3. 第4年次（2009年4月～2010年3月）

(1) 異なる窒素施与量が収量および収量構成要素に及ぼす影響（試験場・実験圃場）

目的：異なる窒素施与量が収量および収量構成要素に及ぼす影響を検討し、本地域における適正窒素施与量を明らかにする。

材料および方法

(1) 実験場所：ショクエ農業試験場、No. 9 試験圃場
(2) 実施時期：2008／09年度稲作期
(3) 播種日　：2008年11月22日
(4) 移植日　：2008 年12月16日
(5) 収穫日　：2009年4月6日
(6) 実験方法
1) 乱塊法　3反復
2) プロットサイズ：5×6 m　(全実験圃場面積：443.6 ㎡)
3) 供試品種：リンポポ　(Limpopo.　Subspecies ***Javanica***)
4) 栽植密度：30×11cm　(30株/㎡)
5) 一株苗本数：4～6本/株
6) 処理法：　N 0　無処理区
N 30　窒素成分量30kg/ha (現物量：尿素 65 kg/ha)
N 60　〃　60kg/ha (現物量：尿素130 kg/ha)
N 90　〃　90kg/ha (現物量：尿素195 kg/ha)
7) 施与時期：　一回目追肥　全量の50%を移植　7-10 日後に表層施与。
二回目追肥　全量の25%を移植 15-20日後に表層施与。
三回目追肥　残り 25 %を減数分裂期直前に表層施与。
8) 圃場管理：分げつ期および生育中期にそれぞれ2回、生育後期に1回手除草。
9) 病害虫防除：なし
10) 収量調査方法：　各試験区境界から 1 m を除外した内側の株を栽植密度に従って1㎡分30株を無作為に地上部から刈取った。収集したサンプル株から平均に最も近い穂数株を選抜した。平均株が複数の場合は穂首から切り取って秤量し、平均に最も近似した1株を選抜し代表株とした。脱穀後1株籾数を計数し、平均1穂籾数を算出した。登熟歩合は、清水による比重選により計数後算出した。千粒重は、3 日間の風乾後籾重を秤量し、籾含水率15%で算出した。

結　果

収量は、N 90区が10.34 t/ha と最大で、窒素施与量が少なくなるに従い収量は小さく

なった。最低収量は、N 0区の4.67 t/haであった。収量は、窒素施与量の増加に従って増大したが、N 60kg区とN 90kg区との間では増大幅は小さかった。N 0区とN 30区との間の増大幅は2.5 t/haと最も大きく、次いでN 30区とN 60区が1.9 t/haであり、N 60区とN 90区との間では1.3t/haに止まった（Table 3-1, Fig. 3-1））。

1株穂数は、N 90区で12.2本/株と最も大きく、窒素施与量が少なくなるに従い小さくなり、N 0区は7.2本/株に止まった。

㎡あたり穂数は、窒素施与量増加とともに増大し、処理区間で最も増大が大きかったのはN 0区とN 30区との間で73本、次いでN 60区とN 90区との間で46本、最も少なかったのはN 30区とN 60区との間で36本であった。

1穂籾数は、N 90区の119粒/穂が最大であり、窒素量が少なくなるに従い小さくなり、N 0区では96粒/穂に止まった。

㎡あたり籾数も1穂籾数と同様の傾向を示し、N 90区が43,000粒/㎡と最大で、N 0区はわずか20,600粒/㎡に止まった。窒素施与量の増加による籾数増大は、N 0区とN 30区との間が10,000粒/㎡と最大であり、N 60区とN 90区では5,000粒であった（表 1-1）。

登熟歩合は、窒素施与量が増加しても大きな変化は認められなかった。統計分析結果でも有意差なしだった。

千粒重は、処理区間に大きな差異は認められなかった。

統計分析の結果は、収量、一株穂数、㎡あたり穂数、1穂籾数および㎡あたり籾数に1%、千粒重に5%の水準で処理間に有意差が認められたが、登熟歩合では有意差なしだった（Table 3-1）。

収量と収量構成要素との間の相関関係は、収量に対し最も強い影響を及ぼしていたのは㎡あたり籾数であり（r=0.994**）、次いで1株穂数（r＝0.970**）および㎡あたり穂数（r＝0.969**）がほぼ同程度の相関関係であった（表 1-2）。登熟歩合は、収量に対し何の関係も認められなかった。全ての処理区で80%以上の登熟歩合を確保していた。千粒重は収量に対し正の相関関係を示し、窒素施与量増加に従って漸増傾向を示した。収量に最も強く影響を及ぼしていた単位面積あたり籾数とそれを構成する㎡あたり穂数および1穂籾数と㎡あたり籾数との相関関係は、構成する両者との間にほぼ同じ程度の影響力が認められた（Table 3-2））。

Table 3-1　窒素施与量が収量および収量構成要素に及ぼす影響

	収量	穂数		籾数		登熟歩合	千粒重
	(t/ha)	一株	㎡	一穂	㎡	(%)	(g)
N 0	4.67	7.2	213	96	20,574	88.5	25.83
N 30	7.13	9.5	286	107	30,639	86.5	26.01
N 60	9.03	10.3	322	118	37,873	89.2	26.74
N 90	10.34	12.2	364	119	43,360	88.3	27.03
有意差	**	**	**	**	**	ns	*
CV (%)	9.6	6.9	7.2	5.3	9.2	--	1.6
LSD .01	1.78	1.63	50.4	15.1	7,263	--	1.00
LSD .05	1.22	1.12	34.6	10.4	4,992	--	0.69

注：**、* は、それぞれ1%、5%水準で有意差あり。

Table 3-2　収量および収量構成要素の相関表

	一株穂数	穂数/㎡	一穂籾数	籾数/㎡	登熟歩合	千粒重
収　　量	0.970**	0.969**	0.925**	**0.994****	-0.038	0.767**
一株穂数		---	0.835**	0.979**	-0.148	0.762**
穂　数/㎡			0.842**	0.981**	-0.155	0.745**
一穂籾数				0.926**	-0.065	0.603*
籾　数/㎡					-0.108	0.743**
登熟歩合						0.030

注：**，＊は、それぞれ1、5%水準で有意な相関関係あり。

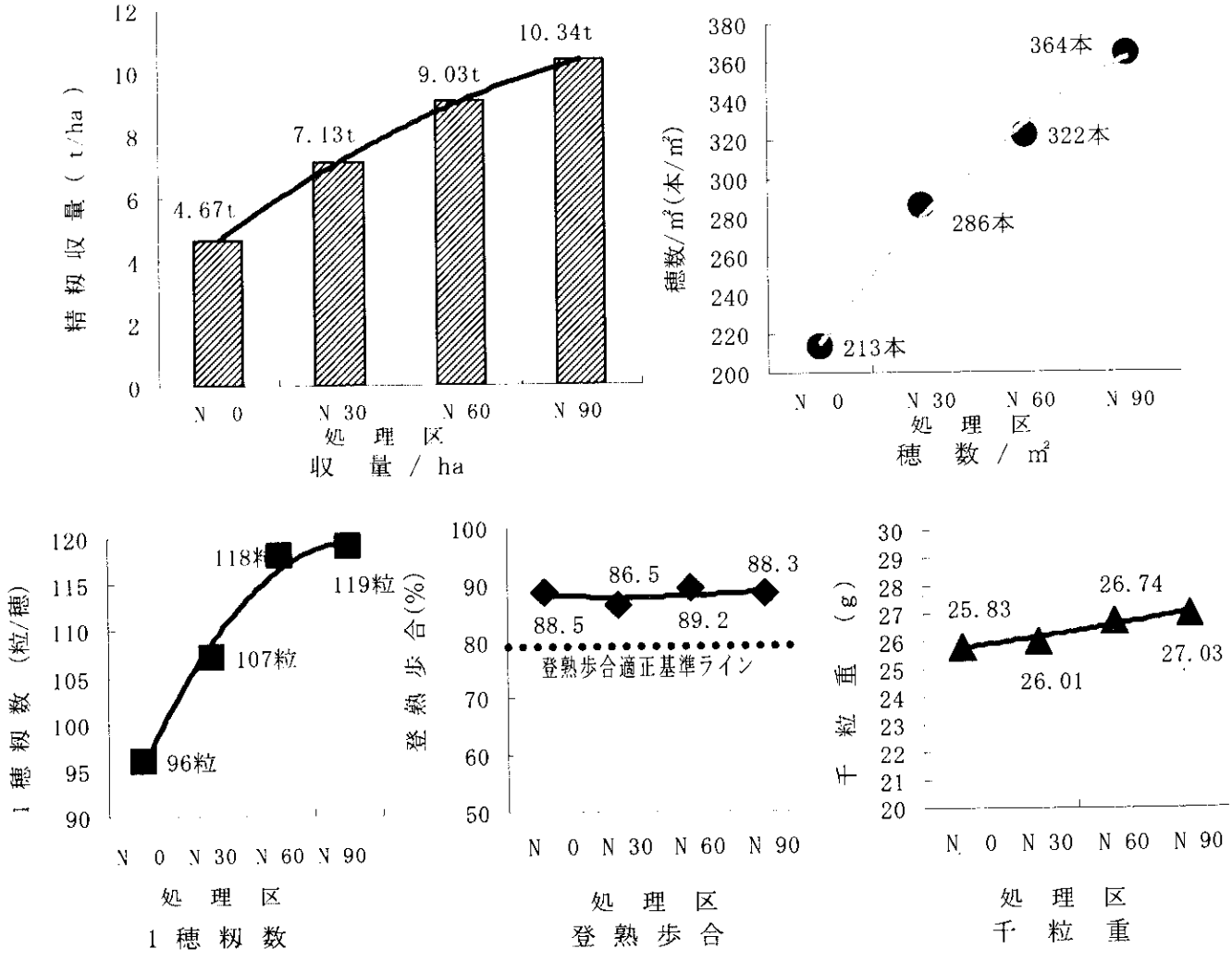


Fig. 3-1　処理による収量および収量構成要素の変化

考察

プロジェクト地区内では元来無肥料栽培が一般的であったが、多収性品種が普及している現在では、増収の最も大きな鍵を握るのはやはり窒素施与であろう。

試験結果でも無肥料区では4.7 t/ha と低収であったが、窒素 30kg/ha (N30 区) の施与により7.1 t/ha という顕著な増収が認められた。そして、窒素60kg/ha(N60区)では9 t/ha 、90kg/ha (N90 区) では 10.3 t/ha と多収を獲得した。この事は施肥効果が著しく高いことを示している。収量を構成する「収量容器」と「収量内容物」とに分けて結果を考察すると、収量はほぼ一元的と言えるほど「収量容器」(単位面積あたり籾数)に強い影響を受けていた。「収量容器」は“単位面積あたり穂数(0.981**)”および“1穂籾数(r=0.926**)”により構成され、単位面積あたり穂数が若干強い相関関係を示した。この事から、穂数確保/獲得が増収の最も重要な鍵を握っていることが明らかである。これに対し、「収量内容物」、すなわち登熟歩合および千粒重と収量との関係では、収量と登熟歩合との間に 1%水準で有意な相関関係が認められるものの、登熟歩合 80%を割り込むことはなかった。千粒重と収量との間にも相関関係が認められ、窒素施与量の増大とともに漸増傾向が認められた。一般的に、登熟歩合が 80%を下回った場合は、その向上のための技術改善が必要であると言われている。本地域の生育後期の気象条件は極めて良好な条件にあり、増収のための技術改善は生育前半の単位面積あたり茎数(穂数)確保に傾注すべきであろう。

技術指導ポイント

(1) 窒素施与の重要性について強力な啓蒙・普及が必要である。本結果からも知られたように、本地区での窒素施与効果は極めて高く、増収のための第一歩と見られた。

(2) 窒素施与とその分施法は切っても切れない関係であるが、本地域の水田土壌は砂含有率が高く、深層土壌が十分吸水していない雨期前半での減水深は極めて大きい。この事は、穂数確保を目的とした分げつ期の追肥を十分注意して施与する必要がある。すなわち、大量の窒素を一度に施与しても流亡・溶脱が容易に起こりうることが推察される。そこで、分げつ期に数回に分けて施与する必要があると推察された。現実的には、窒素 23～35kg/ha (50kg 入り尿素で 1～1.5 袋/ha) の少量施肥では、全量の 60%および 40%をそれぞれ移植 7 日後および 15 日後に分施する方法が効果的であると考えられた。また、窒素施与量が 46kg(1 袋 50kg 入り尿素 2 袋/ha)あるいはそれ以上の場合は、分げつ期に全量の 60～70%を 2～3 回に分けて分施し、残り 30～40%を減数分裂直前に施す施与法が効果的と考えられた。

(3) 本地域の水田は元来畑作圃場として整備された関係上から一筆の圃場で傾斜がつけてある。他方、代かきや均平作業が導入されていない本地区では、上述したように移植後の有効分げつ期の減水深が極めて大きく施与した窒素が容易に流亡・溶脱される事から、丁寧な代かきによる窒素流亡防止策が今後の大きな課題である。また、極めて不均一な圃場に移植が行われている事から、一層の均平化努力と、窒素施与時に高い地点には若干多めに施与することで稲生育の均一化を保つ事が出来ると考えられた。

(2) 異なる栽植密度が収量、収量構成要素に及ぼす影響（試験場・実験圃場）

実験名：異なる栽植密度が収量および収量構成要素に及ぼす影響

目的：本地区気象条件下でのリンポポ品種の適正栽植密度を明らかにする。

材料と方法

(1) 実験場所：ショクエ農業試験場、No. 9 試験圃場
(2) 実施時期：2008／09 年稲作期
(3) 播種日　：2008 年 11 月 21 日
(4) 移植日　：2008 年 12 月 18 日
(5) 収穫日　：2009 年 4 月 6 日
(6) 実験方法
1) 乱塊法　3 反復
2) プロットサイズ：5×6 m　(全面積：450.5 ㎡)
3) 供試品種：リンポポ　(Limpopo)
4) 処理法　：D　1 区　30×33cm　(10 株／㎡)
D　2 区　30×16cm　(20 株／㎡)
D　3 区　30×11cm　(30 株／㎡)
D　4 区　22×11cm　(40 株／㎡)
5) 一株苗本数：4～5 本／株
6) 窒素施与量：90kg／ha
7) 施与時期：一回目追肥　全量の 50%を移植 7 日後に表層施与。
二回目追肥　全量の 25%を移植 15 日後に表層施与。
三回目追肥　残り 25%を減数分裂期直前に表層施与。
8) 病害虫防除：なし
9) 収量調査法：試験区境界から 1m を除外した内側の株を栽植密度に従って 1 ㎡分を無作為に地上部から刈取った。収穫したサンプル株は、平均的穂数株を選抜、平均株が複数の場合は穂首から切断し秤量後、最も平均的な一株を選抜し代表株とした。1 株籾数を計数し、1 穂籾数を算出した。登熟歩合は、水による比重選で選別後計数し算出、千粒重は 3 日間の風乾後籾重を秤量し、籾含水率 15%で算出した。

結　果

収量は、D40 区で 9.3 トン/ha と高い収量を獲得し、栽植密度が疎植に向かうに従い収量は少なくなった。処理区間での収量差は、D10 区と D20 区との間で最大の 3.2ｔ、次いで D20 区と D30 区との間では 1.5t となり、D30 区と D40 区との間ではほぼ同水準の収量であった。この事から D30 区と D40 区との間には有意な収量差は認められなかった(Table 3-3。Fig. 3-2)。

1株および㎡あたり穂数では、1株穂数は栽植密度が密植になるに従い減少したが、㎡あたり穂数は反比例的に顕著な増大傾向を示し、D40 区では㎡あたり穂数は 330 本を獲得した。増大幅の最も大きかったのは D20 区と D30 区との 54 本であった（表 2-1)。

1穂および㎡あたり籾数は、1穂籾数では処理間に大きな差異はないが、㎡あたり籾数には大きな差異が認められた。特にその増大が著しいのは D10 区と D20 区の 9,600 粒で、D10 区に対し 38%の増大率、次いで D20 区と D30 区間の 5,000 粒で D20 区に対し 14%の増大率、そして D30 区と D40 区間では漸減した。

登熟歩合は、D10 区を除き処理区間での差異は小さく、処理区間の分散分析結果でも有意差 5%水準であった。

千粒重は、処理区間に大きな差異は認められず、処理区間の分散分析結果でも有意差は認められなかった。

分散分析結果は、収量、一株穂数、㎡あたり穂数、1穂籾数および㎡あたり籾数に 1%、登熟歩合費 5%水準で処理区間に有意差が認められたが、千粒重には認められなかった (Table 3-3)。

収量と収量構成要素の相関関係は、収量と㎡あたり籾数との間に極めて強い相関関係が認められ(r=0.957**)、次いで㎡あたり穂数(r=0.883**)であった。また、収量と登熟歩合の間には 1%水準の有意な相関関係が認められたが、千粒重との間には有意な相関関係は認められなかった (Table 3-4))。

Table 3-3 栽植密度が収量および収量構成要素に及ぼす影響

	収量	穂数		籾数		登熟歩合	千粒重
	(t/ha)	一株	㎡	一穂	㎡	(%)	(g)
D 10	4.43	24.5	245	103	25,468	72.9	26.66
D 20	7.65	13.3	265	139	35,096	81.8	26.94
D 30	9.19	10.6	319	126	39,974	86.7	27.55
D 40	9.25	8.3	331	120	39,628	86.0	27.11
統計的有意差	**	**	**	**	**	*	ns
CV (%)	7.8	6.9	7.6	6.3	8.1	6.1	--
LSD .01	1.41	2.21	51.1	17.9	6,577	11.8	--
LSD .05	0.97	1.52	35.1	12.3	4,520	8.1	--

注：**、* は、それぞれ 1%、5%水準で有意差あり。

Table 3-4 収量と収量構成要素との相関表

	一株穂数	穂数/㎡	一穂籾数	籾数/㎡	登熟歩合	千粒重
収　量	0.945**	0.883**	0.661*	0.957**	0.824**	0.486
一株穂数		-0.831**	-0.615*	0.958**	-0.831**	-0.531
穂 数/㎡			0.371	0.918**	0.634*	0.347
一穂籾数				0.706*	0.377	0.239
籾 数/㎡					0.652*	0.738*
登熟歩合						0.684*

注：**, * は、それぞれ 1%および 5%水準で有意な相関関係あり。

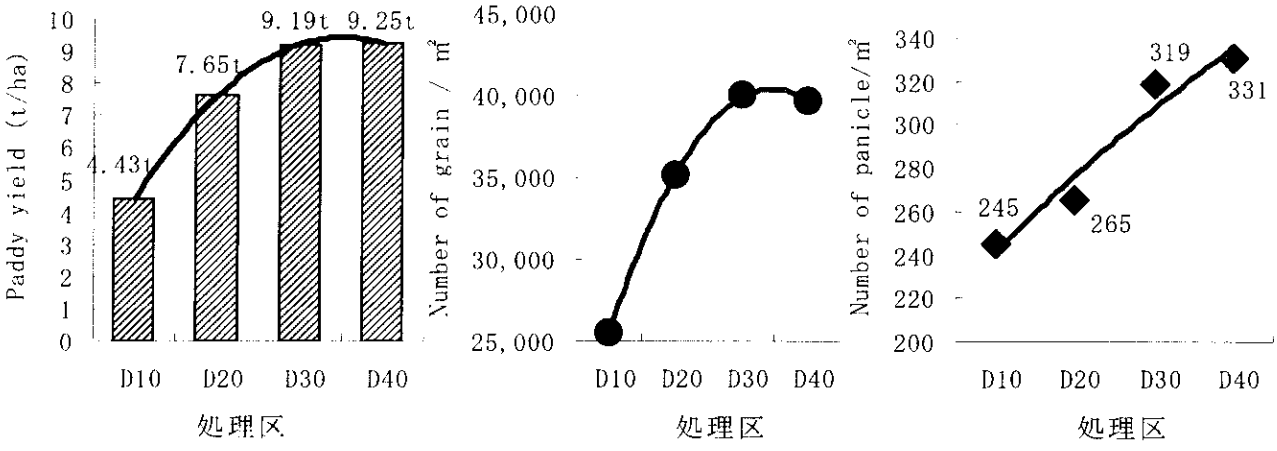


Fig. 3-2　処理による収量、収量要素の変化

考　察

栽植密度は、単位面積あたり必要穂数確保のための最も基本的な技術であり、その栽植密度状態が収量に大きく関与していることは明らかである。本圃場実験でも、疎植から密植に向かうに従い顕著な収量増大傾向が認められた。窒素施与量の少ない本地域の農家圃場では、栽植密度が収量決定要因の最も強い要素となっているものと考えられた。日本のように窒素 100kg/ha あるいは 150kg/ha という大量の施与が可能ならば、栽植密度は 20～25 株/m²程度で十分な収量を獲得可能であろうが、本地域の貧しい農家経済状態では少量の窒素肥料栽培で一定収量を獲得するには密植栽培が推奨できる。また、本試験で明らかなように、密植による登熟歩合および千粒重の低下傾向は全く認められず、生育後期の気象条件が極めて良好であることを物語っている。以上の結果から、穂数確保を最重点課題とした栽培法が妥当と考えられた。

技術指導指針

窒素施与量とその分施法、栽植密度および一株苗本数は、それらが極めて強く相互に関係しており、これらの良好なコンビネーションにより多収が達成可能である。この事から、密植の励行を積極的に啓蒙・普及することが収量増に効果的である。

(3) 品種比較試験（試験場・実験圃場）

目的：本地域で最も広く栽培されている3品種の収量、品種特性などを解明する。

材料および方法

(1) 実験場所：ショクエ農業試験場、No. 9 試験圃場
(2). 実施時期：2008／09年稲作期
(3). 播種日　：2008年11月26日
(4). 移植日　：2008年12月15日
(5). 収穫日　：2009年4月6～16日
(6). 実験方法
1) 乱塊法　3反復
2) プロットサイズ：5×6 m　(全面積：443.6 ㎡)
3) 供試品種：　リンポポ　(Limpopo)
IR 64
ITA 312
4) 栽植密度：30×11cm　(30株/㎡)
5) 一株苗本数：4～6本/株
6) 施肥量：　窒素69kg/ha（尿素：196kg/ ha)
7) 施与時期：一回目追肥　全量の50%を移植7日後に表層施与。
二回目追肥　全量の25%を移植15日後に表層施与。
三回目追肥　残り25%を減数分裂期直前に表層施与。
8) 圃場管理：分げつ期および生育中期にそれぞれ3回および1回手除草
9) 病害虫防除：なし
10) 収量調査方法：試験区境界から1mを除外した内側の株を栽植密度に従って1㎡分30株を無作為に地上部から刈取った。収穫したサンプル株は、平均に最も近い穂数株を選抜、平均株が複数の場合は穂首から切って秤量し、最も平均的な1株を選抜し代表株とした。脱穀後1株籾数を計数し、平均1穂籾数を算出した。登熟歩合は、水による比重選により計数後算出した。千粒重は、3日間の風乾後籾重を秤量し、籾含水率15%で算出した。

結　果

3品種を栽培比較試験した結果、収量はLimpopo品種が最高の9.4 t/ha を獲得し、次いでIR-64品種の7.7 t/ha 、最も低かったのはITA 312品種の6.8 t/ha であった(Table 3-5. Fig. 3-3)。

一株および㎡あたり穂数は、一株穂数ではIR 64 が最も多く13本/株、次いでLimpopo：11本/株、最低はITA 312：10本/株であった。㎡あたり穂数も同様の傾向を示し、最大はIR 64の340本/㎡、最小はITA 312の300本/㎡であった（Table 3-5)。

一穂および㎡あたり籾数は、1穂籾数ではITA 312で最大の128粒/穂、次いでIR 64お

よびLimpopoがほぼ同数の116、117粒/穂であった。㎡あたり籾数では、最大穂数を確保したIR 64が最大の45,000粒/㎡、次いでLimpopoの40,000粒/㎡がつづき、最低はITA 312の38,000粒/㎡であった。

登熟歩合は、品種間に極めて大きな差異が認められ、最も高かったのはLimpopoの86%、次いでIR 64の81%で、ITA 312は極端に低い70%に止まった。

千粒重にも品種間で大きな差異が認められ、最大はLimpopoの27.6 g/㎡、次いでITA 312の25.7 g/㎡で、IR 64は極めて小さい21.4 g/㎡であった。

品種間の統計的有意差の有無は、登熟歩合および千粒重に1%、収量、一株および㎡あたり穂数に5%水準で有意差が認められた。1穂籾数および㎡あたり籾数に有意差は認められなかった（Table 3-5）。

Table 3-5　栽植密度が収量および収量構成要素に及ぼす影響

	収量	穂数		籾数		登熟歩合	千粒重
	(t/ha)	一株	㎡	一穂	㎡	(%)	(g)
Limpopo	9.39	11.4	342	116	39,724	85.9	27.48
IR 64	7.73	12.7	384	117	44,732	80.8	21.38
ITA 312	6.78	9.9	298	128	37,904	69.6	25.74
統計的有意差	*	*	*	ns	ns	**	**
CV (%)	9.7	7.5	7.4	--	--	3.0	1.7
LSD .01	2.03	2.23	65.8	--	--	6.26	1.11
LSD .05	1.34	1.47	43.5	--	--	4.13	0.74

注：**、* は、それぞれ1%、5%水準で有意差あり。nsは有意差なし。

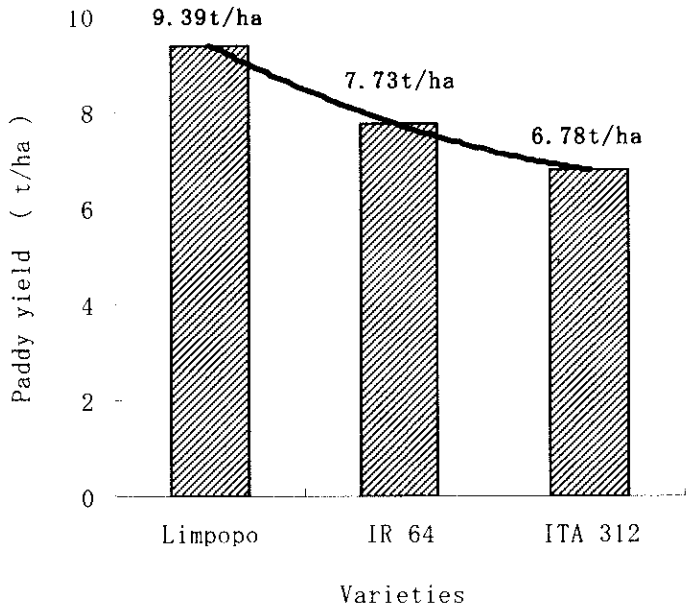


Fig. 3-3　各品種の籾収量

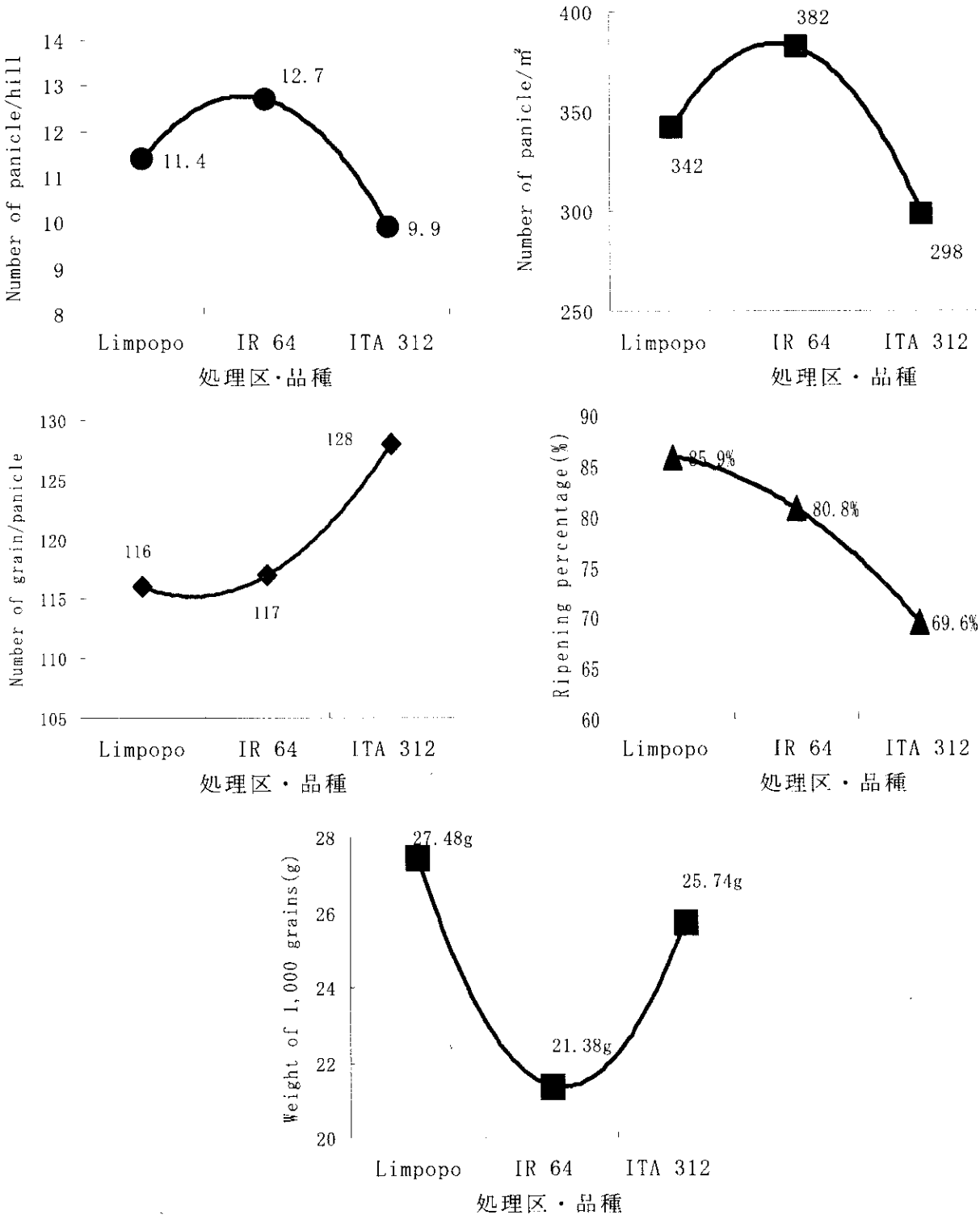


Fig. 3-4　各収量構成要素の品種間差異

考　察

現在、モザンビーク国内で正式奨励品種として登録されているのは11品種があり、それらの品種は広いモザンビーク国の気象条件、地域により奨励されている品種が異なっている（Table 3-6）。奨励品種のうちGaza Provinceで奨励されているのはIR 52, 64, Limpopoおよび ITA 212, 312 である。この内、現在ショクエ地区で多く栽培されているのはIR 64, ITA 312 およびLimpopoの3品種である。Limpopo 品種はジャバニカ種であり、IR 64 およびITA 312 はインディカ種である。

