1984

Transplanting was delayed because puddling was not completed due to poor water standing of the plot.

Insect control:

Diazinon 40E, 1/1000 solution was sprayed to control stem borer at nursery stage and at the time of 1st nitrogen top-dressing. No insect damage was observed.

Weed control:

Weeds were controlled properly by hand. No herbicide was sprayed but weed infestation was not observed in the plot.

Summary table:

1.	Sowing date	13 July 1984
2.	Transplanting date	23 Aug. 1984
3.	Max. tillering	30 Oct. 1984
4.	Effective tillering	7 Nov. 1984
5.	Panicle initiation	---
6.	Heading	15 Nov. 1984
7.	Maturity	---
8.	Effective tiller	83.4 %
9.	Maturity days	---
10.	Panicles/hill	16.1
11.	Spikelets/panicle	112.3
12.	Panicles/m^2	268.9
13.	Spikelets/m^2	30.18×10^3
14.	Ripening ratio	42.6 %
15.	1000 grains weight	14.3 g
16.	Grain/total production	27.3 %
17.	Grain yield/plot	34.0 kg
18.	Grain yield/ha	528 kg

Plant growth:

Date	Plant height	Tillers/hill
25 Sept. 1984	41.4	18.6
2 Oct. 1984	43.9	23.2
9 Oct. 1984	45.4	28.6
16 Oct. 1984	45.7	27.2
24 Oct. 1984	45.8	30.8
30 Oct. 1984	50.3	35.0
7 Nov. 1984	56.9	33.8
13 Nov. 1984	58.0	30.8
20 Nov. 1984	61.1	30.6
27 Nov. 1984	61.6	29.4
4 Dec. 1984	61.7	28.2
12 Dec. 1984	61.7	31.4

All panicles including late panicles were counted.

Remarks:

Heading initiation was observed on 6 Nov. 1984 and heading date was 15 Nov. 1984. Heading of IR - 42 was very irregular. Irregular heading might be a varietal characterisitc of IR - 42.

When heading was observed, plot was dried and many rice plants were died. The water pump installed for irrigation in the trial farm was broken due to low voltage. Alternative water supply was provided to irrigate paddy fields. Water stand in plot D-1 was very poor and water supply to D-1 was stopped completely to provide irrigation water to othe plots.

Precise date of maturity was not observed because rice plants in the plot were died before maturity was completed. Due to water stress, grain weight and ripening ratio were reduced tremendously and these were major cause of low yield.

添付書類－23
Verification Trial 3－12

Variety investigation

Objectives:

To observe varietal characteristics of IR -56 in different growing season and to examine productivity of grain. The trial was also utilized for the 3rd training course.

Variety:

IR - 56

Plot size:

27.0 m x 97.0 m(2619 m^2) in plot D-3

Cultivation practices:

Fertilizer: Nitrogen 100 kg N/ha
Phosphorus 40 kg P_2O_5/ha

30 % of nitrogen and 100 % of phosphorus were applied at the time of puddling. Remaining nitrogen was applied at tillering and panicle initiation stages.

Density:

20 cm x 30 cm(16.7 hills/m^2)
3 seedlings/hill

Sowing date:

10 Aug. 1984

Transplanting date:

7 Sept. 1984

Harvesting date:

26 Dec. 1984

Insect control:

Diazinon 40E, 1/1000 solution was sprayed to control stem borer at nursery stage and at the time of 1st nitrogen top-dressing. No insect damage was observed.

Weed control:

Weed control was carried out properly by hand and no herbicide was sprayed.

Summary Table:

1. Sowing date	10 Aug. 1984
2. Transplanting date	7 Sept. 1984
3. Max. tillering	30 Oct. 1984
4. Effective tillering	7 Nov. 1984
5. Panicle initiation	17 Oct. 1984
6. Heading	22 Nov. 1984
7. Maturity	21 Dec. 1984
8. Effective tiller	75.4 %
9. Maturity days	133 days
10. Panicles/hill	21.1
11. Spikelets/panicle	107.2
12. Panicles/m^2	352.4
13. Spikelets/m^2	27.77×10^3
14. Ripening ratio	86.7 %
15. 1000 grains weight	23.1 g
16. Grain/total production	48.0 %
17. Grain yield/plot	758 kg
18. Grain yield/ha	2783 kg

Plant growth:

Date	Plant height	Tillers/hill
25 Sept. 1984	22.9	2.6
2 Oct. 1984	26.7	5.2
9 Oct. 1984	38.4	10.4
16 Oct. 1984	44.4	18.6
24 Oct. 1984	46.0	22.4
30 Oct. 1984	50.9	25.4
7 Nov. 1984	55.3	28.0
13 Nov. 1984	62.3	27.8
20 Nov. 1984	67.3	28.2
27 Nov. 1984	68.4	31.0
4 Dec. 1984	68.7	34.0
12 Dec. 1984	67.9	36.8

Remarks:

Heading initiation was observed on 17 Nov. 1984 and heading was completed on 29 Nov. 1984. Due to break down of water pump, enough irrigation water was not supplied to the plot since 30 Oct. 1984. Approximately 30 % of the plot was dried. Late panicle emergence was observed.

添付書類－24
Verification Trial 3 -13

Variety investigation

Objectives:

To observe the performance of variety in different growing season and to investigate grain productivity. The trial was also utilized for the 3rd training course.

Variety:

IR - 36

Plot size:

27.0 m x 97.0 m(2619 m^2) in plot D-6

Cultivation practices:

Fertilizer:	Nitrogen	100 kg N/ha
	Phosphorus	40 kg P_2O_5/ha

30 % of nitrogen and 100 % of phosphorus were applied at the time of puddling. Remaining nitrogen was applied at tillering and panicle initiation stages.

Density:

20 cm x 30 cm(16.7 hills/m^2)
3 seedlings/hill

Sowing date:

10 Aug. 1984

Transplanting date:

8 Sept. 1984

Harvesting date:

26 Dec. 1984

Insect control:

Diazinon 40E, 1/1000 solution was sprayed to control stem borer at nursery stage and at the time of 1st nitrogen top-dressing. No insect damage was observed in the plot.

Weed control:

Weed control was carried out properly by hand and no herbicide was sprayed. Weed infestation was observed at the higher portion of the plot.

Summary table:

1.	Sowing date	10 Aug. 1984
2.	Transplanting date	8 Sept. 1984
3.	Max. tillering	30 Oct. 1984
4.	Effective tillering	7 Nov. 1984
5.	Panicle initiation	26 Oct. 1984
6.	Heading	21 Nov. 1984
7.	Maturity	18 Dec. 1984
8.	Effective tiller	78.3 %
9.	Maturity days	130 days.
10.	Panicles/hill	---
11.	Spikelets/panicle	---
12.	Panicles/m^2	---
13.	Spikelets/m^2	---
14.	Ripening ratio	---
15.	1000 grains weight	---
16.	Grain/total production	---
17.	Grain yield/plot	738 kg
18.	Grain yield/ha	2264 kg

Plant growth:

Date	Plant height	Tillers/hill
29 Sept. 1984	28.6	7.0
2 Oct. 1984	35.6	12.5
9 Oct. 1984	41.0	27.0
16 Oct. 1984	47.6	40.0
24 Oct. 1984	55.2	44.5
30 Oct. 1984	61.2	49.8
7 Nov. 1984	66.5	42.0
13 Nov. 1984	73.8	36.4
20 Nov. 1984	77.0	36.8
27 Nov. 1984	78.0	40.8
4 Dec. 1984	78.4	37.0
12 Dec. 1984	78.4	37.8

Late panicle development was observed.

Remarks:

Same as the trial in Plot D-3, enough irrigation water was not supplied to the plot. Since 30 Oct. 1984 when water pump was broken, water stress on rice plant was observed and wiltted leaves were also observed on 6 Nov. 1984.

Heading initiation was observed on 12 Nov. 1984 and heading was completed on 24 Nov. 1984. Heading of IR -36 was not uniform and late panicle emergence was observed.

Low grain yield of the trial was caused by water stress and two sample spots were selected to investigate the effect of water stress on yield components.

1. No water stress:

1.	Panicles/hill	32.9
2.	Spikelets/panicle	86.3
3.	Panicles/m^2	549.3
4.	Spikelets/m^2	47.40×10^3
5.	Ripening ratio	81.3 %
6.	1000 grains weight	20.7 g
7.	grain/total production	51.5 %

2. Water stress:

1.	Panicles/hill	19.6
2.	Spikelets/panicle	99.6
3.	Panicles/m^2	327.3
4.	Spikelets/m^2	32.59×10^3
5.	Ripening ratio	27.7 %
6.	1000 grain weight	15.8 g
7.	Grain/total production	21.2 %

10 sample hills were collected from two spots for yield components analysis. Reduction of ripening ratio and 1000 grain weight were clearly observed in the samples from water stress.

Panicles/m^2 and spikelets/m^2 were calculated basing on the plant population of 16.7 hills/m^2.

添付書類－25
Verification Trial 3－14

Variety investigation

Objectives:

To observe the varietal characteristics of IR - 20 in different growing season and to examine productivity of grain.

Variety:

IR - 20

Plot size:

27.0 m x 97.0 m(2619 m^2) in plot D-5

Cultivation practices:

Fertilizer:	Nitrogen	150 kg N/ha
	Phosphorus	80 kg P_2O_5/ha

30 % of nitrogen and 100 % of phosphorus were applied at the time of puddling. Reamining nitrogen was applied at tillering and panicle initiation stages.

Density:

20 cm x 20 cm(25.0 hills/m^2)
3 seedlings/hill

Sowing date:

14 Feb. 1985

Transplanting date:

15 March 1985

Harvesting date:

1 July 1985

Insect control:

Diazinon 40E, 1/1000 solution was sprayed to control stem borer at nursery stage and at the time of 1st nitrogen top-dressing. No insect damage was observed.

Weed Control:

Weed control by hand was carried out properly. But due to poor water stand in the plot, serious weed infestation was observed.

Summary Table:

1.	Sowing date	14 Feb. 1985
2.	Transplanting date	15 March 1985
3.	Max. tillering	---
4.	Effective tillering	---
5.	Panicle initiation	---
6.	Heading	30 May 1985
7.	Maturity	24 June 1985
8.	Effective tiller	---
9.	Maturity days	130 days
10.	Panicles/hill	---
11.	Spikelets/panicle	---
12.	Panicles/m^2	---
13.	Spikelets/m^2	---
14.	Ripening ratio	---
15.	1000 grains weight	---
16.	Grain/total production	---
17.	Grain yield/plot	681.5 kg
18.	Grain yield/ha	2177 kg

Detail yield components analysis was not completed.

Plant growth:

Date	Plant height	Tillers/hill
26 March 1985	32.0	6.8
2 April 1985	41.8	11.0
9 April 1985	52.8	17.4
17 April 1985	57.4	23.2
23 April 1985	59.2	-
30 April 1985	64.2	29.4
7 May 1985	68.2	28.8
14 May 1985	69.8	21.0
21 May 1985	72.2	25.0
28 May 1985	79.8	18.4
4 June 1985	83.8	19.6
11 June 1985	84.4	19.2

Remarks:

Heading initiation was observed on 21 May 1985 and heading was completed on 6 June 1985. 90 % of the plot was dried on 13 April 1985 when farm pond was cleaned. Since field was dried, water stand in the plot was very poor even after irrigation was started. On 16 April 1985 surface of the field was still dry. On 30 April the field was completely dried and crack was observed. Plants started changing color of leaves and serious weed infestation was observed.

On 6 June 1985 heading was completed. At the same time, whitish tips of panicles were observed. 4 days after heading was completed, typical symptom of cool temperature injury, whitish frail branches of panicle was observed. Due to both problems of irrigation water and cool temperature grain yield was very low. Late emerged panicle form high node of the main stem was not observed.

添付書類－26
Verification Trial 3-15

Variety investigation

Objectives:

To observe the performance of variety in different growing season and to investigate production of grain.

Variety:

IR -32

Plot size:

27.0 m x 97.0 m(2619 m^2) in plot D-6

Cultivation practices:

Fertilizer:	Nitrogen	150 kg N/ha
	Phosphorus	80 kg P_2O_5/ha

30 % of total amount nitrogen and 100 % of phosphorus were applied at the time of puddling. Remaining nitrogen was applied at tillering and panicle initiation stages.

Density:

20 cm x 20 cm(25.0 hills/m^2)
3 seedlings/hill

Sowing date:

28 Feb. 1985

Transplanting date:

29 March 1985

Harvesting date:

20 Aug. 1985

Insect control:

Diazinon 40E, 1/1000 solution was sprayed to control stem borerat nursery stage and at the time of nitrogen top-dressing.

Weed control:

Weed control was carried out by hand properly. No herbicide was sprayed but weed infestation was not observed.

Summary table:

1.	Sowing date	28 Feb. 1985
2.	Transplanting date	28 March 1985
3.	Max. tillering	14 May 1985
4.	Effective tillering	11 June 1985
5.	Panicle initiation	4 June 1985
6.	Heading	11 July 1985
7.	Maturity	7 Aug. 1985
8.	Effective tiller	----
9.	Maturity days	160 days
10.	Panicles/hill	25.6
11.	Spikelets/panicle	42.5
12.	Panicles/m^2	504.3
13.	Spikelets/m^2	21.43×10^3
14.	Ripening ratio	17.4 %
15.	1000 grains weight	20.5 g
16.	Grain/total production	6.4 %
17.	Grain yield/plot	94.5 kg
18.	Grain yield/ha	370kg

Plant growth:

Date	Plant height	Tillers/hill
2 April 1985	20.2	4.0
9 April 1985	22.2	7.2
17 April 1985	34.4	18.2
23 April 1985	39.8	15.4
30 April 1985	44.0	30.4
7 May 1985	49.4	31.6
14 May 1985	49.8	33.8
21 May 1985	51.8	32.2
28 May 1985	54.4	29.8
4 June 1985	56.2	31.0
11 June 1985	57.2	33.0
25 June 1985	58.3	35.2
2 July 1985	61.0	33.2
10 July 1985	61.1	16.4*
16 July 1985	62.7	18.4
23 July 1985	66.4	20.8

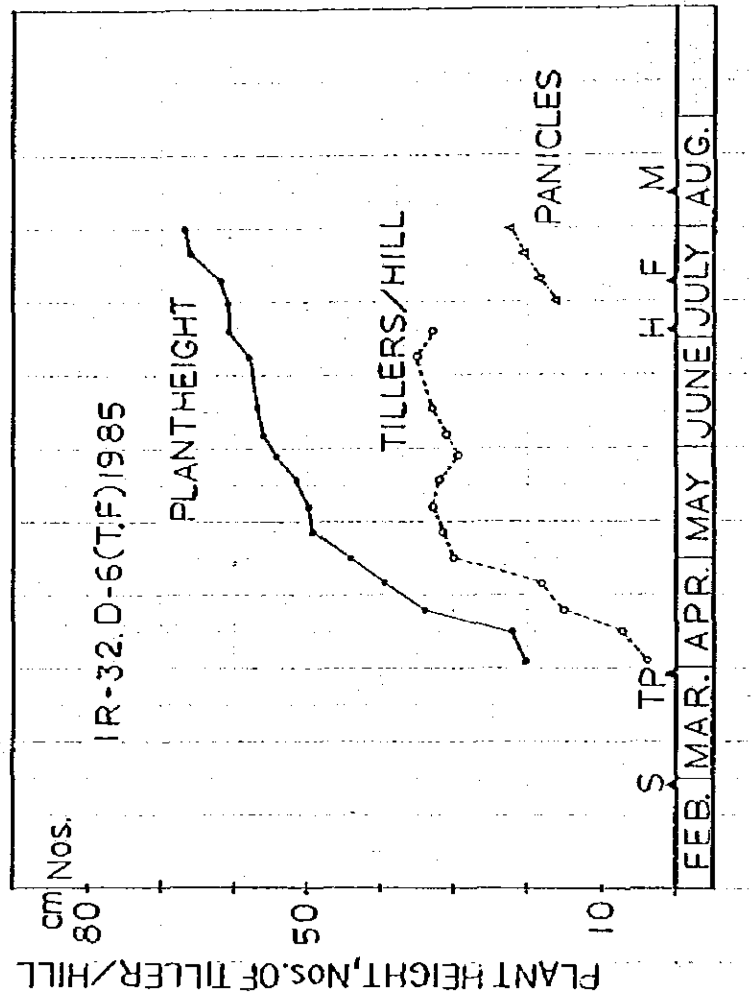
* number of panicles/hill
Production of late panicles were observed even after heading was completed. It seemed to be a syptom of cool temperature injury.

Remarks:

Tremendous reduction of ripening ratio and grain weight were observed. Grain/total production of sample plants was also very low.

On 2 July 1985 heading initiation was observed and heading was completed on 16 July. After heading was completed, whitish tips of panicles, empty spikelets and black spots on spikelet were observed. Symptoms of cool temperature injury were observed. Serious grain reduction of IR - 32 can be due to cool temperature. Panicles were partly enclosed by the sheath of flag leaf and panicle development from 3 - 4th node of the main stem was observed.

FIG -26


IR-32 D-6(T.F) 1985
PLANTHEIGHT
TILLERS/HILL
PANICLES
cm
Nos.
80
50
10
S
TP
H
F
M
FEB.
MAR.
APR.
MAY
JUNE
JULY
AUG.
PLANT HEIGHT, Nos. OF TILLER/HILL

添付書類－27
Verification Trial 3－16

Variety investigation

Objectives:

To observe the performance of variety in different growing season and to investigate grain productivity.

Variety:

IR -42

Plot size:

27.0 m x 97.0 m(2619 m^2) in plot D-3

Cultivation practices:

Fertilizer: Nitrogen 150 kg N/ha
Phosphorus 80 kg P_2O_5/ha

30 % of nitrogen and 100 % of phosphrus were applied at the time of puddling. Remaining nitrogen was applied at tillering and apnicle initiation stages.

Density:

20 cm x 20 cm(25.0 hills/m^2)
3 seedlings/hill

Sowing date:

22 March 1985

Transplanting date:

23 April 1985

Harvesting date:

4 Sept. 1985

Insect control:

Diazinon 40E,1/1000 of solution was sprayed to control stem borer at nursery and at the time of 1st nitrogen top-dressing. No insect damage was observed in the plot.

Weed control:

Weed control by hand was carried out properly. No herbicide was sprayed and weed infestation was not observed.

Summary table:

1. Sowin date	22 March 1985
2. Transplanting date	23 April 1985
3. Max. tillering	4 June 1985
4. Effective tillering	25 June 1985
5. Panicle initiation	28 June 1985
6. Heading	20 July 1985
7. Maturity	29 Aug. 1985
8. Effective tiller	---
9. Maturity days	160 days
10. Panicles/hill	33.8
11. Spikelets/panicle	82.2
12. Panicles/m^2	679.4
13. Spikelets/m^2	55.85×10^3
14. Ripening ratio	7.3 %
15. 1000 grains weight	18.9 g
16. Grain/total production	5.7 %
17. Grain yield/plot	80.0 kg
18. Grain yield/ha	326 kg

Plant growth:

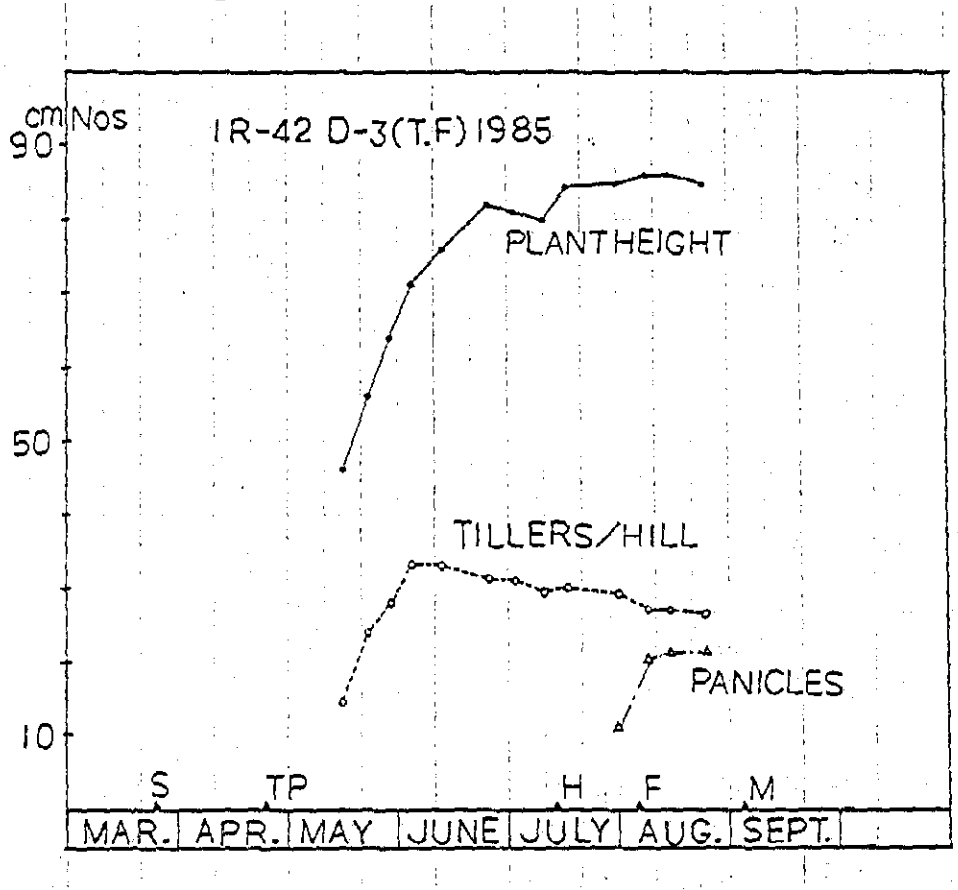
Date	Plant height	Tillers/hill
14 May 1985	45.6	13.8
21 May 1985	55.8	24.0
28 May 1985	64.0	28.4
4 June 1985	70.8	33.2
11 June 1985	76.2	32.8
25 June 1985	82.0	31.2
2 July 1985	81.4	31.0
10 July 1985	80.8	29.4
16 July 1985	84.5	30.0
30 July 1985	84.9	29.6
6 Aug. 1985	86.0	27.0
14 Aug. 1985	86.1	27.0
23 Aug. 1985	85.8	26.8

Remarks:

Tremendous reduction of grain yield was mainly caused by low ripening ratio and reduction of grain weight. Heading initiation was observed on 13 July 1985 and heading was completed on 5 Aug. 1985. Heading of IR - 42 was very irregular. When heading was observed late tillers were still at booting stage and whitish tip of panicle was observed. Many empty grains and black spots on grain were also observed. These are typical symptom of cool temperature injury.

Late tiller development from high node of the main stem was observed. Panicles were partly enclosed by the sheath of flag leaf.

FIG - 27


cm Nos
90
50
10
IR-42 D-3(T.F) 1985
PLANTHEIGHT
TILLERS/HILL
PANICLES
S
TP
H
F
M
MAR.
APR.
MAY
JUNE
JULY
AUG.
SEPT.

Verification Trial 3-17

Variety investigation

Objectives:

To observe varietal characteristics of IR - 36 in diiferent growing season and also to investigate productivity of grain. The trial was also utilized for field practice of 4th training course.

Variety:

IR - 36

Plot size:

27.0 m x 97.0 m(2619 m^2) in plot D-4

Cultivation practices:

Fertilizer:	Nitrogen	150 kg N/ha
	Phosphorus	80 kg P_2O_5/ha

30 % of nitrogen and 100 % of phosphorur were applied at the time of puddling. Remaining nitrogen was applied at tillering and panicle initiation stages.

Density:

20 cm x 20 cm(25.0 hills/m^2)
3 seedlings/hill

Sowing date:

9 Aug. 1985

Transplanting date:

12 Sept. 1985

Harvesting date:

24 Dec. 1985

Insect control:

Diazinon 40 E, 1/1000 solution was sprayed at nursery and at the time of 1st nitrogen top-dressing to control stem borer. No insect damage was observed in the plot.

Weed control:

Weed control by hand was carried out properly. No herbicide was sprayed and weed infestation was not observed.

Summary table:

1. Sowing date	9 Aug. 1985
2. Transplanting date	12 Sept. 1985
3. Max. tillering	6 Nov. 1985
4. Effective tillering	26 Nov. 1985
5. Panicle initiation	28 Oct. 1985
6. Heading	19 Nov. 1985
7. Maturity	16 Dec. 1985
8. Effective tiller	89.1 %
9. Maturity days	129 days
10. Panicles/hill	---
11. Spikelets/panicle	---
12. Panicles/m^2	---
13. Spikelets/m^2	---
14. Ripening ratio	---
15. 1000 grains weight	---
16. Grain/total production	---
17. Grain yield/plot	1710 kg
18. Grain yield/ha	6027 kg

Plant growth:

Date	Plant height	Tillers/hill
9 Oct. 1985	39.1	18.6
15 Oct. 1985	42.8	26.2
22 Oct. 1985	48.6	34.4
29 Oct. 1985	55.3	32.6
6 Nov. 1985	62.0	44.4
12 Nov. 1985	75.0	41.8
19 Nov. 1985	84.0	36.2
26 Nov. 1985	86.0	33.6
3 Dec. 1986	88.4	30.2
10 Dec. 1985	86.8	31.2
17 Dec. 1985	86.8	27.0*

* Number of panicles/hill

Remarks:

Detail analysis of yield components was not completed. Heading initiation was observed on 14 Nov. 1985 and heading was completed on 23 Nov. 1985. Heading of IR -36 was uniform. Reasonable number of panicle production was observed.

Verification Trial 3-18

Variety investigation

Objective:

To observe the performance of variety in different growing season and to investigate grain productivity.

Variety:

IR - 54

Plot size:

27.0 m x 97.0 m(3619 m^2) in plot D-7

Cultivation practices:

Fertilizer: Nitrogen 150 kg N/ha
Phosphorus 80 kg P_2O_5/ha

30 % of total amount of nitrogen and 100 % of phosphorus were applied at the time of puddling. Remaining nitrogen was applied at tillering and panicle initiation staged.

Density:

20 cm x 20 cm(25.0 hills/m^2)
3 seedlings/hill

Sowing date:

12 Sept. 1985

Transplanting date:

11 Oct. 1985

Harvesting date:

28 Jan. 1986

Insect control:

Diazinon 40E, 1/1000 solution was sprayed to control stem borer at nursery stage and at the time of 1st nitrogen top-dressing. No insect damage was observed.

Weed control:

Weed control by hand was carried out properly. Herbicide was not sprayed but weed infestation was observed on 11 Nov. 1985. Water stand in the plot was very poor and that was a cause of serious weed infestation in the plot.

Summary table:

1. Sowing date	12 Sept. 1985
2. Transplanting date	11 Oct. 1985
3. Max. tillering	12 Nov. 1985
4. Effective tiller	3 Dec. 1985
5. Panicle initiation	27 Nov. 1985
6. Heading	27 Dec. 1985
7. Maturity	24 Jan. 1986
8. Effective tiller	72.3 %
9. Maturity days	134 days
10. Panicles/hill	---
11. Spikelets/panicle	----
12. Panicles/m^2	----
13. Spikelets/m^2	----
14. Ripening ratio	---
15. 1000 grains weight	---
16. Grain/total production	----
17. Grain yield/plot	735.0 kg
18. Grain yield/ha	2741 kg

Plant growth:

Date	Plant height	tillers/hill
15 Oct. 1985	16.2	3.4
22 Oct. 1985	26.6	6.6
29 Oct. 1985	32.9	11.2
6 Nov. 1985	36.1	17.0
12 Nov. 1985	40.3	20.8
19 Nov. 1985	41.0	19.8
26 Nov. 1985	42.1	19.8
3 Dec. 1985	44.3	20.2
10 Dec. 1985	53.2	23.8
17 Dec. 1985	58.2	30.4
24 Dec. 1985	60.8	29.8
31 Dec. 1985	66.1	12.6*
7 Jan. 1986	68.5	13.8
14 Jan. 1986	69.3	14.6

* number of panicles/hill

Remarks:

Heading initiation was observed on 21 Dec. 1985 and heading was completed on 6 Jan. 1986. Before heading was initiated, problem of irrigation water was observed. On 5 Nov. 1985 it was observed that the field was always without water. Maintenance water supply to the plot was not sufficient and water stand of the plot was very poor. The field was not flooded and the surface was left without water. The cause of poor water stand of plot D-7 was not known. In the previous crop, water satnd of the plot was not bad as this season.

Heading of IR -54 was very irregular. Normarly heading of IR - 54 was very uniform. Irregular heading might be due to problem of water. Eventually very poor grain yield was obtained. Detail analysis of yield componets analysis was not completed.

添付書類－30

SOWING DENSITY X NURSERY PERIOD EXPERIMENT.

Objectives:

To study effects of sowing density at nursery and nursery period of seedlings on grain yield.

To study interaction between two factors.

Experimental design:

RCBD with 2 replications. Two factors are arranged as A X B factorial experiment.

Treatment:

Sowing density	Nursery period
A1 50 g seeds/m^2	B1 20 days
A2 100 g seeds/m^2	B2 30 days
A3 200 g seeds/m^2	B3 40 days
	B4 50 days

Plot size: 28.8 m^2

Fertilizer: 75 kg of N/ha

Variety: IR-8

Discussion:

1. Dry matter weight of seedling.

Significant effect of two factors were observed the 1% level. The interaction was also significant at the 1% level. Dry matter weight of seedling at 4 nursery periods was significantly different. The highest dry matter weight was obtained when nursery period was 40 days and the lowest was when seedling age was 20 days. When seedling was 20 days any significant difference was not observed even at different sowing densities. When seedlings were 30 days old, the effect of sowing density was significant. Less sowing density at nursery gave higher dry matter weight of seedlings at 30-40-50 days of nursery period respectively. Significant reduction was observed when seedlings were 50 days old.

2. Number of roots.

To examine root development of seedlings, all roots were cut off and after 7 days number and total length of newly developed roots were measured.

The effect of nursery period was highly significant. The largest number of roots was developed when seedling age was 40 days. As the age of seedlings increased number of roots was also increased. Significant reduction of root development was observed at 50 days nursery period. The effect of sowing density was significant. The largest number of roots was developed at 50 g seed/m^2, and there was no difference between other two density levels. This tendency was also observed at 30-40-50- days nursery periods. When seedling was 20 days old, there was no statistical difference among 3 density levels. Young seedling of low dry matter weight could not make any difference even sowing density was largely different.

3. Total length of roots.

Sowing density caused significant difference in root development. The lowest sowing density gave the best root development. The effect of nursery period was also significant. Total length of root developed at 20 days and 30 days was not significantly different, and also no significant difference was observed between two levels of 40 and 50 days. Better root development in length was observed at 40 and 50 days nursery period than other two periods.

Differential response of sowing density was observed at four nursery period levels. At 20 and 30 days period, sowing density did not cause any significant difference. When seedling was 40 days, the 50g seeds/m^2 gave the best root development, though root development of 100 g and 200g seed/m^2 was almost the same.

At 50 days period, root development at 3 sowing density levels was significantly different. As mentioned in summarized data table, tremendous reduction of root development was observed at the highest sowing density of 200 g seed/m^2, while the reduction of 50 g seeds/m^2 was slight.

4. Grain yield.

Significant effect of two factors on grain yield was not significant. The tendency of yield reduction was observed as nursery period was increased. 20 days seedlings of the highest sowing density caused yield reduction of about 1 ton/ha as compared to that of 100 g and 50 g/m^2 levels. Yield difference due to sowing density was getting slight at 40-50 days nursery period. Yield difference due to sowing density was not remarkable.

5. Panicle number per unit area.

Significant effect of sowing density and nursery period was observed at 5% level. The lowest density of 50 g seeds/m^2 produced the largest number of panicles. There was no significant difference between 100 g seed/m^2 and 200 g seed/m^2 panicle production of 100 g seed/m^2 was slightly less than that of 50 g seed/m^2 but, significant difference was not observed.

Nursery period also caused significant difference. Panicle production of 20 days seedling was significantly higher than that of 30 days and 50 days seedlings. Though interaction of two factors was not significant, tendency of reduction of panicle development was observed as sowing density increased and as nursery period increased.

6. Kernel number per panicle.

Significant effect of nursery period was observed at the 10% level. Spikelet production was increased gradually as nursery period increased. Spikelet production of 20 days seedling was the lowest among 4 levels of nursery period. The tendency of spikelet production at different levels of nursery period showed quite different tendency as compared to that of panicle production per unit area. Difference in spikelet production was very slight between 40 and 50 days nursery period. Spikelet production at 3 levels of sowing density was the same. Even slight difference was observed, there was no significant difference among the.

Conclusions:

In the aspect of root development of seedlings, 30-40 days seedling might be better and low sowing density at nursery might be better to get good quality of seedlings.

Old seedlings of 50 days did not cause significant yield reduction, even though seedling age should not be more than 50 days. Yield reduction might be caused due to poor root development of old seedlings.

If 20 days seedlings are transplanted sowing density won't affect root development. Recovery period of seedlings might be less if young seedlings are transplanted. But young seedling like 20 days seedling might create problems of transplanting practice. Short plant height of young seedlings requires well leveled field. Young seedlings are easily damaged during uprooting and transplanting. Chekereni farmers are used to transplant old seedling of 40-50 days deeply. Deep transplanting of young seedlings may be submerged.

Short recovery period of young seedling encourages early tiller development and it causes large number of panicle production. The advantage of young seedling is to encourage vigorous plant development in an early growth stage.

TABLE-9

Summarized Table of Sowing density X Nursery period Experiment

Treat-ments	Grain yield ton/ha	Nos. of panicles/m^2	Nos. of spikelets per panicle	Ripening ratio (%)	Harvest index (%)	Dry matter weight of seedlings	Root develop-ment. total length cm	Root develop-ment. Nos. of roots
A1B1	6.66	281.7	132.4	81.9	44.1	0.06	4.2	3.8
A1B2	6.69	247.0	134.8	88.7	45.9	0.26	9.4	7.3
A1B3	6.43	237.3	139.4	75.9	47.0	0.56	38.4	15.2
A1B4	5.42	226.9	164.6	88.1	43.9	0.48	36.5	7.3
A2B1	6.11	248.4	126.5	82.7	47.3	0.05	5.3	4.4
A2B2	5.54	195.7	133.2	84.2	45.6	0.12	5.2	3.9
A2B3	6.37	247.0	131.4	86.3	47.0	0.43	21.0	7.8
A2B4	5.37	208.1	144.0	87.1	46.1	0.28	26.7	5.5
A3B1	5.15	225.2	114.6	77.2	42.8	0.06	5.0	4.0
A3B2	5.52	215.2	137.0	85.6	46.8	0.16	4.8	5.0
A3B3	5.98	208.2	164.7	82.4	47.3	0.25	21.2	8.7
A3B4	5.23	187.4	135.3	69.8	51.9	0.19	11.9	5.4
$\overline{X}$	5.87	227.3	138.2	82.5	46.3	0.24	15.8	6.5
C.V.(%)	12.7	10.4	10.5	8.5	8.6	7.2	15.2	10.1
Statistical significane	NS	A*, B*	B(10%)	NS	NS	A**, B**, AXB**	A**, B**, AXB**	A**, B**, AXB**
LSD.05 $\overline{XD}$	0.82	25.9	15.9	7.7	4.4	0.02	2.7	0.7
LSD.05 $\overline{X}$P	0.95	30.0	18.4	8.9	5.1	0.02	3.1	0.8
LSD.05 DXP	1.64	51.9	31.9	9.2	8.8	0.04	5.3	1.5

A: sowing density at nursery
B: nursery period in days

A1:50g seeds/m^2
A2:100g seeds/m^2
A3:200g seeds/m^2

B1: 20 days
B2: 30 days
B3: 40 days
B4: 50 days

FIG-28

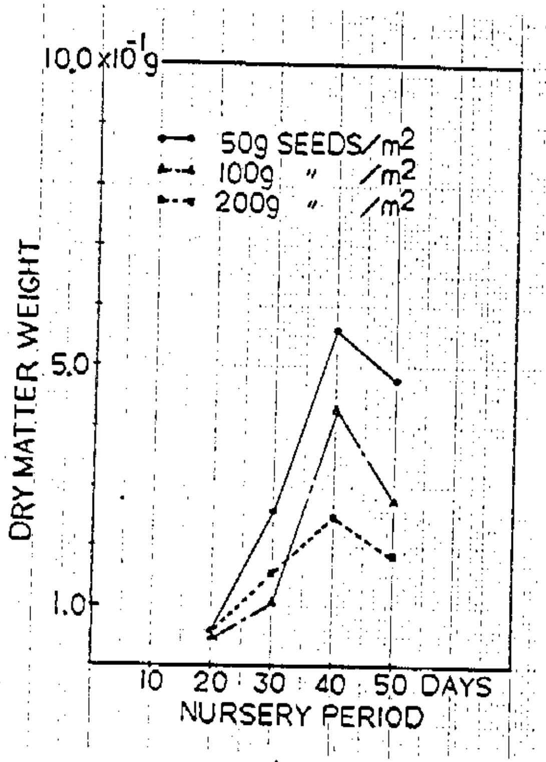


FIG-29

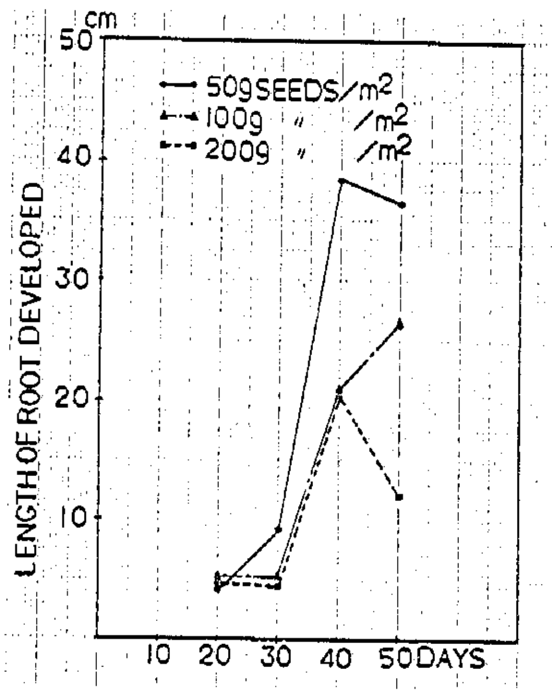
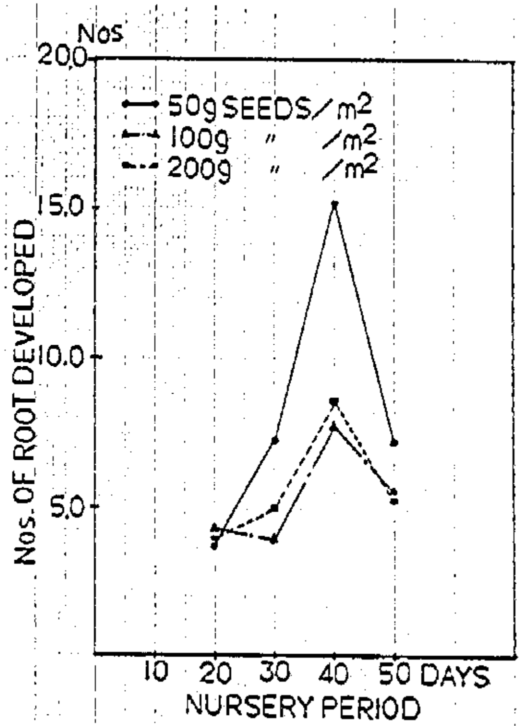


FIG-30



Variety Experiment

Objectives:

To compare variety available to farmers with improved varieties obtained from IRRI and local varieties cultivated in the area of Lower Moshi, for adaptaion to the Lower Moshi environment.

Experimental design:

Randomized complete block design with 4 replications.

Treatments:

Varieties(1982 in plot D-5)

V1. Surinam
V2. Kilombero
V3. Affa Mwanza
V4. Taiwan - 14
V5. IR - 8

All varieties for the 1st experiment were obtained from Tan Seed(Tanzania Seed Corporation).

Varieties(1983 in plot D-1)

V1. IR - 8
V2. IR - 20
V3. IR - 36
V4. IR - 54
V5. IR - 56
V6. Taiwan - 14
V7. Affa Mwanza
V8. Kilombero
V9. Surinam

Varieties(1984 in plot D-4)

V1. IR - 8
V2. IR - 20
V3. IR - 32
V4. IR - 36
V5. IR - 42
V6. IR - 54
V7. IR - 56
V8. Affa Mwanza
V9. Taiwan - 14
V10. Matandiko

Plot Size:

4.0 m x 6.0 m(24.0 m^2) in 1982
3.0 m x 4.0 m(12.0 m^2) in 1983
3.0 m x 4.0 m(12.0 m^2) in 1984

Experimental period:

1. 1982 in plot D-5

   Sowing: 22 April 1982
   Transplanting: 31 May 1982
   Harvesting: 5 Oct. 1982

2. 1983 in plot D-1

   Sowing: 15 Nov. 1983
   Transplanting: 14 Dec. 1983
   Harvesting: 23 March 1984

3. 1984 in plot D-4

   Sowing: 13 Sept. 1984
   Transplanting: 16 Oct. 1984
   Harvesting: 28 Feb. 1985

Cultivation practices:

Fertilizer:	Fertilizer rate for experiments were 75 kg N/ha for the 1st experiment(1982), 100 kg N/ha and 40 kg P_2O_5/ha for 2nd experiment(1983) and 100 kg N/ha and 40 kg P_2O_5/ha for 3rd experiment (1984). In the 1st experiment, only nitrogen was applied. In 3 experiments, 50 % of total amount of nitrogen and 100 % of phosphrus were applied at the time of puddling. Remaining nitrogen was applied at tillering and panicle initiation stages.
Density:	20 cm x 30 cm(16.7 hills/m^2) 3 seedlings/hill
Insect control:	Diazinon 40E of 1/1000 solution was sprayed to prevent stem borer damage at nursery stage and at the time of 1st nitrogen top-dressing.
Weed control:	Weeds in plots were uprooted and controlled by hand propely. No herbicide was sprayed for weed control.

Discussion:

1. 1982(D-5)

This was the 1st experiment conducted in the trial farm and the conditon of field was poor. Puddling was not done properly because powertiller could not be operated well and level of the field was very poor. Puddling was done by hand and basic fertilizer of nitrogen was also mixed by hand.

Significant difference of grain yield was observed among 5 varieties at the 5 % level. The average yield was 3.43 ton/ha and low yield might be due to poor field condtion. The highest grain yield was obtained in IR -8 and the lowest was in Kilombero. Relatively high grain yield was also obtained in Taiwan -14 but it was same as that of Surinam and Affa Mwanza.

Significant difference of spikelet production/m^2 was not observed among five varieties. Spikelet production of Surinam and Taiwan - 14 were higher than other varieties. The lowest production was observed in Kilombero. It seemed that difference of spikelet/m^2 was caused by panicle productivity and number of spikelet per panicle of varieties.

Panicle production of Surinam was significantly higher than other 4 varieties but number of spikelet per panicle was relatively low. The largest number of spikelet per panicle was observed in Taiwan - 14 and IR - 8. Panicle production of these two varieties were 15.2/hill and 16.2/hill respectively. Spikelet/panicle of Kilombero was also high and it was same as that of IR - 8. But panicles per hill of Kilombero was very low as compared to other varieties. That was main cause of low spikelet production/m^2 of Kilombero. Spikelet/panicle of Affa Mwanza was alomst same as Surinam but panicle production was lower than Surinam.

Surinam is small panicle-type variety and tillering ability is very high. Kilombero is large panicle-type variey and tillering ability is very low. Panicle type of Affa Mwanza is inermediate and tillering is higher than other local varieties. Taiwan - 14 is same as Kilombero but tillering seems to be higer than that of Kilombero. Panicle size of IR - 8 is intermediate and tillering is very high.

Significant difference of spikelets/m^2 was not observed among five varieties. However it seemed that spikelets/m^2 of Surinam and Taiwan - 14 were higher than that of other varieties. The lowest spikelets/m^2 was observed in Kilombero.

Significant difference of grain weight among five varieties was observed at the 1 % level. The highest grain weight was observed in Kilomero. Grain weight of IR - 8 was also high but it was not different significantly from that of Affa Mwanza. The lowest grain weight was observed in Surinam. Taiwan - 14 was also small.

Difference in efficieny of grain production was significant at the 1 % level. The highest grain production efficiency was observed in IR - 8 and Surinam. Approximately 50 % of total production of these two varieties was grain. On the other hand, grain production of Kilombero, Taiwan - 14 and Affa Mwanza was 35 - 40 % of total production of sample plants. Vigrous vegetative growth of local variety was the main cause of low grain production efficiency. For these varieties, high rate of nitrogen application might cause more plant body production than grain yield.

Among 5 varieties, earliest maturing was observed in Surinam and the latest was Taiwan - 14. The difference between two varieties was 32 days. IR - 8 and Affa Mwanza matured in almost same days.

High yield of IR - 8 was mainly caused by high panicle production and large grain size. Spikelet production of IR - 8 was also high. Short plant height and high efficiency of grain production are great advantage for high rate of nitrogen application. Surinam is also short plant, high tillering type. But spikelet/panicle is low and grain weight is also low. Taiwan - 14 is large panicle type but panicle production is low. Plant height is so high that yield response to density may not be expected. Low panicle production/m^2 of this variety seems to be a limiting factor. Low spikelet production/m^2 of Affa Mwanza could be compensated if panicles/m^2 is incresed by nitrogen application or increase of density. Low grain yield of Kilombero is mainly caused by low panicle productivity. Good yield can be expected if Kilombero is cultivated at high density.

2. 1983(D-1)

Water stand of the field was very poor. Irrigation water was provided everyday to keep plot flooded but it was not enough. Adequate amount of irrigation was not provided because water pump had been broken due to low voltage. It was the cause of large variance of experimental error.

Significant difference of grain yield among 9 varieties was observed at the 1 % level. The highest grain yield of 7.37 ton/ha was obtained in IR -8. Grain yield of IR - 20, IR - 36, IR - 54, Affa Mwanza and Surinam were 4.5 - 5.0 ton/ha and there was no significant difference. Grain yield of Taiwan - 14 and Kilombero was the lowest. Grain yield of IR - 56 was lower than that of other improved varieties. Low grain yield of varieties might be due to water management problem of the field.

Taiwan - 14, Affa Mwanza and Kilombero were tall plant-type variety. Droopy leaves and vigrous vegetative growth of local variety was observed. Plant height of improved varieties ranged from 70 - 90 cm.

Significant difference of spikelets/m^2 was observed among 9 varieties at the 5 % level. The largest number of spikelets per unit area was obtained in IR - 36. Spikelets/m^2 of other improved varieties, like IR - 8, IR - 20 and IR - 54 were also high. Among improved varieties, spikelets/m^2 of IR - 56 was the lowest. The lowest spikelet production /m^2 was observed in Kilombero. Affa Mwanza produced 24.17 x 10^3/m^2 of spikelet but there was no significant difference between Taiwan - 14 and Affa Mwanza. Among local varieties, the largest spikelets/m^2 was observed in Taiwan - 14.

Panicles/hill of IR - 36 was the highest among 9 varieties. IR - 56 also produced larger number of panicles per hill. Panicles/hill of other improved varieties ranged from 19.0 - 22.0 and there was no significant difference among them. Panicles per hill of Kilombero and Taiwan - 14 was the lowest. Panicle production of Affa Mwanza was high and it was almost same as that of improved varieties.

Spikelet production/panicle of 9 varieties was also significantly different. The largest number of spikelet/panicle was observed in Taiwan - 14. Among improved varieties, the highest spikelet/panicle was observed in IR - 20 and it was same as that of Kilombero. Spikelets/panicle of improved varieties was almost same, however that of IR - 56 was lower among them. Spikelts/m^2 of local varieties such as Kilombero and Affa Mwanza was not high because of low production of panicle even though spikelet per panicle was lower than improved varieties. On the other hand, high production of spikelets/m^2 was observed in improved varieties and that was due to high productivity of panicle. In case of IR - 56, panicles/hill was relatively higher but less production of spikelet/panicle resulted into less production of spikelet/m^2. Among 9 varieties, IR - 36 and IR - 56 seemed to be the highest tillering variety. Panicles/m^2 of Affa Mwanza and Surinam was almost same. Taiwan - 14 and Kilombero produced the lowest number of panicles/m^2.

The highest ripened grain ratio was observed in Affa Mwanza. Ripening ratio of IR - 20, IR - 54 and IR - 56 was also high. The lowest ripening ratio was observed in Taiwan - 14. Among improved varieties, IR - 8 was the lowest and it was almost same as that of Kilombero. Ripening ratio of Kilombero and Surinam was lower and it was almost same as Taiwan - 14. It was observed that ripening ratio of local varieties except Affa Mwanza was lower than that of improved varieties. Ripening ratio of Ir - 8 and IR - 36 was relatively low and that might be due to high production of spikelets/m^2.

Significant difference of grain weight was observed at the 1 % level. Large grain type was observed in Kilombero and Affa Mwanza. Grain weight of IR - 8 was also heavy. Grain weight of Taiwan - 14 and IR - 20 was the lowest among 9 varieties. Grain weight of IR - 36 was lower thah that of other improved varieties. Considering grain weight, 9 varieties could be splited into 3 groups of variety. Small grain type are Taiwan -14, IR-20 and IR - 36. Large grain type can be Kilombero, Affa Mwanza and IR - 8. Medium type are IR - 54, IR - 56 and Surinam.

Significantly low efficiency of grain production was observed in 3 local varieties. Grain production efficiency of 5 improved varieties and Surinam was approximately 50 % while that of local varieties was 30 - 37 %.

Shattering percent of grain was determined by rolling a weighted cylinder of 1 kg several times over panicle samples placed on a flat board and counting percentage of dropped grains. Very high shattering percent was observed in IR - 8 and IR - 54 while low shattering was observed in Surinam, IR -56, IR - 36 and IR - 20. High shattering variety may cause grain loss during harvest but will be easy for threshing. On the other hand, grain loss could be minimized by low shattering variety.

The highest effective tiller percentage was observed in IR - 56. Relatively high effective tiller was observed in IR - 20, IR - 36, IR - 54 and Affa Mwanza. On the contrary, effective tiller of Taiwan - 14, Kilombero, Surinam and IR - 8 was low. Low effective tiller percent may result into low grain prodution efficiency.

Panicle size of local varieties was larger than that of improved varieties.' Among improved varieties, panicle of IR - 20 was the largest and the smallest one was IR - 36 and IR - 56. High tillering varieties of IR - 36 and IR -56 produced small panicles while lareg panicles were produced by low tillering variety of Taiwan - 14.

Insect damage was measured by the number of hills in which white head was observed from 6 m^2 of sample area. Relatively high number of white head was observed in Taiwan - 14 and Kilombero. Even in Affa Mwanza and Surinam, damage of stem borer was observed, while no white head was observed in improved varieties. High number of white head in Taiwan - 14 and Kilombero was also observed in other experiments. Taiwan - 14 and Kilombero might be susceptible to stem borer.

Early maturing was observed in IR - 56, Surinam and IR - 36. These varieties matured in 118 - 121 days. IR - 20 and IR - 54 matured two weeks later. Late maturing was observed in Taiwan - 14 and Kilombero. The difference between early maturing variety and late maturing one was approximately 40 days. Maturity days of IR - 8 and Affa Mwanza was intermeiate.

Grain yield of local varieties was lower than improved varieties. One of the cause of low yield was less production of spikelets/m^2. Number of spikelet per panicle seemed to be higher in local variety. However tillering and percentage of effective tiller were lower in local variety. Grain production efficiency of local variety was very low as compared to that of improved variety. Vigrous vegetative growth and low effective tiller percent were cause of the low efficiency of grain production.

Among improved varieties, IR - 36 and IR - 56 seemed to be high tillering variety but produced small panicle. Grain weight of these variety was also low. IR - 20 and IR - 54 were relatively large panicle type but low in panicle production. Panicle size of IR - 8 was small but production of panicle was high. Among local varieties, varietal characteristics of Surinam and Affa Mwanza were different from other local varieties. Panicle production of Surinam was high but low in spikelet per panicle. Spikelets per panicle of Affa Mwanza was same as that of IR - 8 and panicle production was higher than other local varieties. High yielding can be expected in Surinam and Affa Mwanza under improved cultivation.

3. 1984(D-4)

Significant difference of grain yield was observed among 10 varieties at the 1 % level. Grain yield of local varieties was significantly lower than improved varieties. The highest grain yield was observed in IR - 42 and IR -8. The average yield of improved varieties was 4.09 ton/ha while 2.36 ton/ha was taht of local varieties. Shortage of irrigation water in the field might be a cause of low grain yield of varieties.

10 days after transplanting, water pump was broken due to electric problem. Alternative way of providing water to plots was taken to maintain water level but enough irrigation water was not provided to the experiment.

Significant difference of spikelets/m^2 was observed at the 1 % level. The highest production of spikelet/m^2 was obtained in IR - 36. Numbor of spikelet/m^2 of IR - 42 and IR - 20 was also high. Spikelet production of these 3 varieties was significantly higher than that of Affa Mwanza and Matandiko. Matandiko and Affa Mwanza produced the lowest number of spikelts.

Low spikelet production of local varieties was due to low production of panicles/hill. Even in IR - 20 and IR - 54, low panicle production/hill was cause of less spikelets/m^2. Number of spikelet/panicle of these two varieties was higher than that of IR - 32 and IR - 56. The highest production of spikelets/panicle among improved varieties was observed in IR - 20. IR - 54 and IR - 42 also produced large number of spikelets/panicle. And the lowest number was observed in IR - 56. The largest paniole size was observed in Taiwan - 14. Spikelet number per panicle of Affa Mwanza and Matandiko was same as that of IR - 54.

There was significant difference of panicles/hill among 9 varieties. The highest number of panicles/hill was observed in IR - 36. IR - 32 also produced large number of panicles. The panicles/hill was observed in Matandiko. 16.6 panicles/hill was average of local varieties while that of improved varieties was 24.5/hill. Among improved varieties, panioles/hill of IR - 54, IR - 8 and IR - 20 was relatively low. Affa Mwanza produced the largest number of panicles/hill among local varieties. Eventually significnatly high production of spikelots/m^2 of IR - 36 was caused by high production of panicles per hill. In case of IR - 42 and IR - 20, causes of high spikelet produotion/m^2 were relatively high number of panicle/hill and spikelet/panicle. On the contrary, less panicles/hill of IR -54 resulted into low spikelet production/m^2 even panicle size of the variety was larger than other improved varieties. Large panicle with low tillering variety like IR - 54 or IR - 20 is to be cultivated in high density to obtain high number of spikelets/m^2. Low spikelet production of local variety was mainly due to low tillering.

Panicles/m^2 of improved varieties was significantly higher than that of local variety. High tillering varieties like IR - 36 and IR -56 produced higher panicles/m^2 than other improved varieties. IR - 54 produced the lowest number of panicles per unit area among improved varieties.

Overall mean of ripening ratio, 74.4 % of the experiment was low as compared to other experiments. And that was a reason of low grain yield of the experiment. However the highest ripening ratio was observed in Affa Mwanza. Low ripening ratio of IR - 36 might be due to high production of spikelets/m^2. But ripening ratio of IR - 42 was also high even spikelets/m^2 was high. On the other hand, ripening ratio of Taiwan - 14 and Matandiko was the lowest even spikelets/m^2 of these varieties was low.

Significant difference of grain weight was observed at the 1 % level. Heavy grain weight was observed in IR - 8, Matandiko, Affa Mwanza and IR - 54. Grain weight of Taiwan - 14, IR - 20 and IR - 42 was the lowest among 10 varieties. Grain weight of IR - 32, IR - 36 and IR - 56 was intermediate.

The efficiency of grain production of local varieties was significantly lower than that of improved varieties. The average of 3 local varieties was 27.9 % while 49.5 % was that of improved varieties. Among local varieties, relatively high efficiency of grain production was observed in Affa Mwanza.

All varieties of the experiment matured late as compared to other experiment. Early maturing of IR - 36 took 132 days in this experiment while it matured in 121 days in previous experiment. However early maturing was observed in IR - 36, IR - 56, IR - 54 and IR - 20. IR - 8, Affa Mwanza and Matandiko matured approximately 30 days later than IR - 36. Maturity days of IR - 32 was same as that of IR - 8. Taiwan - 14 and IR - 42 matured approximately 10 days earlier than Matandiko.

Grain yield of local varieties was significantly lower than that of improved varieties. The causes of low grain yield of local varieties were less production of spikelet/m^2 and less production of panicles/m^2. Among improved varieties, IR -36, IR - 56, IR - 32 and IR - 42 were high tillering varieties and IR - 20 and IR -54 were low tillering. IR - 8, IR - 54 and IR - 56 were large grain type and small grain type varieties were IR - 20, IR - 36 and IR - 32. Among local varieties, panicle production of Affa Mwanza was the highest but spikelet/panicle was the lowest. Taiwan - 14 produced the largest number of spikelets/panicle but tillering was the lowest.

Conclusion:

Data obtained from 3 experiments and results of variety verification trial conducted in farmers' field were ploted in Fig. -31 . Moreover 3 varieties of Mdundiko, Super and Turiani obtained from field survey of traditional practices were also ploted to examine varietal characterisitcs in more detail.

As shown in Fig. -31, highly positive coreration of grain yield and spikelets/m^2($r = 0.64^{***}$) was observed. It was clear that grain yield could be increased as spikelets/m^2 was increased. However different range of variation of spikelets/m^2 was observed between improved and local varieties. Spikelet production/m^2 of improved variety ranged from 25×10^3 - 50×10^3 and grain yield was 5 - 8 ton/ha. While the range of spikelet production of local varity was 15×10^3 - $35 \times 10^3/m^2$ and variation grain yield was 2 - 4 ton/ha. It could be generally accepted that grain yield of local variety was lower than improved variety.

Highly positive coreration of spikelets/m^2 and panicles/m^2 was also observed($r = 0.63^{**}$). And it was known that primary factor of spikelet production/m^2 was panicles/m^2 because coefficient of coreration between spikelets/m^2 and spikelets/panicle was not highly significant. Different tendency of panicle production was observed between improved and local varieties. Spikelet production of improved variety ranged from 27×10^3 - $50 \times 10^3/m^2$ at 300 - 600/m^2 of panicle production. While spikelets per 1 m^2 of local variety was 15×10^3 - 35×10^3 at the range of 150 - 350/m^2 of panicles/m^2. It was observed that large panicle type of local variety could be better than improved variety if adequate number of panicles/m^2 was not obtained in improved variety. However it seemed that there was certain level of maximum production of panicles/m^2 in local variety. It might be difficult to obtain more than 350 number of panicles/m^2 in local variety. In case of improved variety, higher spikelet production/m^2 can be expected because of high productivity of panicles/m^2. Highly positive coreration of spikelets/panicle and spikelets/m^2 was not observed. However large panicle type of improved seemed to be effective for higher production of spikelets per 1 m^2 if number of panicles/m^2 could be increased. 30 x 10^3 - 40 x 10^3/m^2 of spikelets was obtained in small panicle type of improved variety.

Spikelets/panicle of local variety was larger than that of improved variety but spikelets/m^2 was lower than improved variety. If number of spikelets/panicle was 80 - 90, difference in spikelets/m^2 was approximately 10 x 10^3 between improved and local varieties. That difference was mainly due to panicle productivity per 1 m^2.

Eventually it could be mentioned that limiting factor of small panicle type variety could be panicle production/m^2. Large number of spikelet/m^2 can not be expected unless adequate number of panicles/m^2 is obtained. For large panicle type of improved variety, panicles/m^2 can also be a limting factor. If number of panicles/m^2 was increased, spikelets/m^2 could be increased mare remarkably than small panicle type. However tillering ability of large panicle type was generally lower than that of small panicle type. For this varietal characteristics, spikelet production/ panicle could be another limiting factor of large paniole type variety.

There was no significant coreration between grain yield and spikelets/panicle. Especially in local variety, grain yield did not vary with number of spikelets per panicle. In cae of improved variety, it was observed that there was high probability of better yielding with large panicle type.

There is certain limit of grain yield of local variety be cause of low panicle productivity. The low efficiency of grain production is disadvantage of nitrogen application. Approximately $300/m^2$ will be optimum number of panicles/m^2. Improved variety of large panicle type can be better than small panicle type for higher spikelet production/m^2. However panicles/m^2 will be a limting factor of both small and large panicle types. Especially for small panicle type, key point of good yield is to obtain more panicles/m^2 by any mean. For large panicle type, high panicle production/m^2 and large number of spikelets/panicle are key point for better yield. Management during panicle initiation to reduction division stages will be critical to obtain larger number of spikelets.

Finally characteristics of varieties investigated in 3 experiments can be summarized sa follows;

1. IR - 5

Grain yield	3.47 - 8.31 ton/ha
panicles/hill	19.7 - 29.8/hill
spikelets/panicle	71.1 - 116.4/panicle
1000 grain weight	21.6 - 23.5 g
grain/total production	32.6 - 46.7%
plant height	80.3 - 98.7 cm
maturity days	145 - 155 days
shattering	intermediate
stem borer damage	not observed
lodging	not observed

2. IR - 8

Grain yield	3.90 - 8.21 ton/ha
panicles/hill	16.2 - 31.7/hill
spikelets/panicle	71.7 - 124.9/panicle
1000 grain weight	26.5 - 31.2 g
grain/total production	38.5 - 53.6%
plant height	75.0 - 93.8 cm
maturity days	137 - 149 days
shattering	high
stem borer damage	not observed
lodging	not observed
remarks:	At max. tillering stage, yellowing of leaves was obsefved several times.

3. IR - 20

grain yield	3.34 - 8.64 ton/ha
panioles/hill	16.6 - 39.6/hill
spikelets/panicle	78.9 - 107.6/panicle
1000 grain weight	18.0 - 20.5 g
grain/total production	43.4 - 54.1 %
plant height	86.7 - 88.0 cm
maturity days	133 - 139 days
shattering	intermediate
stem borer damage	not observed
lodging	not observed
remarks:	very uniform heading

4. IR - 32

grain yield	4.01 - 7.28 ton/ha
panicles/hill	25.2 - 27.2/hill
spikelets/panicle	61.5 - 115.7/panicle
1000 grain weight	21.2 - 23.6 g
grain/total production	42.7 - 51.5 %
plant height	67.8 - 76.2 cm
maturity days	149 - 157 days
shattering	intermediate
stem borer damage	not observed
lodging	not observed
remarks:	Heading was not uniform. Errect flag leaf was observed

5. IR - 36

grain yield	3.67 - 7.10 ton/ha
panicles/hill	10.1 - 31.6/hill
spikelets/panicle	64.0 - 89.0/panicle
1000 grain weight	20.3 - 21.4 g
grain/total production	47.9 - 54.6 %
plant height	75.2 - 83.3 cm
maturity days	121 - 132 days
shattering	very low
stem borer damage	not observed
lodging	not observed

6. IR - 42

grain yield	3.36 - 7.45 ton/ha
panicles/hill	19.6 - 38.0/hill
spikelets/panicle	81.7 - 86.7/panicle
1000 grain weight	17.6 - 20.4 g
grain/total production	45.6 - 52.2 %
plant height	83.5 - 87.6 cm
maturity days	139 - 153 days
shattering	intermediate - high
stem borer damage	not observed
lodging	not observed

7. IR - 54

grain yield	3.88 - 7.87 ton/ha
panicles/hill	19.0 - 33.1/hill
spikelets/panicle	76.3 - 125.8/panicle
1000 grain weight	21.9 - 25.2 g
grain/total production	44.6 - 54.8 %
plant height	68.5 - 90.5 cm
maturity days	131 - 138 days
shattering	high
stem borer damage	not observed
lodging	not observed
remarks:	very uniform heading

8. IR - 56

grain yield	3.38 - 6.71 ton/ha
panicles/hill	20.3 - 41.7/hill
spikelets/panicle	59.4 - 80.1/panicle
1000 grain weight	22.0 - 25.2 g
grain/total production	50.0 - 54.0 %
plant height	79.0 cm
maturity days	118 - 132 days
shattering	low
stem borer damage	not observed
lodging	not observed

9. Surinam

grain yield	3.03 - 5.92 ton/ha
panicles/hill	16.3 - 35.1/hill
spikelets/panicle	66.0 - 96.0/panicle
1000 grain weight	20.8 - 25.9 g
grain/total production	39.2 - 47.5 %
plant height	94.0 cm
maturity days	118 - 120 days
shattering	low
stem borer damage	observed slightly
lodging	not observed

10. Kilombero

grain yield	2.29 - 4.97 ton/ha
panicles/hill	8.5 - 16.3/hill
spikelets/panicle	78.6 - 123.0/panicle
1000 grain weight	27.4 - 33.3 g
grain/total production	30.7 - 42.0 %
palnt height	83.0 - 115.1 cm
maturity days	137 - 153 days
shattering	intermediate
stem borer damage	observed
lodging	observed

11. Affa Mwanza

grain yield	3.13 - 6.50 ton/ha
panicles/hill	10.3 - 27.2/hill
spikelets/panicle	62.8 - 111.3/panicle
1000 grain weight	23.6 - 28.7 g
grain/total production	28.0 - 46.2%
plant height	80.0 - 122.7 cm
maturity days	141 - 162 days
shattering	intermediate - high
stem borer damage	observed
lodging	observed

12. Taiwan - 14

grain yield	2.30 - 5.49 ton/ha
panicles/hill	6.0 - 25.9/hill
spikelets/panicle	109.6 - 144.0/panicle
1000 grain weight	18.5 - 22.7 g
plant height	122.5 - 149.3 cm
maturity days	145 - 158 days
shattering	high
stem borer	observed often
lodging	observed often

13. Matandiko

garin yield	2.44 - 2.63 ton/ha
panicles/hill	12.1 - 14.1/hill
spikelets/panicle	86.0 - 87.8/panicle
1000 grain weight	23.5 - 25.2 g
grain/total production	16.3 - 27.0 %
plant height	120 cm
maturity days	150 - 168 days
shattering	very high
stem borer damage	observed often
lodging	observed often
Remarks:	seems to be very susceptible to stem borer

14. Super

grain yield	3.45 ton/ha
panicles/hill	16.2/hill
spikelets/panicle	65.6/panicle
1000 grain weight	32.7 g
grain/total production	47.0 %
plant height	110 cm
maturity days	---
shattering	high
stem borer damage	observed
lodging	observed

15. Turiani

grain yield	2.93 ton/ha
panicles/hill	10.3/hill
spikelets/panicle	84.5/panicle
1000 grain weight	26.4 g
grain/total production	47.0%
plant height	98.2 cm
maturity days	---
shattering	intermediate
stem borer damage	observed often
lodging	observed often

16. Mdundiko

grain yield	3.31 -3.88 ton/ha
panicles/hill	8.5 - 12.1/hill
spikelets/panicle	112.8 - 162.7/panicle
1000 grain weight	27.6 - 27.9 g
grain/total production	49.7 - 50.3 %
plant height	85.7 - 101.0 cm
maturity days	---
shattering	very high
stem borer damage	not observed
lodging	not observed

Except these varieties, there are other local varieties like Shindano, Manikora, Moshi was cigara, Shingo ya Mwali and Bwa la nzi which are cultivated in Lower Moshi area. But characteristics of these varieties are not yet investigated in detail.

TABLE -10

Summary Table of Variety Experiment 1982

Treatment	Grain yield ton/ha	Number of panicles per hill	Number of panicles per 1 m^2	Number of spikelets per panicle	Number of spikelets per 1 m^2	Ripening ratio %	1000 grains weight g	Grain/total production %	Maturity days
Surinam	3.05 ^{bc}	23.1 ^{a}	371.5 ^{a}	96.0 ^{c}	35.87 $\times 10^3$	72.7	22.5 ^{c}	47.5 ^{a}	120
Kilombero	2.93 ^{c}	13.3 ^{b}	224.1 ^{b}	107.0 ^{bc}	21.72	73.0	32.8 ^{a}	36.9 ^{bc}	137
Affa Mwanza	3.42 ^{bc}	17.0 ^{b}	287.0 ^{b}	95.6 ^{c}	27.09	76.8	28.7 ^{b}	34.1 ^{c}	145
Taiwan - 14	3.62 ^{ab}	15.2 ^{b}	272.1 ^{b}	142.2 ^{a}	35.62	81.1	22.6 ^{d}	40.9 ^{b}	152
IR - 8	4.14 ^{a}	16.2 ^{b}	281.4 ^{b}	122.0 ^{ab}	31.99	76.4	30.5 ^{ab}	51.9 ^{a}	147
$\bar{X}$	3.43	17.0	287.2	112.4	30.46	76.4	27.4	42.3	
Significance	*	*	*	**	10 %	ns	**	**	
C.V.	9.6	17.0	16.7	10.6	25.4	9.8	4.3	7.0	
LSD.05 V	0.62	5.4	75.7	22.4	-	-	2.3	5.6	

Data which is followed by a same letter indicates that there is no significant difference at the 5 % level.

** indicates statistical significance at the 1 % level and * indicates statistical significance at the 5 % level.

TABLE - 11
Summary Table of Variety Experiment 1983

Treatment	Grain yield ton/ha	Number of panicles per hill	Number of panicles per 1 m^2	Number of spikelets per panicle	Number of spikelets per 1 m^2	Ripening ratio %	1000 grains weight g	Grain/total production %	Maturity days
IR - 8	7.37 a	21.5 b	357.9 b	85.9 de	30.32 $\times 10^3$ ab	77.4 bcd	26.5 b	50.1 a	141
IR - 20	4.53 bcd	18.6 b	310.4 b	107.6 bc	33.48 ab	84.3 ab	18.4 f	50.9 a	134
IR - 36	5.52 b	25.5 a	425.0 a	83.7 de	34.58 a	81.2 bc	20.3 e	50.9 a	121
IR - 54	5.02 bc	19.0 b	316.7 b	90.6 cd	28.03 abc	83.5 ab	22.5 d	48.5 a	138
IR - 56	4.04 cd	21.7 ab	362.1 ab	68.1 e	22.34 c	84.4 ab	22.7 d	50.0 a	118
Taiwan - 14	4.02 cd	12.9 c	214.8 c	150.2 a	32.46 ab	71.6 d	19.2 f	34.6 bc	158
Affa Kwanza	5.05 bc	18.3 b	305.0 b	83.9 de	24.17 abc	91.2 a	25.0 c	36.7 b	148
Kilombero	3.57 d	9.8 c	162.4 c	115.3 b	21.18 c	74.9 cd	28.7 a	30.7 c	153
Surinam	4.33 bcd	18.7 b	311.7 b	86.2 d	24.08 b	77.3 bcd	22.0 d	47.2 a	118
$\bar{x}$	4.83	18.4	307.4	96.8	27.84	80.6	22.8	44.1	
Significance	**	**	**	**	*	**	**	**	
C.V. %	16.4	14.3	14.3	12.4	23.0	7.0	2.6	6.5	
LSD.05 V	0.12	3.8	64.2	17.5	9.35	8.3	0.9	4.2	

Data which is followed by a same letter indicates that there is no significant difference at the 5 % level.

** indicates statistical significance at the 1 % level and * indicates statistical significance at the 5 % level.

TABLE - 12

Summary Table of Variety Experiment 1984

Treatment	Grain yield ton/ha	Number of panicles per hill	Number of panicles per 1 m^2	Number of spikelets per panicle	Number of spikelets per 1 m^2	Ripening ratio %	1000 grains weight g	Grain/total production %	Maturity days
IR - 8	4.77 a	20.7 cd	332.9 cde	75.3 ef	25.12 x10^3 bc	77.3 bc	26.5 a	53.0 a	163
IR - 20	3.34 bc	21.6 c	342.8 bcd	91.6 b	31.57 ab	72.1 de	16.0 f	45.6 c	139
IR - 32	4.01 ab	27.2 ab	411.5 bc	67.2 f	27.52 bc	78.7 bc	21.2 e	47.9 dc	163
IR - 36	3.99 ab	31.6 a	545.9 a	71.7 e	39.15 a	68.1 ef	20.8 e	47.9 dc	132
IR - 42	4.74 a	24.3 bc	383.3 bcd	86.8 bc	33.40 ab	81.5 ab	18.2 f	50.6 ab	153
IR - 54	3.88 ab	19.3 d	312.2 def	82.8 bcd	24.90 bc	74.7 cd	23.1 cd	50.7 ab	136
IR - 56	3.88 ab	26.6 b	437.3 ab	68.0 f	29.58 b	74.9 cd	22.5 d	51.1 ab	132
Affa Mwanza	2.16 d	19.0 d	248.9 ef	77.6 cde	19.49 c	85.1 a	23.8 c	33.1 d	162
Taiwan - 14	2.30 d	16.5 de	225.0 f	120.7 a	27.34 bc	64.9 f	18.8 f	23.7 e	158
Matandiko	2.63 cd	14.3 e	223.4 f	87.8 bc	19.73 c	66.0 f	25.2 b	27.0 e	160
$\bar{x}$	3.57	22.1	346.4	82.9	27.88	74.4	21.8	43.1	
Significance	**	**	**	**	**	**	**	**	
C.V. %	16.6	14.0	18.0	6.8	20.1	4.4	2.5	7.4	
LSD.05 V	0.86	4.5	90.6	8.2	8.12	4.8	0.8	4.6	

Data which is followed by a same letter indicates that there is no significant difference at the 5 % level.