Table 3-6　モザンビーク国・水稲奨励品種(*Oryza sativa*)と主な栽培地区

Name of variety	Total growth duration(days)	Rice type	Recommendation of zone	Introduced year
IR 64	115～135	**Subsp. Indica**	Gaza	1995
IR 52	120～140	Subsp. Indica	Gaza, Inhambane	1995
Limpopo	125	**Subsp. Javanica**	Gaza	1999
ITA 312	125～150	**Subsp. Indica**	Maputo, Gaza, Inhambane Sofala and Zambezia	1995
ITA 212	125～150	Subsp. Indica	Maputo, Gaza, Inhanbane, Sofala and Zambezia	1995
M.Muriangani	138～148	Subsp. Indica	Manica	1995
C4-63	140～160	Subsp. Indica	Zambezia, Sofala	1995
Chupa	144～182	Subsp. Indica	Inhanbane, Zambezia	1995
Chibica	145～190	Subsp. Indica	Pais	1995
Mamima	148～218	Subsp. Indica	Zambezia, Sofala	1995
Agulha	140～180	Subsp. Indica	Nampula	1995

生育日数は、IR 64およびLimpopo品種はほぼ同じ生育日数125日を示したが、ITA 312では前者よりも10日程度永い135日であった。

収量と収量構成要素は、収量ではLimpopo品種が最大収量を獲得し、次いでIR 64、ITA 312 の順であった。収量構成要素を見ると、収量に最も強く影響を及ぼしている見られる単位面積あたり穂数は IR 64 が最大で、次いでLimpopo、最も少なかったのはITA 312 であった。この事は、 IR 64 およびLimpopo品種は多分げつ型に近く、ITA 312は少分げつ型（少分げつ型に近い）品種であると推察された。1穂籾数は、ITA 312が最も多く、IR 64およびLimpopoはほぼ同数であり、IR 64 およびLimpopo品種は多分げつ穂数型、ITA 312は少分げつ穂重型に近い品種と想像された。登熟歩合では最も高かったのは Limpopo の86%、次いで IR 64 は81%と両者ともに80%以上であったが、ITA 312は69.6%と極めて低かった。この最も大きな原因として挙げられる点は、不完全出穂（登熟後期になっても穂が葉鞘内から完全に出きらない現象）が原因であり他の品種でも稀に見受けられる品

種特性である。開花期になっても穂の下位部が葉鞘内から出穂しきらず葉鞘内に残るため、その部分の穎花(籾)は開花できず不登熟籾なるため登熟歩合が低くなる。この不完全出穂はITA 312品種の大きなマイナス特性である。他方、千粒重は、Limpopoおよび ITA 312が26～27gであるのに対し IR 64 は21gと極めて小さく、多収を目指す場合には大きなマイナスポイントであると見られた。

生育相は、3 品種ともに最高分げつ期まではほぼ同じ生育相を示したが、生育後半ではITA 312 はLimpopoおよび IR 64 に比べて節間伸長が大きく、最終的には IR 64 およびLimpopoの草丈が110～120cmであったのに対し、ITA 312 は130～140cm近くまで伸長し、出穂期～登熟期の強風と豪雨により倒伏した。他方、 IR 64 は稈が他の2品種に比べて軟弱であり、ITA 312 と同様に倒伏しやすい品種と見られた。

耐肥性は、3品種ともに高かった。

以上の結果から、多収性、品種の生育安定性、栽培しやすい品種としてLimpopo品種が最も有利であるとみられた。

Limpopo 品種は奨励品種の中でも、唯一ジャバニカ種であり、これがどこから持ち込まれたのか殆どの研究者も知らない状態である。マダガスカルでは、全栽培面積の25%がジャバニカ種である (Kiyochika Hoshikawa. The Growing Rice –An Anatomical Monograph–, Nobunkyo. Tokyo. p. 6) ことから、'マダガスカルより導入されたものではないかと想像された。

(4) 異なる窒素施与量が収量および収量構成要素に及ぼす影響（農家・実証圃場）

実験名：異なる窒素施与量が収量および収量構成要素に及ぼす影響

目的：農家圃場において窒素施与による増収効果を明らかにする。

材料と方法

(1) 実験場所：D 4 地区　農家圃場
(2) 実施時期：2008/09 年　稲作期
(3) 播種日　：2008 年 11 月 27 日
(4) 移植日　：2008 年 12 月 17 日
(5) 収穫日　：2009 年 4 月 6 日
(6) 試験方法
1) 乱塊法　反復なし
2) プロットサイズ：10×5 m = 50 ㎡(全面積：280.5 ㎡)
3) 供試品種：リンポポ　(Limpopo)
4) 栽植密度：30×11cm (30 株／㎡)
5) 処理法：窒素施与量(成分量、/ha)

N 0　無処理区
N 23　窒素 23kg/ha (尿素　50kg/ha：尿素 1 袋/ha)
N 46　　46kg/ha (尿素 100kg/ha：尿素 2 袋/ha)
N 69　　69kg/ha (尿素 150kg/ha：尿素 3 袋/ha)

6) 施与時期：一回目追肥　全量の 50%を移植 7 日後に表層施与。
二回目追肥　全量の 25%を移植 15 日後に表層施与。
三回目追肥　残り 25%を減数分裂期直前に表層施与。
8) 圃場管理：分げつ期および生育中期にそれぞれ 3 回および 1 回手除草
9) 病害虫防除：なし
10) 収量調査方法：試験区境界から 1m を除外した内側の株を栽植密度に従って 1 ㎡分を無作為に地上部から刈取った。収穫したサンプル株は、平均的穂数株を選抜し、平均株が複数の場合は穂首から切り離して秤量し、最も平均的な 1 株を選抜し代表株とした。1 株籾数を計数し、1 穂籾数を算出した。登熟歩合は、水による比重選により算出し、千粒重は 3 日間の風乾後籾重を秤量し、籾含水率 15%で算出した。

結　果

収量は、窒素施与量の増加に伴って顕著な増大傾向を示し、最大収量は N 69 区の 9.12 t/ha であった。N 0 区はプロジェクト外の一般農家の平均収量とほぼ同等の 3.5 t/ha に止まり、N 23 区は顕著に増大し 5.7 t/ha、N 0 区に比べて 63%の増大率であった。N 46 区は 7.6 t/ha で N 23 区より 33%の増大率であった。N 69 区では 9, 12 t/ha の多収であ

ったが、N 46区よりも19%の増大率に止まった(Table 3-7. Fig. 3-5)。

穂数は、1株穂数では窒素施与量増加により増大し、㎡あたり穂数も同様の傾向を示した。㎡あたり穂数の増大率は、N0区とN23区の間で最大の30%増であったが、N23区とN46区およびN46区とN69区との間は、それぞれ12および13%であった。

籾数は、1穂籾数ではN0区で70粒と小さかったが、N23区からN69区では100～111粒/1穂であった。㎡あたり籾数は、窒素施与量の増加により顕著な増大傾向を示し、N0区とN23区との間では91%と大きな増大率であり、N23区とN46区との間では15%、N46区とN69区との間では18%であった。

登熟歩合および千粒重には、処理区の間に顕著な差異は認められなかった。

統計分析結果では、収量、1株穂数、㎡あたり穂数、1穂籾数および㎡あたり籾数にそれぞれ1%水準の有意差が認められた。しかし、登熟歩合および千粒重には、処理による有意差は認められなかった(Table 3-7)。

収量と収量構成要素との相関関係では、収量に対し最も高い相関関係を示したのは㎡あたり籾数（r=0.987**. n=12）であり、次いで㎡あたり穂数、1株穂数、1穂籾数の順で1%水準の高い相関関係が認められた。収量と登熟歩合および千粒重との間には相関関係は認められなかった。㎡あたり籾数を構成する㎡あたり穂数および1穂籾数と㎡あたり籾数との相関係数を比較すると、㎡あたり穂数の方が強い相関関係を示した(Table 3-8)。

Table 3-7 窒素施与量が収量、収量構成要素に及ぼす影響

	収量	穂数		籾数		登熟歩合	千粒重
	(t/ha)	一株	㎡	一穂	㎡	(%)	(g)
N 0	3.53	7.4	223	70	15,541	87.2	26.29
N 23	5.74	9.7	291	102	29,647	78.1	26.38
N 46	7.64	10.9	328	104	34,216	83.1	26.92
N 69	9.12	12.2	366	111	40,428	83.8	26.91
統計的有意差	**	**	**	**	**	ns	ns
CV (%)	12.5	6.1	6.1	5.8	9.7	--	--
LSD .01	1.93	1.43	42.8	15.1	6,785	--	--
LSD .05	0.75	0.98	29.4	10.4	4,663	--	--

注：**、* は、それぞれ1%、5% 水準で有意差あり。nsは有意差なし。

Table 3-8 収量および収量構成要素の相関表

	一株穂数	穂数/㎡	一穂籾数	籾数/㎡	登熟歩合	千粒重
収量	0.957**	0.958**	0.902**	**0.987****	0.011	0.504
一株穂数		---	0.815**	0.961**	-0.052	0.433
穂数/㎡			0.817**	0.962**	-0.052	0.432
一穂籾数				0.936**	-0.292	0.415
籾数/㎡					-0.139	0.467
登熟歩合						-0.001

注：**は1%水準で有意な相関関係あり。

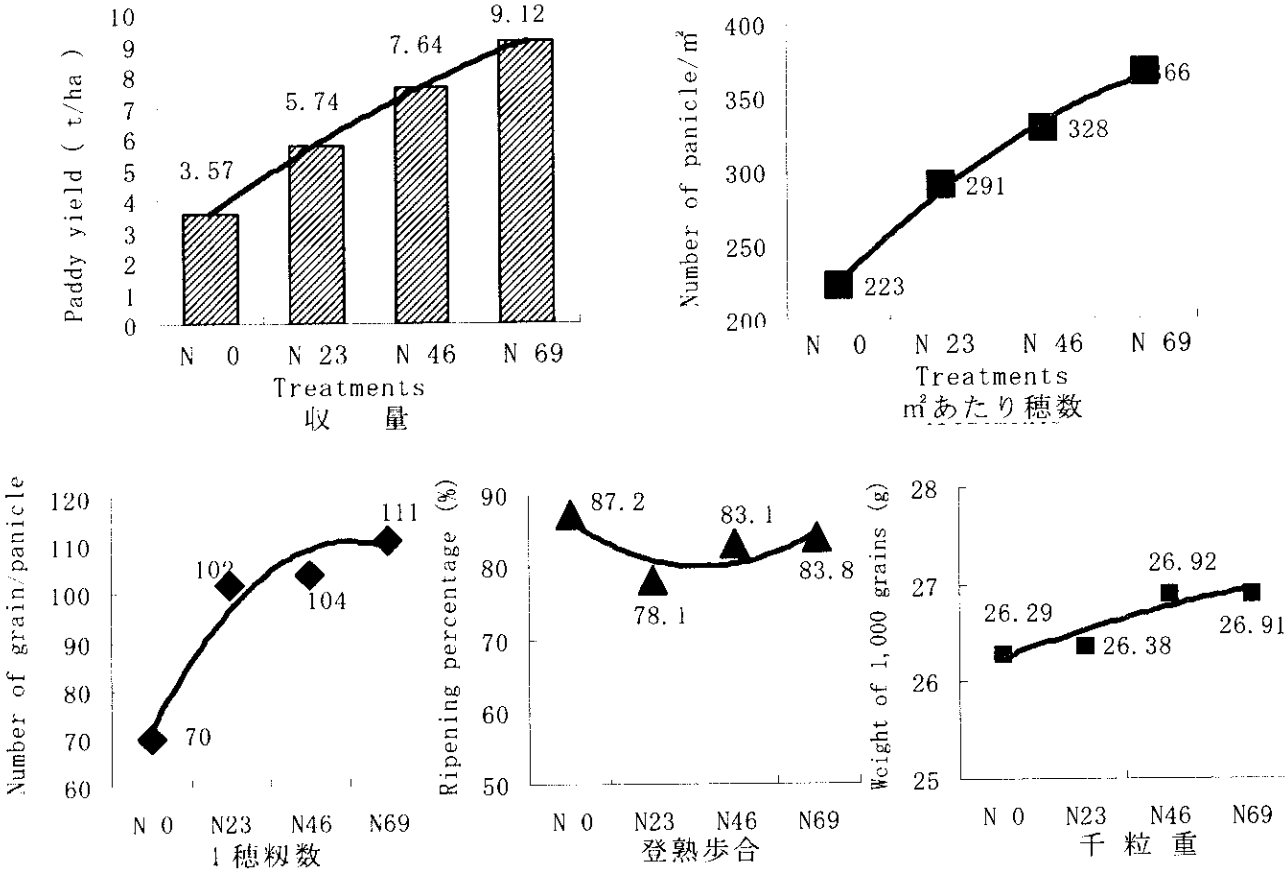


Fig. 3-5　処理による収量および収量構成要素の変化

考　察

当地区での稲作栽培では窒素のみ施与が一般的で、燐酸および加里施用は一般的ではない。他方、試験場にも稲に対する窒素施与効果に関するデータはない。農民は尿素を施与すれば増収すると言うことは感覚的には持っているようである。しかし、窒素施与によりどの程度の増収が可能かのデータはない。そこで農家圃場での窒素施与量を検討した。

窒素施与量は、理解を容易にするために無処理のＮ０区を除き、Ｎ23区は尿素換算で1袋（50kg/ha、成分量46%）、Ｎ46区は2袋(100kg/ha)、Ｎ69区は3袋（150kg/ha）で実証試験を実施した。

収量は、Ｎ０区からＮ23区の間では顕著な増収効果が認められ、尿素1袋でもその効果が大きいと判断された。N23区とN46区との間でも明らかな増収効果が認められ、少なくともhaあたり尿素2袋の投入が望ましいことが明らかになった。しかし尿素を多く施与すれば直ぐに増収すると言うものではなく、増収に必要な技術のセット作り(技術の合成)、すなわち代かき・均平、健苗育成、本田準備、栽植密度・1株苗本数、窒素分施法等を総合的に組み合わせた技術により窒素効果を一層高めることが必要である。

技術指導ポイント

貧しい農家にとって肥料の購入には多大の負担となるであろうが、そこを投入と増収のコスト計算などを詳細に作成し理解させて、納得のいく啓蒙・普及が求められる。加えて、窒素施与奨励の啓蒙・普及は、投入による増収効果などをセットにした技術的アドバイスが必要であろう。

(5) 品種比較試験（農家・実証圃場）

目的：本地域で最も広く栽培されている3品種の収量、品種特性を農家圃場で解明する。

材料および方法

(1) 実証試験場所：D 4　モデル圃場内
(2) 実施時期：2008／09年稲作期
(3) 播種日　：2008年11月26日
(4) 移植日　：2008年12月15日
(5) 収穫日　：2009年4月6～16日
(6) 実験方法
1) 反復なし
2) プロットサイズ：10×5 m
3) 供試品種：　**Limpopo**
IR 64
ITA 312
4) 栽植密度：30×11cm　(30株/㎡)
5) 一株苗本数：4～6本/株
6) 施肥量：　窒素46kg/ha（尿素：100kg/ ha)
7) 施与時期：一回目追肥　全量の50%を移植7日後に表層施与。
二回目追肥　全量の25%を移植15日後に表層施与。
三回目追肥　残り25%を減数分裂期直前に表層施与。
8) 圃場管理：分げつ期および生育中期にそれぞれ3回および1回手除草
9) 病害虫防除：なし
10) 収量調査方法：試験区境界から1mを除外した内側の株を栽植密度に従って1㎡分30株を無作為に地上部から刈取った。収穫したサンプル株は、平均に最も近い穂数株を選抜し、平均株が複数の場合は穂首から切って秤量し、最も平均的な1株を選抜し代表株とした。脱穀後1株籾数を計数し、平均1穂籾数を算出した。登熟歩合は、水による比重選により計数後算出した。千粒重は、3日間の風乾後籾重を秤量し、籾含水率15%で算出した。

結　果

3品種を栽培比較した結果、収量はLimpopo品種が最高の7.5 t/ha を獲得し、次いでIR-64品種が6 t/ha 、最も低かったのはITA 312品種の5.5 t/ha であった（Table 3-9)。

一株および㎡あたり穂数は、一株穂数ではIR 64 が最も多く12本/株、次いでLimpopo で11本/株、最低はITA 312の8本/株であった。㎡あたり穂数も同様の傾向を示し、最高はIR 64の375本/㎡、最低はITA 312の252本/㎡であった（Table 5-1)。

一穂および㎡あたり籾数は、1穂籾数ではITA 312で最大の128粒/穂、次いでIR 64お

よびLimpopoがほぼ同数の93,97粒/穂であった。㎡あたり籾数では、IR 64が最大の35,000粒/㎡、次いでLimpopoの33,000粒/㎡、最低はITA 312の32,000粒/㎡であった(Table 5-1)。

登熟歩合は品種間に大きな差異が認められ、最も高かったのはLimpopoの85%、次いでIR 64の81%で、ITA 312は極端に低い68%に止まった (Table 3-1)。

千粒重にも品種間で大きな違いが認められ、最大はLimpopoの27 g/㎡、次いでITA 312の25 g/㎡で、IR 64は極めて小さい21 gであった (Table 5-1)。

品種間での統計的有意差の有無は、㎡あたり穂数、登熟歩合および千粒重で1%、収量、一株穂数および1穂籾数に5%水準で品種間に有意差が認められたが、㎡あたり籾数には有意差は認められなかった (Table 3-9)。

Table 3-9 農家実証圃場での品種比較試験結果

	収量 (t/ha)	穂数 一株	穂数 ㎡	籾数 一穂	籾数 ㎡	登熟歩合 (%)	千粒重 (g)
Limpopo	7.49	11.1	332	97	33,015	85.6	26.53
IR 64	6.02	12.1	375	93	35,011	81.0	21.27
ITA 312	5.51	8.4	252	128	32,262	67.9	25.20
統計的有意差	*	*	**	*	ns	**	**
CV (%)	11.5	9.7	9.6	9.3	--	3.0	1.3
LSD .01	1.91	2.7	80.2	26.0	--	6.19	0.83
LSD .05	1.25	1.7	52.9	17.4	--	4.09	0.54

注：**、* は、それぞれ1%、5%水準で有意差あり。nsは有意差なし。

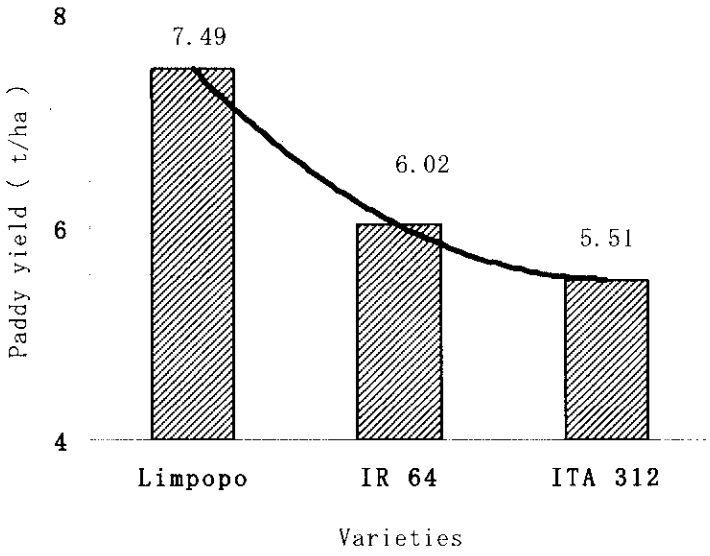


Fig. 3-6 異なる品種の籾収量

考 察

農家圃場における実証試験結果は、試験場の実験結果とほぼ同様の成績であったため、詳細は試験場実験結果を参照ありたい。

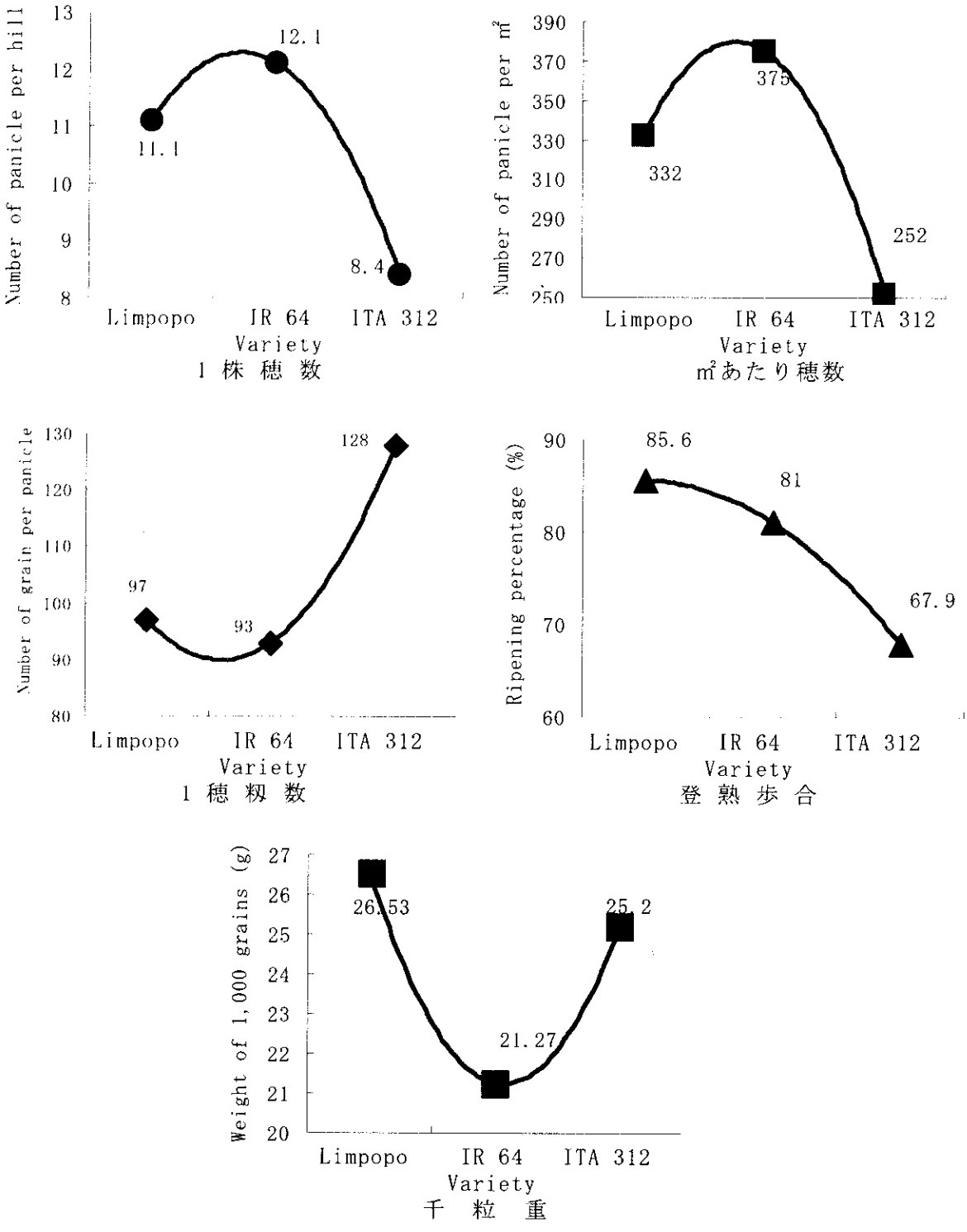


Fig. 3-7　異なる品種の収量構成要素

（6）プロジェクト開始直後と終了直前の農家圃場の籾収量・収量構成要素の変化と栽培技術浸透度合い

営農部門では、業務の重要な柱である水稲移植栽培技術の確立を目指して、種々の圃場試験、ポット試験および調査などを行い、それらを基に技術の確立をほぼ完了するところである。しかし、確立した技術が有効/効果的であったかどうかを検証する必要があると考えた。そこで、プロジェクト開始直後（2007 年 3-4 月）に実施した『農家圃場水稲収量調査』結果と今期（2009 年 3-4 月）に同じ手法で実施したモデル圃場収量調査結果との収量および収量構成要素の比較を試みた。

以下に、その結果および考察を述べた。

材料と方法

収量調査方法は、両年ともに各農家圃場の平均的な 1 点を選び、1 ㎡を円形に刈取り「単位面積当たり株数」を調査した。刈取った株から平均穂数に最も近い株を 1 株選抜した。平均株に近い株が複数の場合は、各株のそれぞれの穂を穂首から切り取って秤量し、平均に最も近似した株を選び代表株とした。この代表株について、「一株穂数」、「一穂籾数」、「登熟歩合」および「千粒重」を調査した。代表株以外の株は、脱穀後乾燥機で 80℃、24 時間乾燥し代表株の籾を加えて秤量し実測値とした。

結　果

籾収量は、2006/07 年稲作期（プロジェクト開始直後）では平均 3.6 t/ha（収穫ロス 15%とすると実質では 3 t/ha）と低収に止まっていた。しかし 2008/09 年稲作期では平均 6.4 t/ha （収穫ロス 15%＝5.44 t/ha） と顕著な増収を達成していた。その増収割合は 76%にも達していた（Table 3-10～3-12)。

収量構成要素の変化は、単位面積あたり株数、すなわち㎡あたり栽植密度は平均 28 株/㎡から 33 株/㎡、23% 増大していた。一株あたり穂数も平均 6 本/株から 9 本/株、43%の増大であった。この結果、収量に極めて強い影響を及ぼしている単位面積あたり穂数は、平均 168 本/㎡から 262 本/㎡、56%の大幅な増大を達成していた。1 穂籾数は、単位面積あたり穂数の増大の影響から漸減の-6%であった。そして最も強く収量に影響を及ぼしている単位面積あたり籾数は、平均 18,197 粒/㎡から 26,986 粒/㎡、48%の増大となっていた。登熟歩合も 6%向上し、千粒重は平均 24g から 27g へと 11%の増大であった。この様に、1 穂籾数を除く全ての構成要素で顕著な増大・向上が認められた。

2006/07 年の収量と 4 収量構成要素（㎡あたり穂数、一穂あたり籾数、登熟歩合、千粒重）との相関関係では、収量と 1 穂籾数との間に強い相関関係が認められ(r=0.745**)、その他の収量構成要素との間には有意な相関関係は認められなかった(Table 3-13)。それは、単位面積あたり籾数と 1 穂籾数（r=0.792**）との間の強い相関関係でも再確認できる。この事は、2006/07 年時の籾収量は、ほぼ一元的に穂の大きさにより収量は決定されていた

ことを意味している。他方、㎡あたり株数と一株穂数（r=-0.870**）との間に強い負の相関関係が認められ、これは栽植密度を密にするに従い一株穂数は急激に減少することを意味し、無肥料栽培がもっとも大きな原因と考えられた。収量と登熟歩合、千粒重との間には有意な相関関係は認められなかった。

次に2008/09年では、収量と㎡あたり穂数（r=0.638**）、また㎡あたり籾数（r=0.806**）との間に強い相関関係が認められた。他方、㎡あたり籾数と㎡あたり穂数(r=0.712**)との間にも強い相関関係が認められた。収量と登熟歩合および千粒重との間には有意な相関関係は認められなかった（Table 3-14）。

Table 3-10 プロジェクト開始時(2006/07年稲作期)の農家圃場の収量、収量構成要素（調査年月日：2007年3～4月）

Sample	Paddy yield	Number of	Number of panicle		Number of grain		Ripening	Weight of 1,000
No.	(t/ha)	hill/㎡	/hill	/㎡	/panicle	/㎡	%	grains (g)
1	2.69	20	6.5	129	99	12,771	83	25.4
2	4.66	38	5.3	200	122	24,400	81	24.2
3	4.23	35	4.5	157	116	18,255	91	25.5
4	2.88	42	4.4	184	79	14,536	88	22.5
5	3.71	22	8.1	179	94	16,826	93	23.7
6	3.57	25	7.0	176	101	17,776	83	24.2
7	4.03	21	7.1	149	120	17,640	94	24.0
8	4.53	16	9.1	146	154	22,484	88	22.9
9	4.27	21	8.0	169	150	25,350	77	21.9
10	3.66	31	5.9	181	122	22,082	70	23.7
11	2.82	40	4.8	191	82	15,662	78	23.1
12	3.36	22	5.9	130	134	17,420	85	22.7
13	2.77	27	5.9	160	83	13,280	88	23.7
14	3.45	38	5.3	201	81	16,281	76	27.9
Av.	**3.61**	**28**	**6.3**	**168**	**110**	**18,197**	**84**	**24.0**

Table 3-11 プロジェクト終了時(2008/09年稲作期)の農家圃場の収量、収量構成要素（調査年月日：2009年3～4月）

Sample	Paddy yield	Number of	Number of panicle		Number of grain		Ripening	Weight of 1,000
No.	(t/ha)	hill/㎡	/hill	/㎡	/panicle	/㎡	%	grains (g)
1	4.60	12	19.5	234	91	21,294	82.7	26.14
2	6.49	28	8.4	235	110	25,850	93.3	26.92
3	6.33	20	13.7	273	101	27,573	85.9	26.73
4	6.35	33	7.7	252	102	25,704	88.9	27.90
5	6.51	24	10.4	250	105	26,250	92.2	27.05
6	6.56	45	7.5	339	84	20,076	86.2	26.68
7	5.61	20	11.8	235	102	23,970	88.7	26.37
8	7.28	35	7.8	274	108	29,592	94.2	26.15
9	6.60	37	7.3	270	93	25,110	92.5	28.36
10	7.16	29	10.0	290	92	26,280	93.2	28.97
11	6.82	36	7.1	256	122	31,232	85.4	25.48
12	6.83	44	6.6	290	96	27,840	87.6	27.89
13	6.88	28	8.6	241	122	29,402	88.7	26.53
14	7.01	51	6.3	321	111	25,631	88.0	22.40
15	5.78	55	4.8	264	96	25,344	84.7	27.16
16	4.87	30	5.7	171	112	19,152	93.2	27.39
Av.	**6.36**	**33**	**9.0**	**262**	**103**	**26,986**	**89.0**	**26.75**