** indicates statistical significance at the 1 % level and * indicates statistical significance at the 5 % level.

FIG. - 31

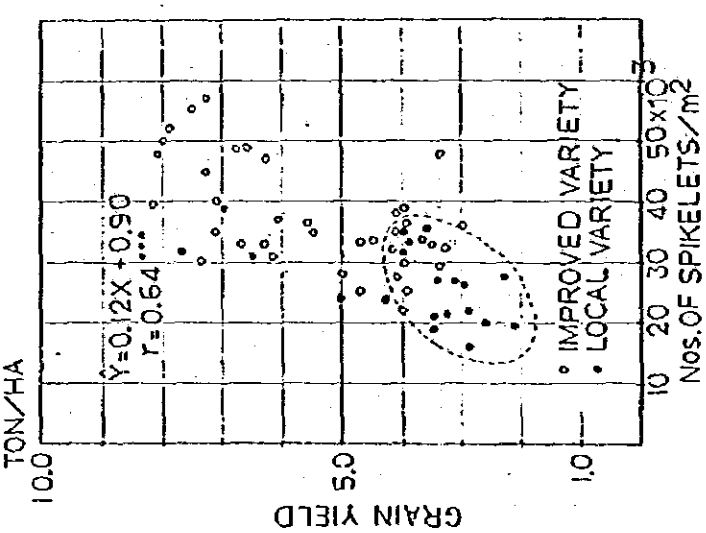

TON/HA
10.0
5.0
1.0
GRAIN YIELD
Y=0.12X+0.90
r=0.64
◦ IMPROVED VARIETY
• LOCAL VARIETY
10
20
30
40
50x10³
Nos.OF SPIKELETS/m²

FIG. - 32

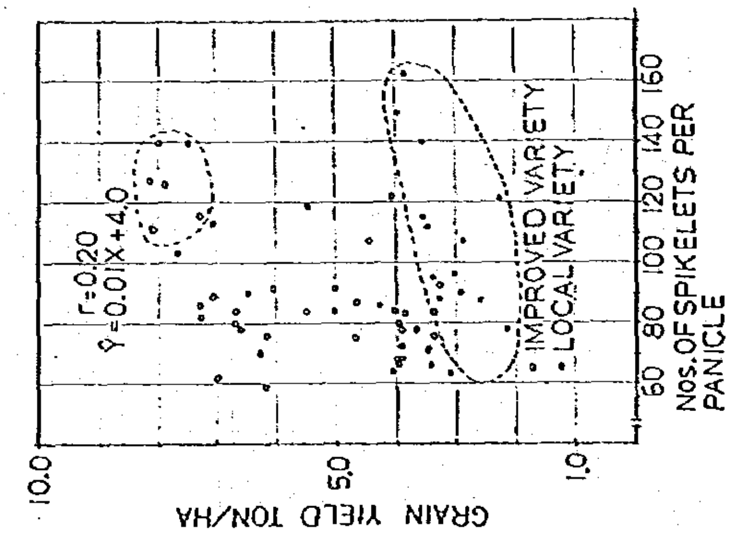

10.0
5.0
1.0
GRAIN YIELD TON/HA
r=0.20
Ŷ=0.01X+4.0
◦ IMPROVED VARIETY
• LOCAL VARIETY
60
80
100
120
140
160
Nos.OF SPIKELETS PER PANICLE

FIG-33

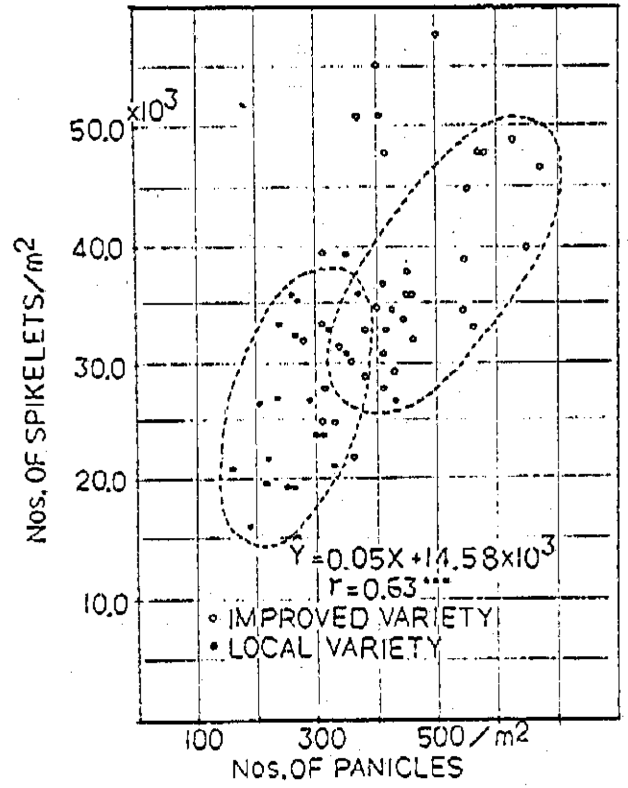
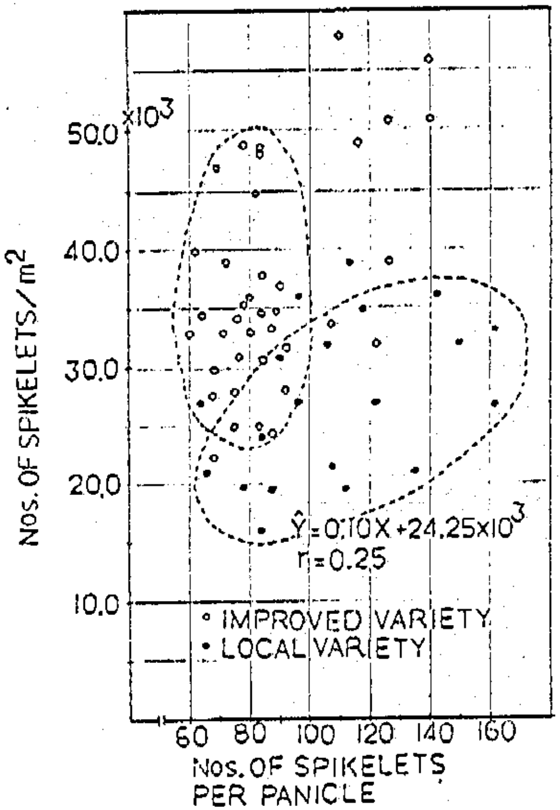

50.0 x10³
40.0
30.0
20.0
10.0
Nos. OF SPIKELETS/m²
Ŷ=0.05X+14.58x10³
r=0.63***
IMPROVED VARIETY
LOCAL VARIETY
100
300
500/m²
Nos. OF PANICLES

FIG-34


50.0 x10³
40.0
30.0
20.0
10.0
Nos. OF SPIKELETS/m²
Ŷ=0.10X+24.25x10³
r=0.25
IMPROVED VARIETY
LOCAL VARIETY
60 80 100 120 140 160
Nos. OF SPIKELETS PER PANICLE

Variety x Density Experiment

Objectives:

To find out proper density level for different variety and to examine interaction between varieties and densities.

Experimental design:

Split-plot design with 4 replications imposed on RCBD.
Main plots are varieties and subplots are densities.

Treatments:

1. 1982 in plot D-5

Varieties:	Densities:
V1. Surinam	D1. 44.4 hills/m^2(15 cm x 15 cm)
V2. Kilombero	D2. 25.0 hills/m^2(20 cm x 20 cm)
V3. Affa Mwanza	D3. 6.25 hills/m^2(40 cm x 40 cm)
V4. Taiwan - 14	
V5. IR - 8	

2. 1983 in plot D-1

Varieties:	Densities:
V1. IR - 36	D1. 25.0 hills/m^2(20 cm x 20 cm)
V2. Taiwan - 14	D2. 44.4 hills/m^2(15 cm x 15 cm)
V3. Surinam	D3. 66.7 hills/m^2(10 cm x 15 cm)
V4. Affa Mwanza	

Plot size:

4.8 m x 6.0 m(28.8 m^2) in 1982
3.0 m x 4.0 m(12.0 m^2) in 1983

Experimental period:

1. 1982 in plot D-5

   Sowing: 22 April 1982
   Transplanting: 31 May 1982
   Harvest: 5 Oct. 1982

2. 1983 in plot D-1

   Sowing: 15 Nov. 1983
   Transplanting: 15 Dec. 1983
   Harvest: 23 March 1984

Cultivation practices:

Fertilizer:	Fertilizer rate for the 1st experiment was 75 kg N/ha and 40 kg P_2O_5/ha. 100 kg N/ha and 40 kg P_2O_5/ha were for 2nd experiment. 50 % of nitrogen and 100 % of phosphorus were applied at the time of puddling. Remaining nitrogen was applied at tillering and panicle initiation stages.
Density:	as specified in treatments 3 seedlings/hill
Insect control:	Diazinon 40E of 1/1000 solution was sprayed to control stem borer at nursery stage and at the time of nitrogen top-dressing.
Weed control:	Weeds in plots were controlled properly by hand and any herbicide was not sprayed.

Discussion:

1. 1982(D-5)

This was the 1st experiment conducted in the trial farm and condition of the field was poor. Puddling was not done by tractor because tractor could not be operated in the field. Puddling was done by hand and basic fertilizer of nitrogen was also mixed by hand.

Significant effect of density on grain yield was observed at the 1 % level. Average yield of 5 varieties was increased as density was increased. Average yield of 3.82 ton/ha at the lowest density was increased to 4.54 ton/ha at 25.0 hills/m^2 which was significantly different from that of 6.25 hills/m^2. The highest grain yield was obtained at the highest density.

Difference of grain yield among 5 varieties was also significant at the 5 % level. The highest grain production was observed in IR - 8. Grain yield of Kilombero and Taiwan - 14 were significantly lower than that of IR - 8. Surinam and Affa Mwanza yielded almost same and their grain yield were lower than that of Kilombero. Differential response of density among 5 varieties was observed. Grain yield of IR - 8 was increased as density increased and the highest grain yield was obtained at 44.4 hills/m^2. The same response of Affa Mwanza to density was observed. On the contrary Kilombero, Surinam and Taiwan - 14 did not show clear response to density when density level was increased from 25.0 hills/m^2 to 44.4 hills/m^2.

The effect of density on spikelets/m^2 was significant at the 5 % level. Spikelet production/m^2 of 5 varieties were increased significantly when density was increased from 6.25 hills/m^2 to 25.0 hills/m^2. Spikelets/m^2 of varieties were increased even at the highest density, however the difference was not significant. Spikelet production of 5 varieties were also significantly different at the 1 % level. Spikelets/m^2 of IR - 8, Taiwan - 14 and Surinam were almost same. Kilombero produced the lowest spikelets among 5 varieties. Differential response of spikelets/m^2 among 5 varieties was observed at 3 density levels. Spikelets/m^2 of IR - 8, Affa Mwanza and Surinam were increased remarkably when density was increased from 6.25 hills per 1 m^2 to 25.0 hills/m^2. But spikelet production of these 3 varieties were reduced at the highest density. On the other hand, Spikelets/m^2 of Taiwan - 14 and Kilombero were increased even at the highest density of 44.4 hills/m^2.

Number of panicles/hill was significantly reduced regardless of varity at higher densities. The largest number of panicles/hill was observed in IR - 8 and Surinam at 6.25 hills/m^2. Panicles/hill of Affa Mwanza and Taiwan - 14 were almost same but they were lower than IR - 8. Panicles/hill of IR - 8 and Surinam were significantly reduced as density was increased. But Kilombero, Taiwan - 14 and Affa Mwanza produced almost same nuber of panicles/hii at 25.0 hills/m^2 and 44.4 hills/m^2. Panicle production of high tillering variety like IR - 8 and Surinam was stronglt affected by density. While number of panicles/hill of low tillering variety was not affected.

While panicles/hill was reduced at higher density levels, panicles/m^2 was increased as density level was increased and the highest production of panicles/m^2 was observed at 44.4 hills/m^2. Panicles/m^2 of Taiwan - 14 , Kilombero and Affa Mwanza were increased significantly even at the highest density. On the other hand, panicles/m^2 of Surinam and IR - 8 was not increaed at highest denity level.

It could be mentioned that reduction of spikelts/m^2 was more distinct in high tillering variety than large panicle type variety. Major cause of the reduction seemed to be less production of panicles at higher densities. Reduction of spikelets per panicle was also another cause of reduction of spikelets per 1 m^2. Panicles/m^2 of high tillering variety like IR - 8 and Surinam was not increased even density level was increased more than 25.0 hills/m^2. On the contrary large nuber of panicle production/m^2 can be expected at higher density levels.

Significant difference of ripening ratio was not observed among 5 varieties. Ripening ratio was not affected by density significantly but ripening ratio was reduced slightly as density level was increased. In case of IR - 8 and Surinam, the lowest ripening ratio was observed at 25.0 hills/m^2.

2. 1983(D-1)

The effect of density on grain yield was significant at the 1 % level. Grain yield of 4 varieties was increased as denity was increased. Difference in grain yield among 4 varities was also significant at the 1 % level. Grain yield of IR - 36 and Surinam were higher than Taiwan - 14. Grain yield of taiwan - 14 was the lowest at all 3 density levels. Grain yield of IR - 36 was slightly increased when denity was increased from 25.0 hills/m^2 to 44.4 hills/m^2 but no yield increase was observed at 66.7 hills/m^2. Other 3 varieties showed more clear response to density. Relatively high yield increase of Surinam was observed at the highest density.

Significant effect of density on spikelets/m^2 was observed at the 5 % level. Spikelets/m^2 of 4 varieties were increased when density was changed from 25.0 hills/m^2 to 44.4 hills/m^2. But spikelet production at 66.7 hills/m^2 was not difference from that of 44.4 hills/m^2. Differential response to density was also observed among 4 varieties when density was increased from 44.4 hills/m^2 to 66.7 hills/m^2. In IR - 36, spikelets/m^2 was not increased very much even density was increased from 25.0 hills/m^2 to 44.4 hills/m^2. And remarkable reduction was observed at the highest density. On the other hand spikelets per 1 m^2 of Taiwan - 14 and Surinam were not reduced significantly even at 66.7 hills/m^2.

Significant difference in spikelets/panicle was observed among 4 varieties. The largest number of spikelet was produced by Taiwan - 14 and it was reduced slightly as density was increased. Spikelets/panicle of IR - 36 and Surinam were the lowest among 4 varieties. Spikelets/panicle of Surinam was increased slightly as density was increased. Spikelts/panicle of Affa Mwanza was smaller than that of Taiwan - 14. and it was also reduced slightly at higher density levels. Reduction in panicle size of varieties might be due to high nutrition competition among plants at higher densitied.

Significant effect of density on panicles/hill was observed at the 1 % level. Panicles/hill of all varieties were reduced as density was increased. The difference among 4 varieties was also significant at the 1 % level. Panicle production of IR - 36 and Surinam were the highest among 4 varieties. The lowest production of panicles/hill was observed in Taiwan - 14. Differential response of variety at 3 density levels was also observed. At 25.0 hills/m^2, panicle production of IR - 36 was the highest and the lowest was Taiwan - 14. The difference among 4 varieties was clearly observed. At 44.4 hills/m^2 of density panicles/hill of all varieties were reduced however panicles of Taiwan - 14 and Affa Mwanza were significantly lower than that of IR - 36. At the highest density of 66.7 hills/m^2, panicles per hill of IR - 36, Surinam and Affa Mwanza were alomst same and the lowest number of panicles/hill was observed in Taiwan-14. Panicle production of Surinam and IR - 36 were reduced significantly at 66.7 hills/m^2 but that of Affa Mwanza and Taiwan - 14 were not reduced significantly. More remarkable reductin of panicles/hill was observed in IR - 36 than Taiwan - 14 and Affa Mwanza. It was also observed that there was no difference in panicles/hill among loe tillering and high tillering varieties when density was more than 44.4 hills/m^2.

Reduction of spikelets/panicle at higher density was not much as that of panicle/hill. That could be a reasons why spikelets/m^2 of high tillering variety was reduced at higher density and less reduction was observed in low tillering variety. High palnt population per unit area could be a way to compensate less panicle production of local variety.

Panicles/m^2 of 4 varieties were increased significantly when density was increased from 25.0 hill/m^2 to 44.4 hills/m^2 but significant increase was not observed at 66.7 hills/m^2. Response to density of IR - 36 and Surinam were different from that of Taiwan - 14 and Affa Mwanza. Panicles/m^2 of IR - 36 and Surinam were increased significantly as density was increased from 25.0 hills/m^2 to 44.4 hills/m^2 but they were reduced significantly at 66.7 hills/m^2. On hte other hand, panicles of Affa Mwanza and Taiwan - 14 were increased slightly even at the highest density. Main cause of reduction of panicles/m^2 of IR - 36 at the highest density could be due to less production of panicles/hill. High plant population in the field caused insect infestation. Except IR - 36, various number of White Head was observed in plots. Highest number of white head was observed in Taiwan - 14.

There was no significant difference in ripening ratio among 4 varieties. Average of ripening ratio was 77.8 % at 25.0 hills/m^2 and 79.8 % at 66.7 hills/m^2. The lowest ripening ratio among 4 varieties was observed in Taiwan - 14. Relatively good ripening of 85.2 % and 82.1 % were observed in Affa Mwanza and IR - 36 respectivley.

Grain yield was increased as density was increased but at the highest density of 66.7 hills/m^2 significant yield increase was not observed. Panicles/m^2 was also increased at higher density levels but differential response to density was observed among varieties. For high tillering varieties, density should not be more than 44.4 hills/m^2 otherwise high production of panicles/m^2 could not be expected. High density could be better for low tillering variety to obtain reasonable number of panicles/m^2 but insect attack is a factor to be considered. Labour requirement for transplanting at high density also should be considered. Time required for transplanting at 66.7 hills/m^2 was approximately 4 times more than that of 25.0 hills/m^2.

6 varieties of the experiments were splited into 4 groups. Taiwan - 14 and Kilombero were ploted together as local variety. IR - 8 and IR - 36 were also ploted as improved variety. In order to compare varieties in detail at different density levels, results of verification trials in the trial farm, pilot farm and farmers' field were also ploted together with experiments in Fig. -35 .

Positive correlation of grain yield and spikelets/m^2 was observed in all varieties. Coefficient of correlation of Surinam and Affa Mwanza were significant($r = 0.89^*$). It was observed that grain yield was increased clearly as spikelets/m^2 was increased. At the same level of spikelets/m^2, difference in grain yield was observed among varieties and it was mainly caused by ripening ratio and grain weight of variety. In case of improved variety, high grain yield was obtained at around 40×10^3 per 1 m^2 of spikelet production however grain yield of local variety at the same level of spikelets/m^2 was approximately 1.2 ton/ha. It seemed that significant increase of grain yield of local variety could not be expected even at $30 \times 10^3 - 40 \times 10^3$/$m^2$ of spikelets production. Low grain yield of local variety might be due to low ripening ratio.

Significant coefficient of correlation of ripening ratio and spikelets/m^2 was not observed. Ripening ratio of varieties was not changed even spikelets/m^2 was increased. Overall mean of ripening ratio was relatively low(73.4 %) and that could be a reason of non-significant difference of ripening ratio.

Positive correlation of spikelets/m^2 and panicles/m^2 was observed in all varieties. Even spikelets/m^2 of local variety was increased as panicles/m^2 was increased. Coefficient of correlation of local variety was not signifcant. In case of high tillering variety, significant increase of spikelets/m^2 could be expected as panicles/m^2 was increased. As mentioned above, high grain yield could be otained at $35 \times 10^3 - 40 \times 10^3$/$m^2$ of spikelet production. To obtain that number of spikelet/m^2, optimum number of panicles/m^2 seemed to be 400 - 500. Even at hiher than this level of panicles/m^2, spikelets/m^2 was not increased. Shortening of panicle size at higher level of panicles/m^2 might be a reason why spikelets/m^2 was not increased at higher level of panicles/m^2. The correlation of Affa Mwanza and Surinam was very similar to that of improved variety. In case of local variety, spikelets/m^2 was also increased as panicles/m^2 was increased. Larger number of spikelets/m^2 can be expected in local variety than in improved variety if number of panicles of improved and local varieties are same. But due to disadvantage of local variety, low tillering, large number of panicles/m^2 as improved variety can not be expected.

There might be certain density level to obtain maximum number of panicles/m^2 which results in high grain yield. Panicles/m^2 of improved variety was reduced when density was higher than 25 - 30 hills/m^2. As shown in Fig. - 36 , spikelet production of improved variety and Surinam was observed at 25.0 hills per 1 m^2 but it was not increased even density was increased more than that level. That was because of reduction of panicles/m^2 and spikelets/panicle. Since improved variety has high panicle productivity, 25.0 hills/m^2 of density level will be reasonable and 37×10^3 - 40×10^3/m^2 of spikelets can be expected at that density. In case of local variety, spikelets/m^2 was increased gradually as density was increased and no reduction was observed at higher density. To obtain 35×10^3/m^2 of spikelets which may be maximum production, approximately 350 panicles/m^2 is necessary. And that number of panicles can be obtained at 40 hills/m^2. However 40 hills/m^2 of density, 15 cm x 10 cm, may cause serious insect infestation and lodging of local variety. Moreover transplanting at 15 cm x 10 cm spacing requires tremendous labour cost and it will be difficult for farmers to transplant in such high density.

It was observed that high density caused significant yield increase of all variety. 25.0 hills/m^2 seems to be optimum density level for improved variety or high tillering variety. Density can be increased more than 25.0 hills/m^2 but significant yield increase can not be expected. From verification trials in farmers' field, high grain yield of improved varieties was obtained at 25.0 hills/m^2 density level.

For local variety, higher density of 40.0 hills/m^2 seems to be maximum density level to obtain high grain yield. However there are many factors to be considered. Stem borer damage may be increased if local variety is cultivated in such high density. Lodging can also be increased. Labour requiermnet for transplanting in such high density will be approximately 4 times more than that of 25.0 hills/m^2. Considering data obtained from verification trials in farmers' field and trial farm, optimum density for local variety will be around 20 - 25 hills/m^2. Growing season is also to be considered. In dry season cultivation, higher density may result in good production of grain. On the contrary, density should be reduced to minimize insect damage especially in local variety. 20 cm x 30 cm(16.7 hills/m^2) can be reasonable density for local variety in rany season.

TABLE -13

Summary Table of Variety x Density Experiment(1982)

Treatment	Grain yield ton/ha	Number of panicles per hill	Number of panicles per 1 m2	Number of spikelets per panicle	Number of spikelets per 1 m2	Ripening ratio %	1000 grains weight g	Grain/total production %
V1 - D1	4.62	9.9	435.6	73.5	31.99 x10³	72.4	25.9	48.3
V1 - D2	4.33	16.3	406.7	83.5	33.80	57.9	25.3	39.2
V1 - D3	3.03	35.1	210.6	92.9	19.35	68.9	22.8	42.0
V2 - D1	4.94	8.5	372.5	78.6	29.31	70.6	33.3	37.2
V2 - D2	4.16	9.7	243.3	82.4	20.00	70.9	31.8	34.5
V2 - D3	3.51	16.3	97.6	123.0	11.69	66.7	31.8	39.0
V3 - D1	5.17	10.3	398.9	80.0	30.53	66.4	28.4	34.3
V3 - D2	3.31	12.2	335.8	83.6	34.42	56.7	28.6	28.0
V3 - D3	3.51	26.2	157.4	97.6	15.55	72.2	28.0	41.0
V4 - D1	5.19	11.0	359.5	130.8	47.18	71.5	22.7	39.5
V4 - D2	5.08	12.9	237.4	150.9	36.15	68.3	21.7	35.9
V4 - D3	4.37	25.9	155.4	144.0	22.20	73.5	22.5	43.0
V5 - D1	7.32	8.7	381.3	100.6	38.00	66.6	30.4	41.8
V5 - D2	5.80	16.6	414.2	124.9	41.74	62.0	31.2	44.0
V5 - D3	4.67	29.3	278.7	94.0	33.24	69.8	30.4	53.6
$\bar{X}$	4.60	16.6	299.0	102.7	26.68	67.6	27.7	40.1
Significance	V**,D*	V**,D**,VxD**	V*,D**	V**,D**	V*,D**	ns	V**,D*	V10%,D10%
C.V. %	19.1	19.1	16.7	14.8	34.6	18.9	4.0	22.0
LSD.05 V	0.76	3.9	71.0	15.7	9.79	12.4	1.3	8.9
LSD.05 D	0.67	2.4	38.4	11.5	7.09	9.7	0.8	6.7
LSD.05 VxD	1.49	5.4	85.8	25.7	15.85	21.7	1.9	15.0

V1: Surinam
V2: Kilombero
V3: Affa Mwanza
V4: Taiwan - 14
V5: IR - 8

D1: 15cm x 15cm(44.4 hills/m^2)
D2: 20cm x 20cm(25.0 hills/m^2)
D3: 40cm x 40cm(6.25 hills/m^2)

** indicates statistical significance at the 1 % level and * indicates statistical significance at the 5 % level.

TABLE -14

Summary Table of Variety x Density Experiment(1984)

Treatment	Grain yield ton/ha	Number of panicles per hill	Number of panicles per 1 m^2	Number of spikelets per panicle	Number of spikelets per 1 m^2	Ripening ratio %	1000 grains weight g	Grain/total production %
V1 - D1	5.86	23.6	548.1	72.9	39.46 $\times 10^3$	78.7	20.8	54.1
V1 - D2	6.21	16.3	635.3	67.2	42,97	82.3	20.9	54.6
V1 - D3	6.13	10.1	531.2	64.0	33.81	85.2	20.9	53.8
V2 - D1	4.50	12.1	268.5	125.0	33.20	71.6	18.2	30.4
V2 - D2	4.56	7.7	304.4	122.6	37.08	72.2	18.5	29.8
V2 - D3	5.09	6.0	320.2	112.1	36.28	70.4	18.8	30.8
V3 - D1	5.31	20.0	486.1	66.0	31.98	77.7	20.8	41.2
V3 - D2	5.92	15.2	585.2	74.0	42.19	79.5	20.9	40.4
V3 - D3	7.02	10.0	514.6	78.0	40.69	77.0	21.5	44.3
V4 - D1	5.09	15.1	336.3	83.7	27.76	83.3	24.6	37.1
V4 - D2	5.81	10.7	401.8	80.5	32.45	85.9	24.6	35.3
V4 - D3	6.44	10.3	535.0	76.0	40.42	86.5	23.6	34.0
$\bar{X}$	5.68	13.1	455.2	85.2	36.52	79.2	21.2	40.5
Significance	V*,D**	V**,D**,VxD**	V**,D*,VxD**	V**	D*,VxD*	ns	V**	V**
C.V. %	11.6	15.4	13.4	11.9	13.3	4.9	6.6	7.8
LSD.05 V	1.09	1.7	75.4	11.4	6.11	-	0.8	6.2
LSD.05 D	0.48	1.5	44.8	7.4	3.58	-	1.0	2.3
LSD.05 VxD	0.97	3.0	89.6	14.8	7.15	-	2.1	4.6

V1: IR - 36
V2: Taiwan - 14
V3: Surinam
V4: Affa Mwanza

D1: 20cm x 20cm(25 hills/m^2)
D2: 15cm x 15cm(44.4 hills/m^2)
D3: 10cm x 15cm(66.7 hills/m^2)

** indicates statistical significance at the 1 % level and * indicates statistical significance at the 5 % level.

FIG - 35

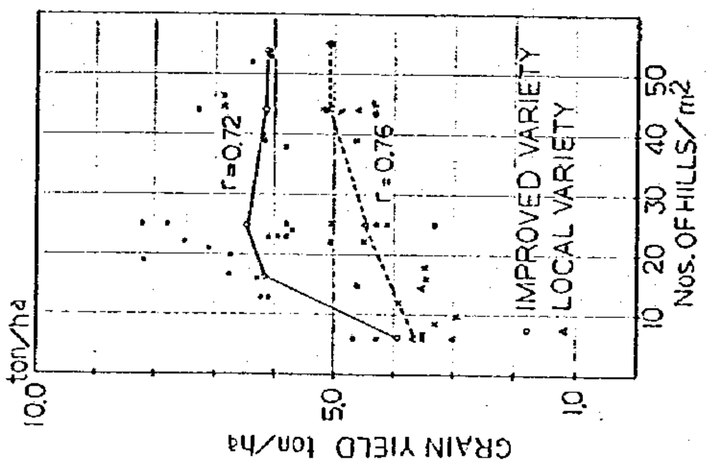

10.0 ton/ha
5.0
1.0
GRAIN YIELD ton/ha
r=0.72**
r=0.76**
IMPROVED VARIETY
LOCAL VARIETY
10 20 30 40 50
Nos. OF HILLS/m2

FIG -36

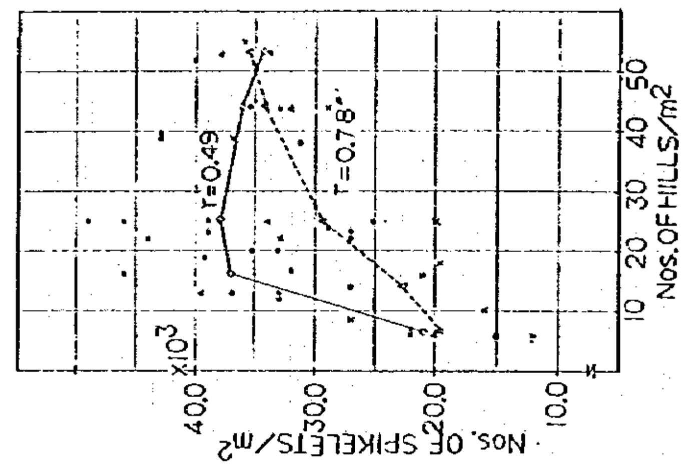

x10^3
40.0
30.0
20.0
10.0
Nos. OF SPIKELETS/m2
r=0.49
r=0.78**
10 20 30 40 50
Nos. OF HILLS/m2

FIG - 37

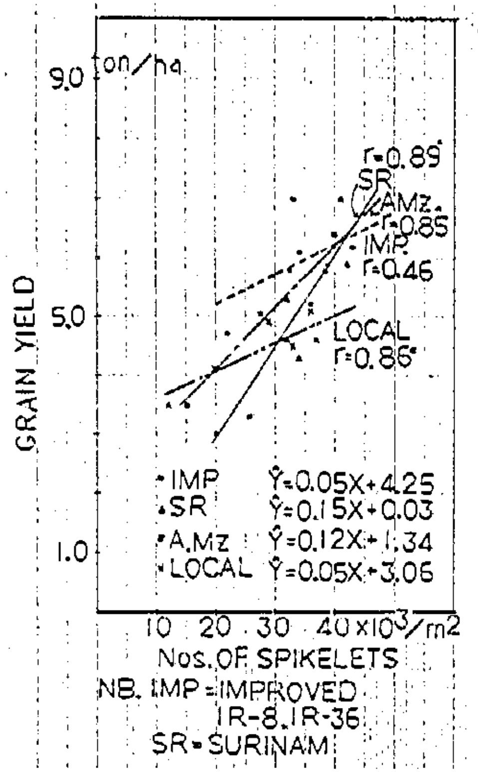


FIG - 38 -

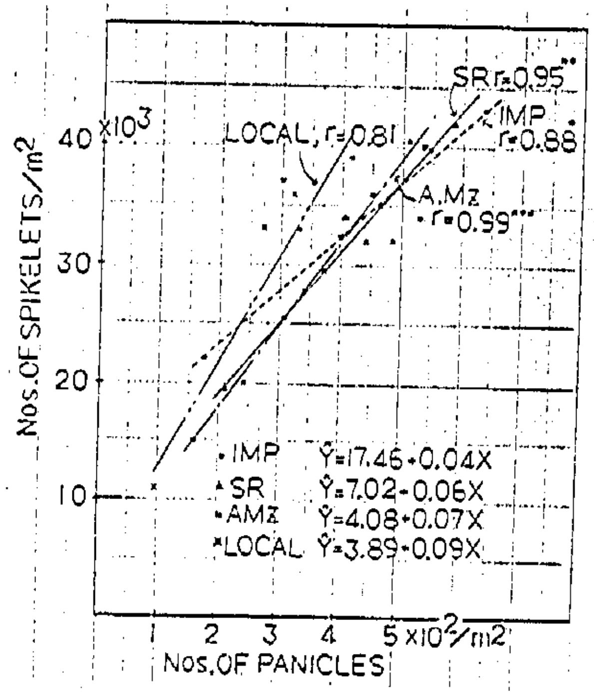
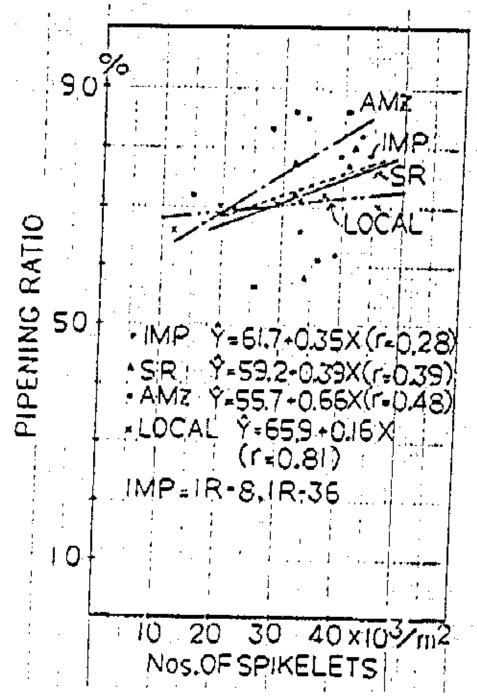


FIG - 39



Fertilizer Experiment

Objectives:

To study the effect of nitrogen and phosphorus fertilizers on grain yield of rice and to determine optimum rate of fertilizer application.

Experimental design:

Randomized complete block design with 4 replications. Two factors of nitrogen and phosphorus were arranged as 4 x 3 factorial experiment.

Treatments:

Nitrogen	N0	0 N applied
	N50	50 kg N/ha
	N100	100 kg N/ha
	N150	150 kg N/ha
	Source of nitrogen: Urea 46 % N	
Phosphorus	P0	0 P_2O_5 applied
	P40	40 kg P_2O_5/ha
	P80	80 kg P_2O_5/ha
	Source of phosphorus: TSP 46 % P_2O_5	

Plot size:

4.0 m x 5.0 m(20 m^2) in 1983
3.0 m x 4.0 m(12 m^2) in 1983 and 1984

Variety:

IR - 8 in 1983
IR - 54 in 1983 and 1984

Experimental period:

1. 1983 in plot D-6

   Sowing: 19 Feb. 1983
   Transplanting: 25 March 1983
   Harvesting: 28 July 1983

2. 1983 in plot D-7 (IR - 54)

   Sowing: 13 Oct. 1983
   Transplanting: 16 Nov. 1983
   Harvesting: 16 Feb. 1984

3. 1984 in plot D-4 (IR - 54)

Sowing: 13 Sept. 1984
Transplanting: 19 Oct. 1984
Harvesting: 22 Feb. 1985

Cultivation practices:

Fertilizer:	50 % of total amount of nitrogen and 100 % of phoshprus were applied at the time of puddling and remaining nitrogen was applied at tillering and panicle initiation stages.
Density:	20 cm x 30 cm(16.7 hills/m^2) 3 seedlings/hill
Insect control:	Diazinon 40E of 1/1000 solution was sprayed to control stem borer at nursery and at the time of nitrogen top dressing.
Weed control:	Weeds in plots were uprooted and controlled by hand properly. No herbicide was sprayed.

Discussion:

1. 1983(D-6) IR - 8

Significant effect of nitrogen application on grain yield was observed at the 1 % level. 1.48 ton/ha of grain yield was increased when nitrogen level was increased form N0 to N50. However the difference in yield among N50, N100 and N150 was not significant. Very slight yield increase was observed at higher nitrogen level. The effect of phosphorus on grain yield was not significant.

Spikelets/m^2 at 4 nitrogen levels was significantly different at the 1 % level. As nitrogen level was increased form N0 to N50, approximately 50 % of increase in spikelets/m^2 was observed. The largest number of spikelets, 37.43 x $10^3/m^2$, was obtained at N150. Significant effect of phosphorus was not observed. The highest spikelet production was observed at P0 and the smallest was at P40. The difference in spikelets/m^2 between P0 and P40 was 1.13 x $10^3/m^2$. Highly significant increase of spikelets/m^2 seemed to be due to high panicle production/m^2 and spikelets/panicle at higher nitrogen level.

Panicles/m^2 was increased significantly by nitrogen application. As nitrogen level was increased from N0 to N50, panicle production was increased from 167.1/m^2 to 244.5/m^2. And

Panicles/m^2 at N150 was the highest among 4 nitrogen levels. But there was no significant difference between N100 and N150. Panicle production/hill was also increased by nitrogen application. Number of panicles/hill at N100 and N150 was almost same. Significant effect of phosphorus on panicles/m^2 was not observed. Nitrogen application caused significant increase of spikelets/panicle when 150 kg N/ha was applied.

Both factors of panicles/hill and spikelets/panicle were increased by nitrogen application. Phosphorus application did not cause significant increase of both factors.

Negative effect of nitrogen application was observed on ripened grain ratio. As nitrogen level was increased form N0 to N50, ripening artio was reduced. The lowest ripening ratio was observed at N150. Significant reduction of ripening ratio might be due to spikelet production at higher nitrogen level. Larger number of spikelets caused reduction of ripening ratio Application of nitrogen caused 84.4 % of increase in spikelet production at N50, while reduction in ripening ratio was very slight. When nitrogen level was increased from N50 to N100 increase in spikelets/m^2 was 18 %, while ripening ratio was reduced from 80.0 % to 69.8 %. The same tendency was also observed at N150 level. The effect of phosphorus on ripening ratio was not observed. It was observed that reduction in ripening ratio was main cause of less increase in grain yield at higher nitrogen levels.

The efficiency of grain production was also reduced significantly as nitrogen level was increased. At N0 and N50 levels, 50 % of total production of sample plants was grain. As nitrogen level was increased from N50 to N100 the efficiency was reduced from 50 % to 44.4 % and the lowest grain production efficiency of 39.8 % was observed at N150.

2. 1983(D-7) IR - 54

Significant effect of nitrogen on grain yield was observed at the 1 % level. At N0 level, grain yield was 4.22 ton/ha. And as nitrogen level was increased from N50 to N100 grain yield was also increased from 5.47 ton/ha to 6.02 ton/ha. The highest grain yiold was obtained at N150 level. The effect of phosphorus was also significant at the 5 % level. Application of 80 kg P_2O_5/ha caused significant yield increase but yield difference between P40 and P80 was not observed.

Highly significant effect of nitrogen on spikelets/m^2 was observed. 22.60 x $10^3/m^2$ of spikelets were produced at N0 level and each 50 kg of nitrogen/ha caused significant increase in spikelets/m^2. The largest number of spikelets/m^2 was obtained at N150 level. The effect of phosphorus was also significant at the 5 % level. But there was no difference between P40 and P80 levels. More distinct effect of phosphrus was observed at higher nitrogen level.

Nitrogen application caused significant difference in panicle production. Panicle production at N0 was 238.8/m^2 which was the lowest among 4 nitrogen levels. As nitrogen level was increased, panicles/m^2 was also increased. Panicles/m^2 at N100 was significantly higher than that of N0 but it was almost same as that of N50. The highest production was obtained at N150. Higher panicle production at N100 and N150 resulted into larger number of spikelet production. The effect of phosphorus was not observed. Significant increase in spikelets/panicle and panicles per hill at high nitrogen level were causes of distinct increase of spikelets/m^2 at higher nitrogen level.

It could be summarized that significant increase of grain yield was mostly caused by higher spikelet production/m^2 at N100 and N150 levels. Even spikelets/m^2 was increased significantly at N100 and N150, ripening ratio was not reduced. Nitrogen application did not cause reduction in ripening ratio. Ripening ratio at 4 nitrogen levels was same even spikelets/m^2 was increased significantly.

The grain production efficiency at all nitrogen levels was approximately 49.6 %. Nitrogen application did not cause significant difference in the efficiency.

It was observed that there was high probability of yield increase when nitrogen was applied. Optimum nitrogen level seemed to be N100 to N150. Phosphorus could be applied at the rate of P40 and nitrogen also should be applied toghether. Yield increase due to nitrogen application was mainly caused by significant increase in panicle production and spikelet production.

3. 1984(D-4) IR - 54

In 3rd experiment, shortage of irrigation water caused yield reduction of all treatments. Approximately 10 days after tranaplanting, water pump was broken and alternative water source was taken to irrigate experimental plots. But water was not enough to cover whole plots. Nitrogen top-dressing was not applied at proper stage because of shortage of irrigation.

As shown in summary table of the experiment, significant effect of nitrogen on grain yield was observed at the 1 % level. Grain yield at N0 was 2.32 ton/ha which was significantly lower than that of N50. The highest grain yield was obtained at N150. However average yield of all treatments was 3.30 ton/ha and it was very low as compared to other experiments. The effect of phosphorus on grain yield was not observed.

Nitrogen application significant increase of spikelet production/m^2 and it was main cause of yield increase. Spikelet production of $12.90 \times 10^3/m^2$ at N0 was extremely low. Application of 50 kgN/ha increased spikelet production from 12.90×10^3 to $18.76 \times 10^3/m^2$ and the highest production was observed at N150 level. However significant difference between N100 and N150 was not observed. Main cause of spikelets/m^2 was high production of spikelet/panicle.

Number of spikelets/panicle was increased by nitrogen application. 64.0 of spikelets were produced per panicle at N0 level while spikelts/panicle at N100 was 78.2/panicle. Application of 150 kg N/ha did not cause significant difference in spikelet/panicle. Nitrogen application also caused very clear difference in panicles/m^2. Panicle produced at N0 was 201.8/m^2 while 50 kg N/ha increased panicle production by 30 %. The highest panicle production was obtained at N150 level. Panicles per 1 m^2 was increased significantly by nitrogen application but number of spikelets/panilce did not respond to nitrogen. Different responses of panicles/hill and spikelets/panicle were cause of non-significant increase of spikelets/m^2 at N100 and N150 levels.

Negative effect of nitrogen was observed on ripening ratio. When spikelets/m^2 was $12.90 \times 10^3/m^2$ at N0, ripening ratio was 82.2 % while 75.1 % of ripening ratio was obtained at 25.86 x

$10^3/m^2$ of N150 level. Coefficient of correlation between spikelets/m^2 and ripening ratio was highly negative. Reduction of ripening ratio at higher nitrogen level was a cause of non-significant yield increase at N150. The effect of phosphorus on ripening ratio was not observed.

In all experiments, positive correlation between grain yield and spikelets/m^2 was observed. Grain yield was rearly increased by nitrogen application. However even at same number of spikelets/m^2, grain yield of 3 experiments was different. At $25 \times 10^3/m^2$ of spikelets production, grain yield of IR - 8 was approximately 5.0 ton/ha and that of IR - 54(1984) was around 3.7 ton/ha. The difference in grain yield of experiments seemed to be due to difference in ripening ratio and grain weight.

In 2nd experiment of IR - 54, spikelets/m^2 incresed to 40×10^3 and grain yield obtained at that level of spikelets was 7.2 - 7.4 ton/ha, while same variety in 3rd experiment grain yield obtained at the highest peoduction of spikelets/m^2 of 28×10^3 was 4.5 ton/ha. In case of IR - 8 in 1983, grain yield was increased as spikelets/m^2 was increased. However grain yield was not increased at all when spikelets/m^2 was more tha $30 \times 10^3/m^2$. Optimum level of spikelets/m^2 of IR - 8 seemed to be $25 \times 10^3 - 30 \times 10^3/m^2$. Even spikelet production could be increased more than this level, yield increase could not be expected. Optimum spikelets/m^2 of IR - 54 could be $35 \times 10^3 - 40 \times 10^3$. The results of 3rd experiment was very important to know the effect of mamagement factor on grain yield. Grain yield of IR - 54 in the experiment was extremly low and it was a cause of shortage of irrigation water. Shortage of water in field may occur often in Lower Moshi area.

Negative correlation between ripening ratio and spikelets per 1 m^2 was observed. The coefficient of correlation of two experiments, IR - 8 in 1983 and IR - 54 in 1984, was significant($r = -0.93$*** in IR - 8, $r = -0.80$** in IR - 54). It was known that ripening ratio was reduced as spikelets/m^2 was incresed. However there must be certain level of spikelets/m^2 which good production of grain can be obtained. As shown in Fig.-44, ripening ratio of IR - 8(1983) and IR - 54(1984) became less than 80 % when spikelets production was higher than $20 \times 10^3/m^2$, while ripening ratio of IR - 54(1983) at same level of spikelets/m^2 was appoximately 90 %. In case of IR - 8, ripening ratio was reduced to 60 % when 40 x $10^3/m^2$ of spikelets was obtained. Ripening ratio of IR - 54(1984) was approximately 75 % at the level of 30 x $10^3/m^2$. In case of IR - 54(1983), ripening ratio did not change even spikelets/m^2 was increased. 90 % of ripening ratio was obtained even 40 x $10^3/m^2$ of spikelets were produced. The reason why negative correlation of IR - 54 in 1983 was not observed was not known, however it is generally accepted that ripening ratio is reduced when spikelet production is increased. In case of IR - 8, 80 % of ripening ratio could be expected at 20 x $10^3/m^2$ of spikelet production. However 20 x $10^3/m^2$ of spikelets could not result in good production of grain. 25 x 10^3 - 30 x $10^3/m^2$ of spikelet could be reasonable level for good grain yield.

In all experiments, positive correlation of spikelets/m^2 and panicles/m^2 was observed. Coefficient of correlation of 3 experiments were highly significant. However spikelets/m^2 of IR - 8 and IR - 54 at same level of panicles/m^2 was different. The difference was caused by spikelt production per panicle of two varieties. At 300 panicles/m^2, IR - 8 produced 35 x 10^3 of spikelets/m^2 which may result in reduction of ripening ratio. To obtain 25 x 10^3 - 30 x $10^3/m^2$ of spikelets, 230 - 270 of panicles/m^2 might be required. For IR - 54, 40 x $10^3/m^2$ of spikelets production could be obtained at 370/m^2 of panicles.

Number of spikelets/m^2 varys with panicle production/m^2 and number of spikelets/panicle. It is not easy to decide optimum level of panicles/m^2 and spikelets/m^2 unless spikelets production/panicle of variety is concerned. There are different ways of getting optimum number of spikelets/m^2. Using large panicle-type variety could be a way to increase spikelets/m^2. Tillering-type varity which produces small panicles can be another way to obtain high spikelt production/m^2.

It was known that spikelts/m^2 was increased when panicles per 1 m^2 was increased. To obtain higher production of panicle per 1 m^2, there are many ways. To increase plant population per unit area by transplanting seedlings at high density and application of nitrogen are reasonable ways.

Conclusion:

Nitrogen application caused significant yield increase. Optimum rate of nitrogen can be 100 - 150 kgN/ha. The effect of phosphorus on grain yield can not be expected very much, however 40 kg P_2O_5/ha seems to be optimum rate. Phosphorus should be applied together with nitrogen.

Spikelets/m^2 is major limiting factor of grain yield. Nitrogen application causes significant increase of spikelets/m^2(which is due to significant increase of panicles/m^2) but at the sametime causes reduction of ripening ratio. Optimum number of spikelets/m^2 of IR - 54 seems to be $35 \times 10^3 - 40 \times 10^3/m^2$ while $25 \times 10^3 - 30 \times 10^3/m^2$ seems to be optimum level for IR - 8. But management problem such as shortage of irrigation water is happened, reduction of spikelets/m^2 and ripening ratio are ocбured.

Economic effect of fertilizer application was examined by marginal rate of return analysis. Net benefit of treatments was caluculated only by price of product and cost of fertilizer. Other cost like labour wage, transport cost of fertilizer and cost for land preparation are not considered because these costs are the same for all treatments. Positive marginal rate of return were observed in N50PO and N100PO in IR - 8(1983), N150PO, N150P40 and N50P40 in IR - 54(1983), N100PO, N50PO and N150P80 in IR - 54(1984).

Economic effect of fertilizer application

Treatments	M.R.R.	Expt.
N50PO	21.18	IR - 8(83)
N100PO	0.86	IR - 8(83)
N50PO	8.88	IR - 54(83)
N50P40	9.56	IR - 54(83)
N100PO	4.43	IR - 54(83)
N50P80	2.46	IR - 54(83)
N150PO	14.59	IR - 54(83)
N150P40	12.24	IR - 54(83)
N50PO	5.05	IR - 54(84)
N100PO	7.89	IR - 54(84)
N150P80	2.87	IR - 54(84)

Economic nitrogen rate seemed to be 100 kg N/ha. Economic effect of N150 was still positive but M.R.R. of N150 was less than that of N100. Economic effect of phosphorus was not observed. Phosphorus application caused increase in cost of fertilizer but did not result in increase of benefit. Optimum rate of phosphorus application could be 40 kg P_2O_5/ha when 100 - 150 kg of nitrogen was applied.

Recommendable fertilizer rate can be summarized as follows; N150P40 is recommendable for farmers who have large capacity of capital investment. However growing season should be considered. N100P40 is also recommendable for farmers who cultivate imporved variety. When N150P40 and N100P40 rate of fertilizers are applied, proper water management, weed control and insect control are strongly required. If farmers do not find effect of phosphorus or phosphorus fertilizer is not available, phosphorus can be applied every 3 - 4 years at the rate of 40 kg P_2O_5/ha. N50P0 is recommendable for farmers who do not have large capacity of capital. Nitrogen application alone can increase grain yield. Farmers can get reasonable benefit from application of nitrogen 50 kg/ha. If water problem or other management problem are observed frequently, application of N150P40 or N100P40 may increase risk for farmers.

Climatic condition of growing season should be considered to decide rate of fertilizer application. It is generally accepted that solar dariation/cm^2 and temperature affect ripening ratio. Recommendable fertilizer rate could be different in rain season and dry season.

N150P40 can be recommended for improved variety in sunny season cultivation. N100P40 is also recommendable for improved variety in rain season. N100P0 can also be recommended for improved variety. N50P0 can be recommended for local variety.

TABLE-15

Summary table of Fertilizer Experiment IR - 8(1983)

Treatments	Grain yield ton/ha	Nos of Panicles per 1 m^2	Nos of spikelets per 1 m^2	Ripening ratio %	1000 grain weight g	Grain/total production %
N0 - P0	2.97	157.2	14.73 x10^3	83.7	28.2	50.3
N0 - P40	3.27	175.0	17.30	82.4	28.9	50.6
N0 - P80	3.33	169.1	16.50	80.4	28.9	49.3
N50 - P0	4.99	256.9	26.00	79.5	28.8	47.4
N50 - P40	4.62	238.7	22.73	80.8	28.9	47.8
N50 - P80	4.41	237.9	25.13	79.6	28.4	48.3
N100 - P0	5.16	264.6	31.73	69.4	28.2	44.1
N100 - P40	5.22	272.9	28.50	70.4	29.3	44.6
N100 - P80	4.99	278.9	27.23	69.7	27.3	44.6
N150 - P0	5.24	294.6	36.50	60.9	28.6	39.2
N150 - P40	5.23	299.7	35.90	60.6	28.3	38.5
N150 - P80	4.99	300.1	39.90	62.6	27.6	41.6
$\bar{X}$	4.54	245.5	26.84	73.7	28.5	45.5
Significance	N**	N**	N**	N**	P(10%)	N**
C.V. %	15.9	13.8	14.0	6.5	2.3	5.8
LSD.05 N	0.70	33.1	3.68	4.7	0.6	2.6
LSD.05 P	0.61	28.6	3.19	4.1	0.5	2.2
LSD.05 NxP	1.22	57.3	6.38	8.1	1.1	4.5

TABLE-16

Summary table of fertilizer experiment IR - 54(1983)

Treatments	Grain yield ton/ha	Nos.of panicles per 1 m^2	Nos. of spikelets per 1 m^2	Ripening ratio %	1000 grain weight g	Grain/total production %
N0 - P0	4.00	235.4	20.54 x10^3	90.4	22.1	50.4
N0 - P40	3.87	234.2	22.97	86.3	21.9	48.9
N0 - P80	4.80	246.7	24.29	90.7	22.2	49.6
N50 - P0	4.90	270.0	23.47	93.1	23.0	51.7
N50 - P40	5.61	272.9	26.74	91.4	22.9	50.1
N50 - P80	5.89	287.5	30.50	90.7	23.2	49.1
N100 - P0	5.74	274.2	27.88	92.0	23.4	49.2
N100 - P40	5.91	309.2	30.64	91.6	23.1	49.9
N100 - P80	6.40	335.0	35.94	91.7	23.1	49.6
N150 - P0	6.62	356.2	35.81	90.2	23.0	49.3
N150 - P40	7.51	361.7	41.14	87.4	22.8	49.9
N150 - P80	7.38	370.4	41.44	89.8	22.9	47.9
$\bar{x}$	5.72	296.1	29.97	90.4	22.8	49.6
Significance	N**, P*	N**	N**, P**	ns	N**	ns
C.V. %	15.1	12.2	16.9	3.5	2.2	4.5
LSD.05 N	0.72	30.1	4.23	-	0.42	-
LSD.05 P	0.62	26.1	3.66	-	0.36	-
LSD.05 NxP	1.24	52.2	7.33	-	0.73	-

TABLE-17

Summary table of fertilizer experiment IR -54(1984)

Treatments	Grain yield ton/ha	Nos. of panicles per 1 m^2	Nos. of spikelets per 1 m^2	Ripening ratio %	1000 grain weight g	Grain/total production %
N0 - P0	2.48	211.6	13.62 $\times 10^3$	83.6	22.4	53.7
N0 - P40	2.11	194.3	12.49	80.5	21.3	51.7
N0 - P80	2.36	199.6	12.60	82.5	21.3	54.7
N50 - P0	3.03	246.5	17.89	81.9	21.8	48.6
N50 - P40	2.96	280.6	19.82	81.0	21.5	48.2
N50 - P80	3.08	257.7	18.57	79.2	21.4	47.5
N100 - P0	3.84	311.6	24.38	78.8	21.9	50.5
N100 - P40	3.70	310.7	23.19	79.1	21.7	50.1
N100 - P80	3.96	295.5	24.38	75.5	21.8	51.3
N150 - P0	3.67	320.7	25.16	76.7	21.1	49.6
N150 -P40	3.68	305.9	26.81	70.8	20.6	46.9
N150 - P80	4.71	360.8	25.61	77.8	21.6	53.2
$\overline{X}$	3.30	274.6	20.38	78.9	21.5	50.5
Significance	N**	N**	N**	N**	ns	N**
C.V. %	18.0	6.9	18.6	5.1	3.4	6.4
LSD.05 N	0.50	15.8	3.17	3.3	-	2.7
LSD.05 P	0.43	13.7	2.74	2.9	-	2.3
LSD.05 NxP	0.86	27.3	5.49	5.8	-	4.7

FIG-40 N x P EXPT

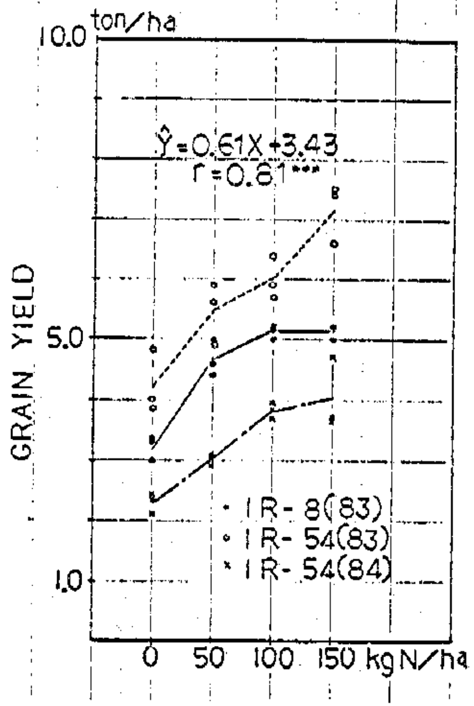


FIG-41 N x P EXPT

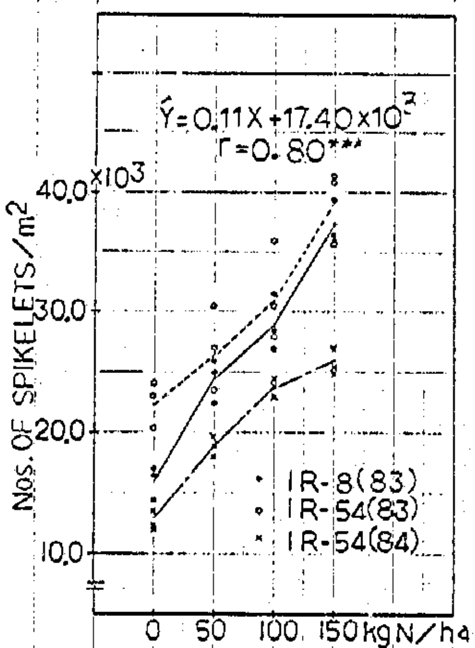


FIG-42 N x P EXPT

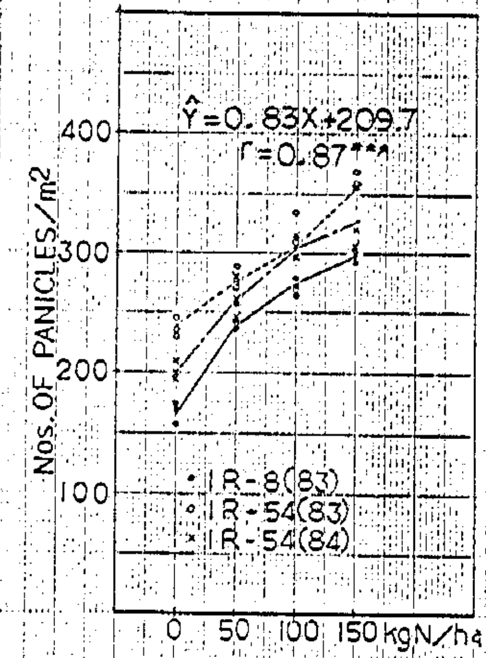


FIG -43

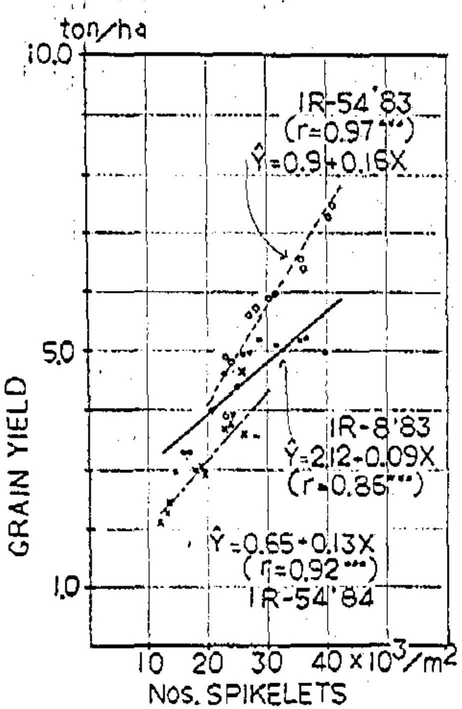


FIG -44

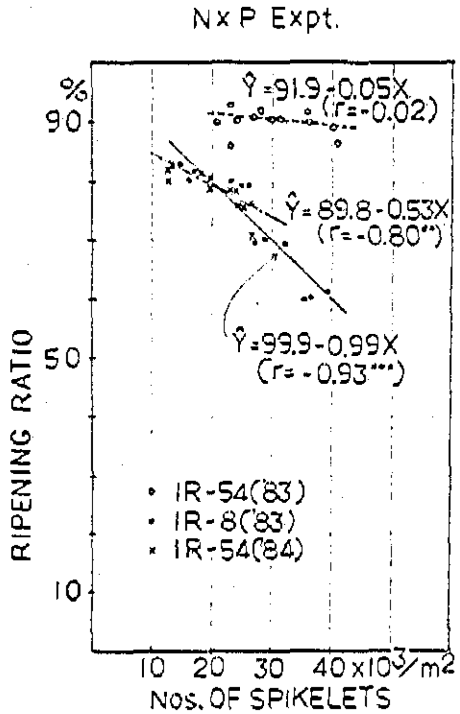


FIG -45

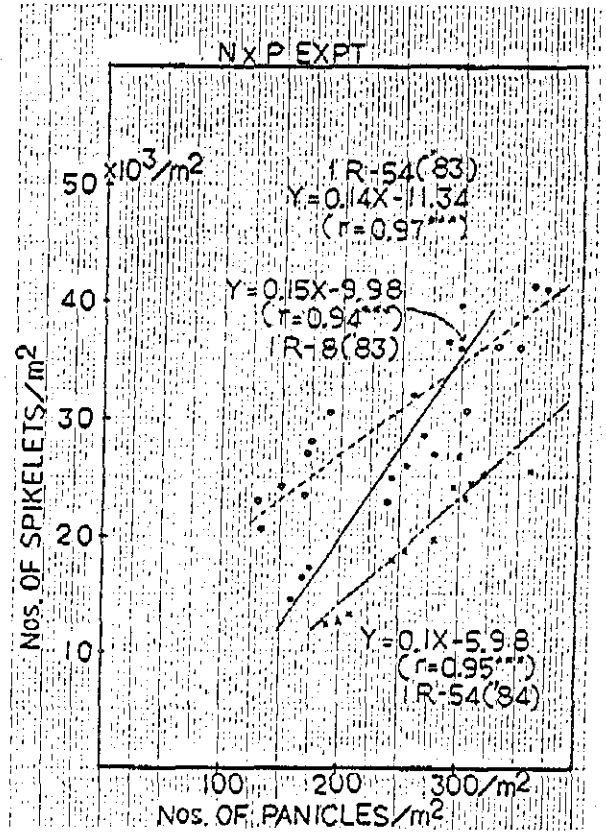
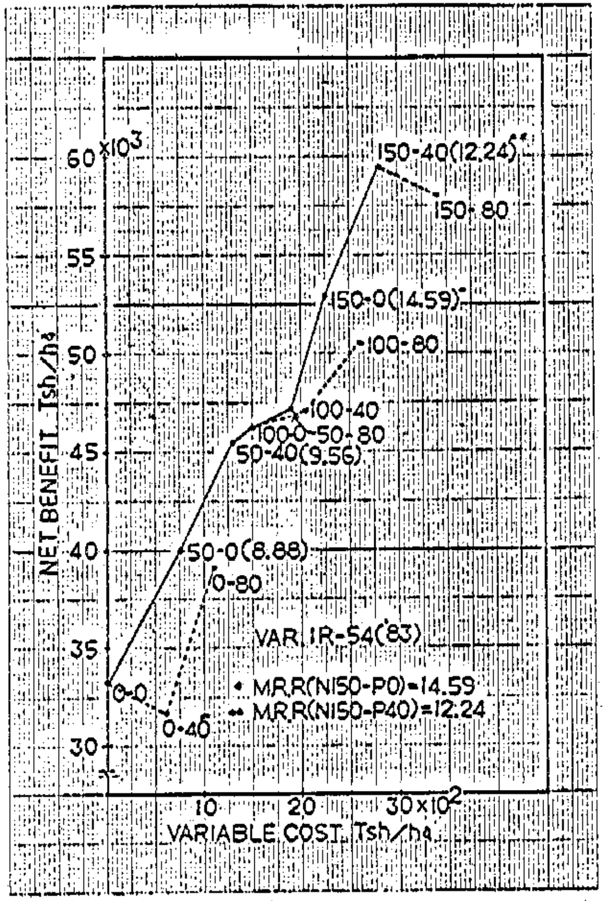


FIG - 46

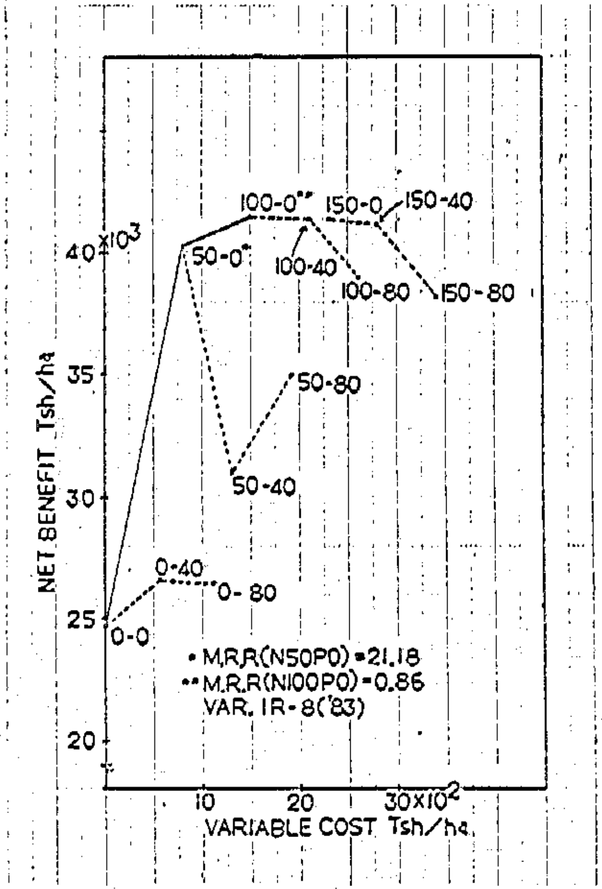
Economic effect of fertiliser application



NB. Price of paddy Tsh.9.80/kg
Price of nitrogen(Urea) Tsh.6.96/kg
Price of phosphorus(TSP) Tsh.6.44/kg

FIG - 47

Economic effect of fertiliser application



NB. Price of paddy Tsh.9.80/kg
Price of nitrogen(Urea) Tsh.6.96/kg
Price of phosphorus(TSP) Tsh.6.44/kg

添付書類－34

Variety x Nitrogen Experiment

Objectives:

To determine an optimum rate of nitrogen application for each variety and to examine the interactions between varieties and nitrogen rates.

Experimental design:

Split-plot design imposed on RCBD with 4 replications. Main plot treatments were nitrogen rates and sub-plot treatments were varieties.

Treatments:

1. 1983 in plot D-6

Varieties:	Nitrogen:
V1. Affa Mwanza	N0. 0 N applied
V2. Kilombero	N50. 50 kg N/ha
V3. IR - 8	N100. 100 kg N/ha

2. 1984 in plot D-7

Varieties:	Nitrogen:
V1. IR - 54	N50. 50 kg N/ha
V2. Taiwan - 14	N100. 100 kg N/ha
V3. Affa Mwanza	N150. 150 kg N/ha
V4. Matandiko	

Plot size:

4.0 m x 5.0 m(20 m^2) in 1983
3.0 m x 4.0 m(12 m^2) in 1984

Experimental period:

1. 1983 in plot D-6

   Sowing: 18 Feb. 1983
   Transplanting: 25 March 1983
   Harvest: 28 July 1983

2. 1984 in plot D-7

   Sowing:13 Oct. 1983
   Transplanting: 16 Nov. 1983
   Harvest: 20 March 1984

Cultivation practices:

Fertilizer:	Fertilizer rate for treatments were mentioned in treatments. 50 % of total amount of nitrogen and 100 % of phosphorus were applied at the time of puddling. Remaining nitrogen was applied at tillering and panicle initiation stages.
Density:	20 cm x 30 cm(16.7 hills/m^2) 3 seedlings/hill
Insect control	Diazinon 40E of 1/1000 solution was sprayed to control stem borer at nursery stage and at the time of nitrogen top-dressing.
Weed control:	Weeds in plots were controlled by hand properly and any herbicide was not sprayed.

Discussion:

1. 1983(D-6)

Nitrogen effect on grain yield was significant at the 10 % level. Grain yield of 3 varieties were increased as nitrogen rate was increased. Average yield of N0 was 2.55 ton/ha and 4.32 ton/ha of average yield was obtained at N100. Significant difference of grain yield was observed among 3 varieties at the 1 % level. The highest grain yield was obtained in IR - 8 and Affa Mwanza. Nitrogen response of the two varieties was almost same. There was very small difference among 3 varieties at N0. When nitrogen level was increased from N0 to N50, different response of Kilombero was observed. Grain yield of IR - 8 and Affa Mwanza were increased at N100 but Kilombero did not indicate yield increase.

The nitrogen effect on spikelets/m^2 was significant at the 1 % level. Nitrogen application caused remarkable increase of spikelets of 3 varieties. Average spikelets/m^2 of 3 varieties at N0 was $14.12 \times 10^3/m^2$ and as nitrogen rate was increased spikelet production was also increased from $20.79 \times 10^3/m^2$ at N50 to $25.80 \times 10^3/m^2$ at N100. Spikelets/m^2 of 3 varieties were also significantly different. The highest production was observed in IR - 8 and the lowest was in Kilombero. Spikelets/m^2 of kilombero did not respond to nitrogen application. Spikelet production of IR - 8 and Affa Mwanza were increased gradually when nitrogen level was increased from N50 to N100 but that of Kilombero was not increased. Differential nitrogen response of kilombero seemed to be due to panicle production/hill and spikelets per panicle.

Number of panicles/hill of 3 varieties were increased significantly by nitrogen application. Nitrogen response of kilombero was different from that of IR - 8 and Affa Mwanza. Panicle production of kilombero was significantly lower than that of other two varieties at 3 nitrogen levels. Significant difference of panicles/hill was also observed among 3 varieties. Panicles/hill of Kilombero was significantly lower than that of other two varieties. IR - 8 and Affa Mwanza produced almost same number of panicles/hill.

Spikelets/panicle was also affected by nitrogen application. Application of 50 kg and 100 kg nitrogen/ha caused significant increase of spikelets/panicle of 3 varieties, however there was no significant difference between N50 and N100. Significant difference of spikelets production among 3 varieties was not observed. The largest number of spikelets/panicle was produced by Kilombero. But due to low productivity of the variety, spikelets/m^2 became the lowest. The highest production of spikelets/m^2 of IR - 8 was due to high productivity of panicles per hill.

Significant effect of nitrogen on panicles/m^2 was observed at the 5 % level. The highest panicles/m^2 was observed at N100. The difference between N0 and N50 was not observed. 3 varieties produced significantly different number of panicles per 1 m^2. Clear nitrogen response of IR - 8 and Affa Mwanza was observed. Nitrogen application did not cause significant increase of panicles/m^2.

Difference in ripening ratio was observed among 3 varieties. Ripening ratio of IR - 8 was the lowest and the highest was observed in Affa Mwanza. Ripening ratio of 3 varieties were reduced slightly as nitrogen level was increased. Especially reduction of IR - 8 was remarkable at high nitrogen levels.

There was differential nitrogen response of varieties. Nitrogen response of IR - 8 and Affa Mwanza seemed to be higher than Kilombero. Panicles/m^2 of Kilombero was not increased even 100 kg N/ha was applied. Ripening ratio of IR - 8 was reduced tremendously at higher nitrogen level.

2. 1984(D-7)

Significant effect of nitrogen on grain yield was observed at the 1 % level. Grain yields of 4 varieties were increased significantly when nitrogen level was increased from N50 to N100 but Grain yield at N100 and N150 was almost same. Difference in grain yield among 4 varieties was observed at the 1 % level. The highest grain production was observed in IR - 54 and the lowest one was Matandiko. Main cause of yield difference seemed to be spikelet production of varieties. Grain yield of Matandiko and Taiwan - 14 were slightly reduced when nitrogen level was increased from N100 to N150.

Significant difference of spikelets/m^2 among 4 varieties was observed at the 1 % level. Spikelet production of IR - 54 was the highest and the lowest production was obtained in Matandiko. Different tendency of spikelets/m^2 was observed among 4 varieties at higher nitrogen levels. Spikelets/m^2 of IR - 54 and Affa Mwanza were increased slightly when nitrogen level was increased from N100 to N150. While Taiwan - 14 and Matandiko produced less number of spikelets at same nitrogen levels. Nitrogen response of two local varieties seemed to be low as compared to that of IR - 54.

Panicle production of 4 varieties was significantly different at the 1 % level. The highest production of panicles/hill was obtained in IR - 54 and the lowest production was observed in Matandiko. Panicles/hill of Matandiko, Taiwan - 14 and Affa Mwanza were reduced slightly when nitrogen level was increased from N100 to N150. Main cause of reduction in panicles/hill at higher nitrogen level might be increase of uneffective tiller.

Spikelets/panicle of 4 varieties was also significantly different. The largest number of spikelets/panicle was obtained in Taiwan - 14 and other 3 varieties produced almost same number of spikelets/panicle. Spikelets/panicle of IR - 54 and Affa Mwanza were slightly increased as nitrogen level was increased but Matandiko and Taiwan - 14 produced less number of spikelets at N150. Reduction of panicles/hill sometime causes increase in spikelets/panicle but that was not observed in Matandiko and Taiwan - 14. Eventually spikelet production of IR - 54 was the highest and was not reduced even at higher nitrogen levels. Taiwan - 14 and Matandiko did not respond to nitrogen.

There was significant difference of panicles/m^2 among 4 varieties. Panicles/m^2 of IR - 54 was the highest and it was increased even at N150 while other 3 varieties reduced panicles/m^2 at same level of nitrogen. Reduction of panicles/m^2 at higher nitrogen levels seemed to be due to low efficiency of nitrogen. Application of 150 kg N/ha caused tremendous increase of uneffective tillers and resulted into over growth of plant of these local varieties. Relatively high number of white head was observed in Matandiko and Taiwan - 14.

Ripening ratio of 4 varieties were significantly different at the 1 % level. Ripening ratio of IR - 54 was the highest and it was not reduced even nitrigen was increased. Ripening ratio of Matandiko and Taiwan - 14 were the lowest and were reduced slightly as nitrogen level was increased from N100 to N150. Ripening ratio of Affa Mwanza was significantly higher than that of Matandiko.

Varieties of two experiments were grouped in IR - 54, IR - 8, Affa Mwanza and local variety(Matandiko, Taiwan - 14 and Kilombero). Data of other experimnets(variety experiments and verification trials in trial farm and farmers' fields) were also ploted so that more detail examination of varieties could be obtained.

Positive correlation of grain yield and spikelets/m^2 was observed and coefficient of correlation was significant. Grain yield of varieties were rearly increased as spikelets/m^2 was increased. However grain yield of varieties were different at same level of spikelets/m^2. At $30 \times 10^3/m^2$ of spikelets level, 6.3 ton/ha of grain yield was obtained in IR - 54 while grain yield of local variety was around 3.8 ton/ha. Major cause of difference in yield seemed to be ripening ratio and grain weight of varieties. In case of IR - 54, approximately 7 - 8 ton/ha of yield can be expected if more than $40 \times 10^3/m^2$ of spikelets is obtained. High yield of IR - 8 can be expected but its yield could be less than IR - 54 because of ripening ratio. In case of local variety, it seems to be difficult to obtain more than $30 \times 10^3/m^2$ of spikelets production. Relatively high grain yield of IR - 8 can be expected at $30 \times 10^3/m^2$ but spikelet production is increased more than that level, reduction of ripening ratio may occur. In case of local variety, high spikelet production like IR - 54 can not be expected. $20 \times 10^3/m^2$ - $25 \times 10^3/m^2$ seems to be maximum level of spikelets/m^2 of local variety.

Negative correlation of ripening ratio and spikelets/m^2 was observed except IR - 54. Ripening ratio is normarlly reduced when spikelets/m^2 was increased. But ripening ratio of IR -54 was not reduced even at higher level of spikelets/m^2. Ripening ratio at $20 \times 10^3/m^2$ of spikelet was 90% and it was same even at $40 \times 10^3/m^2$. Significant reduction of IR - 8 was observed at $30 \times 10^3/m^2$ of spikelets production. The same tendency of Affa Mwanza was observed, however spikelet production of Affa Mwanza was less than that of IR - 8. When $30 \times 10^3/m^2$ of spikelets were obtained in Affa Mwanza, ripening ratio was reduced. Ripening ratio of local variety was slightly reduced as spikelets/m^2 was increased. Approximately 75 % of ripening ratio of local variety can be expected if spikelets of 20×10^3 - $25 \times 10^3/m^2$ are obtained. Since reduction of ripening ratio was not observed at high spikelets/m^2 level, limiting factor of local variety seemed to be less production of spikelets/m^2.

Positive correlation of spikelets/m^2 and panicles/m^2 was observed. In all varieties, spikelet production was increased as panicles/m^2 was increased. Coefficient of correlation of IR - 8, IR - 54 and local variety were significant. In case od IR - 54, large number of spikelets/m^2 was produced when panicles per 1 m^2 was more than 300. In case of local variety, panicle production was 150 - 200/m^2 and spikelets/m^2 was 15 - 20×10^3. It seemed that high production of panicles more than 200/m^2 could not be expecetd in local variety. Varietal characteristics of local variety, large panicle size and low tillering were main cause of low spikelet production. Panicle production of IR - 8 was same as that of IR - 54 and spikelets/m^2 was increased significantly as panicles/m^2 was increased. 25×10^3 - $30 \times 10^3/m^2$ of spikelet could be expected if 250 - 275/m^2 of panicles were obtained. Spikelets production of Affa Mwanza was slightly lower than taht of IR - 54 and IR -8. Spikelets/m^2 was increased as panicles/m^2 was increased. But panicle production of Affa Mwanza seemed to be less than IR - 8. Approximately $25 \times 10^3/m^2$

of spikelets can be expected if $275/m^2$ of panicles are obtained.

Spikelet production of $40 \times 10^3/m^2$ seemes to be maximum level of IR - 54 if ripening ratio is not reduced. This maximum level of $spikelets/m^2$ may results in high grain yield. For IR - 8, optimum level of spikelets will be $25 \times 10^3/m^2 - 30 \times 10^3/m^2$ because reduction of ripening ratio may occur at higher level of spikelet production than $30 \times 10^3/m^2$. $25 \times 10^3 - 30 \times 10^3/m^2$ can also be optimum level of spikelet production for Aff Mwanza. $20 \times 10^3 - 25 \times 10^3/m^2$ will be maximum spikelet production of local variety. Large number of $spikelets/m^2$ can not be expected in local variety because of low tillering.

Considering grain yield and spikelets $production/m^2$ at 4 nitrogen levels, optimum nitrogen level for different varieties can be summarized as follows. 150 kg of nitrogen/ha can be applied to IR - 54. Nitrogen efficiency of IR - 54 seems to be very high and nitrogen application increases $panicles/m^2$ and also $spikelets/m^2$. 100 kg of nitrogen/ha seems to be optimum nitrogen level for IR - 8. $Spikelets/m^2$ can be increased by application of 150 kg N/ha but reduction of ripening ratio may result in non-significant yield increase. Nitrogen efficiency of Affa Mwanza seems to be higher than that of local variety. Relatively large number of $spikelets/m^2$ can be expected if 100 kg N/ha is applied. For local variety, 50 kg N/ha seems to be reasonable nitrogen rate. Significant increase of $spikelets/m^2$ can not be expected even 100 kg of nitrogen/ha is applied. Excessive nitrogen application may cause serious infestation of stem borer and low efficiency of grain production.