Table 3-12　プロジェクト開始時と終了時の平均収量・収量構成要素の比較と'06/07年を100とした'08/09年の増減率

Cultivation year	Paddy yield (t/ha)	Number of hill/㎡	Number of panicle /hill	/㎡	Number of grain /panicle	/㎡	Ripening %	Weight of 1,000 grains (g)
2006/07	3.61	28	6.3	168	110	18,197	84	24.0
2008/09	6.36	33	9.0	262	103	26,986	89	26.8
The increase/decrease percentage (%) in 2008/09 compared with 2006/07.								
(%)	+76	+23	+43	+56	−6	+48	+6	+11

注：両年度の籾収量は、収穫ロスの全く無い数値であり、農家圃場では15%程度の収穫ロスがあると見られ、'06/07年および'08/09根年の農家籾収量はそれぞれ3.1、5.4 t/haであったと推察される。

Table 3-13　プロジェクト開始時の収量および収量構成要素の相関表

	株数/㎡	一株穂数	穂数/㎡	一穂籾数	籾数/㎡	登熟歩合	千粒重
収　量	-0.209	0.402	0.086	**0.745****	**0.858****	0.084	-0.063
株数/㎡		**-0.870****	0.734**	-0.575*	-0.138	-0.304	0.262
一株穂数			-0.351	0.563*	0.366	0.199	-0.304
穂数/㎡				-0.420	0.209	-0.427	0.188
一穂籾数	n=18				**0.792****	-0.043	-0.403
籾数/㎡	1%：0.590					-0.340	-0.307
登熟歩合	5%：0.468						-0.103

注：**,* はそれぞれ1、5%水準で有意な相関関係を示す。

Table 3-14　2008/09年稲作期の農家圃場での収量および収量構成要素の相関表

	株数/㎡	一株穂数	㎡穂数	一穂籾数	籾数/㎡	登熟歩合	千粒重
収　量	0.403	-0.433	**0.638****	0.189	**0.806****	0.321	0.069
株数/㎡		-0.821**	0.543*	-0.067	0.497	-0.071	0.200
一株穂数			-0.159	-0.268	-0.327	-0.334	-0.009
穂数/㎡				-0.430	0.712**	-0.214	-0.234
一穂籾数	n=16				0.319	0.158	-0.426
籾数/㎡	1%：0.623					-0.118	-0.602*
登熟歩合	5%：0.497						0.328

注：**、* はそれぞれ1、5%水準で有意な回帰あり。

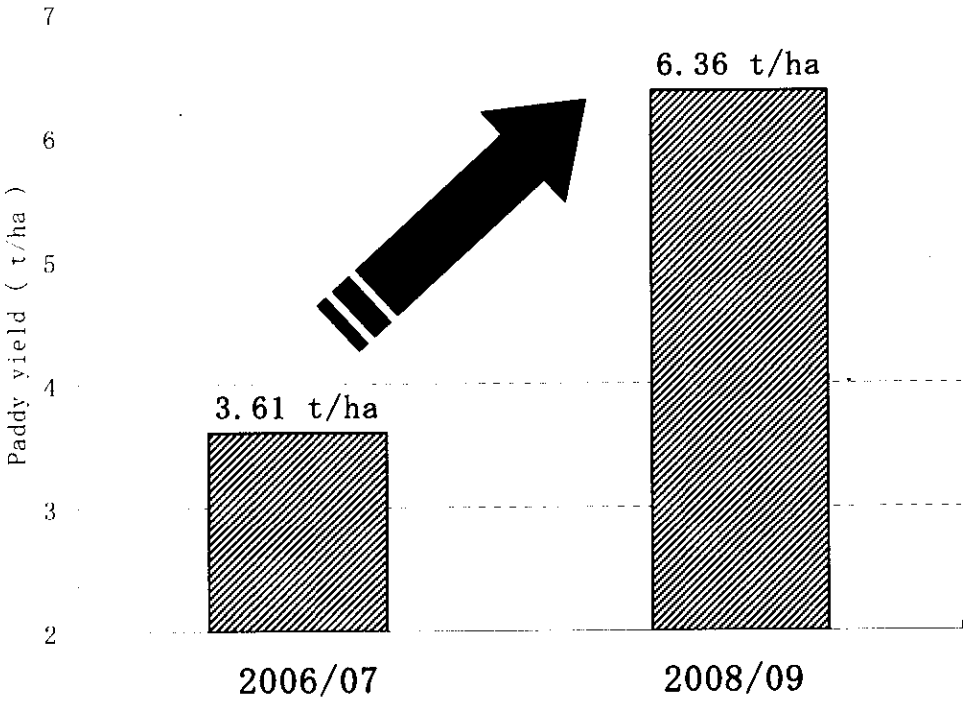


Fig. 3-8　2006/07 と 2008/09 年の収量差

注：両年度の籾収量は、収穫ロスの全く無い数値であり、農家圃場では 15%程度の収穫ロスがあると推察され、'06/07 年および'08/09 年の農家籾収量はそれぞれ 3.1、5.4t/ha 水準であったと推察される。

2006/07 年と 2008/09 年稲作期の 4 収量構成要素（㎡あたり穂数、1 穂籾数、登熟歩合、千粒重）の収量への影響度合いを重回帰分析法で検定した。相関表でもその傾向が顕著であったが、2006/07 年では収量は『1 穂籾数』に 44%と極めて強い影響を受けていた(Fig. 3-9)。そして『㎡あたり穂数』は 27%の関与度合いに止まり、登熟歩合および千粒重の影響は微小であった。しかし、2008/09 年では、その影響要素は『㎡あたり穂数』が最も強く 42%、『1 穂籾数』は 31%と 2006/07 年に比べ両者が入れ替わった形であった。登熟歩合および千粒重は 2006/07 年とほぼ同じ傾向であった（Fig. 3-9)。

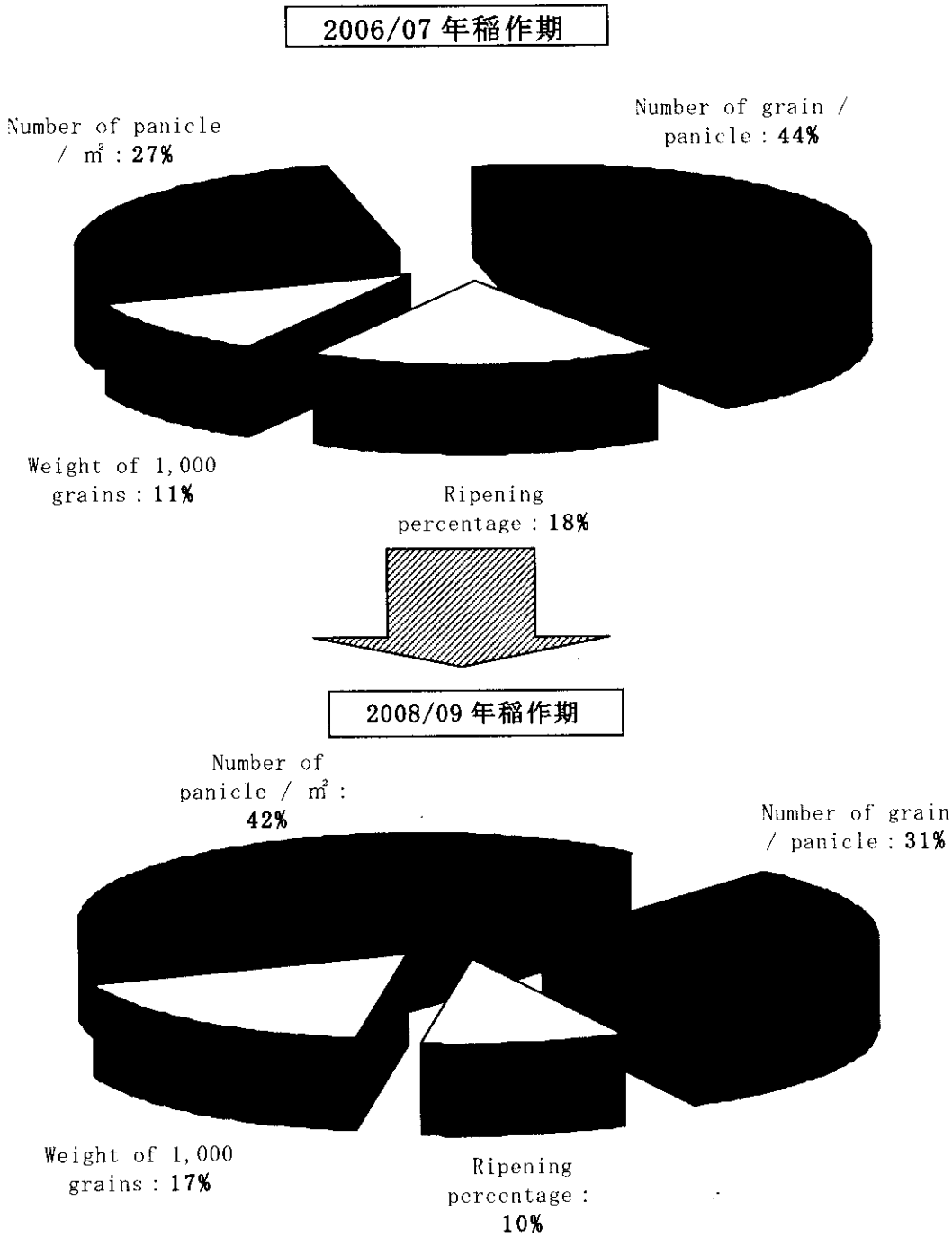


Fig. 3-9 プロジェクト開始直後と終了直前における４収量構成要素の収量に対する影響力割合の変化

考　察

2008/09 年の籾収量および各収量構成要素は、2006/07 に比べて 1 穂籾数を除き顕著な増大/上昇傾向を示した。収量と収量構成要素の関係では、収量は、両年ともに一元的とも言えるほど単位面積あたり籾数に極めて強い影響を受け、この単位面積あたり籾数増大が増収の鍵であることは明白である。そして、『単位面積あたり籾数』は『単位面積あたり穂数』と『1 穂籾数』により成り立っている。そして両者を同時に増大させることが増収に繋がるが、技術的な難易度からみると、「1 穂籾数」の増大には種々の困難と限界がある。すなわち、1 穂籾数には品種特性が強く影響されるとともに、一穂籾数の増大には穂首分化期から減数分裂始期までの土中窒素含有量が関係し、この時期の過度な窒素施与は、過繁茂（群落構造の悪化）、節間過伸長や病害虫発生などを助長し、倒伏･減収の原因となり極めて危険である。倒伏発生は登熟歩合の急速な低下と減収を招く。この事から、現状では単位面積あたり穂数増大を志向することが妥当と思われる。『単位面積あたり穂数』は、『単位面積あたり株数』と『一株あたり穂数』で構成され、特に適切な栽植密度（奨励栽植密度 30 株/㎡）と若苗を使用し、適切な肥培管理（特に分げつ初期の窒素追肥）による穂数増大を図ることが安全で適切な増収の方向であろう。

収量構成要素の比較から見れば、単位面積あたり穂数の増大が増収に大きな影響を及ぼしたことは明白であり、農家の技術が向上/改善したと言える点としては、「育苗技術と若苗の使用」、「一株苗本数」、「栽植密度」、「施肥と分施法」の改善などが挙げられる。しかし、期間中の極めて良好な気象条件からみて、一層の増収が期待できると思われる。しかし、これを妨げているのが圃場準備法の欠陥、すなわち本地域では適切な『耕起、代かき・均平』を行うための機能的/効率的な農具・農機具が皆無であること。また本地域の土壌は砂含有率が高く（Table 3-15）、代かき・均平なしの作業体系と相まって分げつ期の減水深（特に地下への浸透）が極めて大きく施与した窒素の流亡が激しいため、現状では窒素施与効果が小さいものと推察された。これは単位面積あたり穂数にも現れ、試験場の実験圃場でも窒素 90kg/ha を施与しても㎡あたり穂数が 400 本に達しないことからも明らかである。特に、育苗期から分げつ後期（11～1 月下旬）までは減水深が極めて大きく（Fig. 3-10 参照）、窒素施与効果の低下が起こることにより、収量に最も強く影響を及ぼしている単位面積あたり穂数確保を困難にしていると推察された。

以上の結果から、確立した水稲移植栽培技術は妥当であったと判断され、それが確実に農家圃場レベルまで達していたことが確認された。今後の一層の増収には本田準備法の改善、特に代かき・均平作業の改善が不可欠である。現状の畜力による代かき・均平作業ではこれを解決することは極めて困難であり、東南アジアで既に広く導入されているロータリー耕起法などが想定される。他方、移植水稲栽培法では面積拡大が極めて困難であり、将来的には乾田/湿田直播法の検討と導入が課題となると推察され、これを容易にするためにもロータリー耕起法の導入は不可欠であると考えられた。

Table 3-15　モデル地区水田土壌の砂含有率(%：重量比)

地区(上、中、下は3次水路の上、中および下流部)				
D-4	上流	中流	下流	
1	11.0	11.4	9.8	
2	12.5	10.6	4.3	
3	16.8	11.9	13.0	**D4 Av.**
平均	13.4	11.3	9.0	**11.2%**
D-7	上流	中流	下流	
1	27.5	28.8	35.8	
2	29.1	33.3	32.8	
3	32.1	33.4	26.2	**D7 Av.**
平均	29.6	31.8	31.6	**31.0%**

注：上，中および下流とは、各々D4, D7の二次水路の上流、中流および下流を指す。

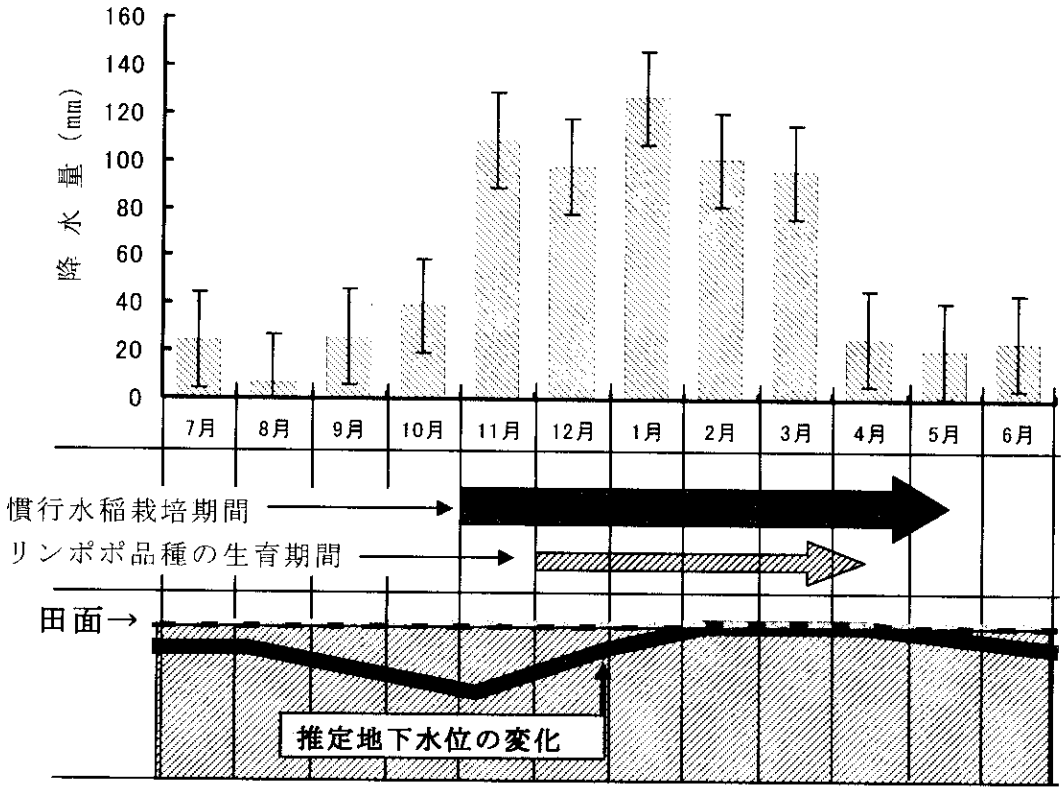


Fig. 3-10　ショクエの降水条件と推定地下水位の変化

注：ショクエ地区の雨期は11月から始まり3月までの5ヶ月間である。雨が降り始める11月の圃場は、最も乾燥した状態で大きく深い亀裂が出来、地下水位も最も深いと推察される。12月に入って徐々に地下水位も上昇を始めるが、激しい地下浸透が止まるのは1月下旬である。苗代播種は11月下旬～12月中旬、田植え時期は12月中旬から翌年1月下旬である。収穫期は4～5月。

添付資料 E-2

MANUAL ON RICE CULTIVATION

【 REVISED EDITION 】

** Based on experiment, verification trial and farmer's survey results**

Dec. 2009

Farming Section

Integrated Agricultural Development Project
for Small Scale Farmers in Chokew Irrigation Scheme

Contents

Page

Introduction

This manual has been prepared based on the results of experiments, verification trial in farmers' field and farmer's field paddy yield/questionnaire survey that has been conducted from March, 2007 to November 2008 in Chokwe Irrigation Scheme. This manual is a draft intended first for farmers, extension officers as well as engineers, and it might need improvement, revision or elimination in future.

I. General Information about Rice

1. Origin and history of rice

The cultivation of rice is said to have begun in the Eastern part of India or in the Yun-nan district of China between 4,000 and 10,000 B.C. Then, it spread to various parts of the world through the various routes as shown on the map below (Minus sign means the century B.C. and no sign is A.D.

In West Africa, African rice (***Oryza glaberrima Steud***), a different rice variety (***Oryza sativa L.***), has been cultivated since early times. Its paddy seeds have few hairs and no awns, and its ligules are small, different from that of ***glaberrima*** rice. It is all non-glutinous, and thus, there is no glutinous rice included in it (**Fig.I-1**). (Sauce: pp 2～7, by Kiyochika HOSHIKAWA, An anatomical monograph, The growing rice plant. 1989.)

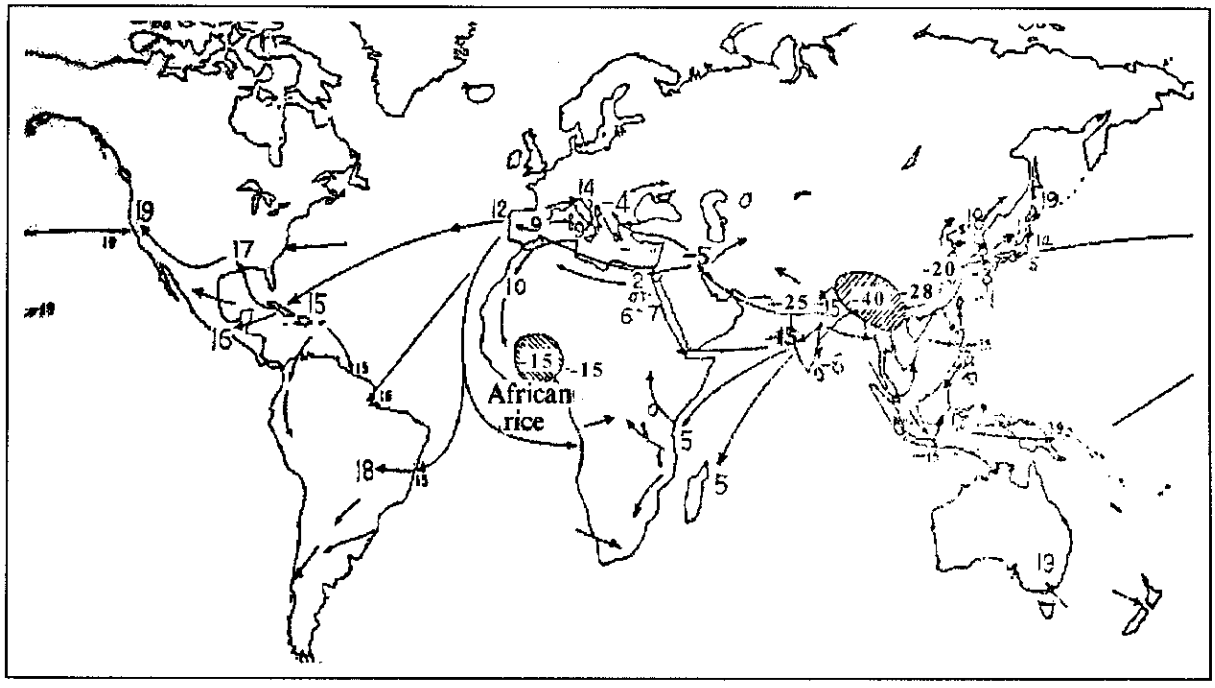


Fig.I-1 Dissemination map of the rice cultivation.
Note: The numerals in the figure indicate the century concerned when the rice plant arrived for the first time. Minus sign means the B.C. and no sign is A.D. respectively.

2. Rice type and cultivation area.

The world rice production is estimated at about 476 million tons of unhulled rice (Paddy.1987). One -half of the world population lives on rice. There are three types of rice in the world as below(Fig.I-2, I-3).

Subspecies ***japonica*** Subspecies ***Javanica*** Subspecies ***indica***

Fig.I-2 Types of rice in the world

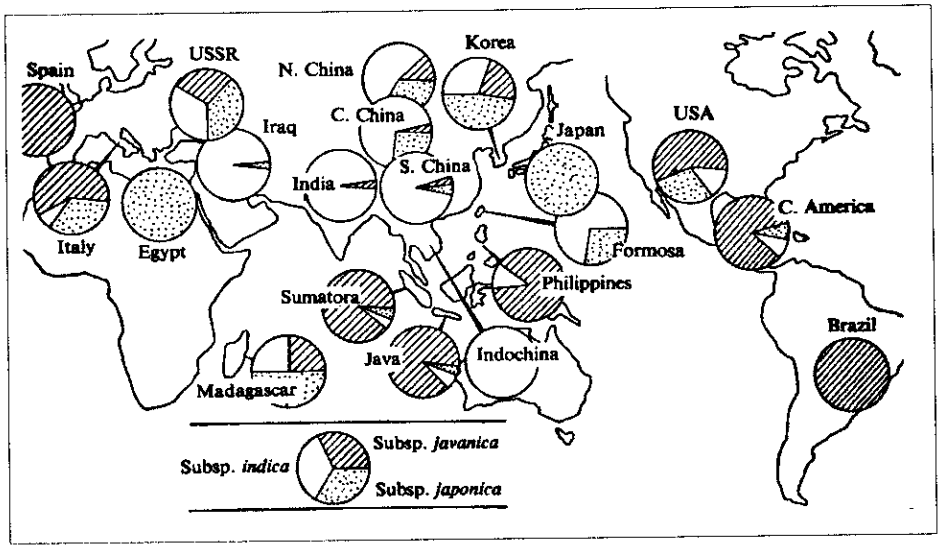


Fig.I-3 The distribution ratio of the three types of rice in the rice cultivation districts in the world.

II. Rice Production in Mozambique and Chokwe

In the past five years in Mozambique the area planted to rice was 170,000 ha/year and production was 120,000 t/yr (average yield of paddy is 0.8-1.6 t/ha). With the increase in demand for rice (25 kg/capita/year) the rice self sufficiency percentage dropped drastically (24.7% in 2004) and more than 300,000 ton of rice was imported to compensate. Rice is the second staple food next to maize. From the food security standpoint, self-sufficiency should be achieved immediately.

The Chokwe Irrigation Scheme (CIS), situated along the Limpopo River in Chokwe District, Gaza Province, is the largest irrigation scheme in the country. Irrigated area is 26,000 ha. The CIS used to be the country's granary, which at its highest capacity; it produced more than 50,000 tons of rice. Today, rice production in the CIS is only about one tenth of the above mentioned production due to many factors: civil war in the 80's, change of the economic system after independence, and the flood of the Limpopo River in year 2000 (Fig.II-1).

The change of cultivation area of major crops in CIS from 2001 to 2007 as shown below;

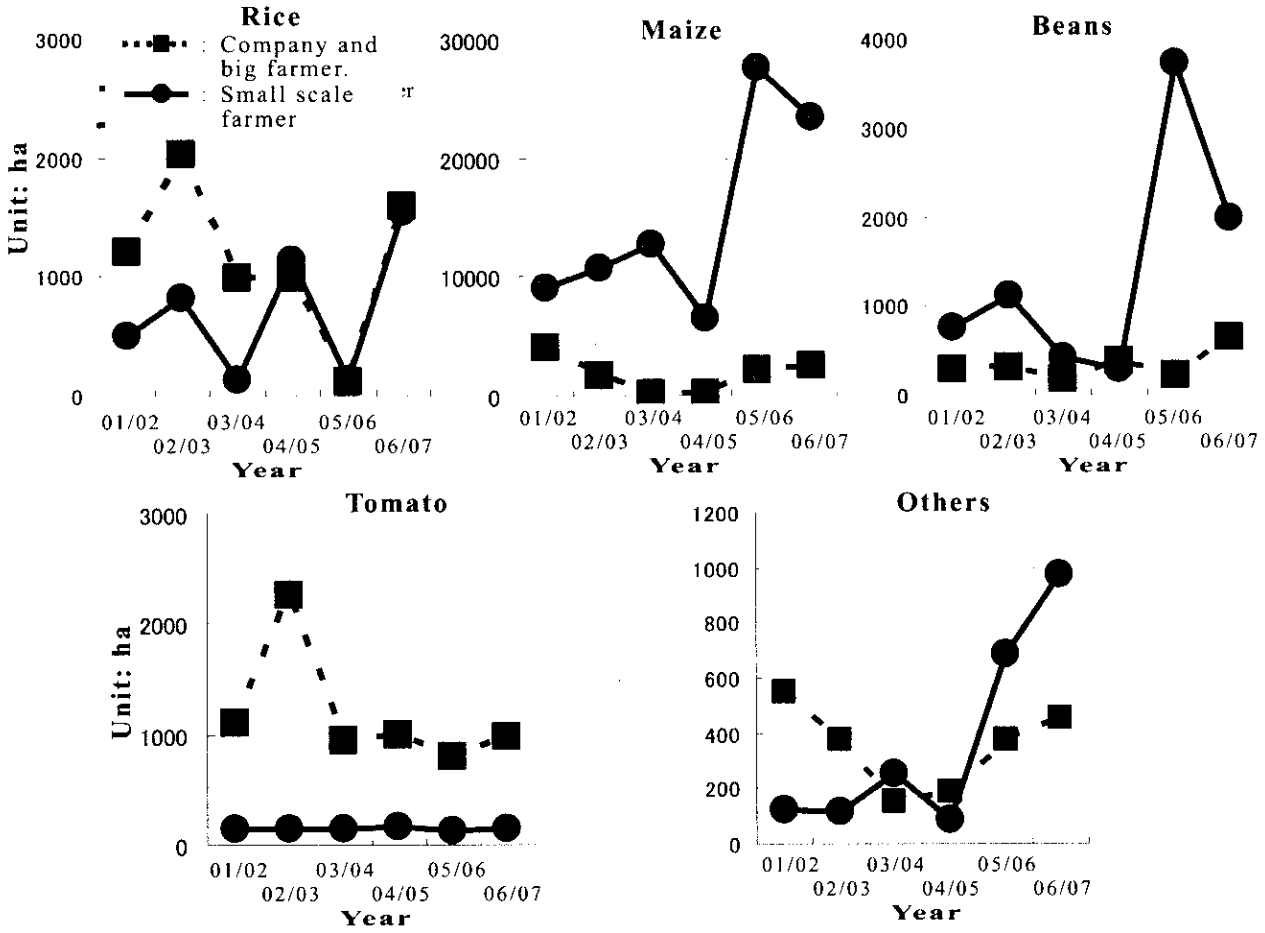


Fig.II-1 Change of cultivated area of major crops in CIS from'01/02 to 06/07.
Note: Cultivation area of maize includes the outside CIS area.
Drought affected in 2005/06 season.
Source: SDAE, Chokwe District, Extension Department.

III. Weather conditions and suitable season for rice cultivation in Chokwe

First of all, Chokwe weather conditions are extremely excellent for paddy cultivation compared with those in Asian countries. The dominant position point of weather in rice cultivation season is: very abundant amount of solar-radiation; big daily temperature range; small precipitation; low relative humidity through the whole growth period.

Especially, the average amount of solar-radiation during the total growth period which has extremely strong influence on paddy yield may be as high as 20 MJ/m^2/day in this area. It is conceivable that 80% or more of the paddy yield per unit area is regulated by the amount of solar-radiation in weather components obtained by computation result of multiple regression analysis (Fig.III-1).

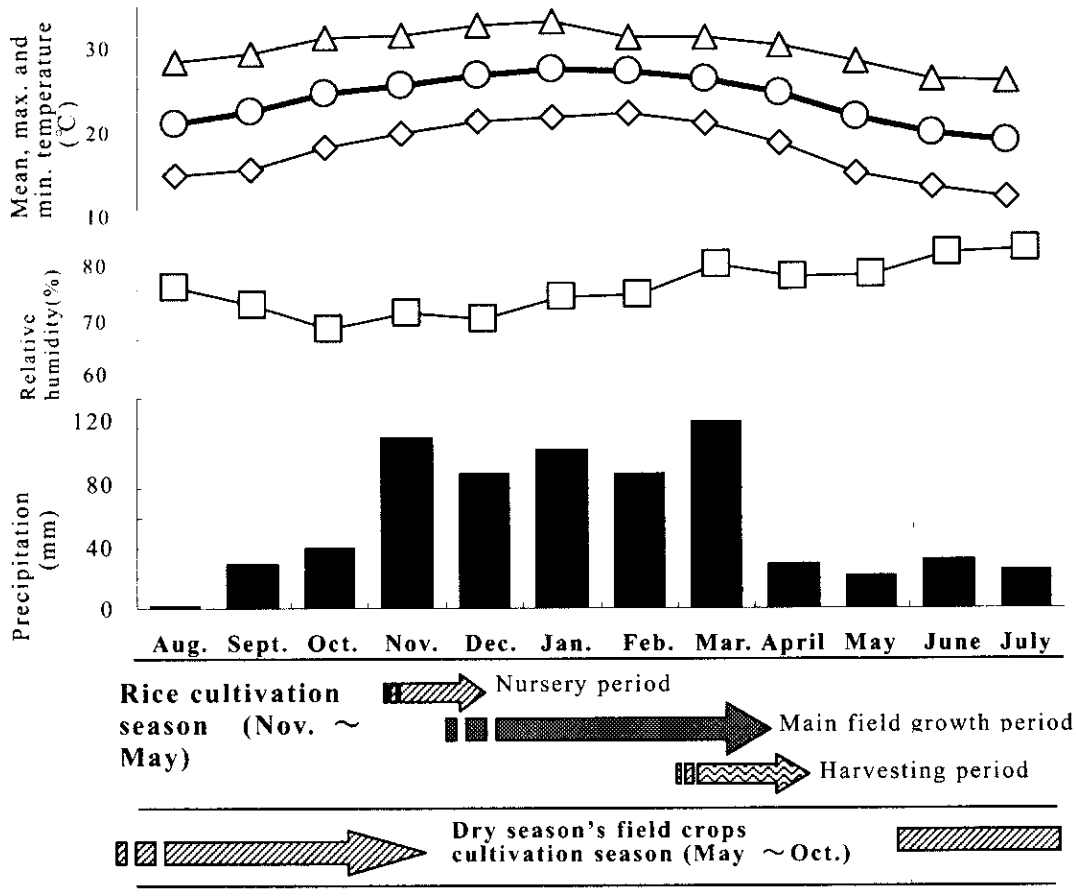


Fig.III-1 Monthly average weather conditions from 1997 to 2006 in Chokwe and crop cultivation season.