Economic effect of nitrogen was examined by marginal rate of return analysis. Net benefit of treatments were calculated by the cost of fertilizer only. Other cost such as labour cost for transplanting, land preparation and transport of inputs and product were not considered because these costs were same for all treatments. Very high marginal rate of return of 22.28 was observed in IR - 54 when nitrogen level was increased from N0 to N50. Positive M.R.R. was still observed at N100 and N150 levels. However decision will be made by farmers which M.R.R is profitable for them. For IR - 54, N100 - N150 seems to be recommendable rate of nitrogen application. In case of IR -8, positive economic effect of nitrogen application was observed at

3 nitrogen levels, however M.R.R of these nitrogen rate were lower than that of IR - 54. When nitrogen level was increased from N0 to N50, 11.78 of M.R.R. was obtained. At N100 level, M.R.R. of 8.00 was obtained and it was quite reasonable to accept it. Additional 50 kg of nitrogen application caused 2.74 of M.R.R. which might be risky for farmers to take. Relatively high marginal rate of return of Affa Mwanza was observed at N50 level. When nitrogen level was increased from N50 to N100, 3.83 of M.R.R. was obtained. Application of 150 kg N/ha did not cause positive effect of nitrogen. For Affa Mwanza, optimum nitrogen rate will be 50 kg N/ha and nitrogen rate should not be more than 100 kg N/ha otherwise application of nitrogen may result into loss of investment. Marginal rate of return of local variety was 6.57 at N50 and 4.39 at N100. 50 kg of N/ha can be optimum rate of nitrogen for local variety. Application of 100 kg N/ha caused 4.39 of M.R.R but actual benefit at N100 was tremendously lower than that of other varieties.

Marginal Rate of Return for each variety

Variety	Nitrogen rate	M.R.R.
IR - 54	N50	22.28
IR - 54	N100	6.57
IR - 54	N150	6.15
IR - 8	N50	11.78
IR - 8	N100	8.00
IR - 8	N150	2.74
Affa Mwanza	N50	10.20
Affa Mwanza	N100	3.83
Affa Mwanza	N150	-
Local var.	N50	6.57
Local var.	N100	4.39
Local var.	N150	-

Conclusion:

N100 - N150 can be optimum nitrogen rate for IR - 54 if ripening ratio is not reduced. For IR - 8, it will be better to apply 100 kg N/ha and not more than that because reduction of ripening ratio at higher nitrogen level may occur and significant yield increase can not be expected. Affa Mwanza seems to have same nitrogen response as IR - 8 , however spikelets production is lower than IR - 8. N50 seems to be optimum rate of nitrogen but should not be more than 100 kh N/ha. For local variety, significant yield increase can not be expected by nitrogen application. Low nitrogen response of local vaeirty is due to low tillering and low efficiency of grain production. Moreover, excessive amount of nitrogen application may cause serious insect infestation. Optimum nitrogen rate for local variety seems to be 50 kg N/ha. Application of 100 kg N/ha will be risky for farmers.

In these two experiments, differential response of variety to nitrogen was observed. In case of IR - 54 and IR -8, non-significant yield increase at higher nitrogen level was caused maily by reduction of ripening ratio. Nitrogen application causes significant increase of panicles/m^2. And spikelets/panicle was not affected very much by nitrogen application. Eventually nitrogen application causes significant increase of spikelets/m^2. On the other hand, limiting factor of local variety seems to be low panicle production. Significant increase of panicle production can not be expected by nitrogen application. High rate of nitrogen application causes tremendous production of uneffective tillers which also reduces the efficiency of grain production. As spikelets/m^2 was increased, ripening ratio of local variety was also reduced nut major cause of low grain yield seems to be low panicle production. Since panicle production of local variety is low and is difficult to be increased by nitrogen application, transplanting in high density can be alternative way to increase spikelet production/m^2.

TABLE-18

Summary Table of Variety x Nitrogen Experiment(1983)

Treatment	Grain yield ton/ha	Number of panicles per hill	Number of panicles per 1 m^2	Number of spikelets per panicle	Number of spikelets per 1 m^2	Ripening ratio %	1000 grains weight g	Grain/total production %
N0 - V1	2.80	10.3	229.4	82.7	14.18 x 10^3	90.0	28.4	45.4
N0 - V2	2.29	8.7	151.0	77.0	12.48	83.2	27.4	42.0
N0 - V3	2.55	11.0	183.3	85.4	15.70	77.4	27.8	49.2
N50 - V1	4.04	12.8	212.5	95.2	20.28	89.6	27.9	40.2
N50 - V2	3.50	10.4	173.2	104.3	18.05	88.5	30.0	40.7
N50 - V3	3.52	12.7	211.3	111.6	24.05	72.5	27.1	46.8
N100 - V1	4.74	16.2	296.6	100.4	27.18	86.3	26.5	37.1
N100 - V2	3.66	10.2	174.6	117.6	21.30	75.5	29.4	35.7
N100 - V3	4.55	17.8	296.7	97.8	28.93	63.2	28.0	41.6
$\bar{X}$	3.52	12.2	204.9	96.9	20.24	80.7	28.1	42.1
Significance	N10%, V**	N*,V**,NxV**	N*,V**,NxV**	N**	N**,V**	V**	ns	N*,V**
C.V. %	13.5	11.4	10.5	19.2	16.8	8.5	8.5	6.5
LSD.05 N	1.44	2.6	41.8	24.2	4.42	9.6	-	5.4
LSD.05 V	0.41	1.2	18.3	15.9	3.36	5.9	-	2.3
LSD.05 NxV	0.70	2.1	31.7	27.6	5.86	10.2	-	4.0

V1: Affa Mwanza
V2: Kilombero
V3: IR - 8

** indicates statistical significance at the 1 % level and * indicates statistical significance at the 5 % level.

TABLE - 19

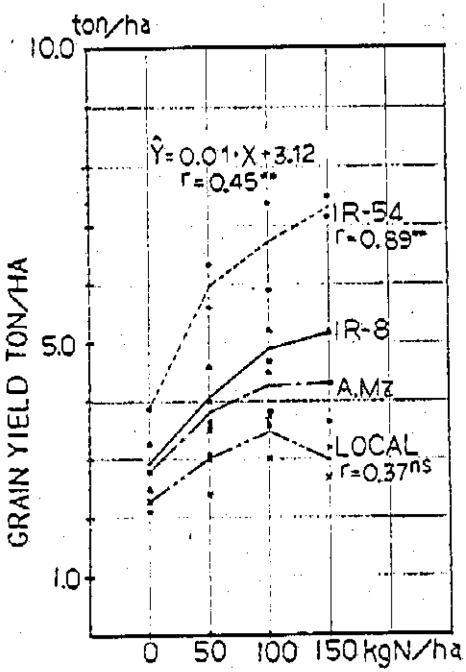
Summary Table of Variety x Nitrogen Experiment(1984)

Treatment	Grain yield ton/ha	Number of panicles per hill	Number of panicles per 1 m^2	Number of spikelets per panicle	Number of spikelets per 1 m^2	Ripening ratio %	1000 grains weight g	Grain/total production %
N50 - V1	6.37	19.1	317.8	101.7	37.56 x 10^3	93.3	25.0	50.7
N50 - V2	3.00	14.4	236.1	125.6	24.76	75.9	19.1	23.8
N50 - V3	3.59	15.4	256.9	86.6	22.39	88.7	24.8	29.2
N50 - V4	2.44	12.1	202.1	85.5	17.27	74.2	23.5	16.3
N100 - V1	7.45	21.4	355.8	103.9	37.09	93.8	25.2	51.0
N100 - V2	3.74	15.4	256.9	119.5	30.39	72.3	19.0	20.3
N100 - V3	3.76	17.4	290.4	91.4	25.47	85.6	24.5	28.2
N100 - V4	3.02	11.9	198.0	96.6	19.12	71.1	24.3	19.8
N150 - V1	7.14	21.5	357.9	110.0	39.54	93.2	25.1	51.4
N150 - V2	3.20	14.3	238.9	109.6	26.12	75.4	18.9	20.2
N150 - V3	4.27	14.4	248.1	111.3	27.86	83.0	25.2	26.4
N150 - V4	2.68	10.9	181.3	90.7	16.33	70.5	24.4	18.0
$\bar{X}$	4.25	15.7	259.3	102.7	26.79	81.4	23.2	29.6
Significance	N**, V**	V**	V**	V*	V**	V**	V*	V*
C.V. %	20.4	12.8	13.8	20.7	21.2	7.2	4.1	12.1
LSD.05 N	0.23	2.9	47.2	8.8	5.19	5.1	1.0	3.2
LSD.05 V	0.74	1.7	30.5	18.1	4.83	5.0	0.8	2.8
LSD.05 NxV	1.28	3.0	57.8	31.4	8.37	8.6	1.4	4.8

V1: IR - 54
V2: Taiwan - 14
V3: Affa Mwanza
V4: Matandiko

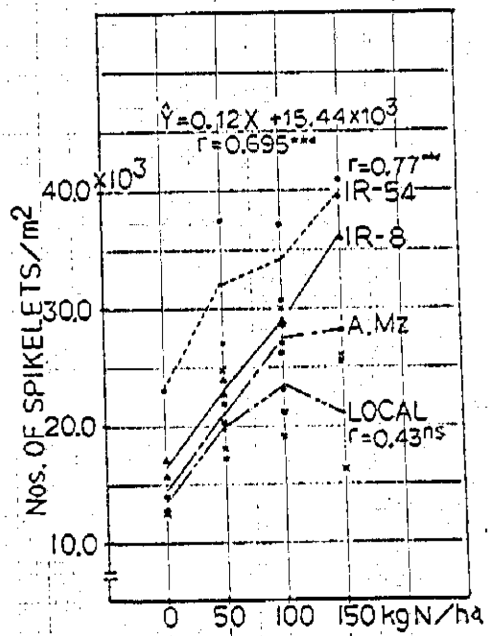
** indicate statistical significance at the 1 % level
and * indicates

FIG - 48



LOCAL = KB, MDK, T-14

FIG - 49



LOCAL=KB, MDK, T-14.

FIG -50

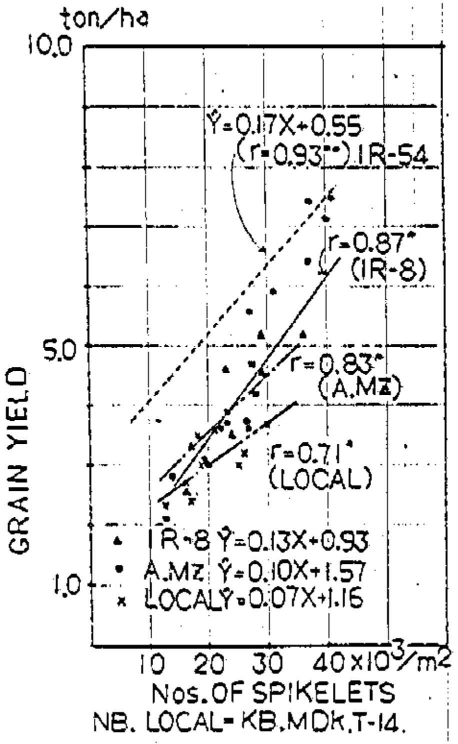


FIG -51

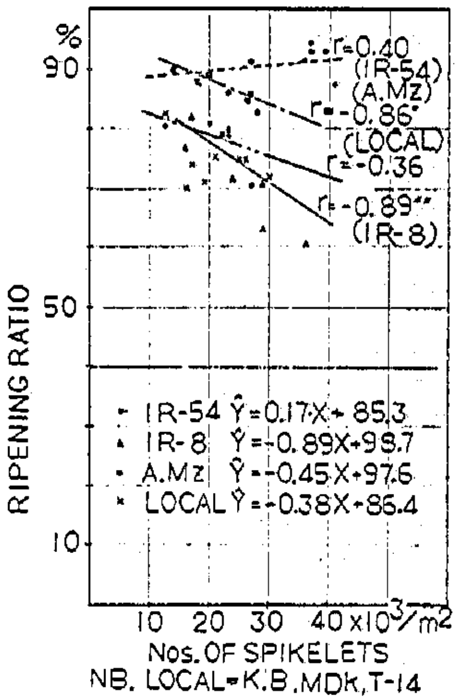


FIG -52

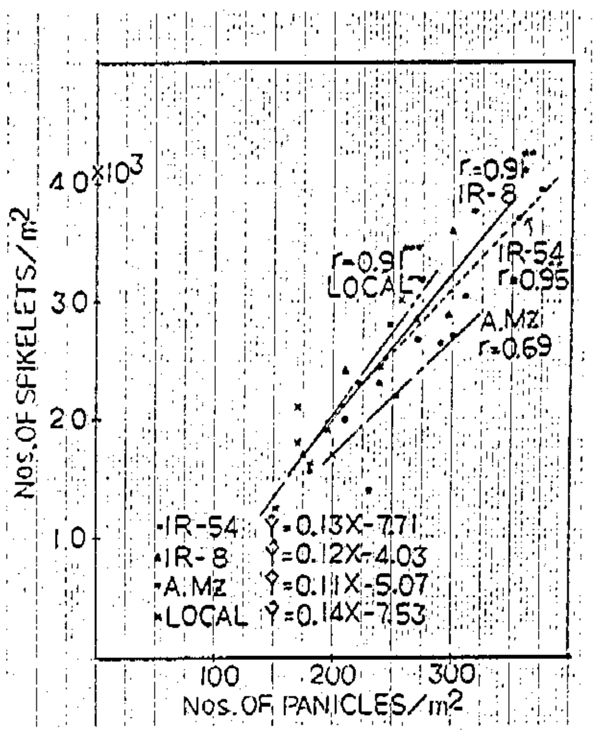
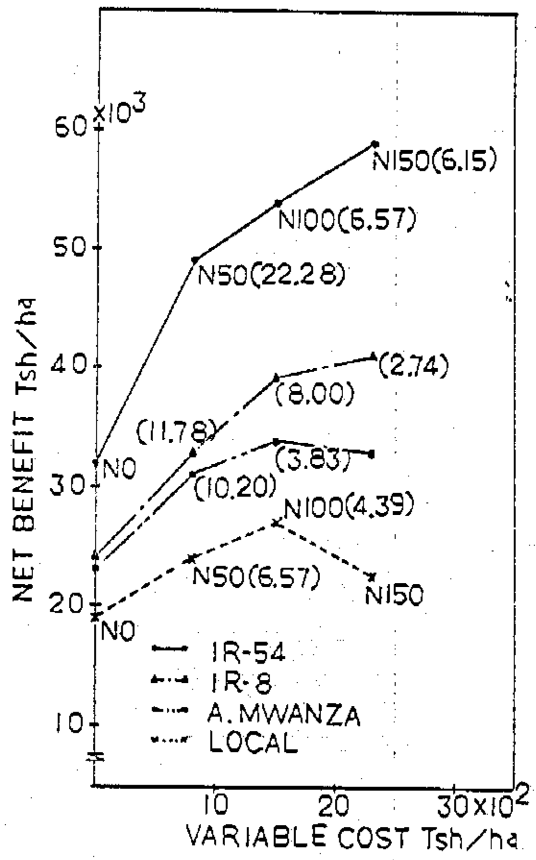


FIG-53



60 ×10³
50
40
30
20
10
NET BENEFIT Tsh/ha
10
20
30×10²
VARIABLE COST Tsh/ha
N150(6.15)
N100(6.57)
N50(22.28)
NO
(2.74)
(8.00)
(11.78)
(3.83)
(10.20)
N100(4.39)
N50(6.57)
N150
NO
IR-54
IR-8
A. MWANZA
LOCAL

Nitrogen application experiment.

Objectives:

To study the effect of nitrogen application and the effect of nitrogen top dressing at different stages on grain production of rice.

To determine an opotimum time of nitrogen application.

Experimental design:

Randomized complete block design with 4 replications.

Treatments:

Treatment - 1:	100 Kg N/ha at puddling
Treatment - 2:	100 KgN/ha at tillering stage.
Treatment - 3:	100 KgN/ha at panicle initiation stage.
Treatment - 4:	50 KgN/ha at puddling and 50 KgN/ha at tillering stage.
Treatment - 5:	50 KgN/ha at puddling and 50 KgN/ha at panicle initiation.
Treatment - 6:	50 KgN/ha at tillering stage and 50 KgN/ha at panicle initiation stage.
Treatment - 7:	50 KgN/ha at puddling, 25 KgN/ha at tillering stage and 25 KgN/ha at panicle initiation stage.
Treatment - 8:	0 N/ha (control).

100 Kg of nitrogen was applied in all treatments except treatment - 8.

Nitrogen was applied as urea (46% N).

Plot size: 3 m x 4 m (12 m^2).

Cultural practices:

Variety: IR-54

Density: 20cm x 30 cm., 3 seedlings/hill.

Fertilizer: fertilizer application was done following the treatments mentioned.

Sowing date: 21st Dec. 1983

Transplanting: 27th Jan. 1984

Weed control: Weeds were controlled properly by hand. Serious infestation of weeds was not observed and no habicide was applied.

Insect control: As prevention of stem borer, diazinon 40 E, 1/1000 solution was sprayed 3 times during growing period. Serious infestation and damage of insect was not observed.

Date of maturity: 24th April, 1984.
After maturity was observed, sample harvest of experiment was completed.

Discussion:

Nitrogen application at different stages caused significant yield difference at the 1% level. 100 Kg of nitrogen/ha was applied in all of the treatments except treatment - 8. The difference of seven treatments was only the time of nitrogen application. When 100 Kg of nitrogen was applied all as basal dose, grain production was approximately 5.6 ton/ha. 100 Kg nitrogen applied in split way, i.e. 50Kg. nitrogen at basal dose and 25 Kg. each at tillering and panicle initiation stages produced approximately 5.9 ton/ha of grain yield. Very slight yield difference was observed between two different nitrogen application methods. 100 Kg. of nitrogen applied all at tillering stage produced 5.14 ton/ha of grain yield which was almost the same as that of treatment - 4. When 100 Kg. of nitrogen/ha was applied all at panicle initiatition stage, grain yield was significantly reduced and it was almost same as that of treatment - 8 (no nitrogen treatment). Grain yield of treatment - 3 was approximately 65% of that of treatment - 7 when nitrogen was applied only at panicle initiation stage and 35% of reduction of grain yield was observed as compared to treatment - 7. When no nitrogen was applied (treatment - 8), 42.5% of grain yield was reduced. There was no significant yield difference between treatment - 3 and treatment - 8. Grain yield of treatment - 4, 5 and 6 were slightly less than that of treatment - 7, however significant difference was not observed.

Significant yield reduction of treatment - 3 was caused by less panicle production per unit area. Panicle production of treatment - 1, 5 and 7 were almost the same and panicle production of treatment -2, 4 and 6 were slightly less than that of treatment - 7. However significant difference among 6 treatments was not observed. Numbers of panicle/m^2 was significantly reduced when 100 Kg of nitrogen/ha was applied all at panicle initiation stage and also when no nitrogen was applied. 13.7 Nos. of panicle was obtained per hill without nitrogen and 15.5 panicles/hill was obtained when 100 Kg of nitrogen was applied at panicle initiation stage. Panicle production of treatment - 3 was reduced approximately 30% as compared to that of treatment - 7. Reduction in panicle production of treatment - 8 was 38%. It was observed that nitrogen application at panicle intitiation stage was not effective to increase number of panicles. Basic nitrogen application was most effective for higher panicle production.

Spikelet production was significantly low when 100 Kg of nitrogen was applied all at panicle initiation stage (Treatment - 3). There was no significant difference between treatment - 3 and treatment - 8. Spikelet production per panicle was also reduced in treatment - 3. Relatively higher spikelet production was observed in treatment - 1, 2, 5 and 7. Spikelet production of treatment - 4 and 6 were slightly lower than that of these 4 treatments, however difference among these 6 treatments was not significant. Spikelet production per panicle of treatment - 3 was lower than that of treatment, however spikelet production per unit area of treatment - 3 was higher than that of treatment - 8. 22.4% of reduction in spikelet production was observed in treatment - 3 and reduction of treatment - 8 was 16.3% as compared to treatment - 7. Less reduction in spikelet production per unit area of treatment - 3 was compensated by high panicle production of the treatment.

Ripening ratio of treatment 1 - 7 were almost the same and which were significantly lower than that of treatment - 8. Ripening ratio of treatments 3 and 7 were slightly higher than that of other treatments, however, significant difference was not observed. When ripening ratio of treatment - 3 and treatment - 7 was compared, it was observed that spikelet production did not always effect ripened grain percentage. Spikelet production of treatment - 3 was significantly less than that of treatment - 7 while ripening ratio of two treatments was the same. The relation of two factors, ripening ratio and spikelet production, of treatment - 8 was different from other treatments. Significantly low spikelet production caused high ripening ratio of treatment-8.

The weight of 1000 grains was not effected by nitrogen application method. Significant difference in grain weight was not observed among 8 treatments.

Harvest index (grain weight/total production of plants) was increased in treatment - 8. Significant effect of nitrogen application method on harvest index was observed at the 10 % level. Average harvest index of treatments was 49.7%. The highest harvest index was observed in treatment-8 and the lowest of 43.8% was observed in treatment - 3. Stimulated vegetative growth due to late nitrogen application might be a reason of low nitrogen efficiency for grain production.

Conclusions:

There is high probability of yield increase if nitrogen is applied. Basic application of nitrogen seems to be effective for higher panicle production. Nitrogen should not be applied only at panicle initiation stage. Even high dose of nitrogen is applied only at this stage, yield increase due to nitrogen may not be expected. Nitrogen can be applied at panicle initiation stage when nitrogen is applied at tillering stage or at the time of puddling. Split application method seems to be better for grain production.

TABLE -20

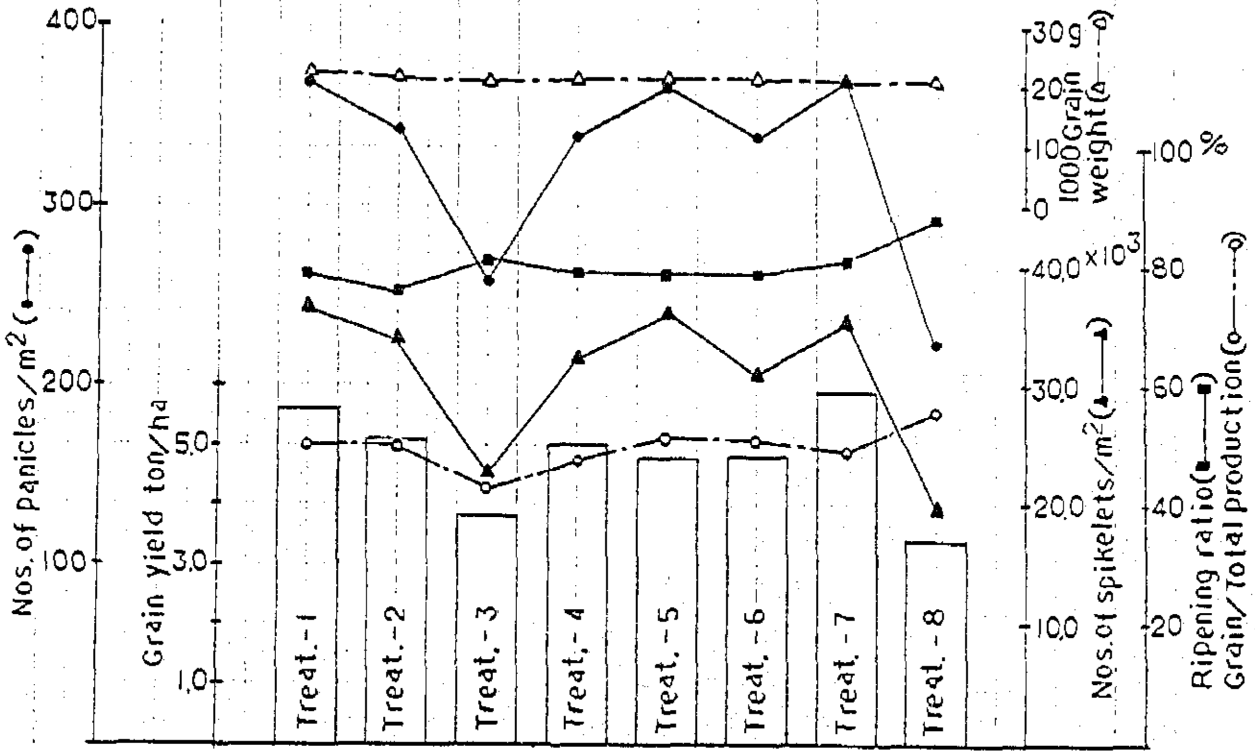
Summary table of Nitrogen Application Experiment

Treatments	grain yield ton/ha	Nos.of pani-cles/hill	Nos.of pani-cles/m^2	Nos.of spike-lets/panicle	Nos.of spike-lets/m^2	ripening ratio %	1000 grains weight gm	grain/total production %
1.	5.590 a	22.1 a	368.1 a	99.3 a	36.63×10^3 a	79.4 b	20.8	49.9
2.	5.137 a	20.7 a	345.4 a	99.1 a	33.61 a	76.4 b	20.9	50.2
3.	3.815 b	15.5 b	258.9 b	76.4 b	20.04 b	81.6 b	20.4	43.8
4.	5.005 a	20.6 a	343.8 a	89.5 a	32.43 a	79.4 b	20.9	47.2
5.	4.768 a	22.1 a	367.5 a	100.6 a	35.82 a	79.0 b	20.4	51.4
6.	4.784 a	21.1 a	341.7 a	92.1 a	31.37 a	78.9 b	20.8	50.6
7.	5.872 a	22.1 a	368.3 a	98.4 a	35.00 a	81.5 b	21.0	49.7
8.	3.375 b	13.7 b	227.9 b	82.4 b	19.03 b	88.6 a	21.0	55.2
$\overline{X}$ treat.	4.793	19.7	327.7	92.2	30.49	80.6	20.8	49.7
C.V.(%)	16.1	9.7	9.9	10.3	15.0	5.2	2.9	8.5
statistical significance	1%	1%	1%	1%	1%	5%	NS	10%
LSD.05	1.137	3.0	47.8	13.9	6.72	6.2	—	6.2

In a column means followed by a common letter are not significantly different at the 5% level.

FIG - 54

Summarized data of Nitrogen Application Expt.



Treat.-1: Basic 100 kg N/ha
Treat.-2: Tillering stage 100 kg N/ha
Treat.-3: Panicle initiation 100 kg N/ha
Treat.-4: Basic 50 kg N/ha + Tillering 50 kg N/ha
Treat.-5: Basio 50 kg N/ha + Panicle initiation 50 kg N/ha
Treat.-6: Tillering 50 kg N/ha + Panicle initiation 50 kg N/ha
Treat.-7: Basio 50 kg N/ha + Tillering 25 kg N/ha + Panicle initiation 25 kg N/ha
Treat.-8: Control 0 kg N/ha

PRODUCTION REPORT OF CHEKERENI PILOT FARM

Introduction:

After discussing with Chekereni Village Leaders on crop cultivation and management of pilot farm in 1983, rice and finger millet cultivation was started at 33 plots of block D, E and F, under direct management of KADC. Rice cultivation was initiated at plot D - 1 on 27, Dec. 1983 and was expanded up to 16 plots of block D and E out of 33 plots. Finger millet was cultivated at the remaining 17 plots of block E and F.

Since rice cultivation was started at D-1, problem of shortage of irrigation water was occured in March and April. Adequate water for puddling and maintenance was not available during this period. Large amount of water was provided for puddling than for maintenance for the plot where seedlings were transplanted. Shortage of irrigation water coused several problems at pilot farm. Limited amount of water was shared between upland field and paddy field. At some plots of D-6, 7, and 8, seedlings were not transplanted at optimum seedling age. Cultivation plan was not carried out as it was scheduled. Shortage of maintenance water coused serious weed infestation at plot D-7 and 8.

During same period, availability of labours from Chekereni village was also one of the problems instead. Most of the villagers were not very much interested in working at pilot farm and they were also busy for preparing their own fields for sowing maize. Transplanting and weeding Transplanting and weeding were several time delayed due to shortage of labourers.

When rice cultivation was somehow expanded up to E-5, it was observed that irrigation water was not enough to expand area of rice cultivation any more and at the same time maintaing enough water for the plots where already transplanting was completed. It was decided that finger millet could be alternative crop to be cultivated at remaining plots.

Sowing finger millet was started on 21 April and was completed on 28 April 1984 at 211 of 17 plots (E-6 to E-11 and all plots of F block). Germination performance at block F (11 plots) was very poor because standing water due to heavy rain could not be drained out and finger millet seeds were washed out by heavy rain in some plots in May. Resowing finger millet at block F was strongly required however it was not done. It might be a results of poor field management and shortage of labourers. Eventually plant population at block F was very low. Weed control was not done at proper stage so that finger millet was totaly defeated by tremondous amount of weeds. Because of the reason, F-1 and F-3 were discanded and at other plots, production was very low. Perfomance of finger millet at block E (E-5 to E-11) was not bad however it could be improved if nitrogen fertilizer was applied. For all plots of finger millet, fertilizer was not applied.

Cultivation practice

Rice:

Varieties cultivated at each plot were mentioned in the summarized table. Three varieties of IR-20, IR-32 and IR-56 were grown. Fertilizer rate was 100 KgN/ha as nitrogen and no phosphorus was applied. Urea (46% N) was applied at the rate of 66 Kg/plot. 30% of total amount of urea was applied at puddling and remaining 70% of urea was splited and applied at tillering and panicle initiation stages at the rate of 23 Kg/plot. Application of Diazinon 40E (1/1000 solution) was followed after nitrogen top dressing. Line transplanting method was applied and spacing was 20 cm x 30 cm with 3 - 4 seedlings per hill. Weed control was done by manual weeding method. Any herbicide was not applied. At some plots where adequate maintenance water was not available, serious weed infestation was observed.

Finger millet.

Variety of finger millet cultivated at Pilot farm was not known however it was called "MPANDA" locally. Seed rate per plot was 3.0 Kg/plot and each plot had 40 rows of 100 m length. 75 g of seeds were sown per row. Line sowing method of 70 cm row to row distance was applied so that weeding could be easily done by Agricultural machinery. First weeding between rows was done by small power tiller and second weeding was done by hand in the rows. Any fertilizer was not applied. Any insecticide was not applied. Any serious insect damage was not observed.

Production.

Harvesting rice was started at D-2 on 24th May, 84 and was continued up to 3rd Oct. 84. For the first stage, harvesting at D-2 to D-7 was completed on 28th June, 84. For the 2nd stage, harvesting at D-8 to D-10 was completed on 11th July. D-11 of IR-56 was harvested on 13th August 84. Final harvest of E-1 to E - 5 was completed on 3rd Oct., 84. Grain yield of each plot was mentioned in the summarized table.

Average yield of block D was 1.545 Kg/plot and that of block E was 984.4 Kg/plot. If grain yield of each plots of block -D was compared with average yield block -D, it was observed that grain yield of plot D-2 to D-6 were higher than the average yield and grain production of plot D-7 to D-10 were less than the average yield.

Grain Yield at Block -D:

Plot	Yield Kg/plot	Yield Kg/ha.	Index %	seedling age
D - 1	-	-	-	-
D - 2	1584	6084	102.5	30 days
D - 3	1900	7255	123.5	31 "
D - 4	2001	7640	130.0	32 "
D - 5	1642	6270	106.3	37 "
D - 6	1547	5907	100.1	39 "
D - 7	1222	4666	79.0	44/47 "
D - 8	1287	4914	83.3	29 "
D - 9	1511	5769	97.8	39 "
D - 10	1121	4280	72.6	48 "
D - 11	-	-	-	26 "
$\bar{X}$D	1545	5865	100%	-

Grain production of D - 11 where IR - 56 was cultivated, was almost nothing (estimated grain yield was approximately 8.0 Kg/plot). It was due to cold temperature during panicle initiation to reduction division stage. Exactly same phenomenon of IR - 56 was also observed at trial farm. IR - 56 started stunting at maximim tillaring stage and producting huge number of uneffective tillers. Almost all spikelet was not ripened. Low temperature destroyed reproductive organ of spikelet so that even after heading, no fertilization of sexual organs was occured and carbohydrate could not be transmitted to spikelets.

Difference in field management of D-1 to D-6 and D-7 to D-10 seemed to be explained in grain production at these plots. At D-7, and D-8 water management was not properly done because of very poor levelling of the field. Especially at D-7 field was spited into two sub plots so that limitted amount of irrigation water could be utilized effectively. Borders of D-10 and D-11 were several times destroyed at near drainage because of water. These borders were repaired several times but it was always causing waste of irrigation water. However, water management at these plot was not properly done as at D-2 to D-6 and which caused serious weed infestation in the field. Age of seedling which were transplanted at D-2 to D-7 might be another factor of yield reduction. At D-2 to D-4, 30 days to 32 days old seedlings were transplanted while the age of seedling for D-6 and D-7 were 39 days and 44 - 47 days old. At D-7, field was so poorly levelled that field was spilited into two subplots but puddling could not be do ne properly. As a result of it, 44 days old seedlings were transplanted at a half plot. Levelling of the paddy field was getting poorer as serial number of plots was increased. Poor levolling caused several problems of field management. Water level of the field was not uniform. At lower spot, water was so deep while there was no water at higher spot. Poor water level in the field reduced efficiency of nitrogen fertilizer and caused weed infestation.

Poor grain production at E-1 to E-5 was mostly caused by low temperature during panicle initiation to reduction division stage. Ripening ratio of IR-20 at E-1 to E-5 was very low and spikelets at the tip of panicle were degenerated and disappeared when ripening was completed. White tips of panicles was observed at E-1 to E-5.

Grain yield at Block - E:

Plot	Yield Kg/plot	Yield Kg/ha.	Index %	Seedling age
E - 1	970	3704	98.5	26 days
E - 2	984	3757	100.0	26 "
E - 3	1084	4139	110.1	26 "
E - 4	800	3055	81.3	35 "
E - 5	1084	4139	110.1	35 "
$\bar{X}$E	984.4	3758.8	100%	--

It could be mentioned that production of IR-20 at block E (5 plots) was very poor as compared to potential productivity of IR - 20 at block - E (5 plots) was very poor as compared to potential productivity of IR-20. The highest yield production of IR-20 obtained at Chekereni trial farm and at farmers fields in Rau ya Kati was 8.6ton/ha and 9.8 ton/ha respectively under same fertilizer rate. Yield reduction at block E seemed to be due to low ripening ratio and degeneration of spikelets.

Harvesting finger millet was started on 25th Aug. 84 from E - 6 and completed on 8th Sept. 84. Finger millet was harvested twice as panicles were matured. Maturity of panicles was not uniform so that harvesting started from ripened panicles first and then late maturity panicles were harvested later again. Harvesting of finger millet was proceeded in such a way that farmers came to harvest randomly without controling plot by plot. So that yield production per plot could not be recorded. After harvesting, picked panicles were piled for drying. After drying, panicles were beaten to thresh grains and weighed.

Total production from 15 plots (excluding F-1 and F-3) was 3,485 Kg. As mentioned above, production at block F was very low and the perfomance was very poor due to lack of good field management.

Conclusion.

For better management of pilot farm and crop cultivation, the following matters should be considered.

1. Problem of irrigation water should be investigated and be solved so that shortage of irrigation water would not prohibit from managing field properly.

2. Cropping partern for whole pilot farm including upland and paddy fields should be established so that crop cultivation can be proceeded systematically. Land utilization, types of crop to be cultivated at pilot farm and suitable season for crops should be examined considering meteorological factors. It seemed that crop cultivation at pilot farm was been carried out without any established programme. Simple problems which could be solved easily if cultivation programme was established were sometimes creating great loss of inputs and crop production at pilot farm.

3. If administration of the village could be improved in such a way that the village could call villagers for work in the field in proper time and organized people for specific field activity, management of pilot farm could be more improved.

TABLE - 21

I. Rice cultivation(plotD - 1 to D - 11 and plot E - 1 to E - 5)

Plot No.	Variety	Date of sowing	Date of trans-planting	Inputs			Volunteer workers from the village	Date of harvest	Production kg/plot (paddy)	Production kg/ha (paddy)
				Fertilizer kg/plot	Insecticide ml/plot	Employed labours man-days/plot				
D - 1	IR-32 IR-20	27/12/83 27/1 /84 28/ 4/84	—	5.0 kg Urea	Diazinon 40E 15 ml (1/1000)	80 man-days	—	—	nursery	
D - 2	IR-32	27/12/83	25/1/84	66.0 kg Urea	Diazinon 40E 45 ml/applic. 3 applications 135 ml	94 man-days	40	24/5/84	1584 kg	6084 kg
D - 3	IR-32	27/12/83	26/1/84	66.0 kg Urea	Diazionon 40E 135 ml	94 man-days	40	1/6/84	1900 kg	7255 kg
D - 4	IR-32	27/12/83	27/1/84	66.0 kg Urea	Diazinon 40E 135 ml	94 man-days	40	4/6/84	2001 kg	7640 kg
D - 5	IR-32	27/12/83	1/2/84	66.0 kg Urea	Diazinon 40E 135 ml	94 man-days	40	4/6/84	1642 kg	6270 kg
D - 6	IR-32	27/12/83	3/2/84	66.0 kg Urea	Diazinon 40E 135 ml	94 man-days	40	6/6/84	1547 kg	5907 kg
D - 7	IR-32	27/12/83	8/2/84 (1/2 plot) 11/2/84	66.0 kg Urea	Diazinon 40E 135 ml	106 man-days	70	28/6/84	1222 kg	4666 kg

Plot No.	Variety	Date of sowing	Date of trans-planting	Inputs: Fertilizer kg/plot	Inputs: Insecticide ml/plot	Inputs: Employed labours man-days/plot	Volunteer workers from the village	Date of harvest	Production kg/plot (paddy)	Production kg/ha (paddy)
D - 8	IR-32	27/1/84	25/2/84	66.0 kg Urea	Diazinon 40E 135 ml	106 man-days	70	10/7/84	1287 kg	4914 kg
D - 9	IR-32	27/1/84	6/3/84	66.0 kg Urea	Diazinon 40E 135 ml	92 man-days	75	9/7/84	1511 kg	5769 kg
D - 10	IR-32	27/1/84	12/3/84	66.0 kg Urea	Diazinon 40E 135 ml	92 man-days	75	11/7/84	1121 kg	4280 kg
D - 11	IR-56	9/3/84	13/4/84	45.0 kg Urea	Diazinon 40E 135 ml	92 man-days	25	13/8/84	—	—
E - 1	IR-20	28/4/84	24/5/84	66.0 kg Urea	Diazinon 40E 135 ml	85 man-days	130	26/9/84	970 kg	3704 kg
E - 2	IR-20	28/4/84	24/5/84	66.0 kg Urea	Diazinon 40E 135 ml	85 man-days	130	26/9/84	984 kg	3757 kg
E - 3	IR-20	28/4/84	24/5/84	66.0 kg Urea	Diazinon 40E 135 ml	85 man-days	95	29/9/84	1084 kg	4139 kg

Plot No.	Variety	Date of sowing	Date of trans-planting	Inputs			Volunteer workers from the village	Date of harvest	Production kg/plot (paddy)	Production kg/ha (paddy)
				Fertilizer kg/plot	insecticide ml/plot	Employed labours man-days/plot				
E - 4	IR-20	28/4/84	2/6/84	66.0 kg Urea	Diazinon 40E 135 ml	85 man-days	70	3/10/84	800 kg	3055 kg
E - 5	IR-20	28/4/84	2/6/84	66.0 kg Urea	Diazinon 40E 135 ml	85 man-days	95	3/10/84	1084 kg	4139 kg

II. Finger millet cultivation(plot E - 6 to E - 11 and plot F - 1 to F - 11)

Plot No.	Date of sowing	Date of weeding	Date of harvest	Employed labours man-day/plot	Volunteer workers from the village.	Production kg/plot
E - 6	21/4/84	power tiller 9/5/84 manpower 14/6/84	25/8/84	15	20	
E - 7 to E - 11	24/4/84	power tiller 10 to 15/5/84 manpower 18 to 26/6/84	25 to 30/8/84	230	280	
F - 1 to F - 11	27/4/84 to 28/4/84	power tiller 14 to 19/5/84 manpower 25 to 30/5/84	1 to 8/9/84	100	215	

N.B. Total production of finger millet form 15 plots was 3485 kg except F-1 and F-3 plots.

FIG -55

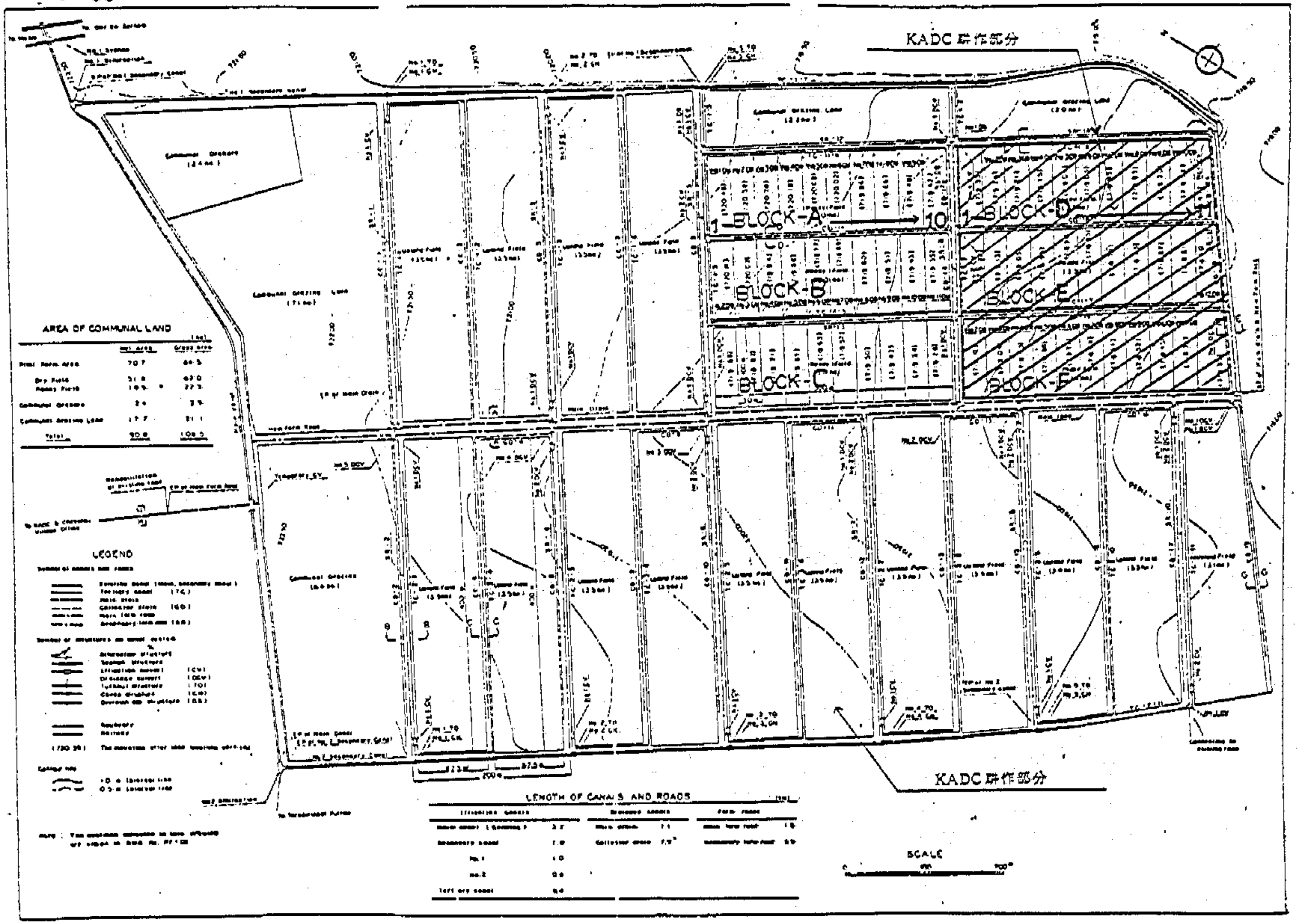

KADC 耕作部分
BLOCK-A
BLOCK-B
BLOCK-C
BLOCK-D
BLOCK-E
BLOCK-F
AREA OF COMMUNAL LAND
LEGEND
LENGTH OF CANALS AND ROADS
SCALE
KADC 耕作部分

FIG - 56

Relation between grain yield and Nos. of plots cultivated in each month

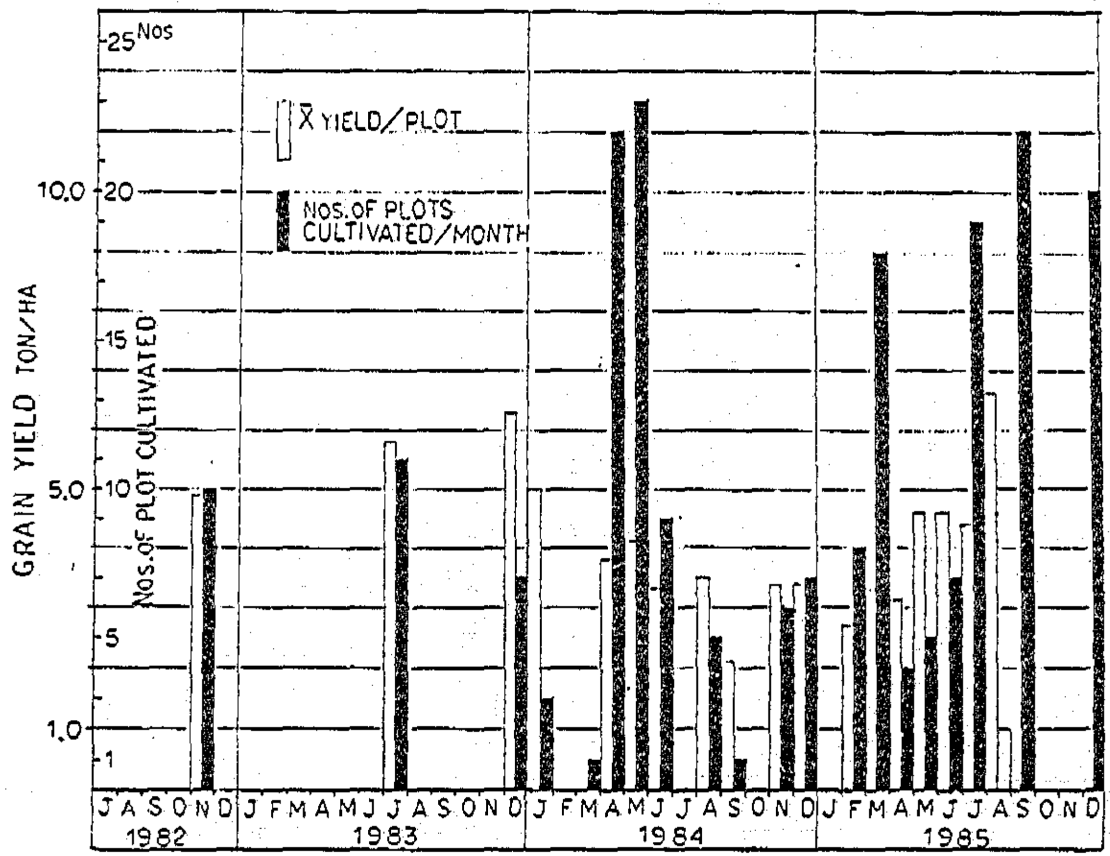


FIG-57

Relation between grain yield and Nos. of plots cultivated in each month

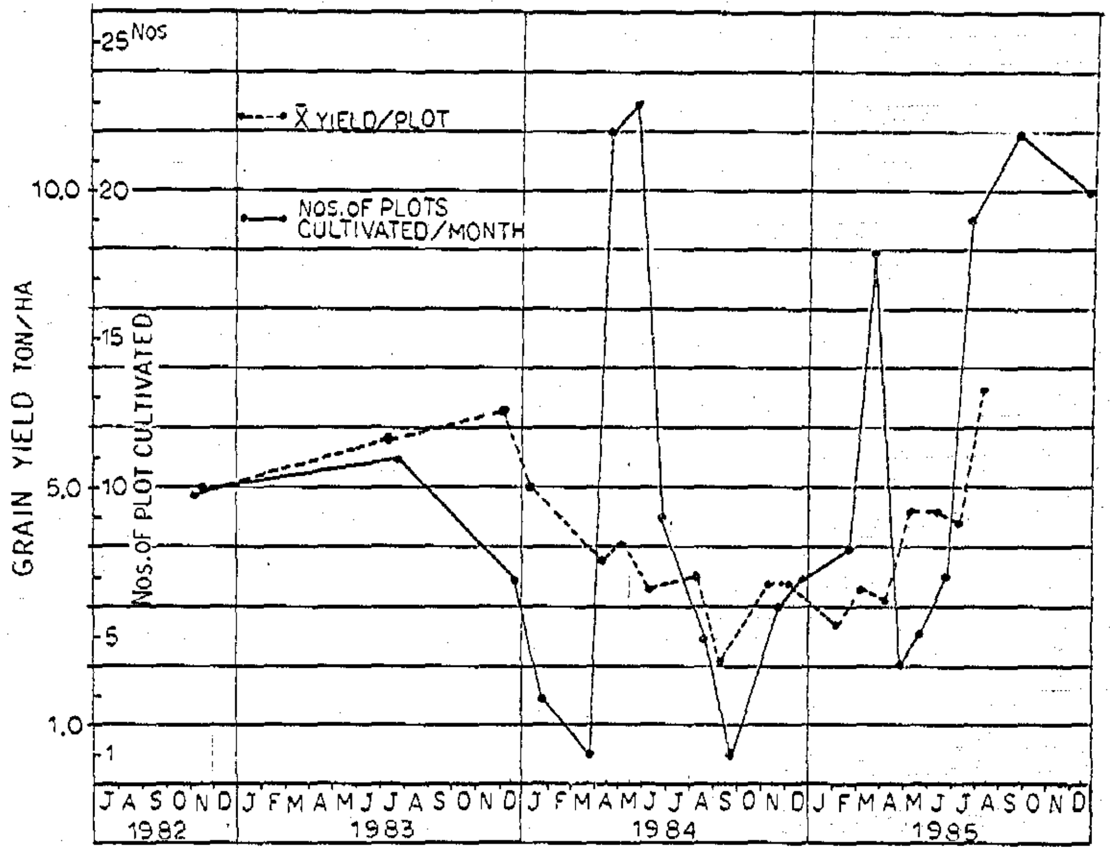


TABLE -22

CULTIVATION RECORD

1982.

PLOT NO.	VARIETY	GROWING PERIOD SOWING - HARVEST	GRAIN YIELD ton/ha	RIPENING RATIO %	1000 GRAIN WEIGHT g	NOS. OF HILLS/12m²	NOS. OF PANICLES/m²	NOS OF SPIKELETS/m²	REMARKS IF ANY
A - 1	AFAA MWANZA	6.11.82 - 25.4.83	6.97	-	-	-	-	-	No sample
2	"	" - 26.4.83	8.74	-	-	-	-	-	analysis was
3	"	" - 26.4.83	6.88	-	-	-	-	-	carried out.
4	"	" - 2.5.83	3.97	-	-	-	-	-	
5	"	" - 3.5.83	4.93	-	-	-	-	-	
6	"	" - 3.5.83	4.45	-	-	-	-	-	
7	IR - 8	20.11.82 - 9.5.83	3.67	-	-	-	-	-	
8	"	" - "	3.26	-	-	-	-	-	
9	"	" - 13.5.83	2.92	-	-	-	-	-	
10	"	" - "	2.92	-	-	-	-	-	

1983

PLOT NO.	VARIETY	GROWING PERIOD SOWING - HARVEST	GRAIN YIELD ton/ha	RIPENING RATIO %	1000 GRAIN WEIGHT g	Nos. OF HILLS/12m²	Nos. OF PANICLES/m²	Nos. OF SPIKELETS/m²	REMARKS IF ANY
B - 1	-	-	-	-	-	-	-	-	NURSERY
2	IR - 8	26.7.83 - 27.12.83	5.83	-	-	-	-	-	
3	"	" - 31.12.83	6.07	-	-	-	-	-	
4	"	" - 5.1.84	7.00	-	-	-	-	-	
5	"	" - 9.1.84	7.00	-	-	-	-	-	
6	"	" - 14.1.84	6.53	-	-	-	-	-	
7	"	" - 18.1.84	6.30	-	-	-	-	-	
8	"	" - 22.1.84	8.17	-	-	-	-	-	
9	"	" - 25.1.84	4.67	-	-	-	-	-	
10	"	" - 26.1.84	0.23	-	-	-	-	-	
C - 1	IR - 8	26.7.83 - 7.1.84	6.07	-	-	-	-	-	
D - 1	-	-	-	-	-	-	-	-	NURSERY
2	IR - 32*	27.12.83 - 24.5.84	6.05	-	-	-	-	-	*under KADC's
3	"	" - 1.6.84	7.25	-	-	-	-	-	direct management
4	"	" - 4.6.84	7.64	-	-	-	-	-	(D.E.F blocks)
5	"	" - "	6.27	-	-	-	-	-	
6	"	" - 6.6.84	5.91	-	-	-	-	-	
7	"	" - 28.6.84	4.67	-	-	-	-	-	
8	"	27.1.84 - 10.7.84	4.91	-	-	-	-	-	
9	"	" - 9.7.84	5.77	-	-	-	-	-	
10		" - 11.7.84	4.28	-	-	-	-	-	
11	IR-56	9.3.84 - 13.8.84	0**	-	-	-	-	-	**cold injury

1984									
PLOT NO.	VARIETY	GROWING PERIOD SOWING - HARVEST	GRAIN YIELD ton/ha	RIPENING RATIO %	1000 GRAIN WEIGHT g	Nos. OF HILLS/12m²	Nos. OF PANICLES/m²	Nos OF SPIKELETS/m²	REMARKS IF ANY
E - 1	IR-20	28.4.84 - 26.9.84	3.71	-	-	-	-	-	
2	"	" - "	3.76	-	-	-	-	-	
3	"	" - "	4.14	-	-	-	-	-	
4	"	" - 3.10.84	3.06	-	-	-	-	-	
5	"	" -	4.14	-	-	-	-	-	
6	- *	24.4.84 - 25.8.84	-	-	-	-	-	-	* Finger millet
7		" -	-	-	-	-	-	-	was cultivated
8		" -	-	-	-	-	-	-	instead of rice.
9		" -	-	-	-	-	-	-	
10		" -	-	-	-	-	-	-	
11		" - 30.8.84	-	-	-	-	-	-	
F - 1	- *	27.4.84 - 1.9.84	-	-	-	-	-	-	* Finger millet
2		" -	-	-	-	-	-	-	was cultivated
3		" -	-	-	-	-	-	-	instead of rice.
4		" -	-	-	-	-	-	-	
5		" -	-	-	-	-	-	-	
6		" -	-	-	-	-	-	-	
7		28.4.84 -	-	-	-	-	-	-	
8		" -	-	-	-	-	-	-	
9		" -	-	-	-	-	-	-	
10		" -	-	-	-	-	-	-	
11		" - 8.9.84	-	-	-	-	-	-	

4

·1984

PLOT NO.	VARIETY	GROWING PERIOD	GRAIN YIELD	RIPENING	1000 GRAIN	NOS. OF	NOS. OF	NOS. OF	REMARKS
		SOWING - HARVEST	ton/ha	RATIO %	WEIGHT g	HILLS/12m²	PANICLES/m²	SPIKELETS/m²	IF ANY
A - 1	IR-8	23.5.84 - 29.10.84	3.27	-	-	-	-	-	
2	"	4.5.84 - 24.10.84	4.20	-	-	-	-	-	
3	"	" - 13.10.84	3.27	-	-	-	-	-	
4	IR-20	24.4.84 - 7.10.84	4.20	-	-	-	-	-	
5	IR-8	4.5.84 - 25.10.84	4.67	-	-	-	-	-	
6	"	" - 16.10.84	3.50	-	-	-	-	-	
7	"	" - 21.10.84	2.80	-	-	-	-	-	
8	"	" - "	4.67	-	-	-	-	-	
9	"	" - "	3.97	-	-	-	-	-	
10	"	" - "	4.20	-	-	-	-	-	
B - 1	-	-	-	-	-	-	-	-	NURSERY
2	IR-20	23.5.84 - 23.10.84	4.67	-	-	-	-	-	
3	"	" - "	5.13	-	-	-	-	-	
4	IR-8	4.5.84 - 19.10.84	3.73	-	-	-	-	-	
5	"	" - 26.10.84	5.13	-	-	-	-	-	
6	"	" - 24.10.84	5.13	-	-	-	-	-	
7	IR-36	23.5.84 - 23.10.84	3.27	-	-	-	-	-	
8	IR-20	23.5.84 - 25.10.84	5.13	-	-	-	-	-	
9	IR-8	4.5.84 - 23.10.84	4.20	-	-	-	-	-	
10	IR-36	23.5.84 - 23.10.84	4.20	-	-	-	-	-	

5

PLOT NO.	VARIETY	GROWING PERIOD SOWING - HARVEST	GRAIN YIELD ton/ha	RIPENING RATIO %	1000 GRAIN WEIGHT g	NOS. OF HILLS/12 m²	NOS. OF PANICLES/m²	NOS OF SPIKELETS/m²	REMARKS IF ANY
C - 1	IR - 8	30.6.84 - 30.11.84	2.80	-	-	-	-	-	
2	"	" -	3.73	-	-	-	-	-	
3	"	" -	3.73	-	-	-	-	-	
4	"	" -	2.80	-	-	-	-	-	
5	"	" - 15.12.84	3.27	-	-	-	-	-	
6	IR - 36	23.5.84 - 23.10.84	5.13	-	-	-	-	-	
7	"	" - "	4.67	-	-	-	-	-	
8	IR - 8	" - 30.10.84	3.73	-	-	-	-	-	
9	"	" -	3.27	-	-	-	-	-	
10	"	" - 15.11.84	2.80	-	-	-	-	-	
D - 1	IR - 20	23.6.84 - 18.11.84	3.27	-	-	-	-	-	
2	"	" - "	3.50	-	-	-	-	-	
3	IR - 42	" - 25.11.84	3.27	89.9	19.3	-	-	-	
4	IR - 8 / 32	30.6.84 - 18.12.84	3.73	-	-	-	-	-	
5	IR - 8	30.8.84 - 15.1.85	3.50	74.0	27.9	-	-	-	
6	"	" - "	4.67	81.1	28.3	-	-	-	
7	"	" - 2.2.85	1.87	80.0	26.7	-	-	-	
8	"	" - "	4.20	83.6	26.3	-	-	-	
9	"	" - 22.2.85	3.27	76.4	27.1	-	-	-	
10	IR - 54	13.11.84 - 20.3.85	3.03	71.6	24.0	-	-	-	
11	"	" - 21.3.85	1.87	74.4	23.1	-	-	-	
F - 1	IR - 8	10.7.84 - 15.1.85	2.10	62.3	25.8	-	-	-	
2	IR - 36	13.12.84 - 26.3.85	3.73	81.5	22.5	-	-	-	

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1984									
PLOT NO.	VARIETY	GROWING PERIOD	GRAIN YIELD	RIPENING	1000 GRAIN	NOS. OF	NOS. OF	NOS OF	REMARKS
		SOWING - HARVEST	ton/ha	RATIO %	WEIGHT g	HILLS/12m²	PANICLES/m²	SPIKELETS/m²	IF ANY
A - 1	- *	-	-	-	-	-	-	-	* variety Trial
2	IR-8	13.11.84 - 9.4.85	2.80	92.6	28.7	-	-	-	(10 varieties)
3	"	" - 17.4.85	3.50	83.9	29.5	-	-	-	
4	"	" - 26.4.85	3.50	83.1	28.1	-	-	-	
5	IR-20	1.12.84 - 23.4.85	2.80	76.7	20.7	-	-	-	
6	IR-8	" - 15.4.85	4.20	80.8	28.6	-	-	-	
7	IR-20	" - 17.4.85	4.20	85.8	19.7	-	-	-	
8	"	" - 24.4.85	4.20	87.7	20.1	-	-	-	
9	IR-8	21.12.84 - 27.4.85	2.10	-	-	-	-	-	
10	-	-	-	-	-	-	-	-	
B- 1	IR-20	1.12.84 - 30.4.85	3.27	86.5	19.6	-	-	-	
2	"	" - "	3.73	85.8	19.6	-	-	-	
3	"	" - 2.5.85	1.40	-	-	-	-	-	
E- 1	IR-36	16.2.85 - 27.7.85	2.33	70.0	20.2	-	-	-	
2	"	" - 27.7.85	3.27	-	-	-	-	-	
3	"	" - 26.7.85	2.10	73.3	21.3	-	-	-	
4	"	" - 27.7.85	3.27	-	-	-	-	-	
5	"	" - 5.8.85	2.33	61.6	20.3	-	-	-	
6	"	" - 30.7.85	3.15	62.2	19.2	-	-	-	
7	"	" - 26.7.85	2.10	57.3	20.4	-	-	-	
8	"	" - 3.8.85	3.03	-	-	-	-	-	
9	IR-20	23.3.85 - 2.9.85	2.68	-	-	-	-	-	
10	"	" - "	2.22	52.4	20.7	-	-	-	
11	"	" - 5.9.85	2.57	61.7	20.4	-	-	-	

1985									
PLOT NO.	VARIETY	GROWING PERIOD	GRAIN YIELD	RIPENING	1000 GRAIN	NOS. OF	NOS. OF	NOS OF	REMARKS
		SOWING - HARVEST	ton/ha	RATIO %	WEIGHT g	HILLS/1.2m²	PANICLES/m²	SPIKELETS/m²	IF ANY
F - 1	IR-20	23.3.85 - 5.7.85	3.57	70.1	20.8	243	374.6	40.25×10^3	
2	"	" - 7.7.85	3.03	-	-	212	-	-	
3	-	—	-	-	-	-	-	-	
4	IR-20	23.3.85 - 8.7.85	3.03	-	-	234	-	-	
5	"	" - "	2.80	73.6	17.8	221	320.5	28.24	
6	"	" - 11.7.85	3.50	69.2	20.8	246	497.1	45.03	
7	"	" - 20.7.85	3.50	70.1	20.7	237	266.9	42.73	
8	"	" - 19.7.85	3.50	76.0	20.7	267	349.1	41.93	
9	"	" - 20.7.85	2.57	83.5	20.7	212	277.6	37.23	
10	"	" - 24.7.85	2.80	47.5	22.1	353	271.2	48.50	
11	IR-42	10.3.85 - 25.7.85	2.10	32.7	21.2	291	271.0	40.03	
A - 1	-	-	-	-	-	-	-	-	
2	IR-54	8.7.85 - 12.12.85	4.50	68.0	25.7	257	318.1	31.41×10^3	
3	"	" - "	4.90	-	-	228	-	-	
4	"	" - "	4.90	-	-	216	-	-	
5	"	" - 14.12.85	4.90	-	-	227	-	-	
6	"	" - 10.12.85	4.90	-	-	145	-	-	
7	"	" - 14.12.85	4.90	-	-	220	-	-	
8	"	" - 17.12.85	5.13	71.9	25.1	284	434.7	37.52	
9	"	" - "	4.90	72.1	25.1	247	413.7	41.66	
10	"	" - "	5.25	-	-	299	-	-	

8

1985									
PLOT NO.	VARIETY	GROWING PERIOD	GRAIN YIELD	RIPENING	1000 GRAIN	NOS. OF	NOS. OF	NOS. OF	REMARKS
		SOWING - HARVEST	ton/ha	RATIO %	WEIGHT g	HILLS/12 m^2	PANICLES/m^2	SPIKELETS/m^2	IF ANY
B - 1	IR-42	10.3.85 - 19.10.85	4.20	55.0	21.0	210	438.2	60.03×10^3	
2	"	" - "	3.97	60.9	20.6	256	469.3	61.37	
3	"	" - "	4.67	-	-	212	-	-	
4	"	" - 16.10.85	3.73	54.8	21.5	230	519.4	69.72	
5	"	" - 17.10.85	3.03	37.9	20.8	234	441.7	61.52	
6	"	" - 15.10.85	3.50	48.2	20.8	298	488.4	67.95	
7	"	" - 13.10.85	3.50	-	-	256	-	-	
8	"	" - 16.10.85	3.62	52.2	21.6	300	476.7	55.51	
9	IR-20	16.5.85 - 10.10.85	3.97	27.6	21.8	231	258.0	42.16	
10	"	" - 11.10.85	3.97	69.7	20.7	270	352.2	43.05	
C - 1	IR-20	16.5.85 - 25.10.85	4.90	72.9	20.8	211	449	55.39×10^3	
2	"	" - "	5.13	81.1	21.1	315	604	57.27	
3	"	" - "	5.25	74.1	22.2	321	564	58.44	
4	IR-56	7.6.85 - 12.11.85	4.20	-	-	266	-	-	
5	"	" - 13.11.85	4.67	80.3	25.7	227	460	39.61	
6	"	" - "	5.13	87.3	22.7	280	724	70.58	
7	"	" - 12.11.85	5.13	-	-	338	-	-	
8	"	" - "	4.90	60.9	26.1	241	556	85.56	
9	"	" - 13.11.85	4.43	83.0	25.8	-	-	-	
10	"	" - 29.11.85	3.73	70.8	26.0	324	475	41.20	

1985

PLOT NO.	VARIETY	GROWING PERIOD SOWING - HARVEST	GRAIN YIELD ton/ha	RIPENING RATIO %	1000 GRAIN WEIGHT g	NOS. OF HILLS/12m²	NOS. OF PANICLES/m²	NOS. OF SPIKELETS/m²	REMARKS IF ANY
D - 1	IR-36	15.7.85 - 10.12.85	4.90	80.6	22.9	268	732.5	66.57×10³	
2	"	" - "	5.37	81.2	23.5	281	720.0	57.30	
3	"	" - 7.12.85	3.50	-	-	-	-	-	
4	IR-56*	9.8.85 - 15.12.85	6.63	75.2	25.6	277	458.5	42.32	*TRAINING PLOT
5	"	" - 19.12.85	6.89	79.7	25.8	276	525.7	44.74	"
6	IR-36	15.7.85 - 16.12.85	3.73	-	-	-	-	-	
7	"	" - 17.12.85	4.67	-	-	-	-	-	
8	"	" - 18.12.85	3.97	82.0	22.9	281	537.6	40.97	
9	"	" - 17.12.85	3.50	84.0	23.4	293	492.4	38.36	
10	"	" - "	3.50	72.0	22.4	208	413.3	41.29	
11	"	" - 21.12.85	1.40	-	-	289	-	-	

Training curriculum for rice cultivation course at Kilimanjaro Agricultural Development Centre(KADC)

Objectives:

The objectives of the training course are to transfer an improved rice cultivation techniques through field practice and lecture in class room and also to train farmers at their own field after completing the course as a follow-up programme in the village.

Contents:

The training course covers whole crop cycle of rice cultivation i.e. from sowing to harvest and post-harvest process. Participants learn basic knowledge of improved rice cultivation method and they perform all operations of rice cultivation in the field.

Period:

Period of the training course is five months including two months intermission between two terms of one and a half month. Actual training period is three months. Normally the course is conducted during leisure season for farmers and two months intermission is arranged during the course so that farmers can also take care of their own field.

Place:

The course is conducted at Kilimanjaro Agricultural Deveopment Centre, Chekereni. All facilities of KADC are fully utilized for the training purpose. For field practice, a group of approximately ten trainees take one plot(0.3ha) at the trial farm and they manage a plot from sowing to harvest. For lecture in class room, slides and films are utilized for better understanding of the subjects.

Time schedule:

From Monday to Friday the course starts at 8:30 and ends at 14:00. On Saturday it starts at 8:30 and finish up at 12:00. One day consists of three units of 90 minutes each. 219 units makes three months training course. Two units on Saturday are normally for summarization of the subject which they learnt during week day.

Teaching materials:

Text book in Swahili called " Kitabu cha Kilimo cha Mpunga" is prepared for trainees. Contents of the text book is still to be improved and many important informations which are obtained from research activities at the trial farm are also to be added so that the text book will be a complete " Rice Cultivation Manual " for farmers. Agricultural films of introduction to improved rice cultivation and slides of physiology, field management, disease and insect ,etc are also utilized in class room.

Facilities:

After completing five months' training course at KADC, trainees get simple inputs like seed of improved variety and sprayer from KADC so that they can try improved cultivation method by themselves at their own field. The connection between participants and KADC is always kept so that they can come and ask any suggestions when they get problems. For participants who completed the course, attendance certificate is offered from Regional Development Director of Kilimanjaro.

Subjects of the training course:

Subject	Content	Unit lecture	Unit practice
1. Oriontation	1. Introduotion to KADC - organization of KADC - target of KADC - activities at the trial farm and the pilot farm 2. Brief orientation of the training course	2	2
2. Introduotion to improved rice cultivation method	1. Comparision of improved and traditional rice cultivation methods - disscussion on farmers traditional practices - difference between improved and local methods - questionaries of farmer's practices	4	0
3. Seed selection	1. Quality of seed - what is good seed - germination percent - disease free seed - seed domancy 2. Seed selection method 3. Soaking seeds 4. Incubation of seeds	1	1
4. Nursery preparation and management	1. Types of nursery and their advantage and disadvantage - dry seed bed - wet seed bed - Dupog seed bed 2. Site selection for nursery 3. Required area for nursery 4. Shape of nursery 5. Seed rate for 1 ac - caluculation of seeds required 6. Nursery preparation method	2	9

	7. Management of nursery - water management of nursery for better establishmant of seedlings - nitrogen application at nursery		
5. Sowing seeds	1. Method of sowing seeds 2. Seed rate for 1 ac - calculation of seed amount concerning germination percent, grain weight and plant population in main field - sowing density at nursery and quality of seedling 3. Water managemont of nursery	0	3
6. Plant growth and development	1. Life cycle of rice plant - physiological phases in the growth process - duration of each growth phases - growth phases in relation to yield - critical growth stages for determination of yield - yield components 2. Photoperiod effect on growth duration of rice plant - varietal reaction to photo period 3. Morphorogy of rice plant - roots - culm - leaves - panicle - spikelets - rice grain	10	2
7. Upland crops	1. Brief explanation of upland crops - types of upland crops - classification of crops - nutrients of crops	2	0

8. Fertilizers	1. Types of fertilizers - major elements(N-P-K) - minor elements - function of N-P-K 2. Nitrogen - nitrogen requirements of rice plant - source of nitrogen - rate of nitrogen application - method of nitrogen application - time of nitrogen application - varietal types and nitrogen application - spacing and nitrogen application - soil characteristics and nitrogen application - water management and split application of nitrogen - characteristics of flooded soil and nitrogen loss - critical stages for nitrogen application 3. Phosphorus - phosphrus absorption of soil - availability of phosphorus in flooded soil - source of phosphorus - rate of phosphorus application - time of phosphorus application - response to phosphorus 4. Potassium - potassium in soil - source of potassium - rate of potassium application - time of potassium application - response to potassium 5. Advantage and disadvantage of fertilizer application - excessive nitrogen - deffiociency of nitrogen - defficiency of P and K	10	5

9. Land preparation	1. Objectives of tillage - weed control - mixing organic matters - easy puddling - formation of hard layer 2. Plowing - plowing method - equipments for plowing - agricultural machinery for plowing 3. Time of starting plowing - steps in preparing paddy field 4. Leveling 5. Puddling - time of puddling - objectives of puddling - method of puddling	6	9
10. Transplanting	1. Transplanting method - random transplanting - straight row transplanting 2. Time of transplanting - optimum age of seedling for transplanting - seedling age in relation to variety 3. Straight row transplanting - plant spacing in relation to variety and soil fertility - different spacing for local variety and improved variety - response of spacing to grain production 4. Field operation of transplanting - preparation of planting rope - up-rooting seedlings	3	12
11. Water management	1. Water management and practices for rice cultivation - effects of water management on yield and plant growth - water management for weed control	6	3

	- water management for insect and disease control - water management and nitrogen loss - water management and soil toxicity - water tempareture 2. Water requirements - source of water required - water loss 3. Actual water requirement and water management practice at the trial farm and the pilot farm - irrigation method - irrigation intervals - water requirement		
12. Inter-cultural practices	1. Management after transplanting - gap filling for missing hills 2. Weed control - importance of weed control - types of weeds - rice-weed competition in relation to yield - effect of duration of weed control on yield - weed control method 3. Time of nitrogen top-dressing at critical growth stage	2	2
13. 1st final examination	1. Final examination for 1st term of one and a half month - cover all subjects which were covered during 1st term 2. Summarization of 1st term	4	0
14. Disease and its control	1. Common disease of rice - fungus diseases - bacteria diseases - virus diseases	20	1

	2. Symptom of diseases, cycle of diseases and control method and favorable condition for out-break of diseases - rice blast - helminthosporium - rice narrow brown leaf spot - rice stem rot - bacteria leaf blight - bacteria leaf streak - rice tungro - orange leaf 3. Typical leaf lesions of common rice diseases 4. Identification of diseases in the field		
15. Insect and its control	1. Common insect pests of rice and chemical control - rice stem borer - leaf hopper - plant hopper - rice bug - storage insect pest 2. Insecticide - types of insecticides - method of insecticide application - time of insecticide application 3. Calibration of sprayer - specific solution of insecticide - amount of solution required for 1 ac - spraying capacity 4. Field practice of insecticide application	16	4
16. Seed production	1. Varietal characteristics of rice plant - adult plant characteristics - growth habit - leaf color - leaf sheath - color of palea and lemma - awn - panicle type	6	2

	- maturity - grain type 2. Maintenance of varietal characteristics of seed - mixture of different varieties - out-cross - random drift - spontaneous mutation - roguing off types - avoid mechanical mixture 3. Seed collection and field management for seed production		
17. Harvest and post-harvest process	1. Preparation for harvest - time for harvest - field preparation for harvest - equipments for harvest 2. Harvest and post-harvest process - harvest, threshing, drying hauling, milling. - storage of production - optimum moisture content for storage - storage problems 3. Field practice of harvest - threshing - winowing - weighing	7	21
18. Questionaire of local cultivation practice	1. Approximately 200 nos. of questions for traditional cultivation practices of farmers - rice cultivation - maize cultivation - bean cultivation - vegetable cultivation - other crops - general questions for size of farm, family, etc	9	0

19. Study tour and report writing	1. short visit to rice production farm in different region - investigation of rice cultivation practices - exchange informations of variety, cultivation practices, etc. 2. Report writing	3	9
20. Final discussion and summarization	1. Discussion about the training course - problems observed - difficult subjects - comments or suggestions for future training course 2. Summarization of whole course - review of important subject and explanation	9	0
21. Final examination	1. Final examination for whole course of 1st and 2nd terms	6	0

TIME TABLE FOR RICE CULTIVATION TRAINING

DATE	8:30 - 10:00	10:30 - 12:30	12:30 - 2:00
1-8-85 THUR.		Opening ceremony (Class room)	Orientation of the training course (Class room)
2-8-85 FRI.	Orientation of KADC activities. (class room)	Orientation of KADC activities. (Trial farm)	Orientation of KADC activities. (Pilot farm).
3-8-85 SAT.	An introduction to agriculture in Japan. (class room)	Discussion of farmer's local practices. (class room)	
5-8-85 MON.	Nursery-preparation method. Area required for a plot (class room)	Nursery preparation different types of nursery. (class room)	Seed selection, soaking incubation and sowing seed rate for a plot. (class room)
6-8-85 TUE.	Nursery preparation cleaning field and measuring area for nursery. (field)	Nursery preparation cleaning field and measuring area for nursery. (field)	Nursery preparation plowing. (field)
7-8-85 WED.	Nursery preparation plowing. (field)	Nursery preparation puddling. (field)	Nursery preparation puddling. (field)
8-8-85 THUR.	Nursery preparation seed bed making, measuring area for nursery. (field)	Nursery preparation seed bed making. (field)	Nursery preparation seed bed making. (field)
9-8-85 FRI.	Nursery preparation sowing seeds. (field)	Nursery preparation sowing seeds. (field)	Nursery preparation sowing seeds. (field)
10-8-85 SAT.	Summarization of the subject. (class room)	Summarization of the subject. (class room)	
12-8-85 MON.	Plant growth and its development. Life cycle of rice plant. (class room)	Plant growth and its development. Life cycle of rice plant. (class room)	Plant growth and its development. Life cycle of rice plant. (class room)
13-8-85 TUE	Plant growth and its development growth stages. (class room)	Plant growth and its development growth stages (class room)	Plant growth and its development growth stages. (class room)