Source : Chokwe Agriculture Experimental Station

Fig.6 shows the relationship between the average amount of solar-radiation during the total growth period of rice and paddy yield per ha in different countries. As for Egypt, the amount of solar-radiation is abundant being 28 MJ/m^2/day and the paddy yield is as high as 13-14 t/ha. But, the amount of solar radiation during dry season of Fiji and Bangladesh is 17 MJ/m^2/day, and the corresponding paddy yield is 7 t/ha. During the rainy season in Asia, which is the most important paddy production region in the world, solar radiation is 15-16 MJ/m^2/day and paddy yield is standing at only 5-6 t/ha. In Chokwe area, the average amount of solar-radiation during the total rice cultivation period is estimated at about 20-21 MJ/m^2/day, and the expected paddy yield is 8-10 t/ha. However, many cultivation technique aspects need to be addressed in order to reach the paddy yield level of 8-10 t/ha (Fig.III-2).

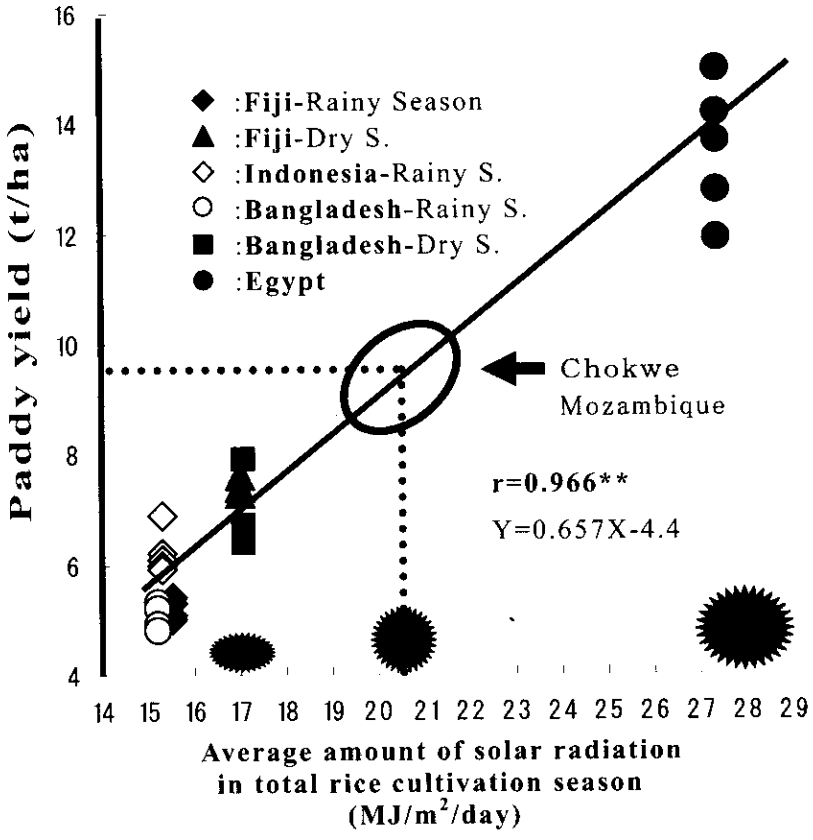


Fig.III-2 Relationship between amount of solar-radiation and paddy yield in different countries.

Notes: Amount of solar-radiation showed average value during the each paddy cultivation season in different countries.

IV. Present farmer's rice cultivation techniques and causes of low paddy yield.

1. Paddy yield in small scale farmers' field.

Results of the survey on the paddy yield from farmers' fields show (fig. 7) that company/contact farmer and research station obtain 4.7 and 4.9 t/ha of paddy yield respectively, but small scale farmer can produce only 3.4 t/ha. The biggest cause of low yield in farmers' field is small panicle number per unit area and low grain number per panicle. On the other hand, there is no big difference in ripening percentage and weight of 1,000 grains between small scale farmers and company/contact farmers and research station (Fig.IV-1).

The following are the defects in small scale farmers' fields:

① Field improvement (plotting, puddling and leveling) are not well done.
② Not improved practical rice cultivation technique.
③ No fertilizer (Urea) is applied.
④ Used seed is not pure.
⑤ Low motivation about rice cultivation.

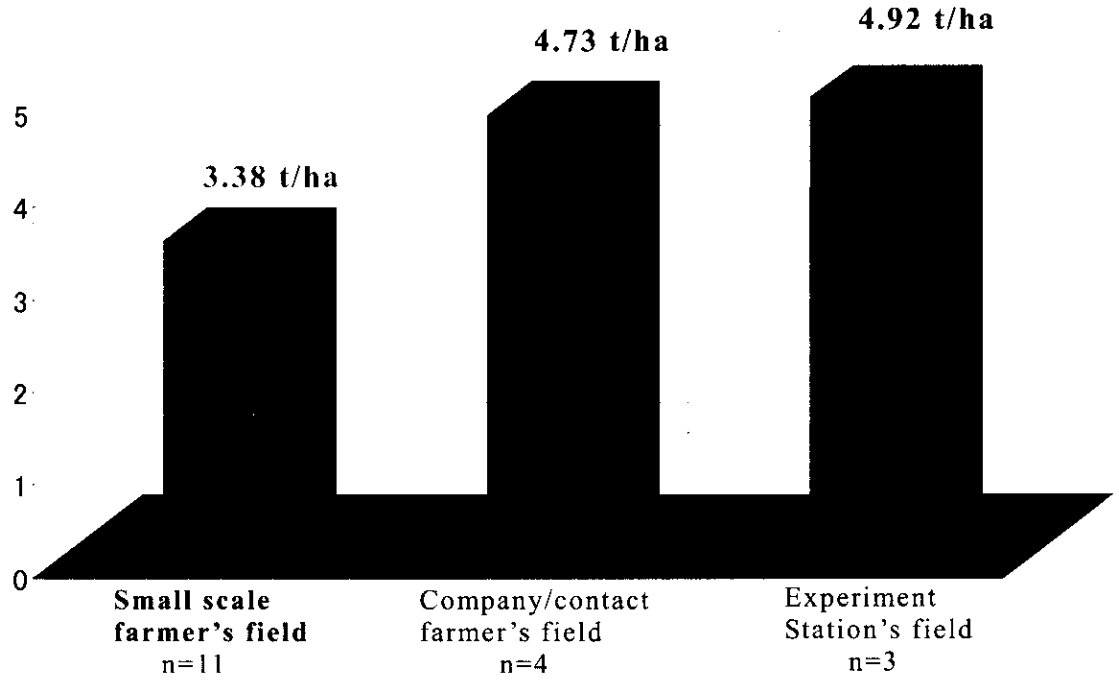


Fig.IV-1 Differentiation of paddy yield between small scale farmer's field, Company/Contact farmer's field and Experimental Station field.
Note: Surveyed in April / May, 2007. n=Sample number.

[for Engineer and Extension Officer]

The correlation coefficient between the four yield components and paddy yield including all surveyed samples was observed. It was found that there is strong correlation between the "Grain number per panicle" and "Paddy yield" (r=0.659**), and 5% correlation level between "Panicle number per m^2" and "Paddy yield". But, there is no correlation between "Ripening percentage", "Weight of 1,000 grains" and "Paddy yield". This means that more grain number per unit area might be needed to increase the paddy yield in farmer's field. To increase the "grain number per unit area"(= Panicle number per m^2 x Grain number per panicle), the method of increasing the panicle number per unit area is easier and shorter way than that of increasing grain number per panicle (Table IV-1).

Table IV-1 Coefficient of correlation between four (4) yield components and paddy yield.

4 yield components	Panicle number per m^2 (nos.)	Grain number per panicle(nos.)	Ripening percentage(%)	Weight of 1000 grains(g)
Paddy yield	**0.482***	**0.659****	0.052ns	0.007ns

Note. *, ** is showed significant correlation at 5% and 1% level. ns: Not significant.

The results of multiple regression analysis to know the **contribution degree** and/or **strength of influence of four (4) yield components to paddy yield** are shown below (Fig.IV-2). Here also results indicated the same tendency as the above results of correlation coefficient. From this result, the direction of rice cultivation technique improvement is to increase the "Grain number per unit area". This grain number per unit area is composed of two factors namely, "Panicle number per m^2" and "Grain number per panicle". The easiest and the most effective way is to increase the "panicle number per unit area" as mentioned above.

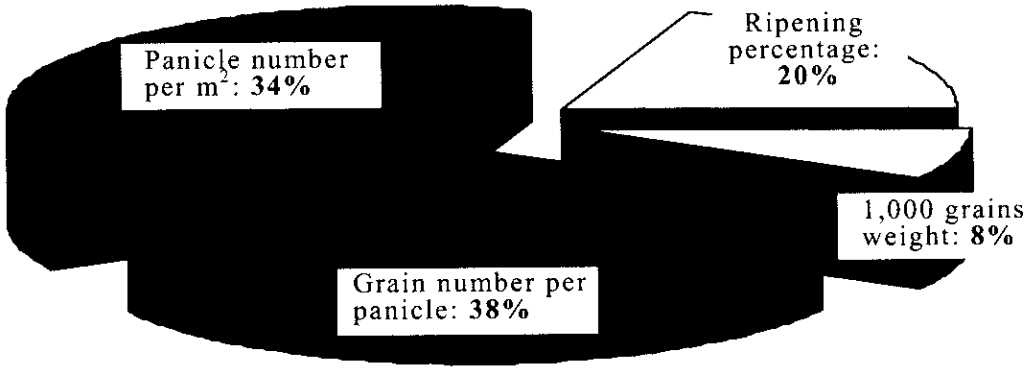


Fig. IV-2 Involvement rate of four (4) yield components to paddy yield in the survey.

2. Results of questionnaire survey.

Present farmer rice cultivation techniques are not adequate for higher paddy yield / production. This is due to the many problems and defects inherent to the current rice cultivation technique. Those problems and defects are listed below;

[Seeds]

① Use of many varietal mixture; no pure seed is used.

② Many weed seeds are mixed with paddy seeds.

③ Many empty and imperfectly ripened grains are mixed.

[Seed pre-treatment, Seed bed and nursing]

① No seed pre-treatment, such as seed selection, soaking and incubation, is carried out.

② Absence of sufficient seed bed area for healthy seedling nursing.

③ Nursery bed style is not suitable for bringing up quality seedlings.

④ Nursing duration is too long.

⑤ Many weeds in the seed bed.

⑥ Germination percentage is low due to seeding with dry seed bed style.

⑦ Too much bird attack due to imperfect covering after seed sowing.

⑧ Water management during nursing period is not good.

⑨ Nursery bed preparation is very rough.

[Main paddy field preparation]

① In case previous crops stay in the field, 1st plowing can't start at proper time.

② Ploughing by tractor is very sloppy and there remain many un-plowed spots.

③ Insufficient weed control due to tillering stage of rice plant.

④ Puddling and leveling work are not done .

[Transplanting]

① Old age seedlings are used.

② Low planting density.

③ Single seedling transplanting per hill.

④ Deep transplanting (5-7 cm).

[Fertilization]

① Most of farmers do not use any kind of fertilizer.

② Even in case of fertilizer applied, application timing is not appropriate.

[Field management]

① There is no weed control.

[Water control]

① There is no water control in accordance with growth period.

[Harvesting and post-harvest]

① No optimum harvesting time and a lot of harvest losses

V. Change of yield and yield components in farmer's field between before (2006/07) and after (2008/09) project.

Establishing rice cultivation technique for the transplanting method was almost completed in the agronomy Section. But, it was necessary to verify the effectiveness / availability at farmer's field level. So, the agronomy Section tried the comparison survey of paddy yield and yield components in farmer's fields; 1st one conducted 2006/07 (just after project began) and 2nd one conducted on rice yield results in model farm in 2008/09 (just before the project terminates). By this comparison, the improvement of cultivation technique at farmer's level could be assessed.

Paddy yield in 2008/09 was significantly higher at 6.4 t/ha compared with 2006/07 at 3.6 t/ha. The yield increase was 76% (Fig. V-1, Table V-1).

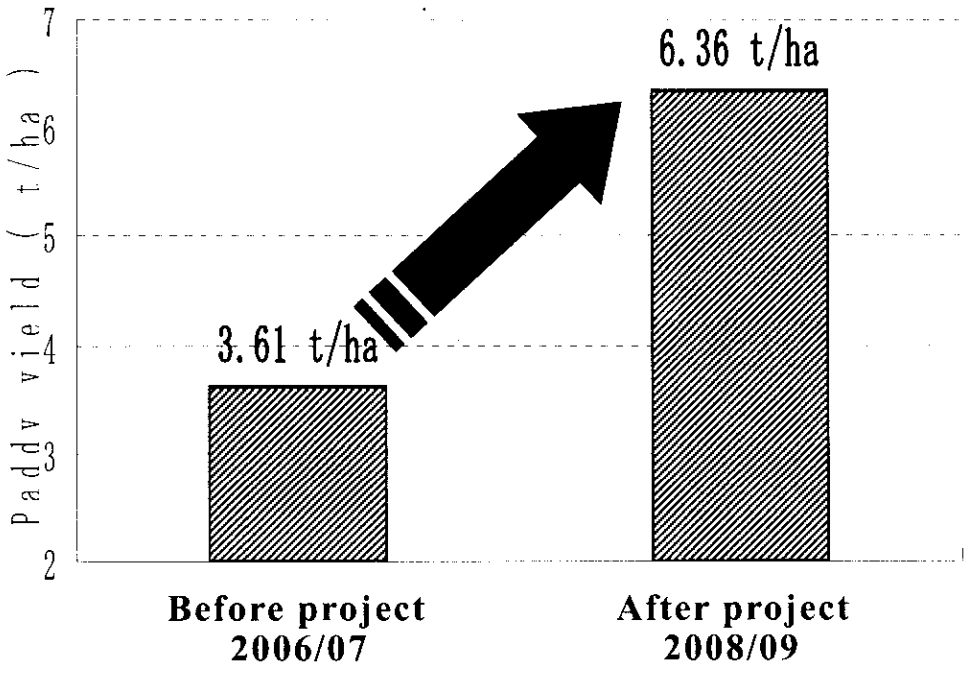


Fig. V-1 Differences of paddy yield between 2006/07 and 2008/09.

Note: Above paddy yield shows no harvesting loss, but the actual harvesting losses in farmer's paddy yield is 15% (2006/07:3.1, 2008/09:5.4 t/ha).

[for Engineer and Extension Officer]

The change of yield components was such that hill number per m^2 increased from 28 to 33 hills / m^2 (28%). The panicle number per hill also increased from 6 to 9 panicles / hill (43%). As a result of these increases, the panicle number per m^2, which strongly influences paddy yield, had a large increase from 168 to 262 panicles/m^2. The grain number panicle was slightly decreased by -6% by the influence of panicle number increasing. And, the grain number per m^2 which strongly influences paddy yield had a remarkable increase from 18,000 to 27,000 grains/m^2 (45%). Ripening percentage and 1,000 grains weight also increased by 6 and 11% respectively (**Table V-1**).

In relation to the correlation between yield and yield components in 2006/07's results, a strong correlation was observed between grain number per panicle and yield but there was no correlation observed in other components (Table V-2). The correlation between grain number per panicle and grain number per m^2 was reconfirmed. This shows that paddy yield was mainly determined by grain number per panicle in 2006/07 rice season. On the other hand, a minus correlation was observed between hill number per m^2 and panicle number per hill. The effect of this was a rapid decrease of grains as the hill number per m^2 was increased, caused by no fertilizer application. There was no correlation observed between ripening percentage, 1,000 grains weight and paddy yield (Table V-2).

In 2008/09's results, quite different correlation was observed between paddy yield and yield components. There was a strong correlation observed between paddy yield and panicle number per m^2 (r=0.638**) as well as grain number per m^2 (r=0.806**). On the other hand, correlation was observed between grain number per m2 and panicle number per m2. But there was no effective correlation between paddy yield and ripening percentage as well as 1,000 grains weight (Table V-3).

Table V-1 Comparison of average paddy yield and yield components, and increase ratio between 2006/07 and 2008/09's rice season.

Cultivation year	**Paddy yield (t/ha)**	Number of hill/m^2	Number of panicle /hill	Number of panicle /m^2	Number of grain /panicle	Number of grain /m^2	Ripening %	Weight of 1,000 grains (g)
2006/07	**3.61**	28	6.3	168	110	18,197	84	24.0
2008/09	**6.36**	33	9.0	262	103	26,986	89	26.8
The increase/decrease percentage (%) in 2008/09 compared with 2006/07.								
(%)	**+76**	**+23**	**+43**	**+56**	**−6**	**+48**	**+6**	**+11**

Note: Above paddy yield is showed no harvesting loss, and the actual farmer's paddy yield is need minus 15% of harvesting loss (2006/07:3.1, 2008/09:5.4 t/ha).

Table V-2 Correlation table between yield and yield components of 2006/07 rice season.

	Hill nos. /m²	Pani. nos. /m²	Pani. nos. /panicle	Grain nos. /m²	Grain nos. percentage	Ripening Weight	1,000 grain
Paddy yield	-0.209	0.402	0.086	**0.745****	**0.858****	0.084	-0.063
Hill nos./m²		-0.870**	0.734**	-0.575*	-0.138	-0.304	0.262
Panicle nos./hill			-0.351	0.563*	0.366	0.199	-0.304
Panicle nos./m²				-0.420	0.209	-0.427	0.188
Grain nos./pani.	n=18				0.792**	-0.043	-0.403
Grain nos./m²						-0.340	-0.307
Ripening %							-0.103

Note : **,* is showed significant correlation at 1 and 5% level.

Table V-3 Correlation table between yield and yield components of 2008/09 rice season.

	Hill nos. /m²	Pani. nos. /m²	Pani. nos. /panicle	Grain nos. /m²	Grain nos. percentage	Ripening Weight	1,000 grain
Paddy yield	0.403	-0.433	**0.638****	0.189	**0.806****	0.321	0.069
Hill nos./m²		-0.821**	0.543*	-0.067	0.497	-0.071	0.200
Panicle nos./hill			-0.159	-0.268	-0.327	-0.334	-0.009
Panicle nos./m²				-0.430	0.712**	-0.214	-0.234
Grain nos./pani.	n=16				0.319	0.158	-0.426
Grain nos./m²						-0.118	-0.602*
Ripening %							0.328

Note : **,* is showed significant correlation at 1 and 5% level.

The influenced strength of four yield components (Panicle number per m^2, grain number per panicle, ripening percentage and 1,000 grains weight) to paddy yield was examined by multiple regression analysis method in each surveyed year.

As above mentioned, the "grain number per panicle" was the strongest influence to paddy yield as 44% in 2006/07 season (Fig. V-2) . The panicle number per m^2 only influenced paddy yield by 27%. Ripening percentage and 1,000 grains weight had very little influence on yield. But, there was a great change in 2008/09 season that the strongest influenced component was panicle number per m^2 as 42%, followed by grain number 31%. The ripening percentage and 1,000 grains weight again had little influence on yield in the 2008/09 season.

Great increases in yield and yield components were observed from the 2006/07 to the 2008/09 season except grain number per panicle. In relation between yield components and paddy yield, the paddy yield was strongly influenced by grain number per unit area in both rice years (Table V-1). So, for paddy yield increase, the key point is how to increase the number of grains per unit area. This grain number per unit area consists of "panicle number per unit area" and "grain number per panicle", and increases in both components are connected to yield increase. If observed from the technical point of view, increasing the grain number per panicle is more

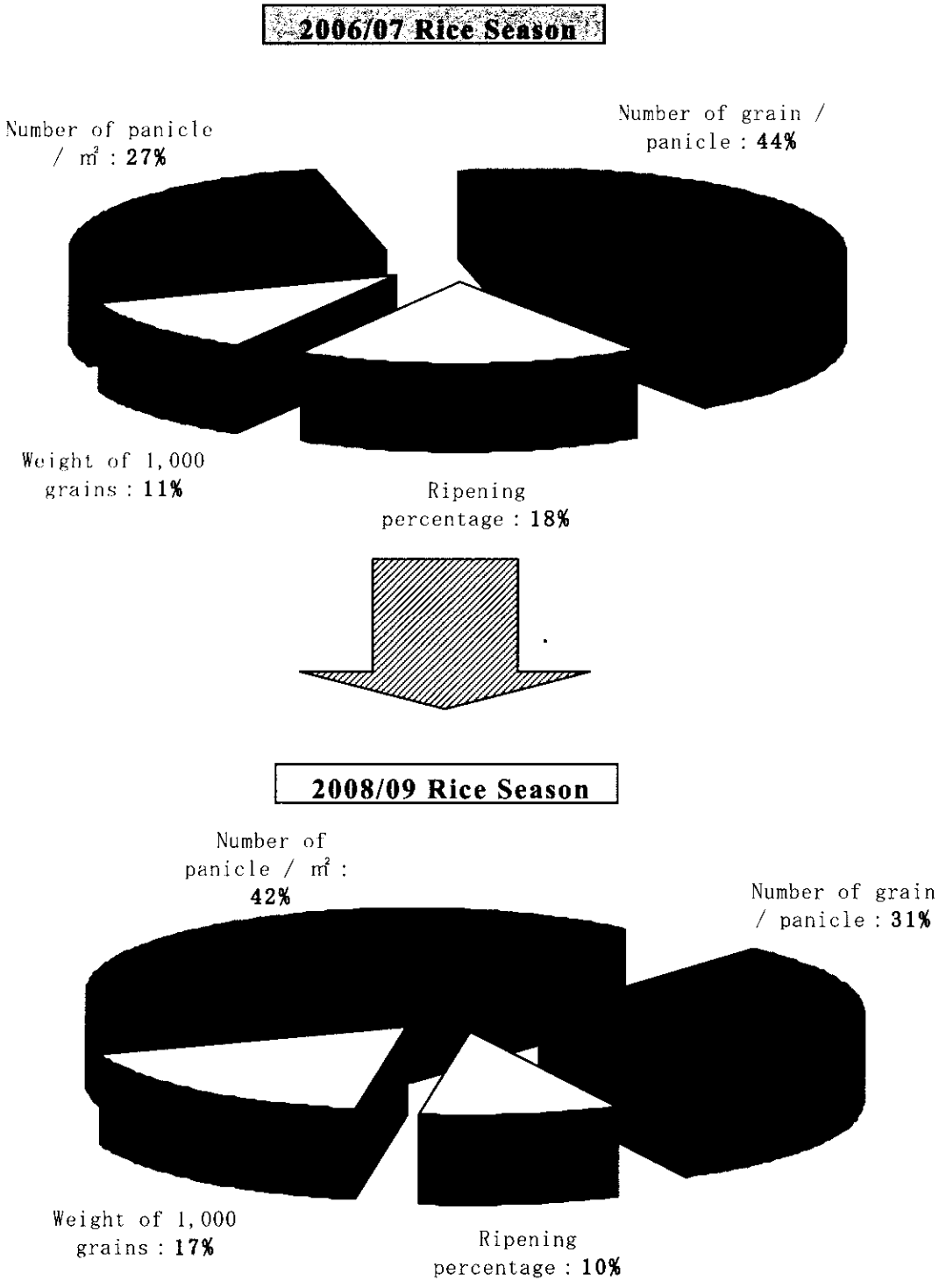


Fig. V-2 Change of relative yield influence of four yield components.

difficult than that of increasing the panicle number per unit area. To increase the grain number per panicle has a big limitation that it is strongly dominated by the characteristic of the variety. On the other hand, grain number per panicle is related to nitrogen content in soil during the Neck-Node Differentiation Stage to just before beginning of Reduction Division. If excessive nitrogen content in this period, lodging occurs very easily at /before heading stage and yield also decreases. From above reason, the best way to increase paddy yield is to ensure bigger panicle number per unit area, the panicle number per unit area consists of two components of "hill number per m^2 and panicle number per hill. To maximize the number of panicle per unit area farmers should: ensure planting density at 30 hills per m^2, use young seedling, practice shallow transplanting, plant 4-6 seedlings per hill, carry out the good puddling and leveling, adequate nitrogen top-dressing and so on. But, the big constraint is poor land preparation, specially puddling and leveling work, because there is no use of puddling and leveling work as well as no tools available for it. On the other hand, in Chokwe area's paddy field soil contains high percentage of sand (D4: 11.2%. D7:31%)(Table V-4), and extremely high water loss in depth occurs, especially during transplanting to the end stage of effective tillering (December ~end of January). Also, "run-off" of applied fertilizer occurs thus reducing then panicle number per unit area. From the above discussion, improvement and establishment of land (paddy field) preparation methods is a top priority subject to be solved in this area.

From above results, the improvement and development of new land preparation method/system especially puddling and leveling is indispensable in future. The introduced animal power method/system is difficult of insufficient for it. Mechanised land preparation, for example with a rotavator, as seen in most rice growing countries, may be necessary. At the same time, introduction of "rotary plow system" could expand the "dry/wet field direct sowing rice cultivation" in small and medium scale rice cultivation's farmer in this area.

Table V-4 Sand content ratio at farmer's paddy field of D4 and D7.

(Unit: % in weight)

Area	S.No.	Upper	Middle	Lower	
D-4	1	11.0	11.4	9.8	
	2	12.5	10.6	4.3	
	3	16.8	11.9	13.0	D4 Av
	Av.	13.4	11.3	9.0	**11.2%**
D-7	1	27.5	28.8	35.8	
	2	29.1	33.3	32.8	
	3	32.1	33.4	26.2	D7 Av.
	Av.	29.6	31.8	31.6	**31.0%**

Note: Upper, Middle and Lower refers to the sampled portion in each tertiary canal.

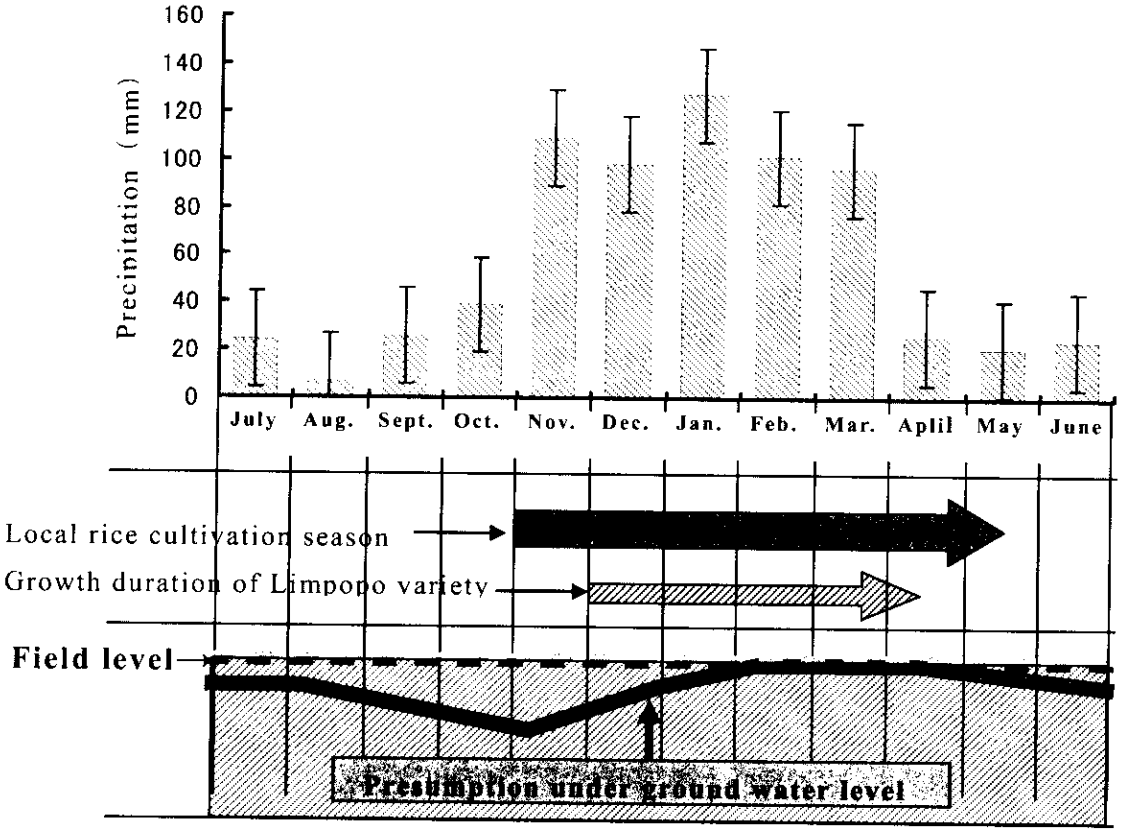


Fig. V-3 Annual precipitation and change of presumptive under ground water level

VI. Difference of variety characteristics

The variety comparative experiment was conducted at experimental field in 2008/09 rice season, and results were obtained as follows;

The maximum yield obtained was 9.4 t/ha in Limpopo variety, followed by 7.7 t/ha in IR 64 and the lowest yield was 6.8 t/ha in ITA 312 (Table VI-1, Fig. VI-1).