DATE	8:30 - 10:00	10:30 - 12:30	12:30 - 2:00
14-8-85 WED.	Plant growth and its development. Duration of stages. (class room)	Plant growth and its development critical stages for yield determination. (class room)	Plant growth and its development critical stages for yield determination. (class room)
15-8-85 THUR	Morphology of rice plant Vegetative organs (class room)	Morphology of rice plant Fibral organs (class room)	Morphology of rice plant Structure of grains. (class room)
16-8-85 FRI.	Upland crops by DR. M. NEZU (class room)	Upland crops by DR. M. NEZU (class room)	Upland crops by DR. M. NEZU (class room)
17-8-85 SAT.	Summarization of the subject. (class room)	Summarization of the subject. (class room)	
19-8-85 MON.	Fertilizer, Function of major and minor elements. (class room)	Fertilizer, Function of Nitrogen on plant growth and production. (class room)	Fertilizer, Function of Nitrogen on plant growth and production. (class room)
20-8-85 TUE	Fertilizer, Function of P_2O_5 on plant growth and production. (class room)	Fertilizer, Function of P_2O_5 on plant growth and production. (class room)	Fertilizer, Function of K_2O on plant growth and production. (class room)
21-8-85 WED.	Fertilizer, Method of fertilizer application. (class room)	Fertilizer, Method of fertilizer application. (class room)	Fertilizer, Time of nitrogen application. (class room)
22-8-85 THUR.	Fertilizer, Time of Nitrogen application. (class room)	Fertilizer, Critical stage for fertilizer application. (class room)	Fertilizer, Critical stage for fertilizer application. (class room)
23-8-85 FRI	Fertilizer, Soil and nitrogen (class room)	Fertilizer, Water and nitrogen (class room)	Fertilizer, Variety and nitrogen. (class room)
24-8-85 SAT.	Summarization of the subject. (class room)	Summarization of the subject. (class room)	
26-8-85 MON.	Land preparation Objective of land preparation and Time. plowing (class room)	Land preparation Objective of land preparation. puddling (class room)	Land preparation Soil change of paddy field. (class room)
27-8-85 TUE.	Land preparation cleaning field. (field)	Land preparation cleaning field. (field)	Land preparation cleaning field. (field)

DATE	8:30 - 10:00	10:30 - 12:30	12:30 - 2:00
28-8-85 WED.	Land preparation Cleaning field (field)	Land preparation Cleaning field (field)	Land preparation. Cleaning field (field)
29-8-85 THUR.	Land preparation Plowing field with Agricultural machinery Section. (field)	Land preparation Plowing field with Agricultural machinery Section. (field)	Land preparation Plowing field with Agricultural machinery Section. (field)
30-8-85 FRI.	Land preparation Plowing field with Agricultural machinery Section. (field)	Land Preparation Plowing field with Agricultural machinery Section. (field)	Land preparation Plowing field with Agricultural machinery Section. (field)
31-8-85 SAT.	Summarization of the subject. (class room)	Summarization of the subject. (class room)	
2-9-85 MON.	Water management by irrigation section (class room)	Water management by irrigation section. (class room)	Water management effect of water on plant growth of rice plant. (class room)
3-9-85 TUE.	Water management by irrigation section. (class room)	Water management by irrigation section. (class room)	Water management effect of flooding. (class room)
4-9-85 WED.	Water management by irrigation section (class room)	Water management by irrigation section (class room)	Water management water management system (class room)
5-9-85 THUR.	Land preparation Puddling and levelling with Agricultural machinery section. (field)	Land preparation Puddling and levelling with Agricultural machinery section. (field)	Land preparation Puddling and levelling with Agricultural machinery section. (field)
6-9-85 FRI.	Land preparation puddling and levelling with Agricultural machinery section. (field)	Land preparation puddling and levelling with Agricultural machinery section. (field)	Land preparation puddling and levelling with Agricultural machinery section. (field)
7-9-85 SAT.	Summarization of the subject. (class room)	Summarization of the subject. (class room)	
9-9-85 MON.	Uprooting seedlings and seedling arrangement. (field)	Uprooting seedlings and seedling arrangement. (field)	Uprooting seedlings and seedling arrangement. (field)
10-9-85 TUE.	Transplanting (field)	Transplanting (field)	Transplanting (field)

DATE	8:30 - 10:00	10:30 - 12:00	12:30 - 2:00
11-9-85 WED.	Transplant (field)	Transplanting (field)	Transplanting (field)
12-9-85 THUR	Transplanting (field)	Transplanting (field)	Transplanting (field)
13-9-85 FRI.	Intercultural management effect of weeding. (class room)	Intercultural management gap tilling (field)	Intercultural management gap tilling. (field)
14-9-85 SAT.	Final (1st): examination (class room)	Orientation for 2nd training course: (class room)	

DATE	8:30 - 10:00	10:30 - 12:00	12:30 - 2:00
15-11-84 THUR	Exploration of the 2nd-half course (class)	- do - (class)	Summarization of previous training course. (class)
16-11-84 FRI	Disease and its control, general (class)	- do - rice blast (class)	- do - rice blast (class)
17-11-84 SAT	Disease and its control rice blast (class)	- do - (class)	
19-11-84 MON	Disease & its control rice blast (class)	Disease & its control brown spot (class)	Diseases and its control brown spot (class)
20-11-84 TUE	Disease & its control Leaf spot (class)	Disease & its control Leaf spot (class)	- do - Stem rot (class)
21-11-84 WED	Disease & its control Stem rot (class)	- do - B.L.B. (class)	- do - B.L.B. (class)
22-11-84 THUR	Disease & its control B.L.S. (class)	- do - B.L.S. (class)	- do - Tungro (class)
23-11-84 FRI	Disease & its control Tungro (class)	- do - Orange leaf (class)	- do - Orange leaf (class)
24-11-84 SAT	Disease & its control Summarization (field)	- do - Summarization (class)	
26-11-84 MON	Insect & its control general (class)	- do - Stem borer (class)	- do - Stem borer (class)
27-11-84 TUE	Insect & its control Stem borer (class)	- do - Leaf hopper (class)	- do - Leaf hopper (class)
28-11-84 WED	Insect & its control Leaf hopper (class)	- do - Rice bug (class)	- do - Rice bug (class)
29-11-84 THUR	Insect & its control rice bug (class)	- do - insecticide (class)	- do - insecticide (class)
30-11-84 FRI	Insect & its control Calibration of sprayer (class)	- do - Calibration of sprayer (field)	- do - Calibration of sprayer (field)
1-12-84 SAT	Insect & its control Summarization (field)	- do - Summarization (class)	
3-12-84 MON	Seed production method of seed collection. (class)	- do - method of seed collection (class)	- do - rouging off plants (class)

DATE	8:30 - 10:00	10:30 - 12:00	12:30 - 2:00
4-12-84 TUE	Seed production varietal characteristics of rice plant. (class)	- do - varietal characteristics of rice plant (class)	- do - varietal characteristics of rice plant. (class)
5-12-84 WED	Study tour	- do -	- do -
6-12-84 THU	Study tour	- do -	- do -
7-12-84 FRI	Study tour	- do -	- do -
8-12-84 SAT	Summarization of the subject (class)	Report writing (class)	
10-12-84 MON	Preparation for harvest equipments for harvesting (class)	- do - harvesting method (class)	- do - thereshing (class)
11-12-84 TUE	Preparation for harvest Drying (class)	- do - Roguing (field)	- do - Roguing (field)
12-12-84 WED	Harvest & Post harvest process hauling (class)	- do - Milling (class)	- do - Storage (class)
13-12-84 THUR	Questionarie of local cultivation method (class)	- do -	- do -
14-12-84 FRI	Questionarie of local cultivation method. (class)	- do -	- do -
15-12-84 SAT	Summarization of the subject (class)	- do -	
17-12-84 MON	Harvest (field)	- do -	- do -
18-12-84 TUE	Harvest (field)	- do -	- do -
19-12-84 WED	Threshing (field)	- do -	- do -
20-12-84 THUR	Threshing (field)	- do -	- do -
21-12-84 FRI	Threshing (field)	- do -	- do -
22-12-84 SAT	Summarization (class)	- do - (class)	
24-12-84 MON	Final examinations (class)	- do - (class)	- do - (class)

DATE	8:30 - 10:00	10:30 - 12:00	12:30 - 2:00
25-12-84 TUE	H O	L I D A Y	
26-12-84 WED	Final examinations (class)	- do -	- do -
27-12-84 THU	Discussion about the course (class)	- do -	- do -
28-12-84 FRI	Comments writing (class)	- do -	- do -
29-12-84 SAT	Summarization of the course. (class)	- do -	
31-12-84 MON		Closing Ceremony (class)	

TABLE -23

Summary table of variety verification plot in farmer's field Location: Rau ya Kati village, Moshi Cooperative farmer Mr. Michael Furia

Variety	Grain yield kg/ha	Nos. of panicles per hill	Nos. of spikelets per panicle	Nos. of panicles per 1 m^2	Nos. of spikelets per 1 m^2	Ripening ratio %
IR - 5	3472	29.8	71.1	464.9	33.03 $\times 10^3$	72.9
IR - 8	3899	27.2	77.6	459.7	35.65	65.3
IR - 20	4053	25.9	84.4	453.3	38.25	63.1
IR - 32	4101	33.4	63.6	544.4	34.65	74.2
IR - 36	3670	28.8	77.8	440.6	34.29	64.4
IR - 42	3361	38.0	83.1	581.4	48.30	68.1
IR - 54	4003	26.4	80.0	451.4	36.14	61.3
IR - 56	3353	25.9	74.9	383.3	28.73	62.9
Affa Mwanza	3126	23.5	62.8	433.7	27.25	84.1
Taiwan - 14	—	—	—	—	—	—

Variety	1000 grain weight g	Nos. of hills harvested/12 m^2	Nos. of hills per 1 m^2	Harvest index %	Maturity days
IR - 5	21.6	187	15.6	32.6	155
IR - 8	27.6	203	16.9	45.0	148
IR - 20	18.4	210	17.5	43.4	136
IR - 32	22.2	195	16.3	42.7	157
IR - 36	21.4	183	15.3	49.9	127
IR - 42	17.6	184	15.3	45.6	140
IR - 54	22.5	205	17.1	44.6	134
IR - 56	23.6	177	14.8	49.4	131
Affa Mwanza	25.5	219	18.3	34.7	160
Taiwan - 14	—	—	—	—	—

Harvest index; grain wieght/ total weight of samples x 100

TABLE - 24

Summary table of variety verification plot in farmer's field Location: Chekereni pilot farm A - 1 plot Cooperative farmer Mr. J. Ngowi

Variety	Grain yield kg/ha	Nos. of panicles per hill	Nos. of spikelets per panicle	Nos. of panicles per 1 m^2	Nos. of spikelets per 1 m^2	Ripening ratio %
IR - 5	6713	49.8	83.9	577.7	48.45 $\times 10^3$	73.8
IR - 8	6110	31.7	90.6	408.9	37.05	82.2
IR - 20	6608	39.6	78.9	625.7	49.36	86.6
IR - 32	7035	57.4	61.5	652.8	40.12	84.3
IR - 36	6276	41.3	69.1	677.3	46.83	79.0
IR - 42	7288	34.2	81.7	550.7	45.08	88.8
IR - 54	6175	33.1	76.3	407.1	31.06	85.6
IR - 56	6216	41.7	59.4	558.8	33.17	86.0
Affa Mwanza	6558	27.2	89.9	348.2	31.30	84.4
Taiwan - 14	7116	23.6	113.4	349.3	39.62	88.1

Variety	1000 grain weight g	Nos. of hills harvested/12 m^2	Nos. of hills per 1 m^2	Harvest index %	Maturity days
IR - 5	23.5	139	11.6	45.1	152
IR - 8	28.6	155	12.9	50.3	145
IR - 20	18.7	189	15.8	49.3	133
IR - 32	23.6	152	12.7	50.4	155
IR - 36	20.4	197	16.4	53.9	122
IR - 42	19.6	193	16.1	46.8	143
IR - 54	23.0	147	12.3	51.9	136
IR - 56	22.0	161	13.4	54.0	126
Affa Mwanza	28.5	154	12.8	35.0	158
Taiwan - 14	22.4	177	14.8	37.6	166

Harvest index: grain weight/total weight of samples x 100

TABLE-25

Summary table of variety verification plot in farmer's field Location: Rau ya Kati village, Moshi Cooperative farmer Mr. Fransis Silayo

Variety	Grain yield kg/ha	Nos. of panicles per hill	Nos. of spikelets per panicle	Nos. of panicles per 1 m^2	Nos. of spikelets per 1 m^2	Ripening ratio %
IR - 5	8125	19.7	116.4	413.9	48.15 $\times 10^3$	77.9
IR - 8	8205	16.3	126.9	311.3	39.49	71.1
IR - 20	8002	16.6	139.5	366.9	51.17	84.7
IR - 32	7284	25.5	115.7	499.8	57.83	76.6
IR - 36	7097	19.5	89.0	397.8	35.40	85.8
IR - 42	7448	19.6	140.1	397.9	55.73	85.2
IR - 54	7866	21.3	125.8	406.8	51.19	74.6
IR - 56	6711	20.3	80.1	412.1	33.01	92.9
Affa Mwanza	7726	17.4	102.8	318.4	32.74	87.1
Taiwan - 14	5486	13.8	118.1	259.4	35.77	85.3

Variety	1000 grain weight g	Nos. of hills harvested/12 m^2	Nos. of hills per 1 m^2	Harvest index %	Maturity days
IR - 5	22.0	252	21.0	46.7	145
IR - 8	27.4	229	19.1	48.2	149
IR - 20	20.5	265	22.1	54.1	134
IR - 32	22.5	235	19.6	51.5	149
IR - 36	23.7	245	20.4	51.1	128
IR - 42	20.4	243	20.3	52.2	139
IR - 54	25.2	229	19.1	54.8	131
IR - 56	25.2	243	20.3	53.7	122
Affa Mwanza	28.5	183*	18.3	46.2	141
Taiwan - 14	20.6	225	18.8	33.8	145

* Harvested area of Affa Mwanza was 10 m^2. Harvest index: grain weight/ total weight of samples x 100

Traditional practices of farmers in Lover Moshi area.

1. General questions:

Family size:

Size of family varys from 2 - 20 persons per family, however the most popular family size is 4 - 12 persons. 26 % of farmers mentioned that their family members were 4 - 6 persons. Approximately 52 % of farmers had 6 - 8 persons per family. And majority of farmers were less than 12 persons in family.

Considering 15 years old is critial age of family member for agricultural work, number of family member whose age is more than 15 years old was investigated. Majority of farmers mentioned that they had 2 - 6 persons per family. Approximately 15 % of farmers had 6 - 8 persons in their families.

60 % of farmers had 2 - 4 persons who always worked in agriculture. And 26 % of farmers answered they had 4 - 6 persons in family. Standard family size is 6 - 8 persons and out of 6 - 8 persons, 2 - 4 persons are engaged in agriculture and 2 - 4 persons are more than 15 years old. When farmers are busy for transplanting rice, weeding maize field and harvest rice and maize, almost all farmers get 2 - 4 person to help them temporaly. Major non-agricultural job are bussiness and driver.

2. Maize cultivation:

Area of field

Most of farmers cultivate maize in an area of 1.0 ac - 4.0 ac. Approximately 53 % of farmers hold less than 3.0 ac of maize field. There are a few farmers who cultivate in large area of field. Largest size of maize cultivation in 24.0 ac was observed in the survey.

Variety

4 varieties are commonly cultivated in the area. These are Ilonga Composite, Katumani, Hybrid and local variety. However these are not pure variety. Normarly farmers produce seeds from previous product and most of them do not purchase seeds. Varie-

Size of family

Nos. of family member	Nos. of farmers	%
1 - 2	0	0
2 - 4	7	9.6
4 - 6	12	26.0
6 - 8	19	52.0
8 - 10	9	64.3
10 - 12	15	84.8
12 - 14	8	95.8
14 - 16	1	97.2
16 - 18	0	-
18 - 20	1	98.6
35	1	100.0
Total	73	

Number of family member whose age is more than 15 years

Nos. of family member	Nos. of farmers	%
1 - 2	3	4.1
2 - 4	26	39.7
4 - 6	27	76.7
6 - 8	11	91.8
8 - 10	2	94.5
10 - 12	1	95.0
12 - 14	0	-
14 - 16	3	100.0
16 - 18	0	
18 - 20	0	
Total	73	

Nos. of family member who is engaged in agriculture.

Nos. of family member	Nos. of famrers	%
1 - 2	6	8.2
2 - 4	43	67.1
4 - 6	19	93.1
6 - 8	2	95.0
8 - 10	1	97.2
10 - 12	2	100.0
12 - 14	0	
14 - 16	0	
16 - 18	0	
18 - 20	0	

Nos. of family member who is not engaged in agriculture.

Nos. of family member	Nos. of farmers	%
1 - 2	21	28.8
2 - 4	30	69.9
4 - 6	11	85.0
6 - 8	7	94.6
8 - 10	2	97.3
10 - 12	2	100.0
12 - 14	0	
14 - 16	0	
16 - 18	0	

tal characteristics of varieties are not known and segregated palnts are commonly observed in farmer's field. All of these varieties are white dent-flint corn. Katumani is early maturing variety. The most popular variety is Ilonga composite and 63 % of farmers cultivate this variety.

Size of maize field

Size of field	Nos. of farmers	%
0 - >1 ac	1	1.4
1 - >2	16	24.2
2 - >3	20	52.9
3 - >4	10	67.2
4 - >5	6	75.8
5 - >6	2	78.7
6 - >7	6	87.3
7 - >8	1	88.7
8 - >9	2	91.6
9 - >10	0	-
10 - >11	3	95.2
15	1	97.3
16	1	98.7
24	1	100.0
total	70	-

Favorite variety of maize

Variety	Nos. of farmers
Ilonga composite	50
Katumani	11
Hybrid	9
Local	9
Total	79

Maize seed is available in TFA(Tanganika Farmers Association) and Tan Seed(Tanzania Seed Corporation) but 87 % of farmers do not purchase seeds and they use previous product as seeds. Farmers select large ears in required quantity and keep them as seeds. Selection criteria of seed seems to be size of ear and maturity days.

Growing season

Most of farmers cultivate maize only once a year. Approximately 26 % of farmers grow twice a year where irrigation water is available. Land preparation for main season is started on

Land preparation		Sowing		Harvest	
month	%	month	%	month	%
Oct.	4.2	Jan.	1.4	July	10.0
Nov.	-	Feb.	14.3	Aug.	28.6
Dec.	2.8	March	68.6	Sept.	51.4
Jan.	26.8	April	14.3	Oct.	7.1
Feb.	45.1	May	1.4	Nov.	2.9
March	19.7	June	-	Dec.	-
April	1.4				
Total	100	Total	100	Total	100
		July	1	Jan.	1
		Aug.	1	Feb.	4
		Sept.	2	March	2
		Oct.	3	April	1
		Nov.	1	May	-

Feb. to March after several rainfalls and sowing starts from March. For off-season cultivation, land preparation is started from Aug. to Sept. and sowing is started on Sept. Harvest of main season crop starts on Aug. to Sept. and that of off-season starts on Feb. Growing season of two crops is summarized as follows.

Main-season: March - August

Off-season: Sept. - Feb.

Land preparation

More than 85 % of farmers prepare land by tractor. Tractor plowing is common prctice, however some farmers prepare land by manpower when tractor is not available. Animal plowing is not common practice in Lower Moshi area. Tractors are provided from

Tractor Hire Service Center(THS) but tractors are not always available from the center. 77 % of farmers mentioned that there was problem of getting tractor. And 67 % of farmera are getting tracotr from private owner. 44 % of farmers said that they did not get tractor in time last year. After several rainfall in Jan. to Feb., plowing is started and is to be complted in March. In short period, plowing and harrowing are to be completed otherwise farmers miss rain for good germination of seeds.

During Feb. to March, demand for tractor becomes very high and THS center can not provide enough number of tractors. These main reasons why farmers are getting tractor from private owner and they do not get tractor in time.

Official charge for tractor plwoing is Tsh.275.00/ac. But many farmers pay Tsh. 400.00 - 500.00/ac. Some farmers pay upto Tsh. 600.00 - 700.00/ac to get tractor in time. After plowing by tractor harrowing and leveling are followed. Harrowing and leveling are done by manpower.

Seed rate

Many farmers sow seed at the rate of 1/2 tin to 2 tins per 1 ac. 5 - 6 tins make 1 gunia of 90 - 100 kg of maize. Tin and Gunia are traditional measuring units of volume in the area.

Seed rate/ac

kg/ac	Nos. of farmers
7.2	6
8.0	1
9.0	10
10.0	8
12.0	1
13.5	1
14.4	1
15.0	4
18.0	10
20.0	3
27.0	1
36.0	3
total	62

1 tin container is equivalent to 20 lits. Weight of maize grain of 1 tin is 18 kg. There are other local measurment like " gallon tin" and "bakuri". After measuring weight of maize grain of different units, seed rate vary from 9 - 18 kg/ac. Many farmers sow seed at the rate of 1/2 - 1 tins/ac. Some faremers sow at higher rate. 13 number of famer said their seed rate was 1.8 kg to 5.4 kg/ac.

Sowing

55 % of farmers sow in line. Line sowing is somehow practiced in maize cultivation. One of the reasons why line sowing is common in maize cultivation is convenience to weeding. Weeding in maize feild is the highest labour consuming practice.

Farmers use thier local unit of "hatua"(means step) to measure row to row and hill to hill distances. 1 hatua is equivalent to 90 cm. Common row-row distance is 90 cm - 100 cm but hill-hill distance is not precise as row-row distance. Hill to hill distance seems to be 90 cm - 60 cm. 90 cm x 90 cm - 90 cm x 60 cm are commonly practiced spacing. Number of seeds per hill is 2 - 4 and no thining is practiced. Number of hills per unit area and plant population is as follows.

Nos. of hills: 1.2 - 1.9/m^2
Nos. of seeds 2 - 4 /hill

After sowing seeds, field is left till seeds to germinate and weeds to grow. Most of farmers do not employ labour for sowing. Required man.days for sowing ranges from 4 - 8 md/ac. Many farmers complete sowing within 4 days. When sowing is done by employed labour cost is Tsh. 200.00/ac.

Fertilizer

Almost all farmers(95%) do not apply fertilizer. Some farmer apply compost and ammonia sulfate in hole but amount of fertilizer applied is very small. There are many reasons why they do not allpy fertilizer. Apprximately 56 % of farmers answered that they did not know hoe to use it. 40 % of farmers said that fertilizer was very expensive and was not available. It is known that fertilizer application is not common in the area.

Cost for sowing

Tsh./ac	Nos. of farmers
60.00	1
70.00	1
80.00	1
100.00	4
150.00	4
200.00	2
250.00	1
300.00	1
700.00	1
Total	16

16 farmers out 70 mentioned that they employed labours for sowing maize.

Required Man.Day/ac for sowing with family members

Man.Days/ac	Nos. of farmers
2.0	4
3.0	3
4.0	17
5.0	4
6.0	11
7.0	0
8.0	6
9.0	3
10.0	3
11.0	0
12.0	2
13.0	0
14.0	1
15.0	2
16.0	2
24.0	2
30.0	1
40.0	2
49.0	1

Water management

In main-season, maize is cultivated in rain-fed field. Irrigation in maize field is not practiced widely in the area. In many years, farmers lost their product due to shortage of rain at late growth stage of maize plant. In 1983 total rainfall was lower than that of other year and rain season started from April. Sowing was delayed and rainfall was not available very much. That was a cause of drought and many farmers did not harvest maize. If irrigation water is available, farmers irrigate maize field when maize plant is at ear formation to flowering.

Weed control

Weeding is one of the major field work in maize cultivation. Many farmers mention that weeding is the highest labour consuming practice. They control weeds twice per crop and they start weeding 2 - 4 weeks after sowing. Nonc of them use herbicide and herbicide is not available.

63 % of farmers employ labour for weeding. Required MD for weeding vary from 6 - 8/ac. Cost for weeding is Tsh.500 - 700/ac. However 87 % of farmers said that there was problem of getting labour during weeding period. Two months of April and May are the busyest period for weeding. Almost all farmers are busy for weeding in their maize field. Many farmers employ labours so that weeding can be completed in time. When labours are not employed, 12 - 20 MD/ac is required and it takes about 5 - 7 days to complete weeding 1 ac of field.

Insect control

Approximately 75 % of farmers mentioned that they observed insect damage on maize. But they do not control insect. Only 25 % of farmers apply DDT and Thiodan to control insect. Insect observed in the area are Maize stalk borer(busseola fusca), Spoted stalk borer(chilo partellus), Pink stalk borer(sesamia calamistis) and stored grain insect of Rice weevil. Howver it seems that insect damage is not very serious and farmers are not very worried about insect damage.

Harvest

Farmers start harvesting on Aug. to Sept. Farmers pick ears and pile the in field. They normarly do not harvest ears at time, They harvest protion by portion when they need grains for home consumption.

Requierd Man.Day/ac for harvesting with family members

Man.Day/ac	Nos. of farmers
5.0	3
6.0	6
7.0	4
8.0	8
9.0	5
10.0	4
11.0	1
12.0	2
13.0	1
14.0	2
15.0	3
16.0	3

Other farmers mentioned that they needed 18.0 to 60 MD to harvest 1 ac.

89 % of farmers do not employ labours for harvest. A few farmers who have large scale of maize cultivation employ labours and they complete harvest at time. Reouired man.day for harvest varys from 6 - 10 md/ac. Harvest is completed within 6 days. When labours are not employed, farmers harvest by themselves and 4 - 16 MD/ac is required and they pay Tsh.240.00 - 280.00/ac. After harvest, crop residure is left in field for feeding cattle. Farmers do not utilize crop residure for compost or any other purpose. Sometime they burn it in field.

Production

Grain yield of maize varys from 7 - 10 gunias/ac which is equivalent to 1.75 - 2.25 ton/ha. However production of maize is not measured by gunia and it is very difficult to know accurate grain yield per 1 ha. Because many farmers do not harvest at a time and they measure product by height of plie of ears

Required Man.Day/ac for weeding with family members

Man.Day/ac	Nos. of farmers
9.0	1
10.0	1
12.0	6
14.0	4
15.0	2
16.0	1
18.0	3
20.0	4
21.0	1
25.0	1
27.0	1
28.0	1
30.0	1
32.0	1
35.0	2
36.0	1
40.0	1
42.0	1

10 other farmers mentioned that required Man.Day/ac for weeding was 3.0 MD to 60 MD.

in the field or by number of trailor. When production was poor farmers harvested 3 - 5 gunias/ac which is equivalent to 0.75 - 1.25 ton/ha. Large protion of product is for home consumption. Only large scale farmers sell product to market. They normarly keep ears without husk in their house. Storage insect problem and rat are commonly observed.

Production of maize/ac in "gunia"

Production/ac	Nos. of farmers
3.0	1
5.0	2
6.0	2
7.0	6
8.0	11
9.0	1
10.0	10
12.0	1
15.0	1
17.0	1

Only 36 famers answered production of maize/ac. Other farmers did not know their actual production because they did not measure by gunia or any other means. Normarly farmers do not measure maize yield.

Black market price of maize is not very much different from official price. Black market price varys from Tsh. 600.00 - 800.00/gunia while official price is Tsh. 580.00/gunia. That is one reason why farmers do not sell product to market. And farmers are not interested very much in investing their capital to maize cultivation.

3. Rice cultivation

Area of rice field

Many farmers own paddy field ranging from 1.0 ac - 3.0 ac. approximately 70 % of farmers hold less than 3.0 ac of paddy field. And size of a paddy is less than 1 ac.

Size of paddy field

Size of field	Nos. of farmers	%
0 - 1 ac	2	3.8
1 - 2	21	44.2
2 - 3	14	71.1
3 - 4	7	84.6
4 - 5	3	90.4
5 - 6	0	-
6 - 7	1	92.3
7 - 8	2	96.1
12	1	98.1
14	1	100.0
Total	52	

Variety

12 local varieties are known from the survey. All farmers grow local varieties. Varietal characteristics are late-maturing, large-panicle type, low-tillering, tall plant type with droopy leaf and heavy grain weight. Name of local varieties are Super, Turiani, Kahogo, Matandiko, Kilombero, Shingo ya mwali, Magandannue, Mdundiko, Moshi wa cigara, Manikora, Shindano and Bawa la Nzi. Many farmers prefer Matandiko, Manikora and Shigo ya mwali because of high yield, heavy grain and good taste.

These local varieties are not well classified. Sometime same variety is called in different name. The name of person who introduced a variety is sometime given to the variety. Matandiko is a name of farmer who brought it from another region. Matandiko, Turian and Manikora are very resemble in charateristics. Normarly 2 - 3 varieties are mixed and cultivated in a field. Farmers do not pay much attention to mixture of variety.

Favorite variety of rice

Variety	Nos. of farmers
Super	7
Turiani	2
Kahogo	3
Matandiko	23
Kilombero	2
Manikora	19
Shindano	4
Shingo ya mwali	10
Magandannue	1
Moshi wa cigara	1
Bawa la Nzi	2
Mdundiko	1
Total	75

Growing season

There are two cultivations of rice per year. But most of farmers(96.0 %) cultivate once a year. Very few farmers grow rice twice a year.

Cultivation period of rice

Land preparation		Sowing		Harvest	
month	%	month	%	month	%
Sept.	2.0	Oct.	4.8	March	-
Oct.	27.2	Nov.	23.9	April	13.7
Nov.	78.2	Dec.	71.5	May	54.9
Dec.	97.2	Jan.	92.9	June	92.2
Jan.	100.0	Feb.	100.0	July	98.1
				Aud.	100.0

Many farmers start land preparation on Oct. and sowing seeds on Nov.. 30 - 40 days after sowing farmers start transplanting. Very few farmers grow rice in off-season only where irrigation water is available. Many farmers grow vegetable and bean in paddy field during off-season. Landpreparation for off-season cultivation starts from May - June and harvest on May.

Groving season of two crops is summarized as follows.

Main season: Nov./Dec. - May/June
Off-season: May/June - Dec.

Land preparation

Most of farmers prepare land(ploving) by tractor. Very few farmers do hand ploving. For ploving paddy field, tractor from THS center is available but many farmers can not get tractor in time. 80 % of farmers mentioned that they did not get tractorin time during ploving. Only 20 % of farmers got tractor from THS and paied official charge. Other farmers got tractor from private owner paid Tsh. 350.00 - 450.00/ac. For ploving disc plov is commonly used. Harroving by hand is followed.

Puddling is followed by harroving. Normarly farmers split paddy field into small plots considering availablity of irrigation water and level of the field. It is generally accepted in Lower Moshi area that 70 hatuas x 70 hatuas make 1 ac. They measure size of plot by hatua. Size of small plot is 100 - 200 m^2. Puddling is done by hand. Puddling by tractor is not common in the area.

For puddling many farmers employ labours and there are two ways of payment. Daily payment of wage and contract are common in the area. It costs Tsh.800.00 - 1200.00/ac for puddling and leveling and puddling is completed in 7 - 14 days/ac. Required Man.Day for puddling is 16 - 28 /ac.

Official charge of tractor ploving is Tsh.275.00/ac but most of farmers pay Tsh.350.00 - 450.00/ac. Because tractor is not available during land preparation period. Some farmers do ploving by labours when tractor is not available or tractor can not get into the field due to water stand. They pay Tsh.600.00-800.00/ac for ploving

Nursery preparation

There is no specific measurement for nursery area. Normarly farmers prepare nursery in the field. Traditional measurement of nursery is 10 hatua x 10 hatua(81 m^2) for 1 ac of main field. In Lower Moshi area nursery varys 81 m^2 - 162 m^2 for 1 ac. Farmers prepare dry seed bed in the field without any measurement. Seed are sown in strips of 5 - 7.5 cm width and 30 cm apart. Normary area of nuesry is decided by amount of seed. After sowing seeds, nursery is covered by soil and rice straws. 1 - 2 weeks after sowing, farmers start irrigating nursery. Poor germination of seed and serious infestation weed in nursery is commonly observed.

Seed rate

Most of farmers sow seeds at the rate of 1 "debe" to 3 debe for 1 ac of main field. Debe is one of the traditional measurement of volume. Weight of 1 debe of paddy is 13 kg. There is variation of seed rate, however traditional seed rate seems to be 13 kg - 26 kg for 1ac.

Seed rate/ac

kg/ac	Nos. of farmers
13.0	20
14.0	1
15.6	1
19.5	8
26.0	8
30.0	1
32.5	4
36.0	1
39.0	4
52.0	1
58.5	1
65.0	2
Total	52

Local measurement of seed rate is converted into kg.

These amount of seed are sown in the strips of 5 - 7.5 cm width. Sowing density is extermely high and that is the main cause of poor seedling.

Seedlings are kept in nursery for 30 - 40 days. When seedlings are 30 - 40 days, farmers start transplanting. So when farmers complete transplanting in all of their paddy field seedling age is more than 40 days.

Transplanting

Almost all farmers transplant seedling randomly. Only 2 farmers mentioned that they transplant in line. 1 ac of paddy field is splited into 7 subplots and one subplot is transplanted in a day by 3 - 4 persons. 21 - 28 MD is required to complete transplanting 1 ac of field. However required man.day varys with size of plot and also type of work. In case of contract work, it ranges from 16 - 30 MD/ac while 24 - 32 MD/ac is required when transplanting is done by family members only. Nos. of required for transplanting ranges from 7 - 14 days. Approximately 65 % of farmers employ labours for transplanting and they pay Tsh. 700.00 - 1200.00/ac.

Required Man.Day/ac for transplanting with family member

Man.Day/ac	Nos. of farmers
14.0	1
15.0	1
16.0	1
22.0	1
24.0	3
27.0	2
28.0	1
32.0	2
35.0	1
45.0	1
48.0	1

Other farmers mentioned that required Man.Day for transplanting was 7 - 100 MD/ac.

Number of seedlings per hill is 4 - 5, however 7 - 8 seedlings are sometime transplanted when seedlings are poor. High sowing density in nursery is a cause of poor seedling and waste of seedlings. Many farmers trasplant seedlings without specific measurement, however they use local unit of distance. 20 - 22 cm for row-row and 10 - 15 cm for hill-hill distances seems to be traditional measurement. Large variation of plant population was observed in farmer's field. Range of plant population was 17.0 hills/m^2 to 57.0 hills/m^2.

After transplanting, paddy field is flooded but shortage of irrigation water is commonly observed in farmer's field. Approximately 62 % of farmers answered that they faced problem of irrigation water after transplanting. Eventually palnt popu lation per unit area can be summarized as follows.

Density: 30 - 40 hills/m^2
Seedling/hill: 7 - 8 seedlings/hill

Fertilizer

86 % of farmers do not apply fertilizer. Very few farmers apply fertilizer but amount of fertilizer is very small. One farmer said that he applied 50 kg of ammonia sulfate per lac when plant was at tillering stage. Another farmer applied 33 kg of Urea/ac at flowering stage. 4 more farmers applied nitrogenous fertilizer but amount was very small and they did not apply basic fertilizer. Applied amount of nitrogen is 10 - 15 kg per 1 ac which is equivalent to 25 - 38 kg N/ha.

There are many reasons why farmers do not apply fertilizer. 43 % of farmers metioned that they did not know how to use it. 20 % of farmers could not purchase fertilizer and other farmers said that fertilizer was not available. It is known that most of farmers do not apply fertilizer. Only 6 farmers out of 52 apply 25 - 38 kg N/ha at tillering and flowering satges.

Rate of application: 25 - 38 kg N/ha
Type of fertilizer: Ammonia sulfate and Urea
Time of application: tillering stage and flowering stage

Water management

All farmers irrigate paddy field but 70 % of farmers have problem of irrigation water. Whenever water is available they flood paddy field. 88 % of farmers answered that they irrigate paddy field continously till field is completely flooded. Very few farmers control water level in the field.

Shortage of irrigation water is commonly observed in the area. 76 % of farmers mentioned that they had problem of irrigation water several times after transpalnting. 5 months from

Doc. to Aripl seems to be critical periof for water management. Many farmers eager to cultivate rice twice a year but major constraint is availablity of irrigation water. 47 % of farmers answered that water problem and high concentration of quelea bird are primary problems if rice is cultivated in off-season.

Weed control

Most of faremrs control weed once or twice per season. 2 - 4 weeks after transplanting, farmers complete weeding paddy field. Farmers also mention that Feb - March is busyest period for weeding. 90 % of farmers control weed by hand. Herbicide is not commonly sprayed in the area. Moreover herbicide is not available and is very expensive.

40 % of farmers employ labours for weeding. And 60 % of farmers control weed by themselves. Large variation of required Man.Day/ac for weeding was observed. When farmers control weed

Required Man.Day/ac for weeding with family members

Man.Days/ac	Nos. of farmers
7.0	1
14.0	1
15.0	1
16.0	1
22.0	1
24.0	3
27.0	2
28.0	1
32.0	2
35.0	1
45.0	1
48.0	1
54.0	1
96.0	1
100.0	1
Total	19

by themselves 20 - 48 MD/ac is required for weeding. And it takes about 10 - 30 days to complete weeding in 1ac of field.

While weeding is done by labours it take 14 - 15 days and farmers pay Tsh.700.00 - 1500.00/ac.

Insect control

Approximately 53 % of farmers mentioned that they observed insect damage on rice. However most of them(90.4%) do not cotrol insect and they don not know the name of insect. DDT, Thiadan and Marathion are sprayed to control insect by a few farmers. Insects observed in the area are Stak-eyed shoot fly(Diopsis macrophthalma), Pink stalk borer(Sesamia portellus), White rice borer(Maliarpha separatella), Rice hopper(Orialas sp) and Rice bug(Stenocoris maculosa).

Many farmers observe insect damage but they are not worried very much about insect damage. Insect damage in farmer's field is not serious. When local variety is cultivated at the high rate of nitrogen "white head" is observed in some of farmer's field.

Bird damage

Tiny bird looks like spallow called "quelea quelea" causes serious yield reduction unless bird control is carried out properly. All farmers complain that Quela bird is one of the biggest problem. Farmers scare quelea birds by thier local method. The most common method is to install empty tins connected with sisal rope over the field. When quelea birds are observed over the field, tins create noise by pulling rope and scare birds. Throwing stones or small mud balls is commonly practiced. There is variation in number of birds in season. Heading to maturity is critical period. Quelea birds start attacking rice plants when spikelets are at milk ripe stage. Farmers mention that they observe high concentration of quela birds in March to May. From through the year observation of quelea in KADC trial farm, the highest concentration was observed during Oct. - Nov.. Several scaring methods are verified in the center but traditional method seems to be most effective.

Harvest

Normarly farmers harvest rice in April to June. 56 % of farmers employ labours for harvest. Required Man.Day/ac for harvest varys from 16 - 30. And it takes 7 - 14 dats to complete harvest 1 ac. Farmers pay by rice instead of cash. Cost for harvest is 1 tin(20 lit.) of rice when one gunia of paddy is harvested and packed. 1 gunia of paddy weigh 75 kg. Harvest includes threshing, winowing and packing paddy in sial bag. In few cases, labour are paied Tsh. 1000.00 - 1500.00/ac.