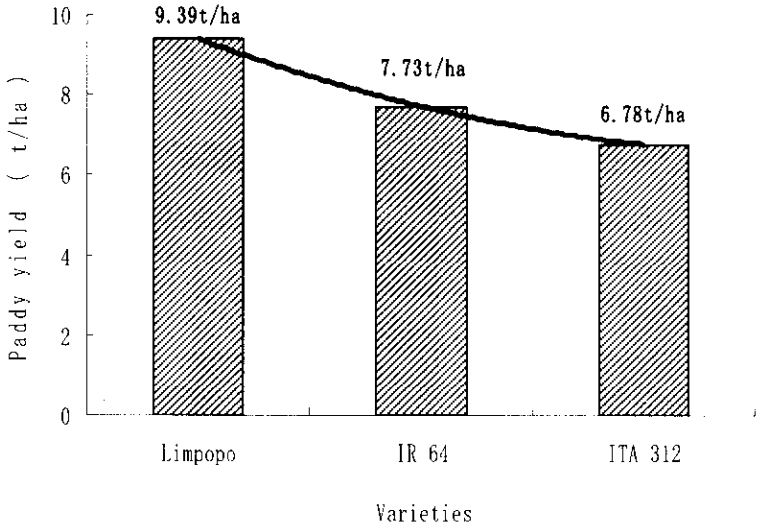


Fig. VI-1 Paddy yield in each variety

[for Engineer and Extension Officer]

The number of panicle per hill was biggest in IR 64 and Limpopo (11) followed by ITA 312 (10 panicles/hill). The number of panicle per m^2 showed the same tendency as the number of panicle per hill. The largest panicle number per m2 was in IR 64 (384 panicles/m^2) followed by Limpopo (342 panicles/m^2) and the smallest was observed in ITA 312.

Table VI-1 Effect of planting density on yield and yield components.

	Paddy yield (t/ha)	Panicle number /Hill	Panicle number /m^2	Grain number /panicle	Grain number /m^2	Ripening percentage	Weight of 1,000 grains (g)
Limpopo	9.39	11.4	342	116	39,724	85.9	27.48
IR 64	7.73	12.7	384	117	44,732	80.8	21.38
ITA 312	6.78	9.9	298	128	37,904	69.6	25.74
Statistical significance	*	*	*	ns	ns	**	**
CV (%)	9.7	7.5	7.4	--	--	3.0	1.7
LSD .01	2.03	2.23	65.8	--	--	6.26	1.11
LSD .05	1.34	1.47	43.5	--	--	4.13	0.74

Note : **、 * is showed significant difference at 1%、 5% respectively. ns is no significant.

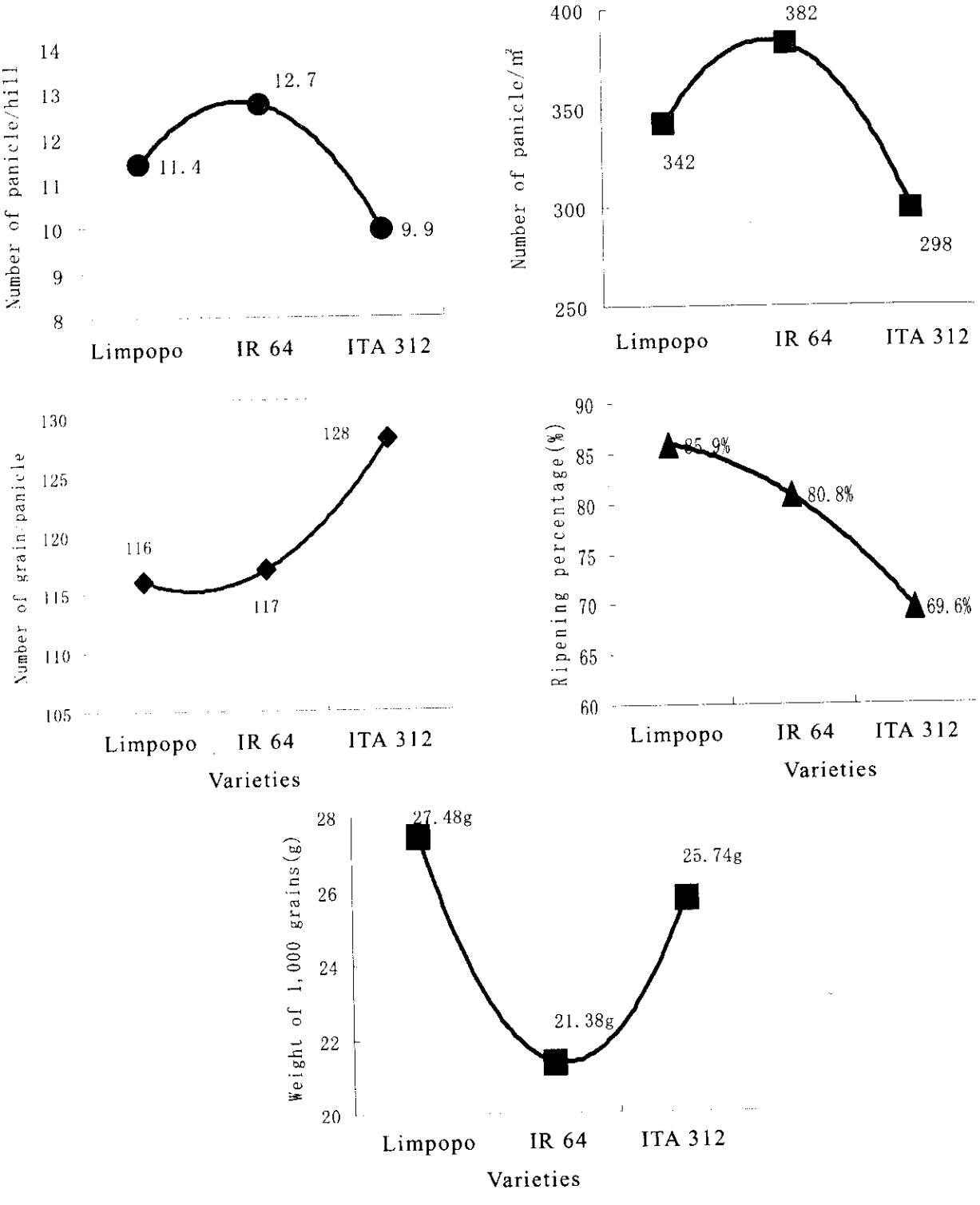


Fig. VI-2 Differences of yield components in varieties.

The number of grain per panicle was biggest in ITA 312 (128 grain number per panicle) and the one in other two varieties were the almost same number as 116 in IR 64 and 117 in Limpopo. The number of grain showed that the largest number of grain per m^2 as 45,000 grains

was found in IR 64, followed by 40,000 grains in Limpopo and ITA 312 showed the lowest as 38,000 grains per m^2 (Table VI-1).

The ripening percentage in three varieties showed that highest was in Limpopo as 86%, followed by IR 64 as 81% and the lowest was in ITA 312 as 69.6% (Table V-1).

The weight of 1,000 grains also showed great differences that the largest in Limpopo as 27.6 g followed in ITA312 as 25.7 g and the smallest just 21.4 g in IR 64 (Table V-1).

The statistical significance among the varieties were observed at 1% level between ripening percentage and weight of 1,000 grains and at 5% level between paddy yield and number of panicle per hill & m^2, and there was no significant differences between grain number per panicle and m^2 (Table V-1).

At present, there are 11 varieties recommended officially in the country and these varieties are widely cultivated in Mozambique. And, each variety is suitable in different area/state. The recommended variety for Gaza province is IR52, 64, Limpopo and ITA 312. Most widely cultivated varieties in Chokwe are IR 64, ITA 312 and Limpopo. From above reason, these three varieties were taken up for variety comparative experiment (Table VI-2).

Table VI-2 Recommended variety (***Oryza sativa***) and cultivation area in Mozambique.

Name of variety	Total growth duration(days)	Rice type	Recommendation of zone	Introduced year
IR 64	115～135	Subsp. indica	Gaza	1995
IR 52	120～140	Subsp. indica	Gaza, Inhambane	1995
Limpopo	125	Subsp. Javanica	Gaza	1999
ITA 312	125～150	Subsp. indica	Maputo, Gaza, Inhambane Sofala and Zambezia	1995
ITA 212	125～150	Subsp. indica	Maputo, Gaza, Inhanbane, Sofala and Zambezia	1995
M.Muriangani	138～148	Subsp. indica	Manica	1995
C4-63	140～160	Subsp. indica	Zambezia, Sofala	1995
Chupa	144～182	Subsp. indica	Inhanbane, Zambezia	1995
Chibica	145～190	Subsp. indica	Pais	1995
Mamima	148～218	Subsp. indica	Zambezia, Sofala	1995
Agulha	140～180	Subsp. indica	Nampula	1995

Source: Publication of IIAM.

The total growth duration in ITA 312 is about 135-140 days in Chokwe area and other two varieties as Limpopo and IT 64 is around 125 days respectively.

The maximum paddy yield was obtained in Limpopo variety followed by IR 64 and ITA 312 (Table V-1). In yield components, the component strongly influenced paddy yield was panicle number per unit area. The panicle number per unit area obtained in IR 64 was 384 numbers per m^2, followed by Limpopo with 342 number of panicle and the smallest was ITA

312 with 298 number of panicle per m^2. This shows that both Limpopo and IR 64 varieties can be said to be "Panicle number type varieties" and ITA 312 is "standing between panicle number type and panicle weight type.

The ripening percentage was highest in Limpopo as 86% and IR 64 followed with 80.8%, but ITA 312 was just stand with only 69.6%. The biggest reason of low ripening percentage in ITA 312 was due to "imperfect heading" i.e a portion of grain of the panicles remained in the stem after the heading stage and this portion produced neither flowering nor rice. This symptom was characteristic of the ITA 312 variety and is one of the disadvantageous characteristics of this variety. On this other hand, the 1,000 grain weight in IR 64 was smallest as 21 g and this variety is also difficult to obtain higher paddy yield (Table VI-1).

The growth condition was quite good in the three varieties but inter-node elongation was observed more in ITA 312 than in the other two varieties. Plant height was highest in ITA 312, at 130-140cm compared with IR 64 and Limpopo as 110-120cm. ITA 312, being tall, tends to lodge easily. The weak stems observed in IR 64 in the latter half of the growth period also make it more prone to lodging. Fertilizer resistance was high in three varieties.

From above results, Limpopo can be said as suitable variety in this area for the reasons of easy cultivation and good yield performance.

VII. Basic Knowledge of Paddy Yield Constitution.

The paddy yield is constituted by **four (4) yield components, namely ① Panicle number per unit area, ② Grain number per panicle, ③ Ripening percentage, and ④ 1,000 grains weight** as shown below;

To increase the paddy yield, these four yield components need to be "lifted up"; but each component is determined at a different stage/period during the total rice growth stage. On the other hand, some components are influenced by the varietal characteristics strongly, such as 1,000 grains weight and grain number per panicle.

The easiest component for effective "lifting up" in order to increase yield is the panicle number per unit area. Determination time of each component is shown in Fig. VII-2.

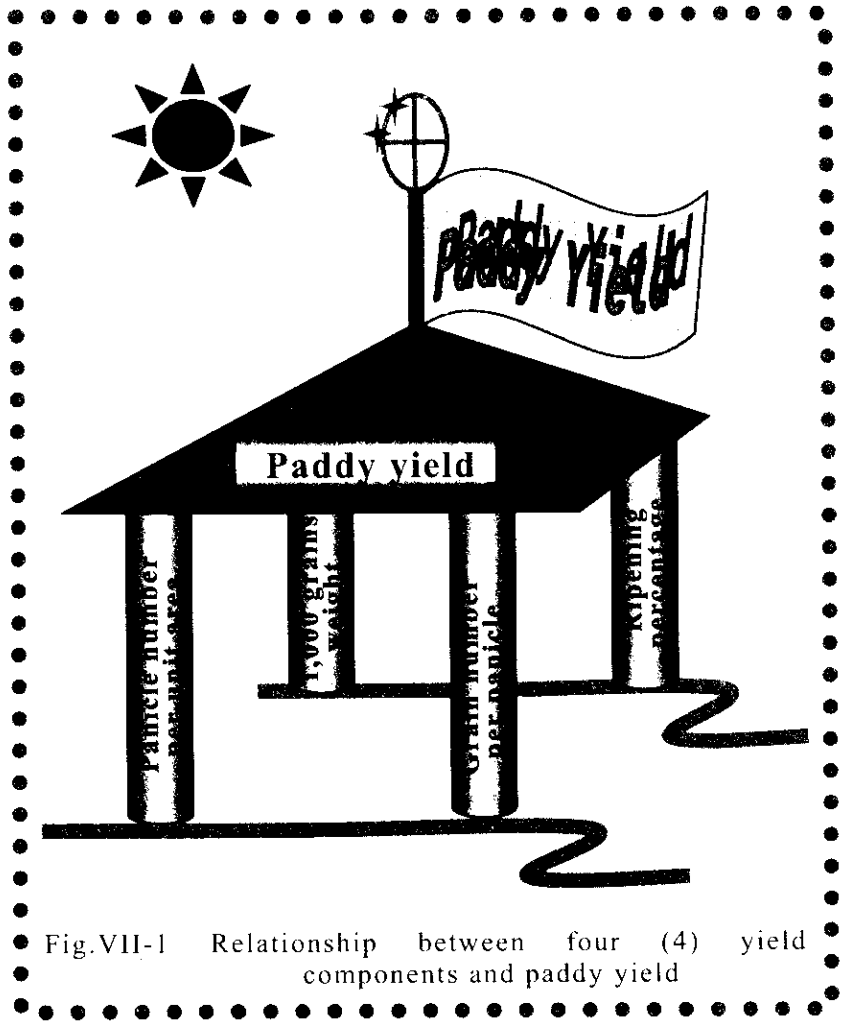


Fig.VII-1 Relationship between four (4) yield components and paddy yield

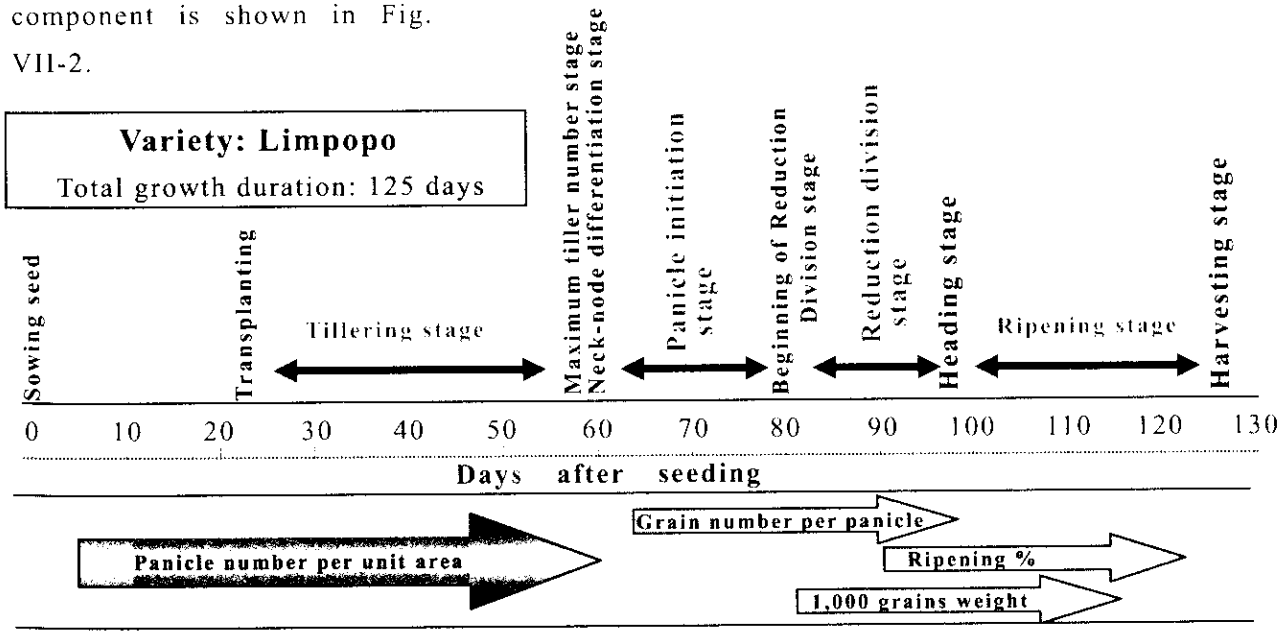


Fig.VII-2 Time of determination of each yield component.

VIII. Rice Cultivation Techniques

The most important issues in rice cultivation technology are 1) cultivation season, 2) main land preparation, 3) nursing healthy seedling, 4) transplanting work and fertilizer application method, and 5) main field management including water control and so on. It is conceivable that obtaining 10 t/ha paddy yield in farmer's field is not a dream if new cultivation techniques and practices are introduced.

Now, let us express the improved technology of rice cultivation in accordance with cultivation order.

1. Seed bed style and preparation method.

The raising of seedling is the first step in rice cultivation. Japanese farmer says that the quality of seedlings is generally responsible for 50% of rice yield.

(1) Seed bed style

A rectangular shaped and semi-wetted seed bed is recommendable.

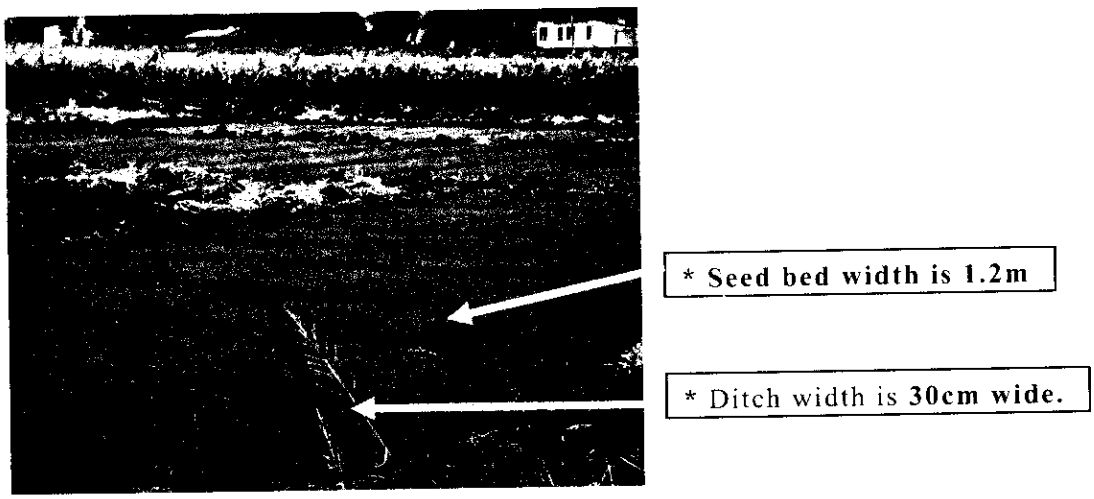


Photo VIII-1 View of good growth seedling bed.

According to experiment results, high quality and heavy dry matter seedlings are obtained in a "Semi-wet type seed bed". Heavier seedling will have shorter setting period after transplanting, and more number of tillers during tillering period than seedling from wet and/or dry seed bed. It means that there is high accumulation of the photosynthesis product in semi-wet type bed seedlings as shown in Fig. 11.

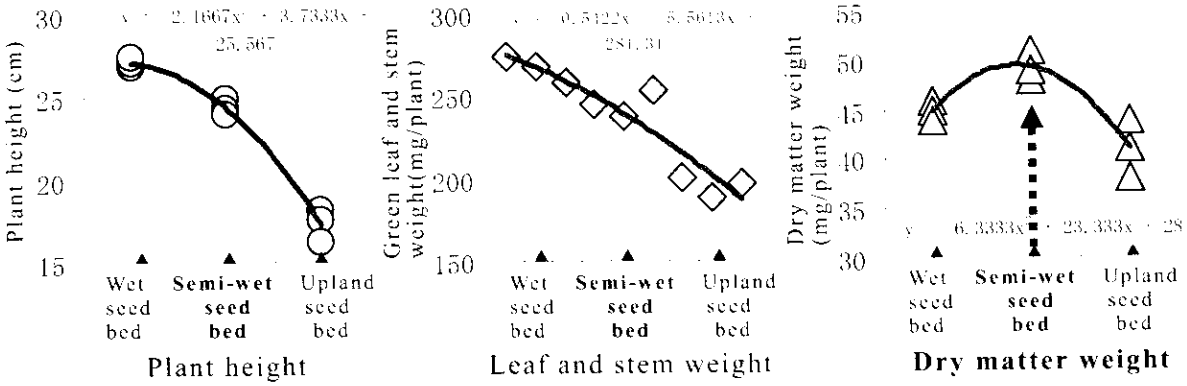


Fig.VIII-1 Differences of plant height, Leaf and stem weight and dry matter weight by different seed bed style.

(2) Seed bed area.

A **seed bed area of 400～500 m²** is necessary for each 1 ha of paddy field (The seed bed area includes ditch.)

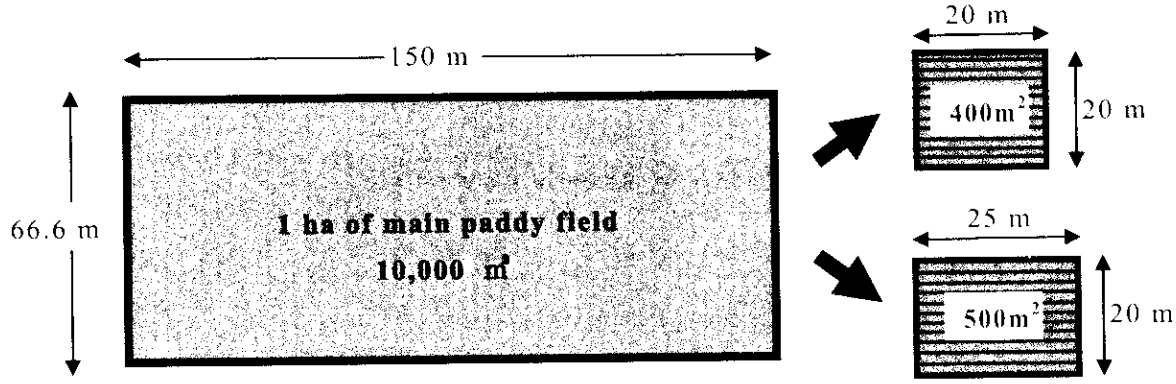
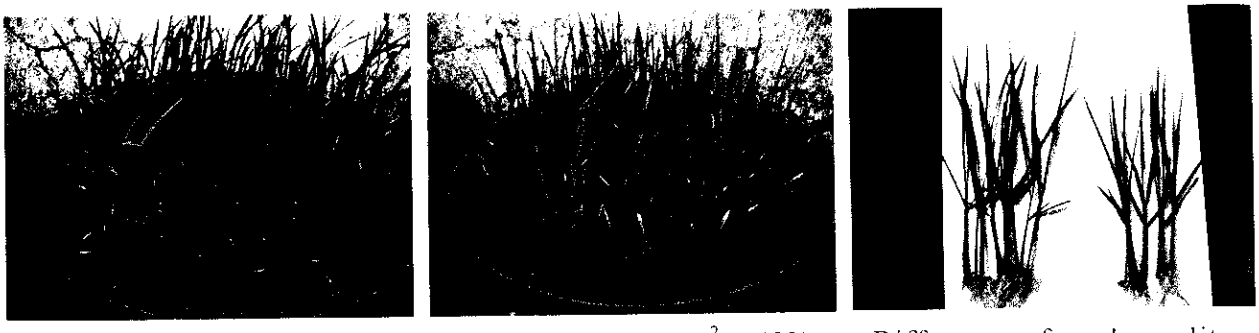


Fig.VIII-2 Optimum seed bed area per 1ha of main paddy field.

According to experiment results, the seedlings become shorter and smaller if seed bed area narrows to less than 400 m² against 1 ha of main paddy field (Fig. VIII-3).



Seed bed area 500 m² (1/20) for 1 ha of paddy field.

Seed bed area 200 m² (1/50) for 1 ha of paddy field.

Difference of seeds quality. Left: 1/20. Right: 1/50.

Photo VIII-2 Differences in seedling quality between optimum and small seed bed area.

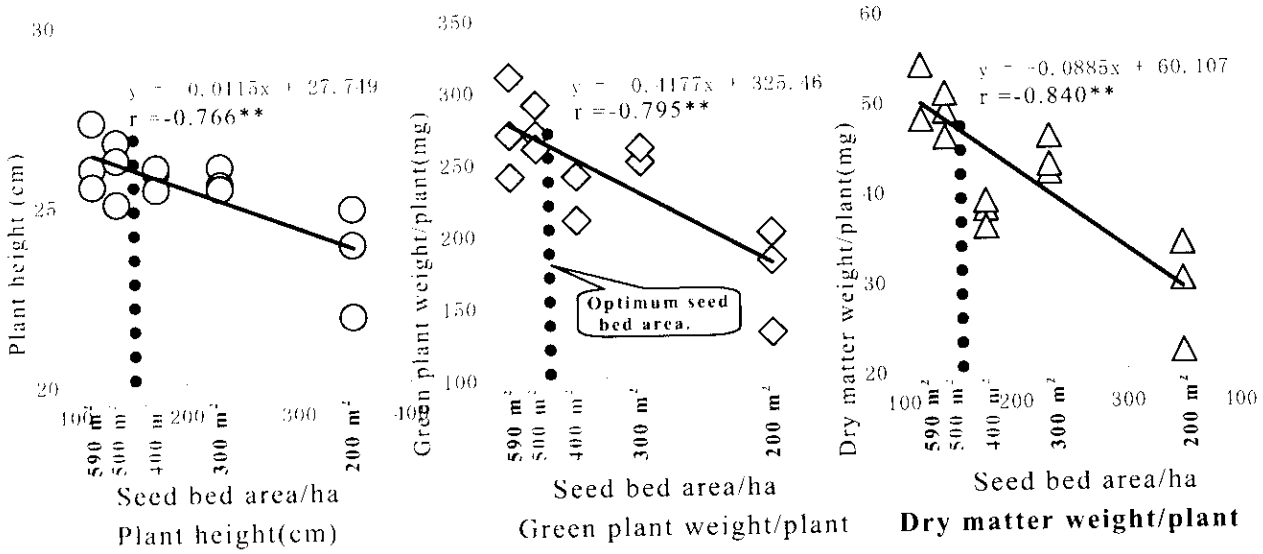


Fig.VIII-3 Change of plant height, green plant weight and dry matter weight in different seed bed area against 1 ha of main land.

Note:● ● ● ● ● is show optimum seed bed area.

2. Seed quantity and purity.

(1) Necessary seed quantity for 1 ha of main paddy field.

The quantity of seed per ha differs according to grain moisture contents; just before seed measuring, the moisture content must be checked using moisture meter

Table VIII-1 Seed quantity differs by moisture content as shown below;

Water content in paddy seed(%)	Necessary seed quantity (for 1 ha of main land)
15～16%	**65 ～ 75 kg**
13～14%	**55 ～ 60 kg**
10～12%	**45 ～ 53 kg**

(2) Use pure paddy seed.

The paddy yield decreases by the percentage of varietal mixture as shown below. The utilization of pure paddy seed is indispensable for obtaining high yield.

Table VIII-2 Different variety mixture rate and yield decrease rate.

Variety Mixture %	Expecting yield	Actual yield	Decrease yield	Decrease percentage
25%	5 t/ha	4 t/ha	1 t/ha ↓	20% ↓
40%	5 t/ha	3 t/ha	2 t/ha ↓	40% ↓

Note. ↓ show's decrease.

3. Pre-treatment of seed.

The procedure of the seed pre-treatment is as follows:

(1) Specific gravity selection.

The specific gravity selection of seed by water must be done before soaking.

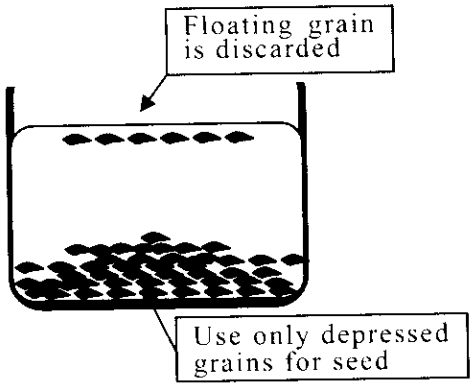


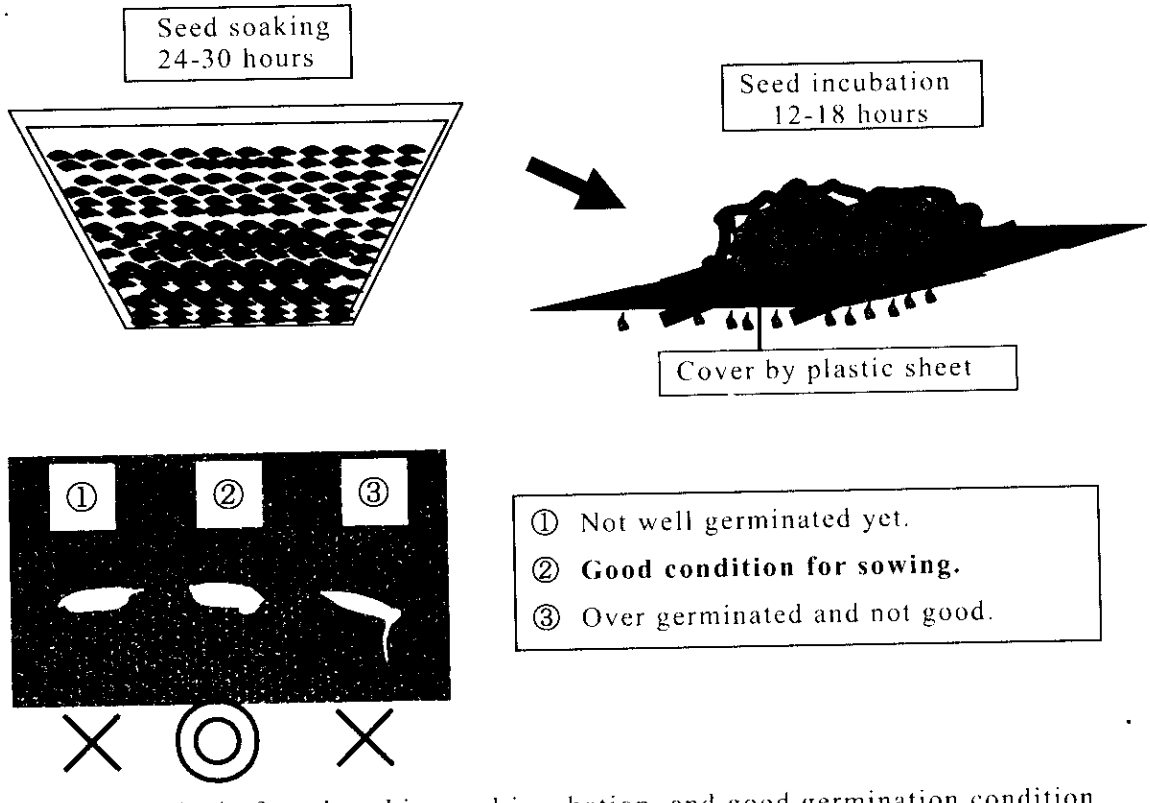
Fig.VIII-4 Method of specific gravity selections by flash water.

Steps in pre-treatment of seed are;

(1) First of all, prepare bucket, fill it with water.
(2) Put the seed into water.
Fully mature seeds sink and immature or not fully mature seed float.
Use only the soaked grains for seed.
(3) Afterwards these seeds are put into water for about 24-30 hours for sufficient water absorption.
(4) After soaking, take the seed to incubation spot for about 12 to 18 hours. Seed incubation will need careful checking for germination.

(2) Seed soaking into water and incubation.

Soaking the seed into water for about **24-30 hours, and Seed incubation** is about **12-18 hours.** During incubation process there is need for careful checking of the germination condition.



① Not well germinated yet.
② **Good condition for sowing.**
③ Over germinated and not good.

Fig.VIII-5 Method of seed soaking and incubation, and good germination condition.

4. Preparation method of seed bed

Order in nursery bed preparation is shown below;

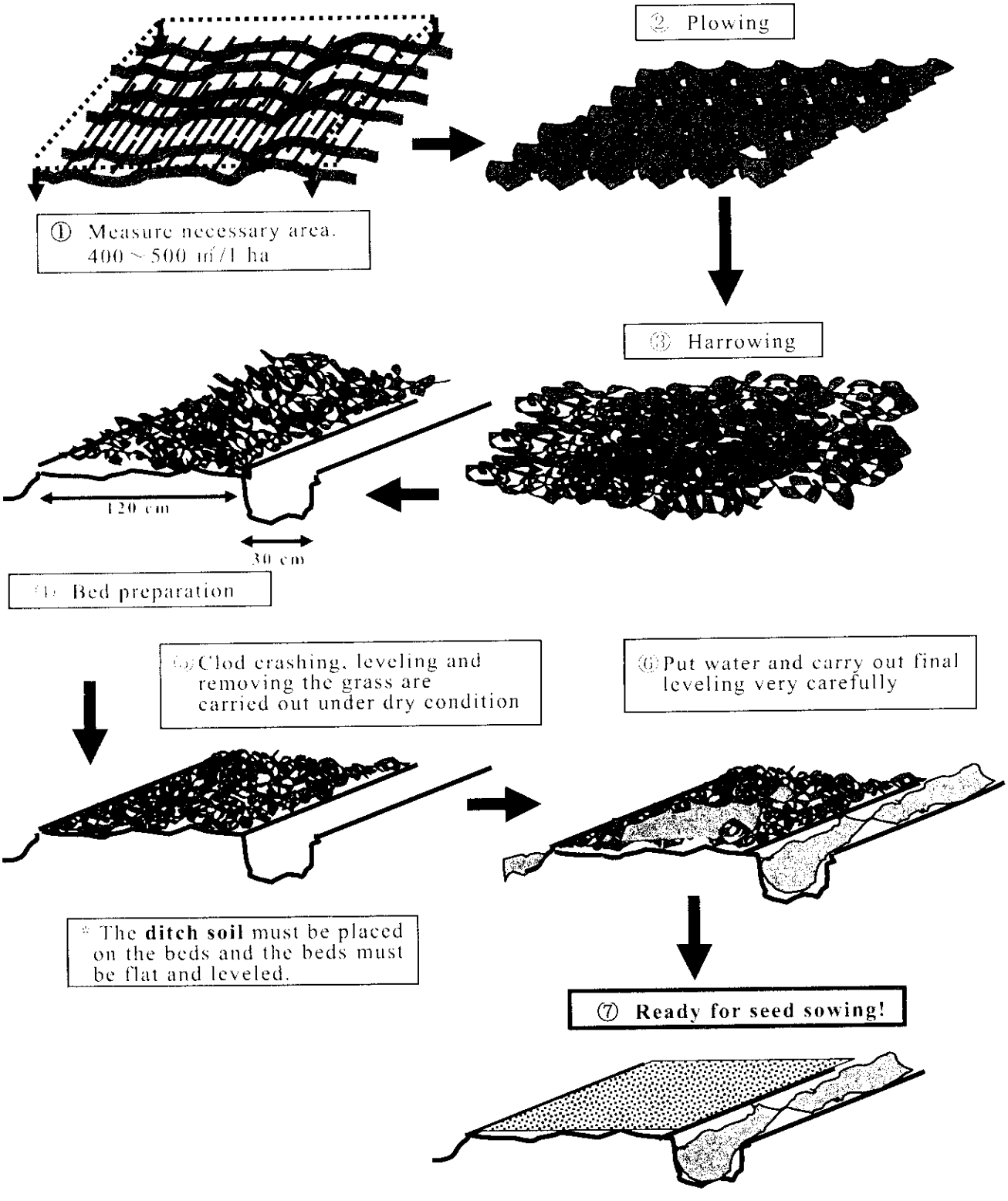


Fig.VIII-6 Process of seed bed preparation.

1. Measuring the seed bed area.

2. Making the seed bed and ditch.

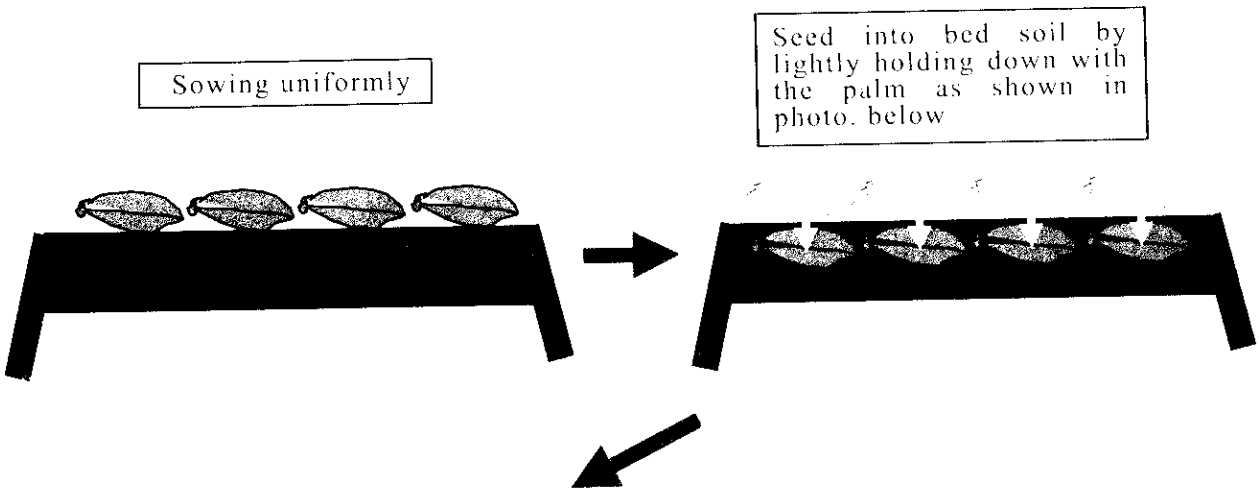
3. Leveling under dry condition.

4. Final leveling after putting

Photo VIII-3 View of seed bed preparation work

5 Seed sowing

The seed sowing process is shown below;



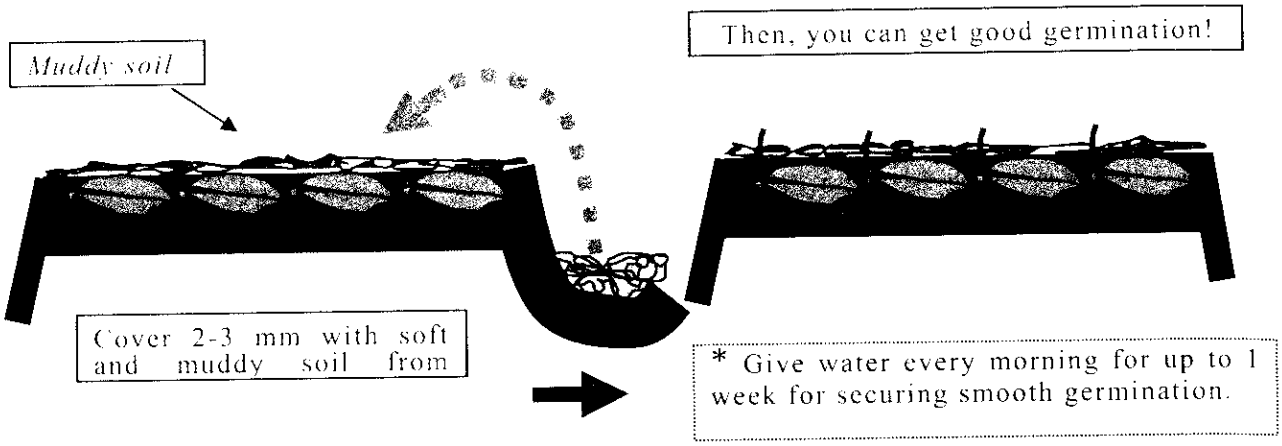
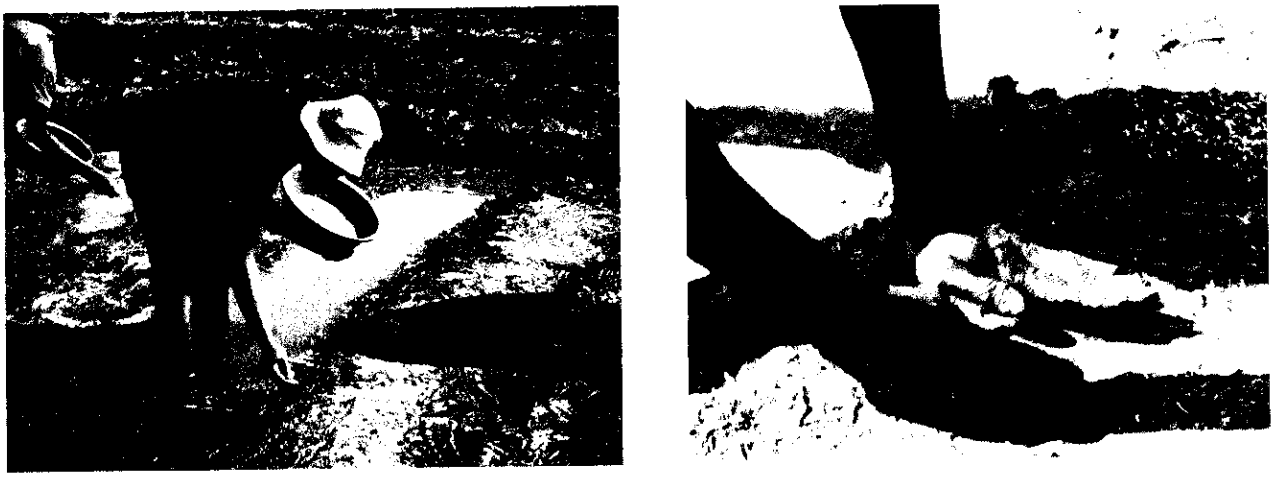


Fig.VIII-7 Process of sowing seed to nursery bed and covering method .



1. Seeding work. 2. Tapping and covering work by hand.

Photo VIII-4 View of seeding and covering work.

6. Seed bed management and nursing duration

(1) Seed bed weeding

Weeding work is needed from time to time during nursing period if weed comes out. If no weeding is practiced, many grass come out, seedling becomes small and tiny, the setting period takes too long which finally results in reduced tiller number/panicle number.

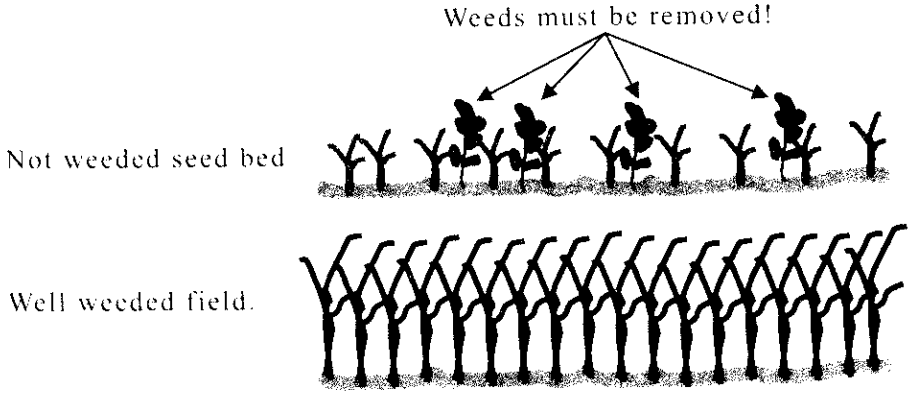
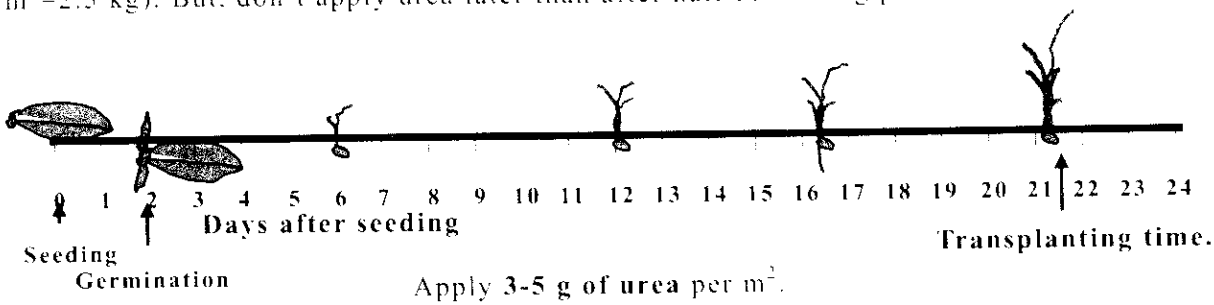


Fig.VIII-9 Comparison of weeded and not weeded nursery beds.

(2) Urea top-dressing to seed bed

If leaf color becomes yellow at middle stage, apply urea 3-5 g per m^2 ($400m^2$=2 kg, 500 m^2=2.5 kg). But, don't apply urea later than after half of nursing period.



Apply **3-5 g of urea** per m^2.

Fig.VIII-10 Optimum time for urea top-dressing to seed bed.

(3) Water management of seed bed

* **Just after seeding up to 7 days:** Every morning, give water at about 1-2 cm height from the bed surface
* **7-14days:** Give water every 2-3 days using the same method as above.
* **15days-transplanting time:** Give water every 4-5 days, and give sufficient water 1 or 2 days before seedling uprooting work start.

(4) Nursing duration

Nursing duration is very important for ensuring large and healthy tillers as well as big panicle size and big panicle number per unit area. Nursing duration must be between 21days and 30 days. Nursing duration of more than 30 days will usually cause un-seasonal sprouting of panicles just after transplanting, small panicle size and less panicle number per unit area.

← ↑ Most ideal seedling condition.
Leaf age: 4-5 leaf stage.
Plant height: 20-25 cm.

But, it is very common to see many farmers using these 40 or 50 days seedling.

Photo VIII-5 Good quality seedlings(left) and farmer's very bad seedling(right)

They are transplanting into unleveled and very deep paddy field

Single seedling transplanting per hill is one of the big causes of low yield in farmer's field.

Photo VIII-6 Farmer's field transplanting view and single seedling transplanting.

7. Main paddy field preparation

(1) Ploughing and harrowing.

Use a tractor to plough not deeper than 20-25 cm. Ploughing and harrowing timing is very important. Indeed ploughing in September or October is good for killing the weed if there is no preceding crop. Any way, the grass killing effect of plowing and harrowing are long days.

(2) Plotting work, if the whole field is not well leveled.

Most of the fields in this irrigation scheme are slightly inclined. Therefore under these conditions, it is very difficult to keep water uniformly spread throughout the whole area. So, land needs to be divided into small plots, which allows good leveling as shown below:

If for example land area has 0.5 ha, divide it into at least 8 small plots; further division would be needed if field is very sloppy.

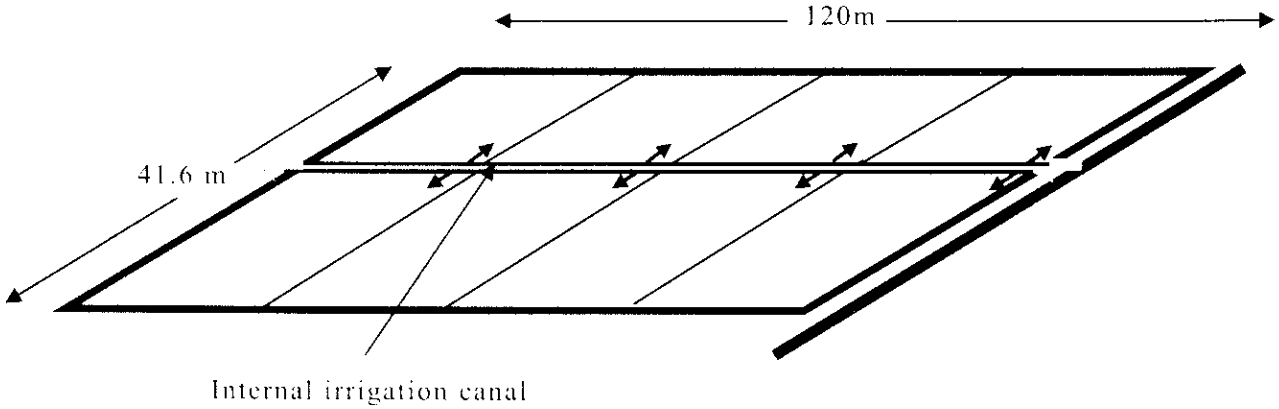


Fig.VIII-11 Unleveled field must be divided into small plots to facilitate good leveling.

Fig.VIII-12 Well plotted field.

Small plotted paddy field because of hard inclination.

Puddling and leveling work by hoe.

Photo VIII-7 View of plotted small plots and puddling work by hoe.

(3) Puddling and leveling.

The purpose of puddling is to make soil soft for easy rooting of the rice plant just after transplanting, and to save irrigation water by minimizing percolation. After the puddling, leveling work is also continuously needed. Rice plants grow well under 10 cm of flooded soil. Flooding irrigation prevents weeds from coming out just after transplanting. Puddling and leveling can be done using cattle as shown below.

Photo VIII-8 Puddling and levelling work by cattle

Leveling work is also important as it allows uniform growth of rice plant. Uniform growth is one of the factors that determine high yield. Many grass breaks out where soil is exposed just after transplanting and urea effect also is reduced if field surface is not well leveled.

The view of a well leveled field and transplanting work in D 4, '07/08.

The view of uniform growth of rice two weeks after transplanted in D 4.

Photo VIII-9 Ideal transplanting work and excellent growth condition after 15 days after transplanting at D 4 in 2007/08 season.

Table VIII-3 Supposition yield if field is un-leveled.

Field condition (1 ha: 10,000m2)	If good leveled condition (Paddy yield: t/ha)	Actual paddy yield (Paddy yield: t/ha)
10% is high and no water.	6	4.5
25%	6	3.5
50%	6	2.5

8. Transplanting

(1) Planting density

The recommended planting density should be of 30 hills per m^2 (hill to hill's space: about 18cm between two neighbor hills). To obtain more paddy yield, increasing seedling population per unit area is very effective and quick.

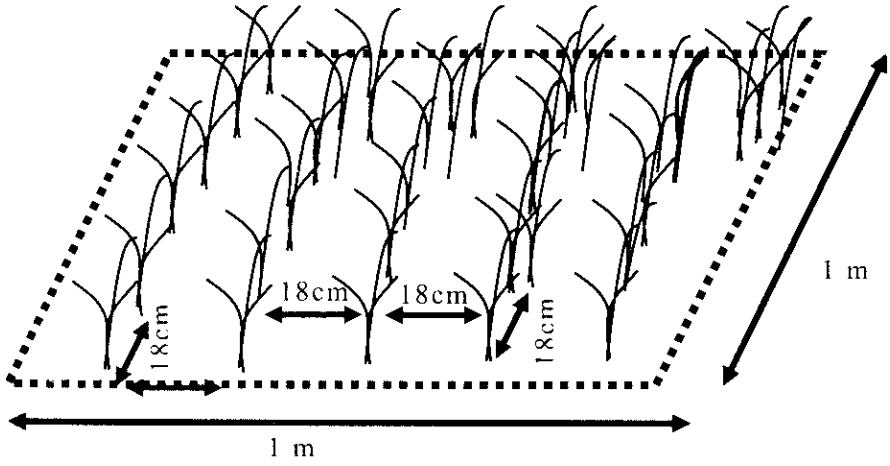


Fig.VIII-13 Image of 30 hills per m^2.

[for Engineer and Extension Officer]

The Farming Section has conducted experiment on "Planting density" at Research Station's experimental field in year 2007/2008 rice season.

According to experimental results, paddy yield increases as transplanting density increases but from the point of view of work efficiency 30 hills per m^2 are the optimum.

The highest yield increasing rate of 52% is achieved with transplanting density between 10 and 20 hills per m^2 of plot; it drops to 26% with density between 20 and 30 hills per m^2; the lowest yield increasing rate of 16% is obtained with density between 30 and 40 hills per m^2 of plot (Fig. VIII-14).

The correlation between the four (4) yield components and paddy yield indicates very clearly that yield is very strongly influenced by the "**Panicle number per m^2**"($r=0.929^{**}$), and to less extent by "**Grain number per panicle**" ($r=0.818^{**}$) (Fig.VIII-15). But, there is no correlation between ripening percentage, 1,000 grains weight, and paddy yield. On the other hand, the result of contribution and/or influence degree of each of the four (4) yield components to paddy yield obtained by multiple regression analysis indicated very clearly that **"panicle number per m^2 exceeds 65% of influence,** while **"grain number per panicle" is only 18%**, and "ripening percentage" and "1,000 grains weight" is only 12% and 5% respectively.

From this result, the direction of paddy yield increasing techniques indicated clearly that increasing the panicle number per m^2 is the most important point. Finally, we can recommend **"planting density of 30 hills per m^2"** for obtaining higher paddy yield.

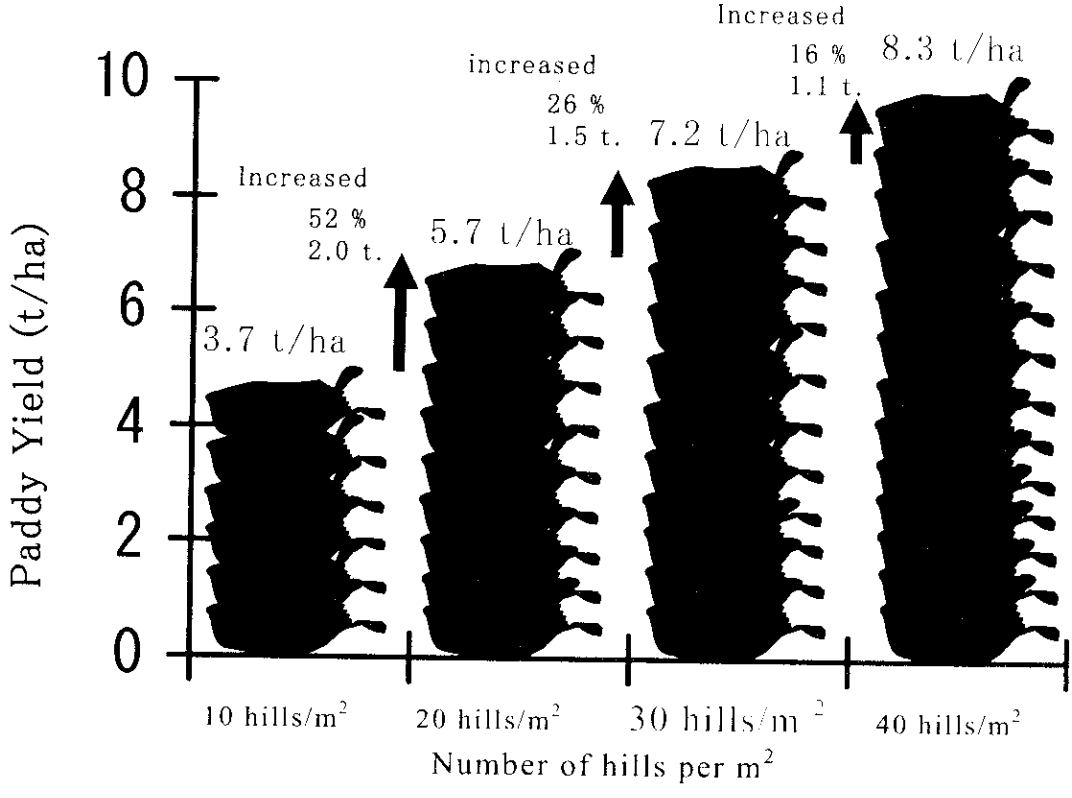


Fig.VIII-14 Different planting density and paddy yield.

Table VIII-4 Summary table of paddy yield and yield components and contribution degree of four (4) yield components to paddy yield.

	Paddy yield(t/ha)	Panicle number per m^2	Grain number per panicle(nos)	Ripening percentage(%)	1,000 grains weight(g)
10 hills/m^2	3.74	156	100	88	26.2
20 hills/m^2	5.69	247	98	90	26.2
30 hills/m^2	7.16	326	97	87	26.1
40 hills/m^2	8.27	372	98	85	26.4
Contribution degree of each yield components	(100)	**65.4%**	**19.9%**	11.5%	5.2%

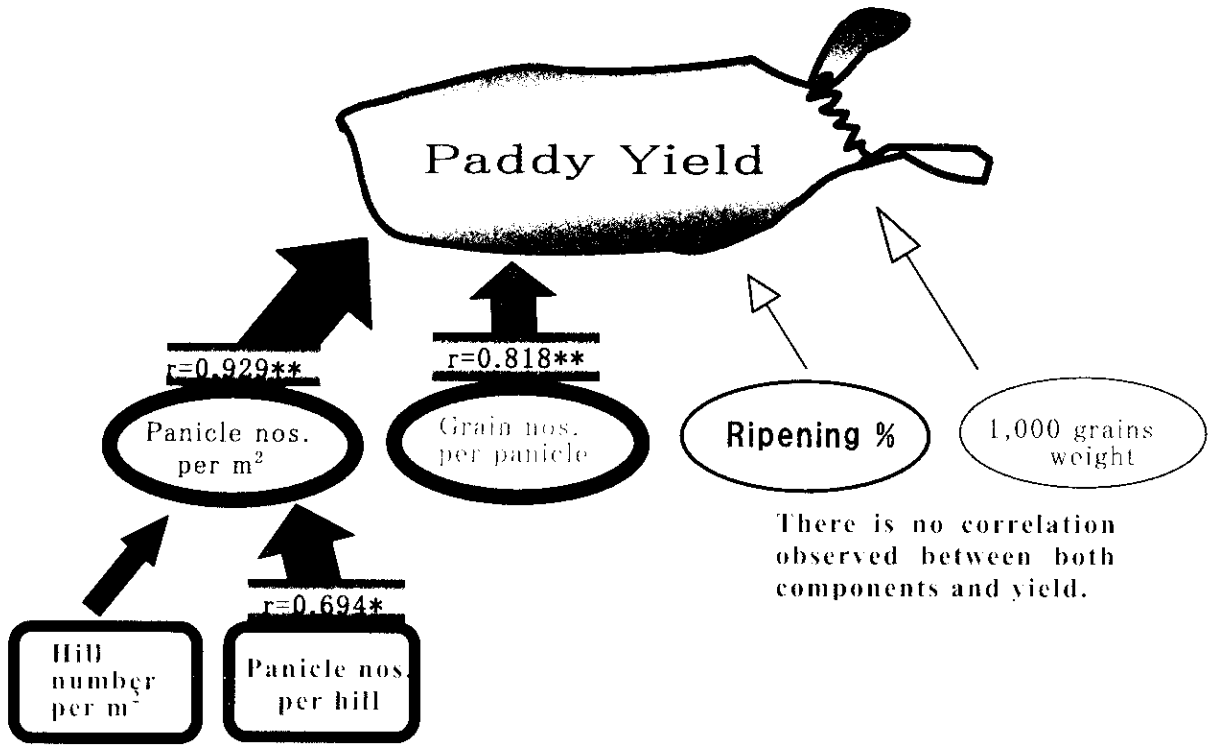


Fig.VIII-15 The relationship between four yield components and paddy yield in different planting density schemes.

The following technique can be pointed out for increasing panicle number per unit area;

[Related technique for increasing the **"panicle number per unit area"**]

* Leveling of paddy field: Perform Puddling and leveling well.
* Planting density: 30 hills/m^2.
* Urea application: Apply urea 2 - 3 bags (100 - 150 kg) /ha.
* Urea split application: 2 times top-dressing 7-10 and 15-20 days after transplanting.
* Use young seedlings: Strict observance of nursing duration of 21 - 28 days.
* Puddling and leveling: Strict enforcement of puddling and leveling.

[Related technique for obtaining the optimum **"grain number per panicle"**]

* Top-dressing just before the Reduction Division Stage.

  20-18 days before heading (see cultivation calendar).

* Use young seedling.

(2) Number of seedlings per hill.

The experiment of "Seedling number per hill has been conducted at Experimental Field in Research Station during 2007/08 season using the method shown below:

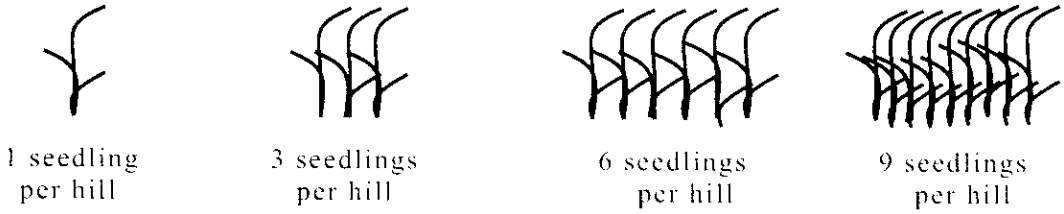


Fig.VIII-16 Treatment method of seedling number per hill.

Through this experiment, the result was that with 6 seedlings per hill the maximum paddy yield obtained was 8.7 t/ha. With 9 and 3 seedlings, the yield was 8.6 and 7.8 t/ha respectively, while with 1 seedling per hill the maximum paddy yield obtained was only 4.5 t/ha, being the lowest yield in four treatments (Fig. VIII-17).