When labours are not employed, required Man.Day is 14 - 32/ac, however majority of farmers need 14 - 20 MD/ac to complete harvest. It takes 10 - 14 days to complete harvest 1 ac of field. In case of Chekereni pilot farm, 32 Md/ac for harvesting, winouing and packing in sial bag is required.

Traditional method of harvest starts cutting plant near ground level and piling them in the field and threshing by beating plants. Normarly farmers leave rice plants in the field for one or two days. After threshing, winouing is followed and grains are packed in sisal bag.

Production.

Grain yield/ac varys from 5 gunias to 18 gunias, i.e. 350 kg/ac to 1.26 ton/ac. However majority of farmers get 8 - 12 gunias of paddy/ac. When production is poor, standard production is 6 - 10 gunias. Average yield in Lower Moshi area seems to be 1.4 - 2.1 ton/ac. When production is poor, production may fall to 1.1 - 1.8 ton/ac.

Production of paddy/ac

production/ac	Nos. of farmers
5	2
7	2
8	2
10	7
11	2
12	6
13	2
14	2
15	5
16	1
18	4

Other farmers mentioned that production is less than 5 gunias(6 farmers) and more than 24 gunias(11 farmers).

Farmers who produce large amount of paddy tend to sell larger portion of their product while small farmers keep large portion of product for home consumption. 56 % of farmers sell more than 60 % of their product and 38 % of farmers sell more then 70 % of their product. All farmers sell their product to black market because there is large difference between official price and black market price. Black market price varys from Ths.1200.00 - Tsh.1600.00/gunia with season and variety while official price is Tsh.686.00/gunia regardless of variety. Price of rice is very high as compared to that of maize in black market. Price of maize varys from Tsh.600.00 - 800.00/gunia in black market while official price is Tsh.580/gunia. This is one of reasons why farmers prefer to grow rice more than maize.

Insect and rat are major cause of grain loss during storage period. Grains are kept in sisal bags and kept in house. Farmers do not have special place for grain store. All farmers mention that there is serious grain loss due to insect and rat damage.

Favorite variety

Matandiko, Manikora and Shigo ya Mwali are most favorite varieties of farmers in Lower Moshi area.' Matandiko and Manikora are large grain tupe and 1000 grain weight is 30 - 32 g. Shingo ya Mwali is slender grain type and good paratability. Farmer criteria for variety selection seem to be 1. high yield 2. good taste, 3. heavy grain weight and 4. early maturing.

4. Bean(maharage) cultivation

Area of bean field

Most of farmers cultivate maharage in area of 1/4 -1.0 ac. Maharage is cultivated by 64 % of farmers and it is one of staple food in Tanzania. However area of maharage cultivation is not large as that of rice.

Size of maharage field

Size of field	Nos. of farmers	%
0 - 1/4 ac	1	7.2
1/4 - 1/2	14	33.3
1/2 - 1.0	18	73.3
1.0 - 1.5	3	80.0
1.5 - 2.0	6	93.3
2.0 - 2.5	1	95.5
2.5 - 3.0	2	100.0
Total	45	

Variety

4 varieties of maharage are cultivated in the area and popular varieties are Canadian Wonder, Masai Red and local one. Approximately 50 % of farmers purchase seed from TFA or local market. Price of seed varys from Tsh.270.00 - 400.00/tin which is equivalent to Tsh.16.00 - 24.00/kg. Varietal characteristics of these varieties are not investigated in detail.

Favorite varieties of maharage

Variety	Nos. of farmers
Selian Wonder	1
Canadian Wonder	13
Masai Red	7
Local variety	26
Total	47

Local variety means seed which is produced from previous product.

Growing season

All farmer grow maharage once a year in paddy field after rice is harvested. After rice is harvested, farmers start plowing by hand. Area for maharage is decided by availability of water. Farmers sow seed in June - July and harvest in Aug. - Oct. In rare case farmers sow maharage in Sept. when irrigation water is available. Maharage is cultivated during dry season and availability of water is major limiting factor.

Cultivation period of maharage

Land preparation		Sowing		Harvest	
month	%	month	%	month	%
March	3.3	April	6.0	June	6.5
April	16.6	May	14.0	July	-
May	26.6	June	54.0	Aug.	34.8
June	73.3	July	92.0	Sept.	58.7
July	90.0	Aug.	94.0	Oct.	100.0
Aug.	100.0	Sept.	96.0		
		Oct.	98.0		
		Feb.	100.0		

Main season: June/July - Aug./Oct.
Off-season: Sept./Oct. - Feb.

Land preparation

Approximately 22 % of farmers prepare land by tractor. Majority of farmers plow by hand. Tractor plowing in maharage cultivation is not common. Required Man.Day for plowing by manpower is 12 - 24/ac. After rice is harvested, farmers start land preparation. Maharage and tomato are commonly cultivated after rice in paddy field in Lower Moshi area.

Seed rate

Seed rate of maharage varys from 8 kg/ac - 30 kg/ac. Majority of farmers sow seed at the rate of 20 - 30 kg/ac however large variation of seed rate was observed in the survey. Area of maharage field is not large as rice field and farmers do not measure area precisely. 15 % of farmers cultivate maharage mixed with maize and other farmers cultivate mahagare alone. Farmers use their local measuring unit of tin. 1 tin of maharage weighs 20 kg and 5 tins makes 1 gunia.

Seed rate

kg/ac	Nos. of farmers
2.0	1
3.0	1
4.0	1
5.0	1
8.0	3
10.0	6
16.0	2
20.0	16
30.0	7
35.0	1
40.0	2
60.0	3
Total	44

Sowing

80 % of farmers practice random sowing. Line sowing is not common in maharage cultivation. However farmers follow traditional measurment to decide row-row and hill-hill distances. 1/2 - 1 "hatua"(45 - 90 cm) for row-row distance and 30 cm for hill-hill distance seems to be common in the area. However there is large variation of row-row and hill-hill distances. It is not easy to get precise plant population per unit area.

Number of seeds per hill is 2-3 and farmers do not thin after germination. Most of farmers do not employ labours for sowing maharage. Required Man.Day for sowing varys from 12 - 30/ac. It takes 3 - 7 days to complete sowing in 1 ac of field. When labours are employed for sowing, farmers pay Tsh.200.00 - 500.00/ac.

Fertilizer

100 % of farmers do not apply fertilizer. Fertilizer application is not common in maharage cultivation in the area.

Reasons why they do not apply fertilizer are 1. they do not know how to use it(67%), 2. fertilizer is not available(12%) and 3. they think fertilizer is not needed for maharage(15%). As mentioned before, maharage is cultivated after rice and maharage seems to be grown well without fertilizer.

Water management

As maharage is cultivated in dry season, almost all farmers irrigate their field. Many farmers mention that they irrigate once - twice per week. However frequency of irrigation depends on availability of water. Whenever water is available they irrigate maharage field. Farmers mentioned that germination to two leaf stage and flowering stages are critical for irrigation. Practically farmers start irrigation about 1 week after sowing.

Weed control

Weeding is one of major field work in maharage cultivation. Farmers start weeding after germination and they complete one month after sowing. Required Man.Day for weeding varys from 5 - 25 MD/ac and they complete weeding within 7 days. However there are other farmers who mentioned that they need more than 25 MD/ac for weeding.

Required Man.Day/ac for weeding with family member

Man.Day/ac	Nos. of farmers
5.0	2
10.0	2
12.0	1
13.0	1
18.0	2
20.0	2
21.0	1
24.0	4
25.0	2
27.0	1
28.0	1
30.0	3

other farmers answered more than 30 MD/ac.

It can be mentioned that 20 - 30 MD/ac is required for weeding maharage field in the area. Tsh.400.00 - 900.00 is paied when labours are employed for weeding. Farmers say that there is no problem of getting labours during weeding of maharage. Herbicide application is not common.

Insect control

Almost all farmers do not control insect while 81 % of farmers mentioned that they observed insect damage. Out of 47 farmers, 2 farmers said that they used ash of rice straw and 6 farmers sprayed Thiodan to control insect. Farmers do not know name of insect. Insect observed in the area are, 1. Bean leaf beetle(ootheca bennigseni), 2.Thrips(Megalurothrips sp, Frankniella sp) and 3. Bean aphis(Aphisfabae). Damage of field rat is somtime observed when maharage is ready for harvest. Farmers install mid-rib of banana leaf around maharage field to protect maharage from rats.

Harvest

When pods of maharage are dried, farmers start harvesting in Aug. and complete in Oct.. Farmers do not employ labours for harvest. They up-root whole plants of maharage and pile them in the field. After piling, shelling bean by beating is followed. Required Man.Day for harvest is 16 - 20/ac. After shelling bean crop residure is left in the field for cattle feeding.

Production

Grain yield of maharage varys from 2 - 6 gunias/ac which is equivalent to 0.5 - 1.5 ton/ha. When production is poor, yield falls to 1/2 - 1 gunia/ac.

Production of maharage

gunia/ac	Nos. of farmers
2.0	7
3.0	4
4.0	6
5.0	6
6.0	2
7.0	4

Other farmers mentioned that uield of maharage is more than 9 gunias/ac.

Many farmers sell 30 - 60 % of their product to the market and they cultivate maharage for consumption. Only 21 % of farmers mentioned that maharage cultivation is for selling.

Rat and insect(rice weevil) are major storage problem of maharage. However farmers do not control rat and insect.

Favorite variety

Canadian Wonder and Masai Red are farmers' favorite varieties. They prefer these varieties because of 1. High yielding and early maturing. Other farmers also cultivate local variety because of good taste. It seems that paratability and market price are important factors for variety selection.

5. Vegetable cultivation

Type of vegetable

Tomato is the most popular vegetable cultivated in Lower Moshi area. Onion, cabbage and okura are also cultivated in the area. Normarlly vegetables are cultivated during dry season in paddy field after rice is harvested. Area for vegetable is less than 1 ac, however tomato is cultivated in larger area than 1 ac of field in some cases.

Type of vegetables	Nos. of farmers
Tomato	34
Okura	9
Onion	13
Cabbage	9
Egg plant	1
Pea	2
Muchicha	3

Nos. of farmers who cultivate vegetable is 40 in total out of 73 farmers in the survey.

Tomato

Tomato is one of the most popular and important vegetables in the area. 85 % of farmers cultivate tomato after they harvest rice in paddy field. Sowing time of tomato is June - July and harvest is in Sept. - Oct.. After they harvest rice, they select spot where irrigation water is available and prepare land by hand. Farmers normarlly prepare seedlings in nursery and trasplant them in main field. Precise production of tomato is not known because they harvest by small amount. Farmers mentioned that Tsh.4000.00 - 14000.00/ac was net benefit. Normarlly farmers take product to the market in Moshi town. In soem cases, middle man comes to buy tomato in faremr's house. Variety of tomato is not known, however seed produced by Holland seed company(Royal Sluis) is available in TFA, Tan Seed and local dealer. Detail production practices were not investigated in the survey.

Onion

Onion is also an important vegetable in the area. As mentioned before, tomato and onion are staple vegetables for traditional Tanzanian food. Price of onion sometime goes upto Tsh.60.00 - 80.00/kg in dry season which is higher than price of pollished rice in black market. Approximately 33 % of farmers cultivate onion in the area after they harvest rice. Onion is also cultivated in paddy field. Sowing period is May - June and Aug. - Sept. is for harvest. Onion and tomato are cultivated in same season. Precise production of onion was not known. Normarlly farmers do not harvest all at a time. They mentioned that they measure product by number of tins/day.

Approximately Tsh.6000.00/ac is net benefit from onion cultivation. Many farmers bring product to the market. Variety name is not knwon but popular one is red onion. Seeds from Holland seed company is available. Many farmers do not purchase seed. Detail cultivation practices were not investigated in the survey.

Okura

Approximatelt 23 % of farmers cultivate okura. Area of okura cultivation is smaller than that of onion. Okura is cultivated for home consumption and they prepare small garden near their house. Cultivation period is June - Oct., however many farmers grow in different season like Jan. - April or Dec. - April. Even a few farmers mentioned that they grow okura any time through year. Production/ac and cultivation practices are not known.

Cabbage

Cabbage is also cultivated by 23 % of farmers. Area of cabbage seems to be less than 1/2 ac. Cabbage is also important vegetable to prepare "Kachunbari". Required vegetables for Kachunbari are tomato and cabbage. Farmers sow seed in May and harvest in Aug. - Sept.. Cabbage cultivation seems to be for home consumption in the area. Large scale of cabbage cultivation is observed in high land of Mt. Kilimanjaro.

There are other vegetables cultivated in Lower Moshi area such as pea, egg plant and muchicha(local leaf vegetable). Area for these vegetables is very small and these are mainly for home consumption. Vegetables are cultivated in larger scale in highland of Mt. kilimanjaro.

Detail cultivation practices of vegetables were not investigated in the survey. Target crops of the survey were maize, rice and bean which are staple food in Tanzania. Vegetables are also important in the area of Lower Moshi, however area is smaller than that of staple crops. Vegetables are cultivated mainly for home consumption in the area. Vegetable can be cash crop for farmers in the area if vegetable like tomato and onion are cultivated under irrigation. As mentioned before, price of tomato or onion can be higher than that of pollished rice if these vegetables are cultivated in dry season.

Detail investigation of vegetable cultivation should be carried out in 2nd survey.

Fig. - 58
Number of family member

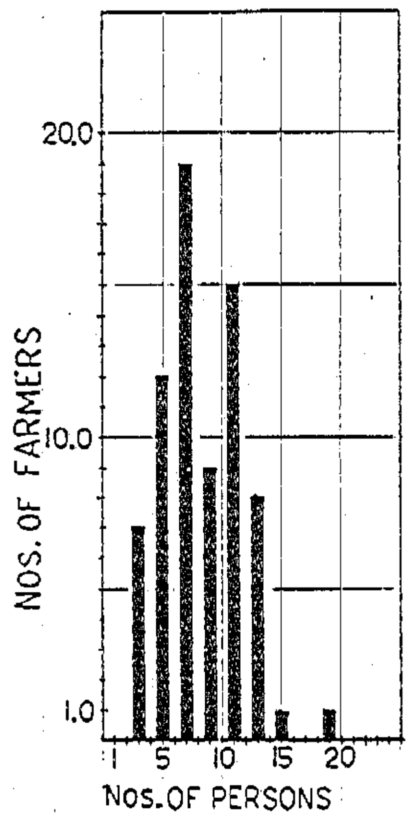


Fig. - 59
Number of family member whose age is above 15

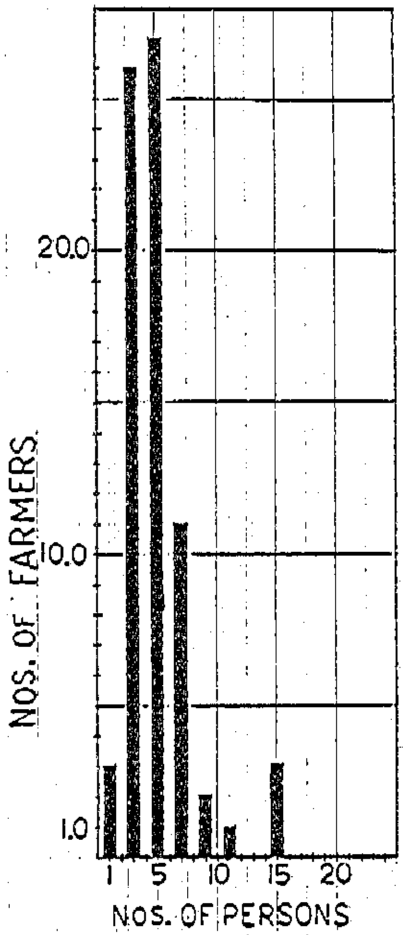


Fig. - 60
Busyest month through the year

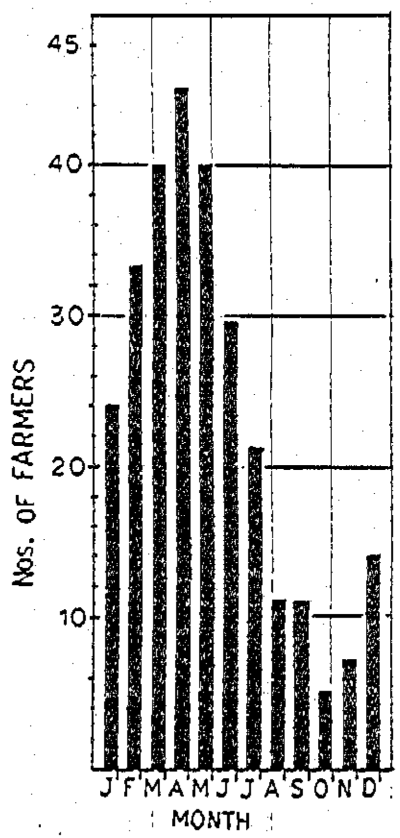


FIG-61
MAIZE

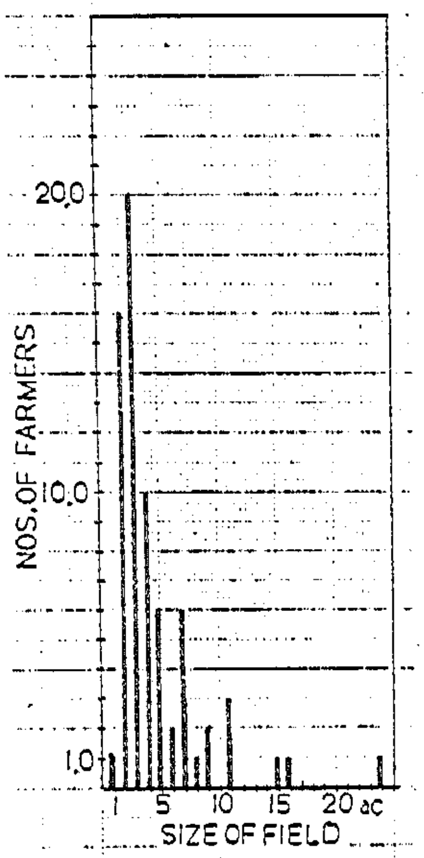


FIG-62
PADDY

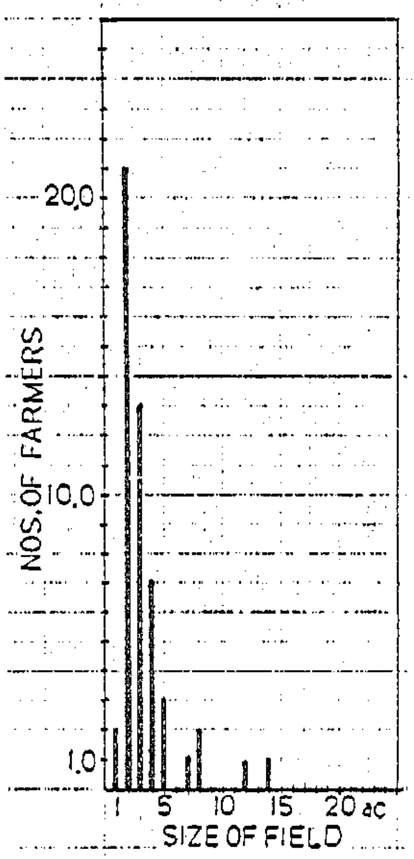


FIG-63
MAHARAGE

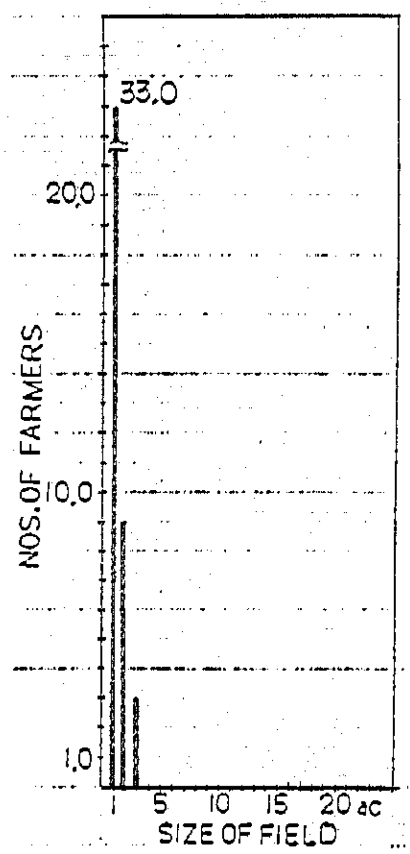


FIG-64
VEGETABLE

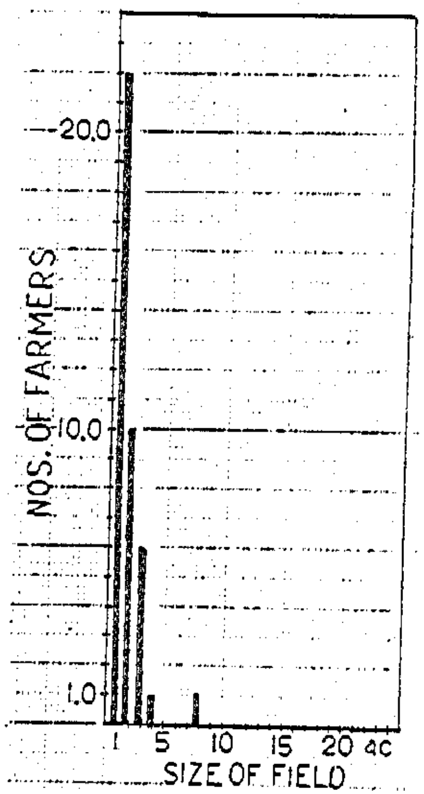
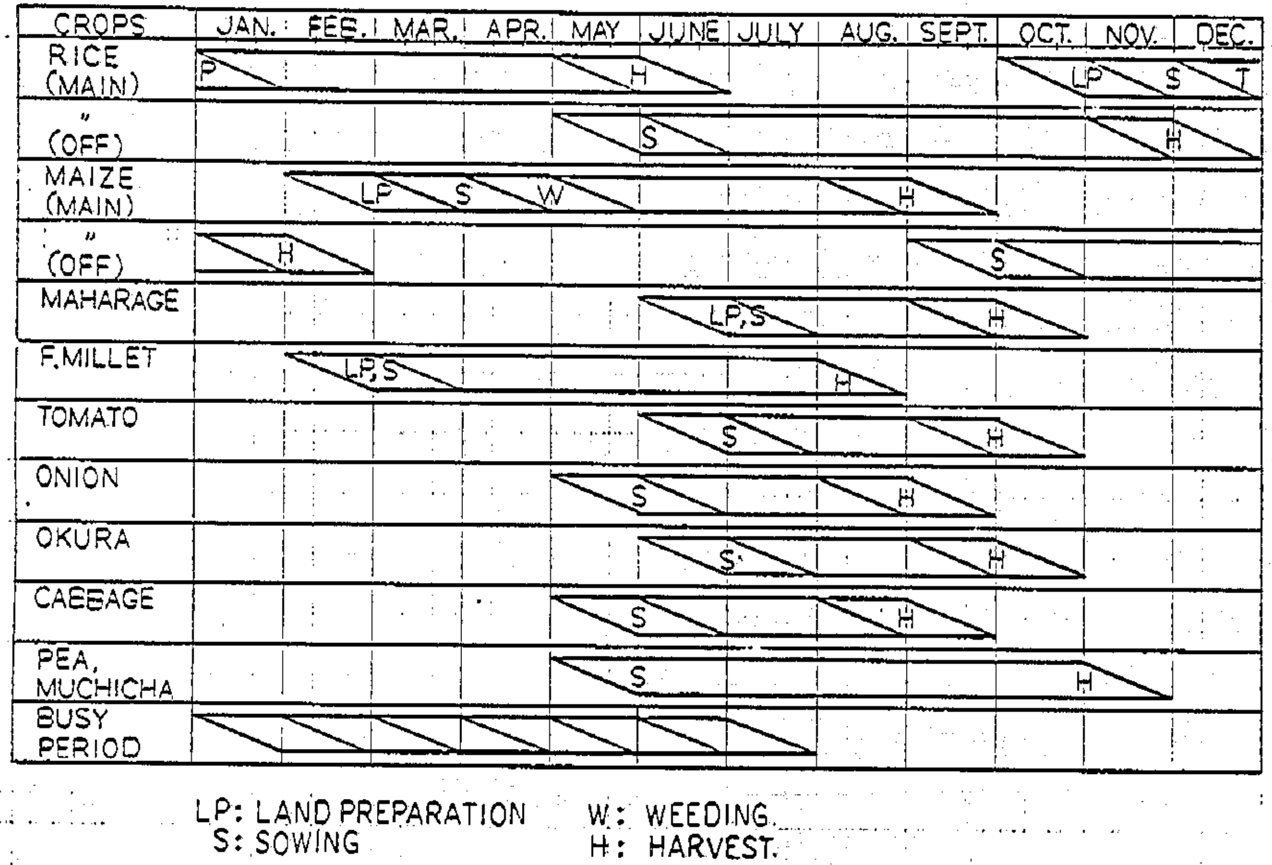


Fig. - 65

Traditional cropping pattern of crops in Lower Moshi area



MBOLEA ZA CHUMVI-CHUMVI

1. NI NINI ?

Chakula cha mimea cha aina ya madini yatengenezwayo kiwandani na ambayo huweza kuipa mimea aina moja au zaidi ya chakula (nutrients).

2. KWA NINI TUTUMIE MBOLEA ?

Chakula cha mimea hupungua ardhini au kupotea kwa sababu ya:-
(i)Kutumiwa na mimea
(ii)Mmomonyoko wa udongo
(iii)Kuzamishwa ardhini mbali na mizizi ya mimea.
(iv)Kupotea angani kwa njia ya mvuke.

Hivyo inatubidi kutumia mbolea ili:-

(i)Kurudisha ardhini rutuba iliyopotea au kupungua

(ii)Kwa kufanya hivyo tunaongeza wingi na ubora wa mazao tunayolima.

(iii)Kutuwezesha kupata mavuno bora mwaka hata mwaka kwani mbolea huipa mimea nguvu ya kustawi vyema.

3. TUTUMIE, WAKATI, KIASI NA NAMNA GANI?

Mbolea ya chumvi-chumvi huweza kutumiwa wakati wa mvua au wakati wo wote mradi maji (unyevu) yawepo. Kiasi na namna ya kutumie kutegemea aina ya zao unalolima, udongo na hali ya mahali penyewe. Kwa maongozi ya kukuelekeza zaidi, onana na Bwana-Shamba wako au Mtaalam wa Mbolea.

4. JE, SHAMBA LAKO LAHITAJI MBOLEA ?

Kama mvua inapatikana au maji ya kunyeshea, na mavuno yako ni haba yawezekana kuwa mbolea yahitajika. Mambo manne yaweza kukupa uongozi zaidi, nayo ni:-

i)Kwa kuona jinsi mimea inavyokua - rangi ya majani, rangi ya shina, urefu wake, n.k.

ii)Kupima udongo na kutambua chakula kilichokosekana au kupungua.

iii)Kufanya majaribio ya mbolea shambani.

iv)Kupima mimea.

Yafuatayo ni mambo muhimu yanayoweza kukuwezesha kutambua aina ya chakula kilichopungua au kukosekana udongoni kwa kuona hali ya ukuaji wa mimea:-

(a)UKOSEFU WA NITROGEN

i)Mmea huwa dhaifu na mdogo mdogo.

ii)Majani huwa ni madogo na kijani kijano.

iii)Majani ya chini hudhoofika na kufa pale pale, yaani hukauka wakati ambapo majani ya juu huwa na kijani chake cha kawaida.

iv)Mavuno huwa haba sana.

(b)UKOSEFU WA PHOSPHORUS

i)Mmea unakuwa na ukuaji wa mkunyato.

ii)Mazao huchelewa kukomaa, tena hubakia kijani na wakati mwingine mimea ni mirefu na dhaifu.

iii)Matunda ya mimea mingine huwa na sura mbaya na huzaa kwa uchache.

iv)Majani huwa na kinjano hafifu au kikahawia mwishoni au pembeni.

/2.

(c) UKOSEFU WA POTASH:

(i) Majani huwa na sehemu ndogo zilizo nyeupe, Njano, au rangi ya kutu kwenye kingo au nchani mwa jani.

(ii) Nchani mwa jani hukunjana na husababisha kukauka.

(iii) Matunda huwa madogo na yenye mabaka mabaka ya kuoza na kuhifadhiwa kwa shida.

(iv) Ukuaji ni wa kunyongea sana.

(v) Shina huwa hafifu (hasa nafaka) na kuvunjika ovyo.

(d) UKOSEFU WA CALCIUM:

(i) Majani ya sehemu ya chini huwa na rangi hafifu ya kijani.
(ii) Majani machanga huwa na njano au weusi na kupindika pindika.
(iii) Mimea inaonekana kama imenyauka.
(iv) Mizizi huwa si ya kawaida - mibovu.

(e) UKOSEFU WA MAGNESIUM:

(i) Majani huwa na rangi ya kijani nyepesi au njano iliyofifia.
(ii) Rangi ya njano hutokea katikati ya vena (veins).
(iii) Majani huwa na michirizi ya rangi ya kikahawia.

(f) UKOSEFU WA SULFUR:

(i) Ukuaji huwa dhaifu na uliyonyongeana.
(ii) Mmea mzima huwa na rangi ya njano kama kwamba una ukosefu wa Nitrogen.
(iii) Majani huwa ya manjano hata wakati wa umeaji mpya.
(iv) Mazao hukomaa pole pole.

MBOLEA PEKE YAKE YATOSHA?

Utumiaji wa mbolea ni mojawapo ya njia kubwa za mafanikio katika kilimo cha Kisasa; Inabidi mkulima afuate kanuni nyingine zifuatazo:-

(i) Kutayarisha shamba na kupanda mapema.
(ii) Kutumia mbegu bora.
(iii) Kupanda kwa nafasi zinazoshauriwa na wataalamu wa Kilimo.
(iv) Kupalilia vyema kwa kadri inavyotakiwa, shamba liwe safi.
(v) Dawa za kuua wadudu zitumike kama zinahitajika.
(vi) Kuvuna kwa wakati unaofaa.

ZAO	AINA YA MBOLEA type of fertilizer	KIASI KINACHOPENDEKEZWA rate of fertilizer	WAKATI WA KUTUMIA time of application	NAMNA YA KUTUMIA method of application
KAHAWA (KUBWA) COFFEE	SULPHATE OF: AMMONIA 21%N CALCIUMU AMMONIUM NITRATE (C.A.N.26%N) AMMONIUM SULPHATE NITRATE (A.S.N. 26%N) N.:P.:K k.m 25 : 5 : 5 20 : 10 : 10	Tumia gramu 114 - 226 kwa kila shina na kila wakati	Mara tatu kwa mwaka: a) Mwanzo au katikati ya mvua za vuli. b) Mwanzo wa mvua za masika. c) Mwisho wa masika.	Zungushia umbali wa sm. 30 kutoka shinani na mbolea iwekwe udongoni na siyo juu ya metakataka, au "mulch".
KAHAWA (NDOGO)	TRIPLE-SUPER PHOSPHATE (T.S.P.)	Kila mche upate gramu 57 - 70	Kabla au wakati wa kutulizia miche [illegible]	Changanya na udongo wa juu wa kupandia na samadi. Kama samadi haipatikani, zidisha kiasi maradufu
MIGOMBA BANANA	SULPHATE OF AMMONIA 21%N MURIATE OF POTASH -60% K_2O	Kila shina gm. 227-450	a) Wakati wa mvua ya vuli mara moja b) Wakati wa mvua za masika mara mbili.	Zungushia umbali wa sm. 30 kutoka shinani na iwekwe udongoni.
MPUNGA RICE	TRIPLE-SUPER PHOSPHATE (46-48% P_2O_5)	Kilo 100- kwa hekta.	Weka shambani kabla ya kutulizia. apply in the field before puddling	Changanya na udongo kabla ya kuhamisha miche. mix with mud(soil) before transplanting
	SULPHATE OF AMMONIA(21%N)	Kilo 100 - 200 kwa hekta.	Weka [illegible] tatu baada ya kutulizia na [illegible] yobakia wakati mpunga karibu ku[illegible] [illegible] apply 3 weeks after puddling	Tapanya shambani wakati majani hayana maade. broadcast in the field at the time of weeding
MAHINDI MAIZE	TRIPLE-SUPER PHOSPHATE	Kilo 100 kwa hekta	Weka kabla au wakati wa kupanda. apply before or at the time of sowing	Tapanya shambani na changanya na udongo wa juu. broadcast in the field and mix with surface soil
	SULPHATE OF AMMONIA 25 : 5 : 5	Kilo 200 - 300 kwa hekta. au wastani wa kijiko kimoja cha chai kila mdea. 200 - 300 kg/ha or average of one teaspoon per hill	Mihindi ifikiapo kwenye goti au wiki 3 - 4 baada ya kuota. knee high stage or 3 - 4 weeks after sowing	Zungushia au weka upande mmoja umbali sm. 8 - 10 apply around the plant or apply every 8 - 10 sm

ZAO	AINA YA MBOLEA	KIASI KINACHOPENDEKEZWA	WAKATI WA KUTUMIA	NAMNA YA KUTUMIA
PAMBA COTTON	TRIPLE-SUPER PHOSPHATE	Kilo 100 kwa hekta	Weka kabla ya kupanda mbegu	Tapanya shambani na changanya na udongo.
	SULPHATE OF AMMONIA	Kilo 200 kwa hekta	Weka wiki sita baada ya mbegu kuota na hasa baada ya palizi ya kwanza.	Zungushia au weka upande mmoja au mbili umbali wa sm. 10 - 15 kutoka shinani
KABICHI CABBAGE	TRIPLE - SUPER PHOSPHATE (T.S.P.)	Kilo 100 kwa hekta	Weka kabla ya kutuliza	Changanya na udongo.
	SULPHATE OF AMMONIA -21%N	Kijiko kimoja cha chai kwa kila mmea	Wiki tatu baada ya kupandikiza. Weka tena mara mbili au tatu na uwekaji utengane kwa wiki tatu.	Itawanye karibu na mmea au izungushiwe kila mmea umbali wa sm.10-12 na unyeshe maji
VITUNGUU KAROTI MCHICHA	KAMA ILIVYO KWA KABECHI	Kijiko kimoja cha chakula kwa eneo la hatua moja mraba.	Kama ilivyo kabechi, lakini kumbuka karoti haitulizwi	Iwekwe katikati mistarini na maji yawekwe.
NYANYA TOMATO	TRIPLE-SUPER PHOSPHATE	Kilo 100 kwa kila hekta	Weka kabla ya kutulizia	Changanya na udongo.
	SULPHATE OF AMMONIA	Kijiko kimoja cha chakula kwa kila mmea	Wiki tatu baada ya kuhamishiwa shambani na kisha tena matunda ya kwanza yaonekanapo na tena kabla ya matunda ya kwanza karibu kuiva.	Kama ilivyo Kabichi.

ONION
CARROT

one spoon per area of one "hatua(90cm)" square

same as for cabbage, apply near the plant or apply around the plant of 10 - 12 sm area

same as cabbage but adjust for carrot

apply near furrow for irrigation

apply before land-preparation

mix with soil

same as cabbage

apply 3 weeks after transplanting, then again when 1st fruit is observed again before the fruit is ripen

ZAO	AINA YA MBOLEA	KIASI KINACHOPENDEKEZWA	WAKATI WA KUTUMIA	NAMNA YA KUTUMIA
ULEZI (MBEGE) FINGER MILLET	SULPHATE OF AMMONIA	Kilo 100 kwa hekta	Weka nusu kabla ya kusia, na nusu iliyobakia weka wiki tatu mpaka nne baada ya kuota	Mara ya kwanza changanya mbolea na udongo. Mara ya pili tapanya mbolea lakini pasiwe na umande, Weka siku iliyo kavu na inayotegemewa kunyesha mvua.
NGANO WHEAT	DI-AMMONIUM PHOSPHATE 18%N 47%P_2O_5	Kilo 160 kwa hekta	Weka kabla ya kupanda	Changanya na udongo wa juu
	SULPHATE OF AMMONIA	Kilo 100 - 200 kwa hekta	Weka wiki 4 - 6 baada ya kuota	Tapanya wakati hakuna umande
MICHUNGWA: LIMAO NDIMU BALUNGI N.K. ORANGE LEMON	TRIPLE - SUPER PHOSPHATE	gm:60 -120 kwa kila mmea	Wakati wa kupanda	Changanya samadi, na kama haipatikani zidisha mbolea mara mbili.
	SULPHATE OF AMMONIA	gm.450-700 kwa kila mmea; Kilo moja kwa mikubwa kuliko kawaida.	Mara moja au mbili kwa mwaka na hasa wakati maua yaanzapo kuchanua.	Zungushia mmea kwa kufuatana na ueneo wa majani yake.
	N : P : K			
VIAZI ULAYA	DI-AMMONIUM PHOSPHATE	Kilo 270 - 400 kwa hekta	Weka kabla ya kupanda	Changanya mbolea na udongo kabla ya kupanda.
	SULPHATE OF POTASH	Kilo 50 - 200 kwa hkt.	Wiki 3 - 6 baada ya kuota.	Zungushia shina.
PARETO	TRIPLE-SUPER PHOSPHATE	Kilo 150 - 200 kwa hekta	Kabla ya kupanda	Tandaza na changanya na udongo.
MANYASI	SULPHATE OF AMMONIA	Kilo 300 - 400 kwa hekta moja.	Weka kila mwaka baada ya kukata. -Mvua zimalizikapo -Mapema wakati wa vuli.	Tapanya vyema baada ya kukata na siku iliyo kavu au wakati hakuna umande.

KIELELEZO:

1) Kijiko kimoja cha chai = gramu 7 za sulphate of Ammonia au Triple Super-Phosphate

2) Kijiko kimoja cha Chakula = gramu 14 za Sulphate of Ammonia au Triple Super Phosphate

3) Hatua moja mraba = Eneo la meta moja kwa moja.

KUMBUKA: Kiasi cha Mbolea kilichopendekezwa kinaweza kufaa sehemu unayolima au kikazidi au kupungua. Hali kadhalika aina ya mbolea huenda isiwe ya lazima katika sehemu yako. Kama huna uhakika onana na Bwana - Shamba wako au Watoalam wa Mbolea kwa maelezo zaidi.

UHURU NA SHIBE KUTOKANA NA KILIMO BORA CHA KUTUMIA

M B O L E A Z A C H U M V I - C H U M V I

TML/eas

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JICA