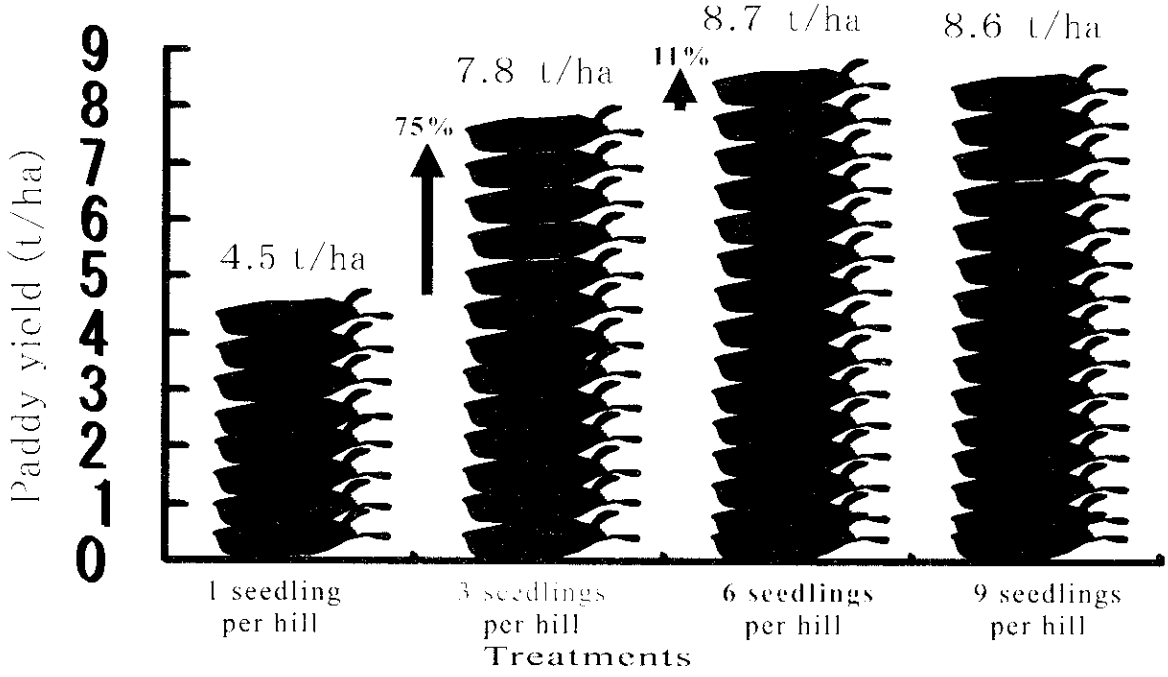


Fig.VIII-17 Difference of paddy yield by different seedling number per hill treatments.

[for Engineer and Extension Officer]

The Farming Section has conducted trial on "Different seedling number per hill "at Research Station's experimental field during year 2007/2008 rice season.

According to the results of the trial, paddy yield increases as the seedling number per hill increases, but it starts to decrease when the number of 9 seedlings per hill is reached The conclusion is that **optimum seedling number per hill is 4 to 6 seedlings per hill**.

The correlation between the four (4) yield components and paddy yield indicates very clearly that yield is very strongly influenced by the "**Panicle number per m^2**"(r=0.827**), and to less extent by "**Grain number per panicle**" (r=0.721**). But, there is no correlation observed between ripening percentage, 1,000 grains weight, and paddy yield.

On the other hand, the result of contribution and/or influence degree of each the four (4) yield components to paddy yield obtained by multiple regression analysis indicates very clearly that **"panicle number per m2 is 63%**, and **"grain number per panicle" is only 27%**, and **"ripening percentage"** and **"1,000 grains weight"** are only **11%** and **9%** respectively.

From this result, the direction of paddy increasing techniques indicated clearly that increasing the panicle number per m^2 is a technique to be considered as a priority.

Finally, we can recommend that **"4-6 transplanted seedlings per hill"** is important point for obtaining higher paddy yield.

Table VIII-5 Summary table of paddy yield and yield components among treatments and contribution degree of each of the four (4) yield components to paddy yield.

	paddy yield(t/ha)	Panicle nos. per m^2	Grain nos.. per panicle	Ripening percentage(%)	1,000 grains weight(g)
1 seedling /hill	4.6	235	90	86	25.6
3 seedlings/hill	7.8	308	105	88	27.4
6 seedlings/hill	**8.7**	**348**	**108**	**87**	**26.1**
9 seedlings/hill	8.6	423	97	83	25.0
Contribution degree of each yield components	(100)	**53.3%**	**27.3%**	10.7%	8.7%

Table VIII-6 Number of seedlings per hill and tiller increasing rate 30days after transplanting

Number of seedling/hill	After 30 days of transplanting	Increased rate(%)
1 seedling	2.6 tillers	260
2 seedlings	5.6 tillers	280
4 seedlings	**12.4 tillers**	**310**
6 seedlings	**17.4 tillers**	**290**
8 seedlings	20.0 tillers	250
10 seedlings	22.0 tillers	220

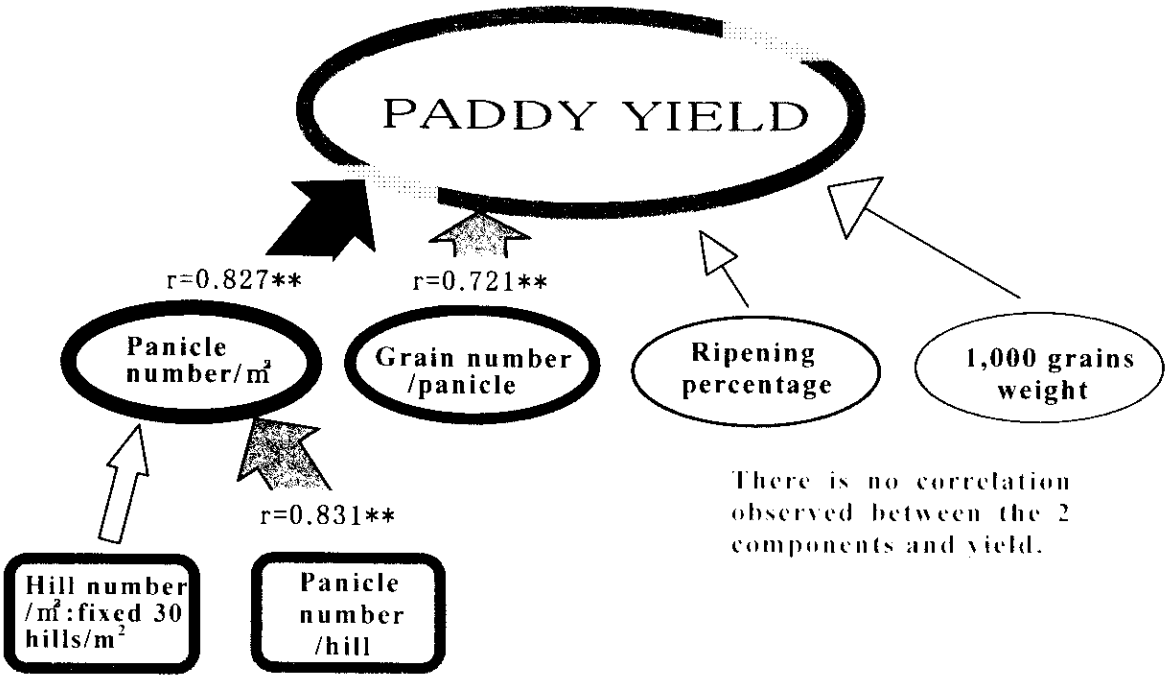


Fig.VIII-18 Relationship between four (4) yield components and paddy yield.

[Related technique for increasing **"panicle number per unit area"**]

* Leveling of paddy field	Perform well puddling and leveling.
* Planting density.	30 hills/m^2.
* Urea application	Apply urea 2 - 3 bags (100 - 150 kg) /ha.
* Urea split application	2 times top-dressing 7-10 and 15-20 days after transplanting
* Use young seedlings	Strict observance of nursing duration of 21 28 days.
* Puddling and leveling	Strict enforcement of puddling and leveling.

[Related technique for obtaining optimum **"grain number per panicle"**]

* Top-dressing just before RDS. 20-18 days before heading.
  (RDS: Reduction Division Stage) = (See calendar).
* Use young seedlings

According to the result of the trial, **optimum seedling number per hill is from 4 to 6.** With a single seedling per hill, it is very difficult to get high tiller number per unit area, and consequently paddy yield drops.

(3) Transplanting depth.

Shallow transplanting is also an important factor for improving tiller outbreak during the effective tillering period.

If transplanting has been correctly executed, i.e. in shallow depth, tiller outbreak is smooth from the rooting (setting) period (about 7 days after transplanting). By the contrary, if transplanting is carried out as deeply as 8-10 cm into soil, first few roots will come out from the bottom, then other roots will come out from upper node near soil surface.

If this occurs, rooting period will take more than 2 weeks, and tiller outbreak will also delay and tiller number will be smaller.

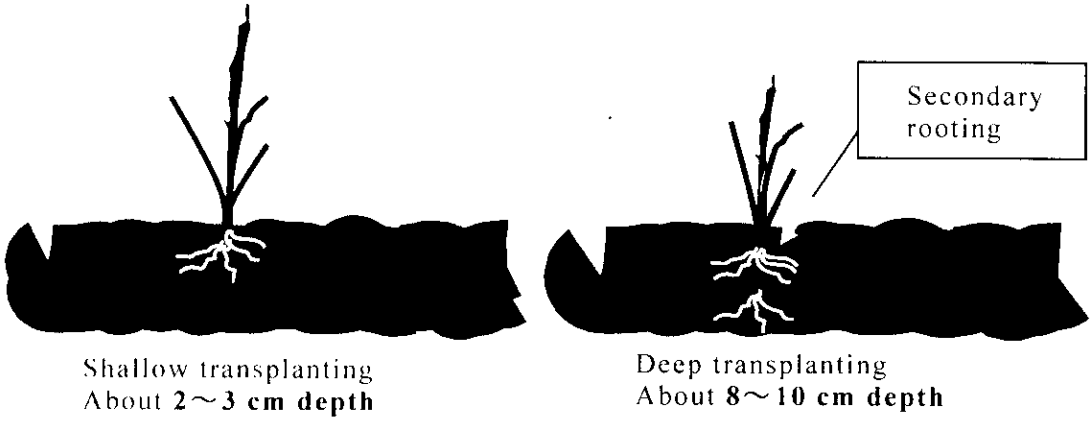
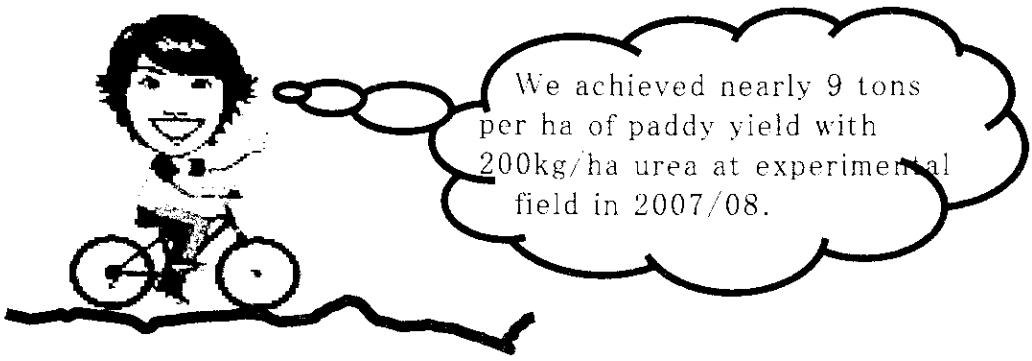


Fig.VIII-19 Comparison of shallow and deep transplanting.

In shallowly transplanted hill, new roots come out just after transplanting. But, deeply transplanted hill needs more days to complete the setting period, because in deeply transplanted seedlings secondary rooting occurs from upper node. This means that effective tillering period becomes shorter which eventually reduces tiller (panicle) number per unit area.

9. Fertilizer application quantity.

Today, high yielding rice variety has been widely introduced in this area. In case of cultivation of high yielding variety such as IT 312, IR 64 or Limpopo, nitrogenous fertilizer application is indispensable. Indeed, some times paddy yield is lower in high yielding variety compared with local variety if no fertilizer is applied. Fertilizer application is a crucial practice that allows for full appearance of the varietal characteristics.



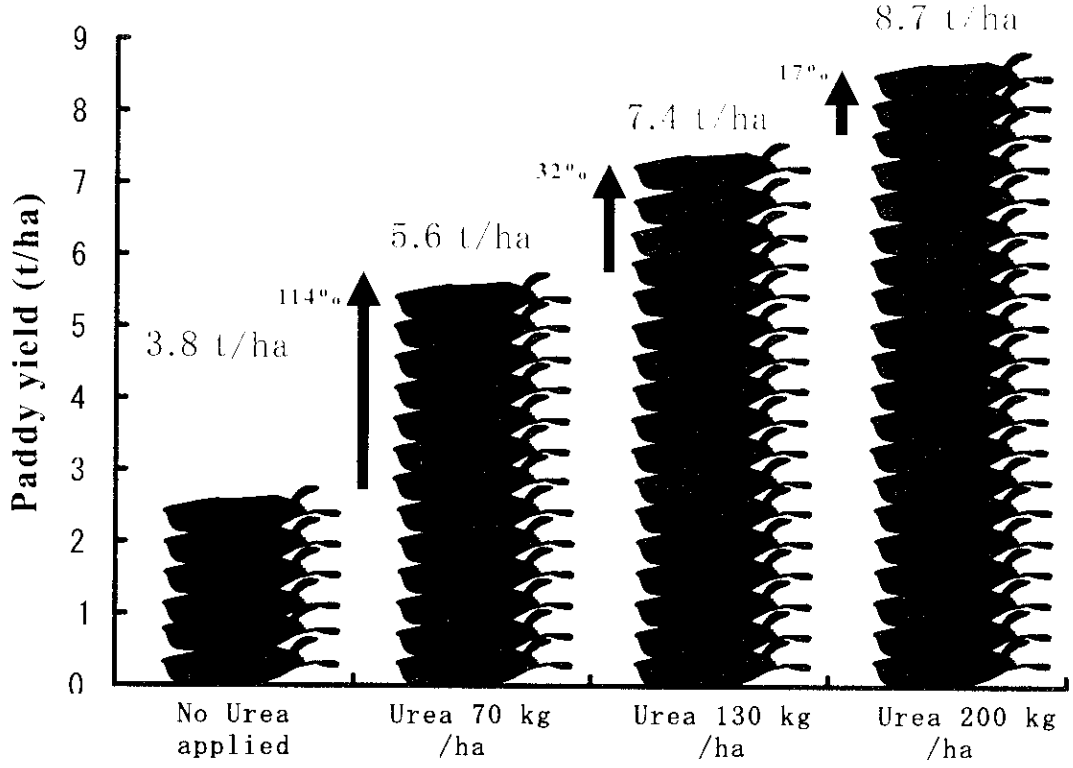


Fig. VIII-20 Paddy yield difference according to the different applied urea quantity.

The minimum quantity of urea needed is **2 ~ 3 bags per ha, if one expects to get** high effect, 1 bag of urea can not be expected to provide high nitrogen effect.

[for Engineer and Extension Officer]

The Farming Section has conducted "Urea application quantity experiment" at Research Station's experimental field during 2007/2008 season.

According to the results of the experiment, paddy yield increases as applied quantity of urea increases, but application of quantities between 130 and 200kg/ha has small yield increasing rate.

The results of this trial indicated that optimum urea quantity to apply may be around 130 kg/ha (about 2.5 bags/ha).

The correlation between the four (4) yield components and paddy yield indicated very clearly that yield is very strongly influenced by the "Panicle number per m^2"(r=0.947**), and moderately by "Grain number per panicle" (r=0.818**). But, no correlation has been observed between ripening percentage and 1,000 grains weight, and paddy yield.

On the other hand, the result of contribution and/or influence degree of each of the four (4) yield components to paddy yield obtained by multiple regression analysis indicated more clearly that "panicle number per m^2 is 57.5%, and "grain number per panicle" is only 31.3%, and "ripening percentage" and "1,000 grains weight" are as small as 8.8% and 2.4% respectively.

From this result, the direction of paddy yield increasing techniques indicated clearly that increasing the panicle number per unit area should be the technique to be recommended. The technique for increasing the panicle number per unit area can be expressed as follows:

(1) Good puddling and leveling of main paddy field=Good land preparation,
(2) Seeding and transplanting at optimum time,
(3) Using young and healthy seedlings,
(4) Planting density with 30 hills per m^2,
(5) 4-6 seedlings per hill,
(6) Shallow transplanting,
(7) Optimum quantity fertilizer application,
(8) Optimum fertilizer split application,
(9) Perform the weeding during the tillering stage,

Finally, since urea application is crucial for obtaining higher paddy yield, we can recommend **that 2 to 3 bags per ha be applied**.

Table VIII-7 Summary table of paddy yield and yield components according to treatments and contribution degree of each four (4) yield components to paddy yield.

	paddy yield(t/ha)	Panicle nos per m^2	Grain nos.. per panicle	Ripening percentage(%)	1,000 grains weight(g)
No urea apply	3.8	192	83	92	26.0
70 kg/ha Urea	5.6	212	113	88	26.7
130 kg/ha Urea	**7.4**	**313**	**111**	**84**	**25.7**
200 kg.ha Urea	8.7	346	122	82	25.3
Contribution degree of each yield components	**(100)**	**57.5%**	**31.3%**	8.8%	2.4%

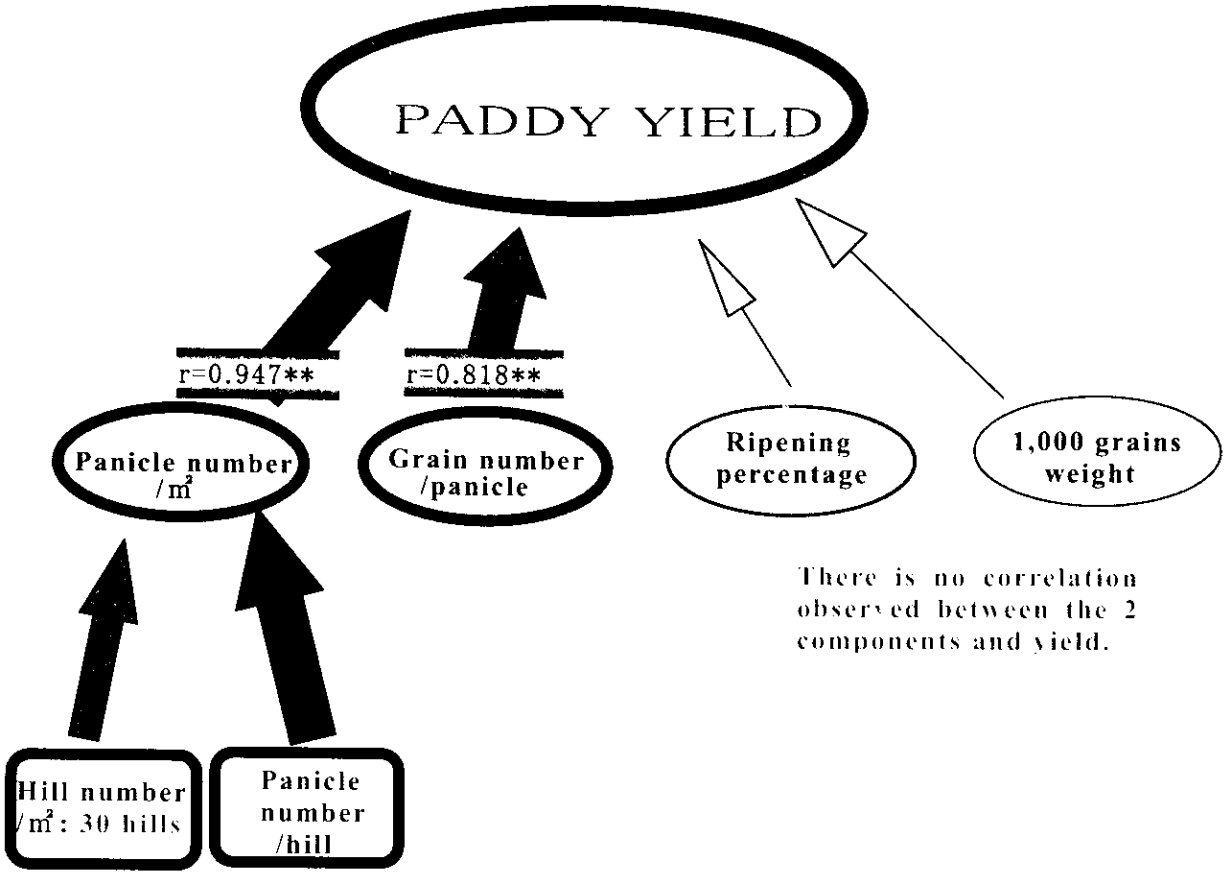


Fig.VIII-21 Relationship between yield components and paddy yield.

[Related technique for increasing the **"panicle number per unit area"**]

* Leveling of paddy field	Perform puddling and leveling well.
* Planting density.	30 hills/m^2.
* Urea application	Apply urea 2 - 3 bags (100 – 150 kg) /ha.
* Urea split application	2 times top-dressing 7-10 and 15-20 days after transplanting
* Use young seedlings	Strict observance of nursing duration of 21 – 28 days.

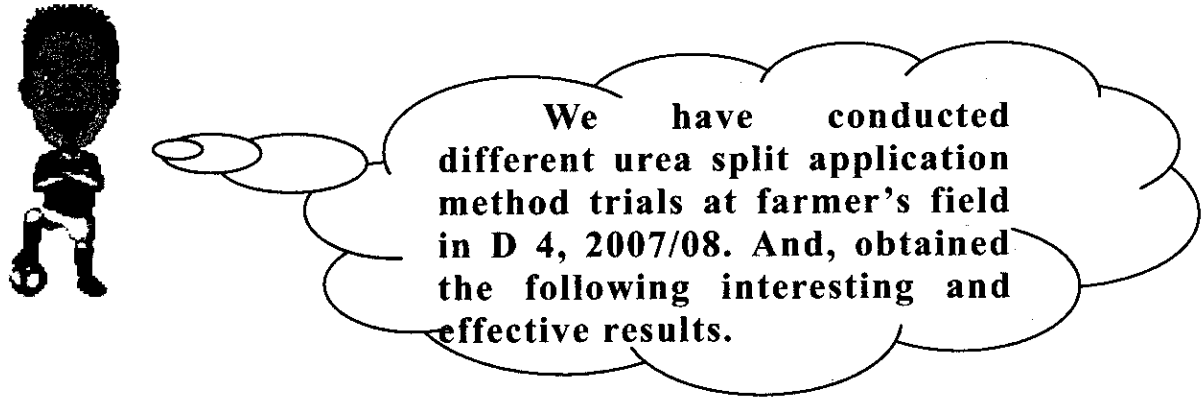
[For obtaining the optimum **"grain number per panicle"**]

* Top-dressing just before RDS. 20-18 days before heading (see cultivation calendar).
  (RDS: Reduction Division Stage)
* Use young seedlings.

According to experiment result, **optimum quantity of urea fertilizer is 2 to 3 bags for high yielding variety as Limpopo, IT 312 and IR 64.**

10. Fertilizer split application method

The Farming Section has conducted trial on "Urea split application method" and its paddy yield at farmer's field during 2007/2008 season.



As a result of the trial, the SA 2 (Split Application Method 2) obtained maximum paddy yield of 7.3 t/ha, SA 3 followed with 6.1 t/ha, and the lowest yield of 5.9 t/ha was obtained with SA 1 application method. From this result, we can recommend 3 times top-dressing method, i.e. the 1st top-dressing with 40-50% of total urea quantity 7 to 10 days after transplanting, the 2nd with 20-30% of total urea 15 to 20 days after transplanting, and the 3rd using the remaining quantity of urea just before the Reduction Division Stage (18 to 20days before the heading stage).

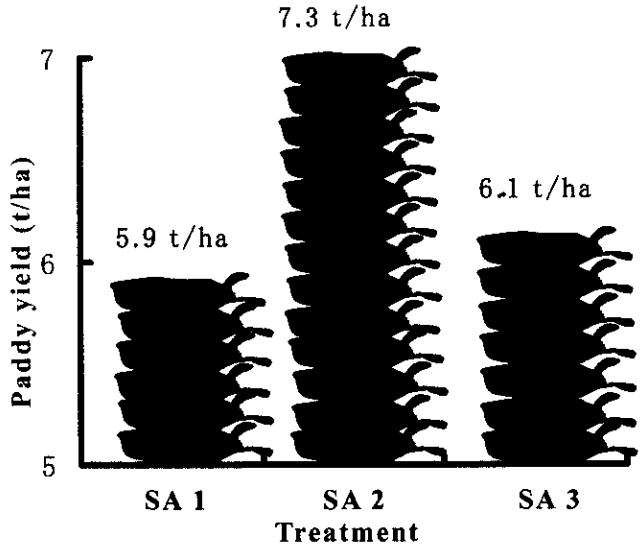


Fig.VIII-22 Paddy yield obtained with different urea application methods.

[for Engineer and Extension Officer]

The trial design with details on urea application time and quantities is shown below;

(1) Total nitrogen fertilizer: 46kg per ha. (=2 bags of urea)

(2) Split application method.

SA 1 : Basal + 1st TD + 3rd TD (50 : 25 : 25%)
SA 2 : 1st TD + 2nd TD + 3rd TD (50 : 25 : 25%)
SA 3 : 1st TD + 3rd TD (70 : 30%)

Notes: **SA**: Split Application method. **TD**: Top Dressing

(3) Time of application:

Basal dose = Just before the plowing or puddling with all layer application method.
1st top-dressing = 7 days after transplanting.
2nd 〃 = 15 days after transplanting.
3rd 〃 = just before Reduction Division Stage
(About 18 to 20 days before heading stage=see calendar).

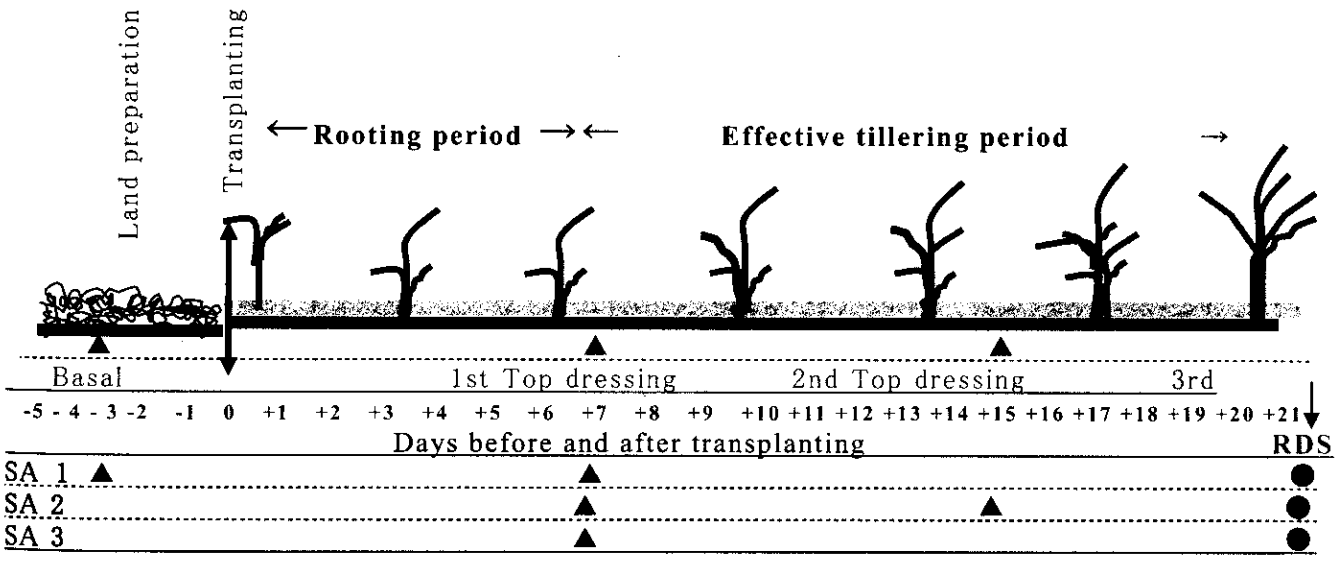


Fig.VIII-23 Treatment method (Split application method)
Note. ▲ shows time of urea application.
RDS: Reduction Division Stage (18-20 days before heading).

According to experimental result, the paddy yield is increased with SA 2 split application method, but yields of SA 1 and SA 3 application methods remained almost at the same level (Table VIII-9).

The correlation between the four (4) yield components and paddy yield indicated very clearly that yield is very strongly influenced by the "**Grain number per panicle**"(r=0.905**), and moderately influenced by "**Panicle number per m^2**" (r=0.762**). On the other hand, there is no correlation observed between ripening percentage, 1,000 grains weight, and paddy yield (Table VIII-8).

The result of contribution and/or influence degree of each of the four (4) yield components to paddy yield obtained by multiple regression analysis indicated very clearly that "**grain number per panicle is 45%**, and **"panicle number per m^2" is only 30%**, and "ripening percentage" and "1,000 grains weight" are as small as 11% and 14% respectively (Table VIII-9).

From this result, the direction of paddy increasing techniques indicated clearly that increasing the grain number per panicle as well as panicle number per unit area is top priority technique. Finally, we can recommend that the "Urea split application method" be used as follows: 1st top-dressing with 40-50% of total urea 7-10days after transplanting, the 2nd top-dressing with 25-30% 15-20 days after transplanting and the 3rd urea top-dressing with the remaining urea just before the Reduction Division Stage (18-20 days before heading).

Table VIII-8 Coefficient of correlation between four (4) yield components and paddy yield.

	Panicle nos./m^2	Grain nos./panicle	ripening %	1,000 grains weight
Paddy yield	**r=0.762****	**r=0.905****	0.315ns	-0.262ns

'**, * is significant correlation at 1% and 5% level. ns is not significance.

Table VIII-9 Summary table of paddy yield and yield components according to treatments and contribution degree of each four (4) yield components to paddy yield.

	paddy yield(t/ha)	Panicle nos per m^2	Grain nos.. per panicle	Ripening percentage(%)	1,000 grains weight(g)
Split application-1	5.9	269	88	92	27.3
Split application-2	7.3	318	100	88	25.8
Split application-3	6.1	296	90	87	26.1
Contribution degree of each yield components	**(100)**	**30.0%**	**45.2%**	**10.6%**	**13.7%**

Table VIII-10 Detailed urea dividing method in accordance with total urea quantity]

In case of **50 kg (1 bag)** of Urea per ha		In case of **100kg (2 bags)** of Urea per ha	
1st Top-dressing	25.0 kg, (50%)	1st Top-dressing	40-50 kg, (40-50%)
2nd Top-dressing	12.5 kg (25%)	2nd Top-dressing	25-30 kg (25-30%)
3rd top-dressing	12.5 kg (25%)	3rd top-dressing	20-25 kg (20-25%)

*** And apply following times respectively.**

1st top-dressing: 7-10 days after transplanting.

2nd top-dressing: 14-20 days after transplanting.

3rd top-dressing: 18 days before the Reduction Division Stage.
(About 13 –15th Feb=see carender.).

11. Paddy field management

(1) Weeding work.

Weeding work is very important especially up to Maximum Tiller Number Stage about 30 – 40 days after transplanting. During this period, the panicle number per unit area is determined which has strong effect on paddy yield. Therefore, weeding during tillering stage is very important work.

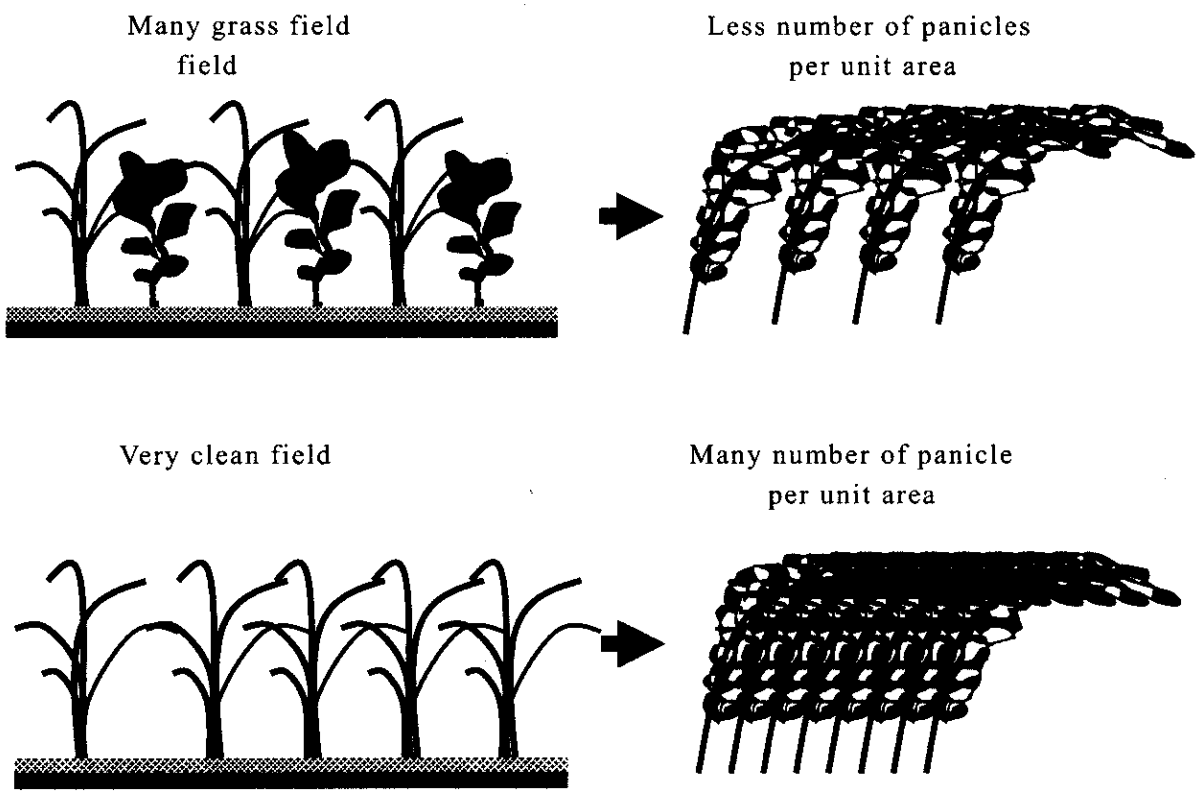


Fig.VIII-24 Comparison between paddy field with out weeding and weeded paddy field.

If there are many weeds during tillering stage, absorption of nitrogen by rice plant is hindered and photosynthesis is also reduced, and finally panicle number per unit area is lower.

(2) Water management

It is important that deep water (4-6 cm) be maintained during the whole rooting stage, i.e, up to 7-10 days after transplanting. Deep water will also be needed during the last half of the growth stage, i.e from the end of the Reduction Division Stage to the Milky Stage, which, in case of Limpopo variety is around 25th of Feb.-15th of March.
From maximum tiller number stage to the beginning of the Reduction Division Stage intermittent irrigation can be recommended

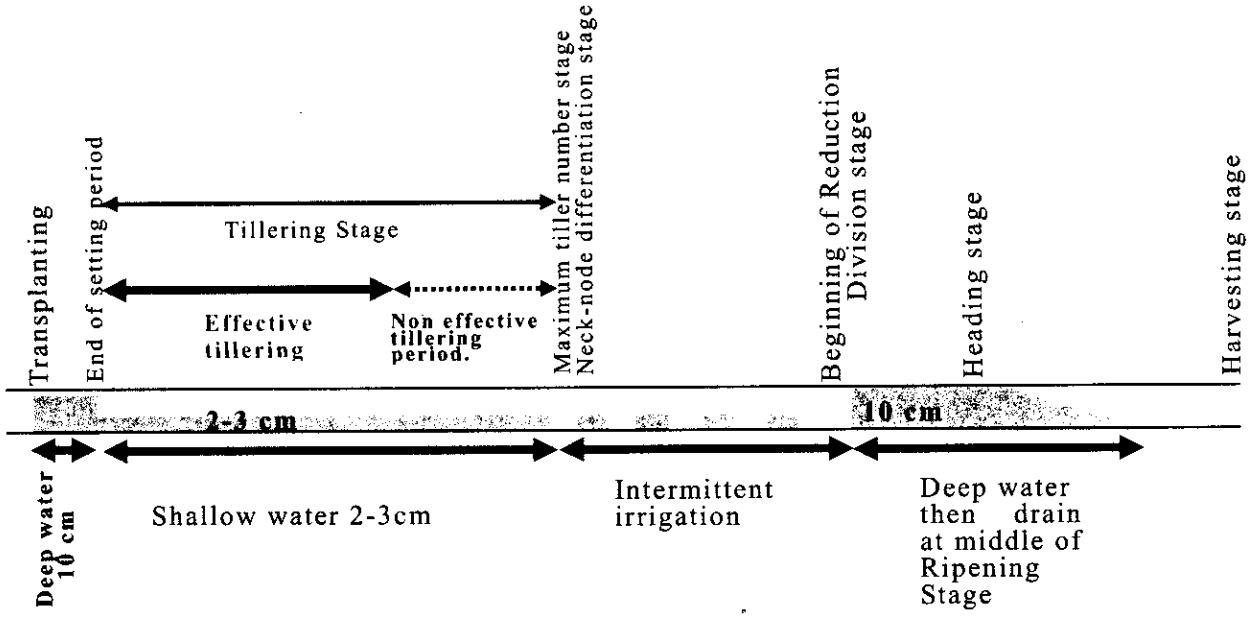


Fig.VIII-25 Water control method in total growth period.

12. Harvesting

(1) Optimum harvesting time is very important for ensuring good quality of rice.

It is internationally recognized that optimum harvesting stage is when grain panicles are 80% fully mature as shown in fig.35 below. When harvest occurs at this stage, high quality rice is produced with minimum harvesting loss.

Passed the optimum harvesting stage, harvesting loss due mainly to rice grain cracking will increase day after day. Moreover, if harvesting work waits until all grains become yellowish, rice quality will rapidly decrease and harvesting losses will be higher.

If after the optimum harvesting time, rice is kept long time in fields in standing condition, grain cracking (upper half of panicle) even in high quality rice producing grains will occur. Rice cracking and cracked rice percentage will become higher and milling ratio will also be substantially reduced.

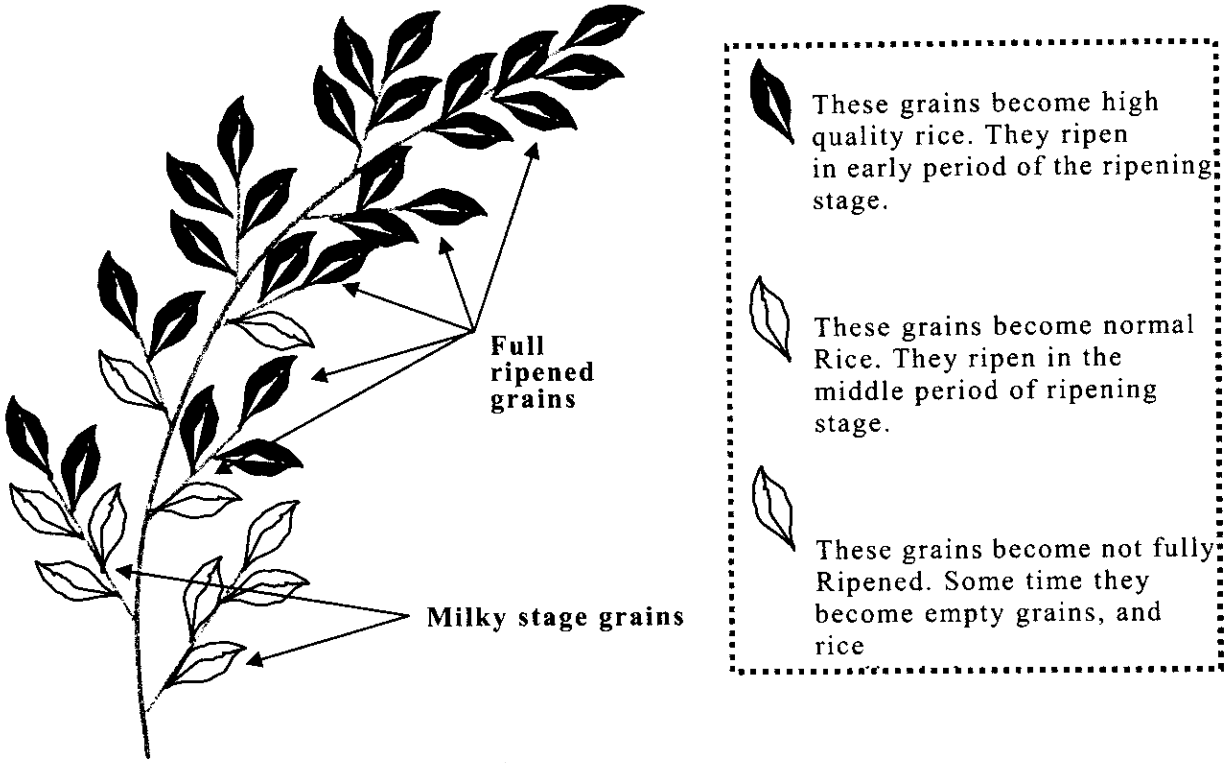


Fig.VIII-26 Optimum harvesting period at 80% full ripened panicle condition.

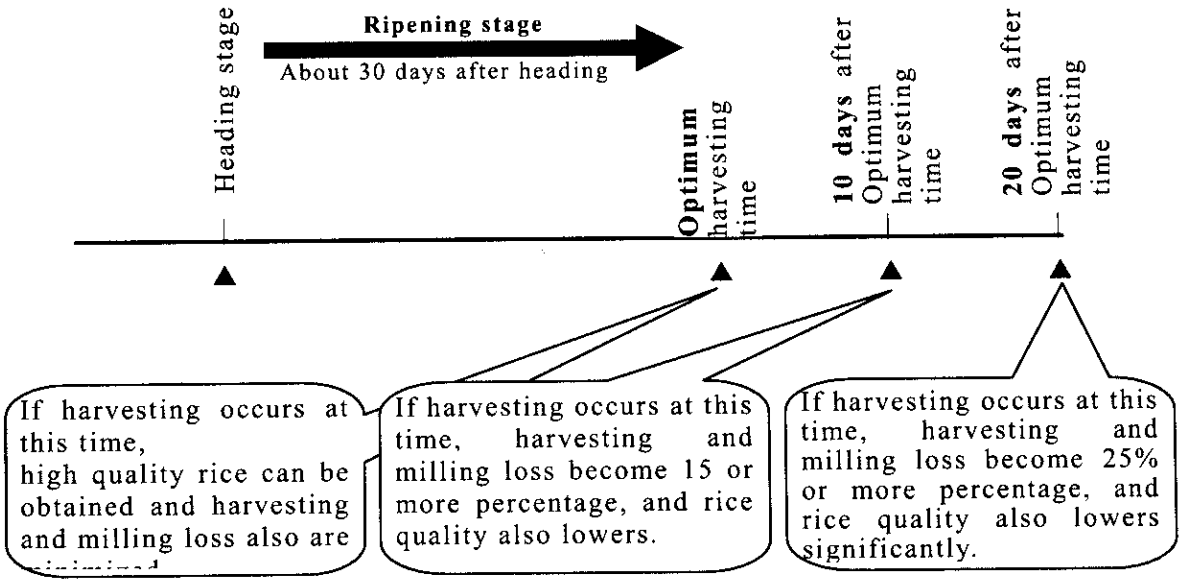


Fig.VIII-27 Harvesting timing and its problems.

(2) Threshing and drying

If harvesting and threshing are carried out under rainy condition, water content in paddy grain may be more than 15 % as moisture ; There is need for quickly drying it in the sunshine up to less than 15%. If it is kept in a bag with high moisture, rice quality decreases as rice color changes to yellow, mold outbreaks may occur and some time germination, depending on variety (on variety dormancy).

(3) Rice milling

The rice milling percentage and rice quality are strongly related with moisture contents of paddy grain. Milling testing result with different grain moisture contents and husking and milling ratio indicated that best milling ratio is obtained between 15 to 13 % of grain moisture content as shown below(Fig.37)

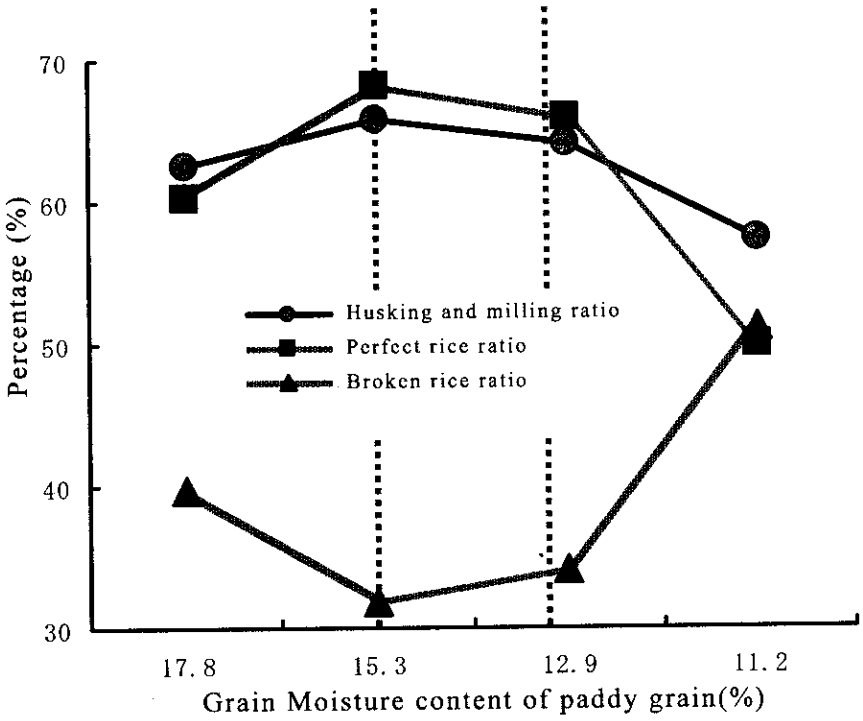


Fig.VIII-28 The relationship between grain moisture content and milling ratio.

IX. Method of Home Seed Production

The farmer is doing home seed production mainly in rice producing countries, and never buys seeds so frequently. Rice varietal characteristics do not change under normal cultivation condition in several years. So, home seed production can be recommended in this area with following procedure:

Step 1: Seed and seed pre-treatment

* Use pure variety seeds at first.
* Strict enforcement of seed pre-treatment, seed selection work is especially important.

Step 2: Nursing

* Nursing by improved semi-dry bed style method.
* Nursing technique should follow improved method as above.
* **During nursing period, extract the different shaped seedlings if there are taller seedlings(Fig. 39).**
* Nursing duration must be respected: 21 to 30 days

Step 3: Transplanting

* Transplanting with normal cultivation method with 4-6 seedlings per hill, 30 hills per m^2 and shallow transplanting.

Step 4: Field management and fertilizer doses

* Weeding must be done from time to time and mixing weed and seed must be avoided.
* Fertilizer doses and water management are the same as for normal cultivation.

Step 5: Extraction of the different mixed varieties

* This **extraction work of different mixed varieties** is crucial for seed production. Extraction work needs to be performed at least 4 times during the total rice growth period as

shown below (Fig. IX-1): during nursery stage, during tillering stage, during panicle initiation stage, and during ripening stage. The point of identification of different varieties at each extraction is that 1st and 2nd is height and leaf color of rice plant, 3rd is mainly height of rice plant, and 4th is maturity condition (Fig. IX-1).

In case of Limpopo Variety

Total growth duration: 125 days

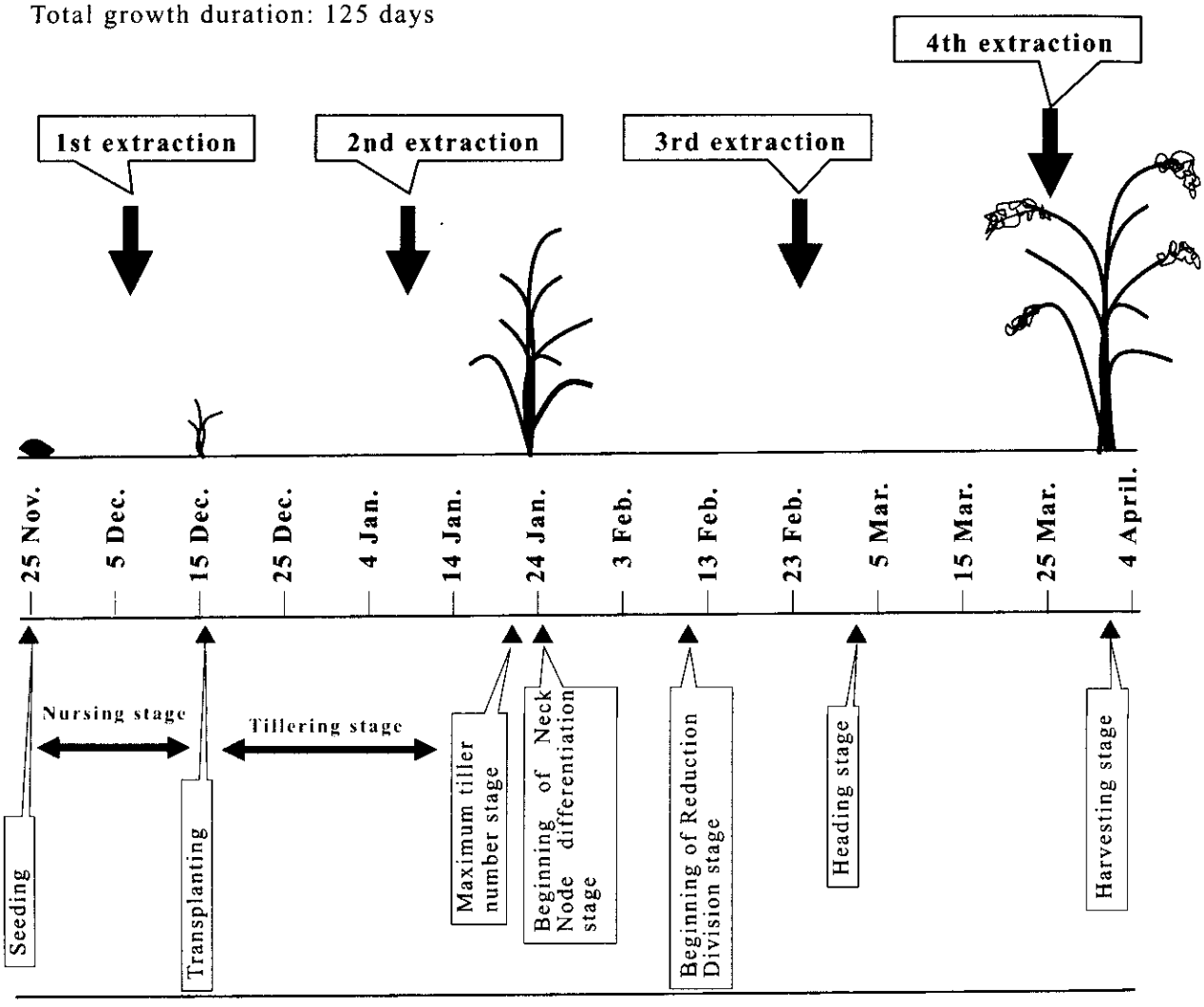


Fig.IX-1 The extraction timing in total growth stage of rice.

How to identify the mixed different varieties?

① Plant height.

② Leaf blade width and color.

③ Timing of ripening.

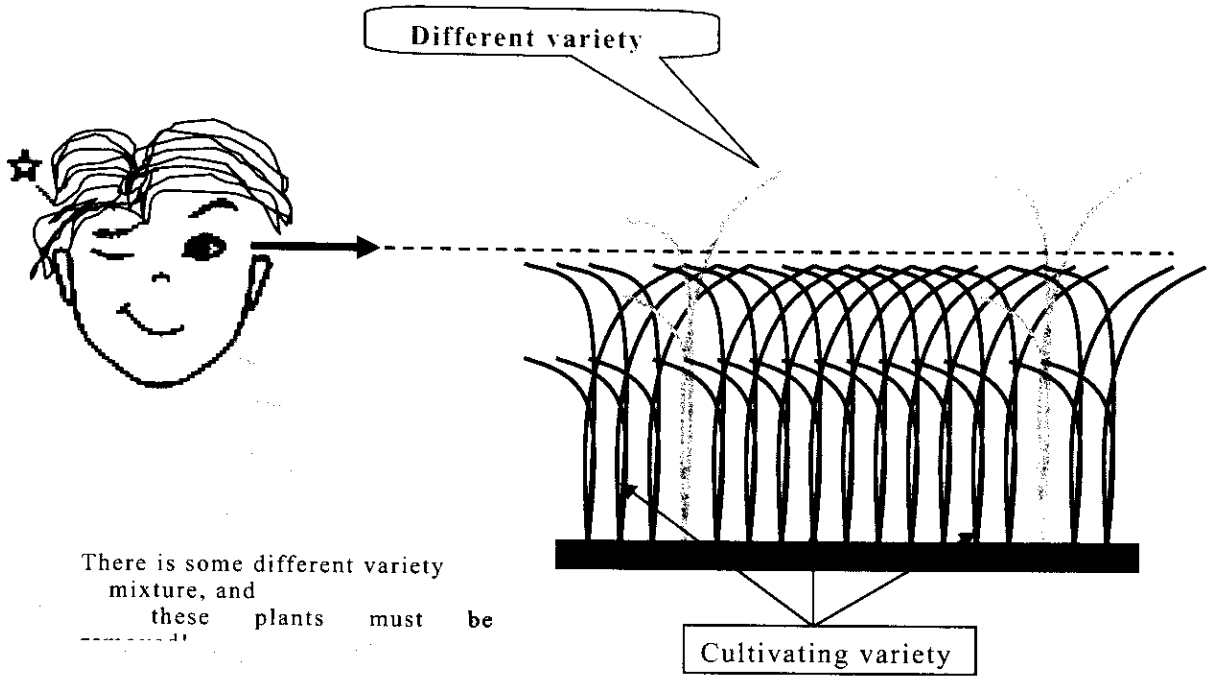


Fig.IX-2 Method of identification by plant height at seed bed and initial growth stage.

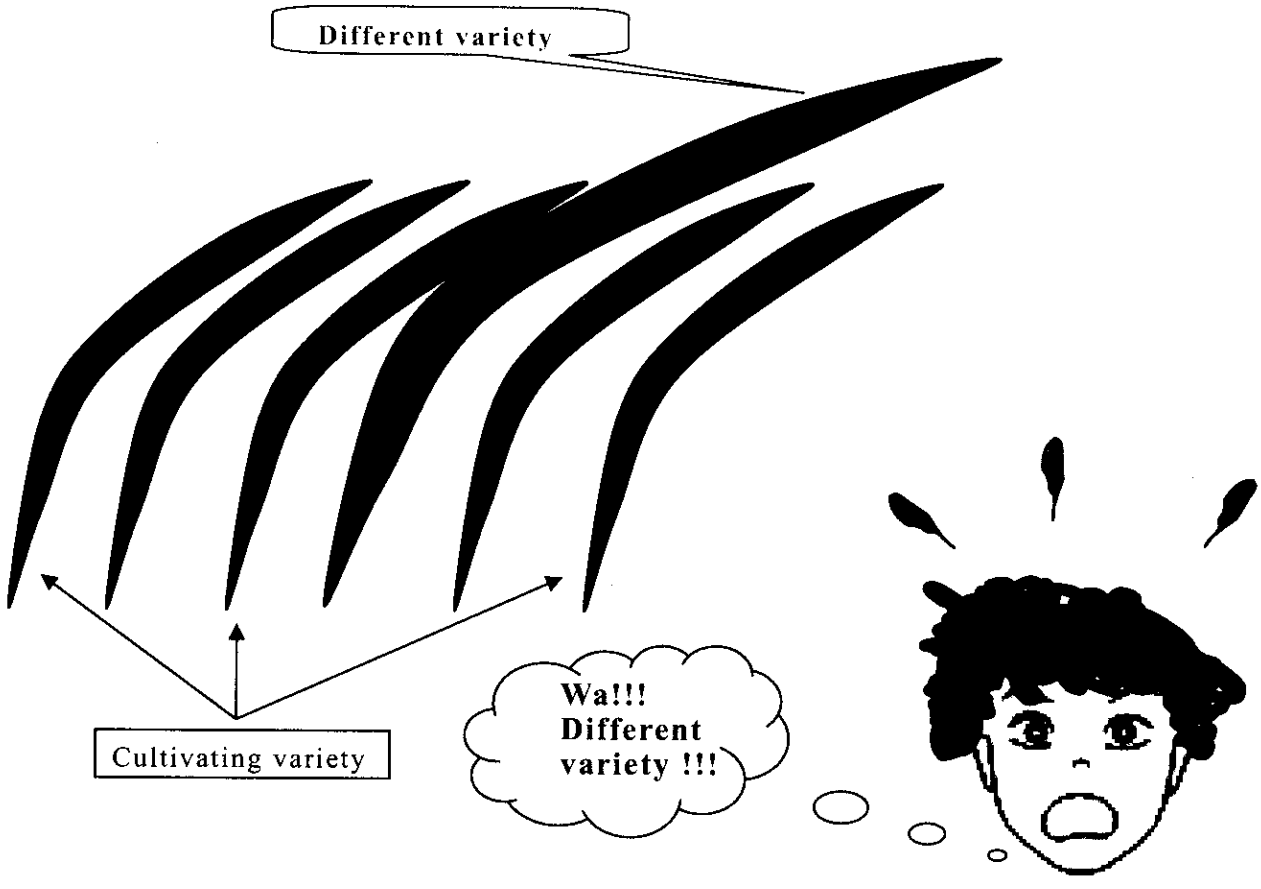


Fig.IX-3 Method of identifying the different variety at middle growth stage.

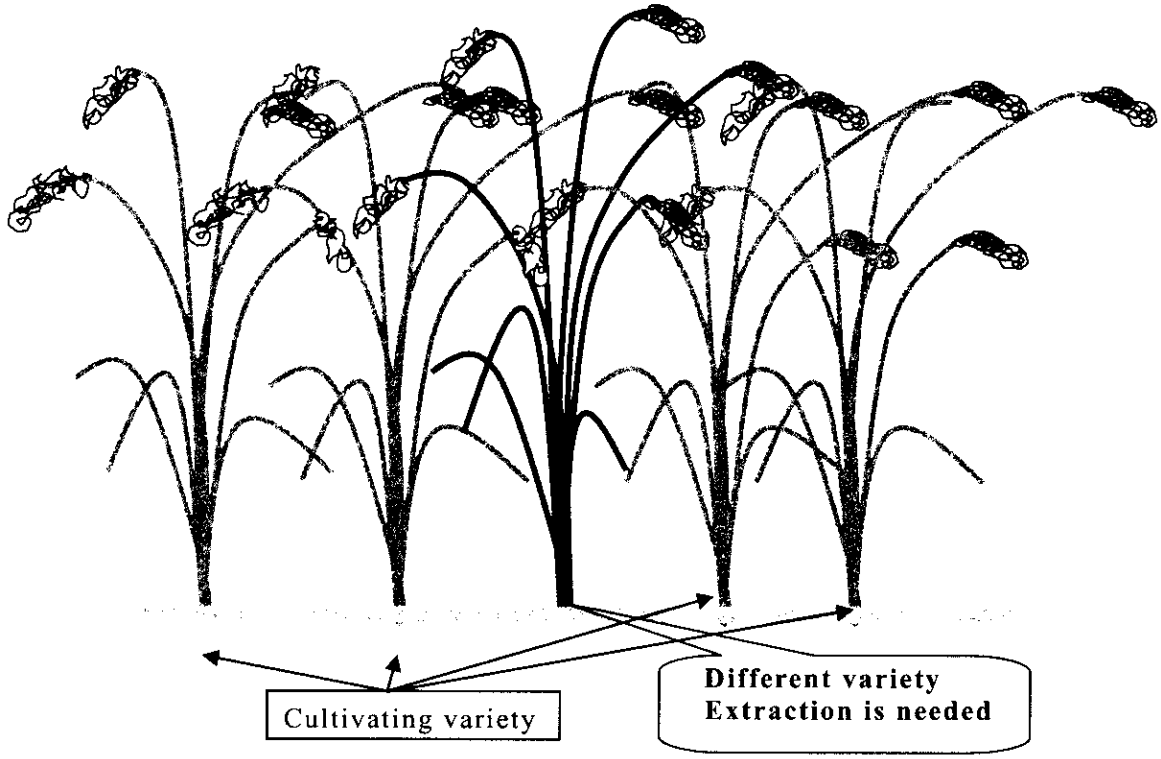


Fig.IX-4 Method of identify the different variety at ripening stage.

Step 6: Time of seed collection and method

The best period for practicing seed collection is when 80% of panicle is fully ripened (fig.35). The big head (panicle)-selection method is used to collect only big and healthy panicles as shown below. The quantity of seed needed per ha is 80-90 kg at panicle collection time under condition of 18% of grain moisture.

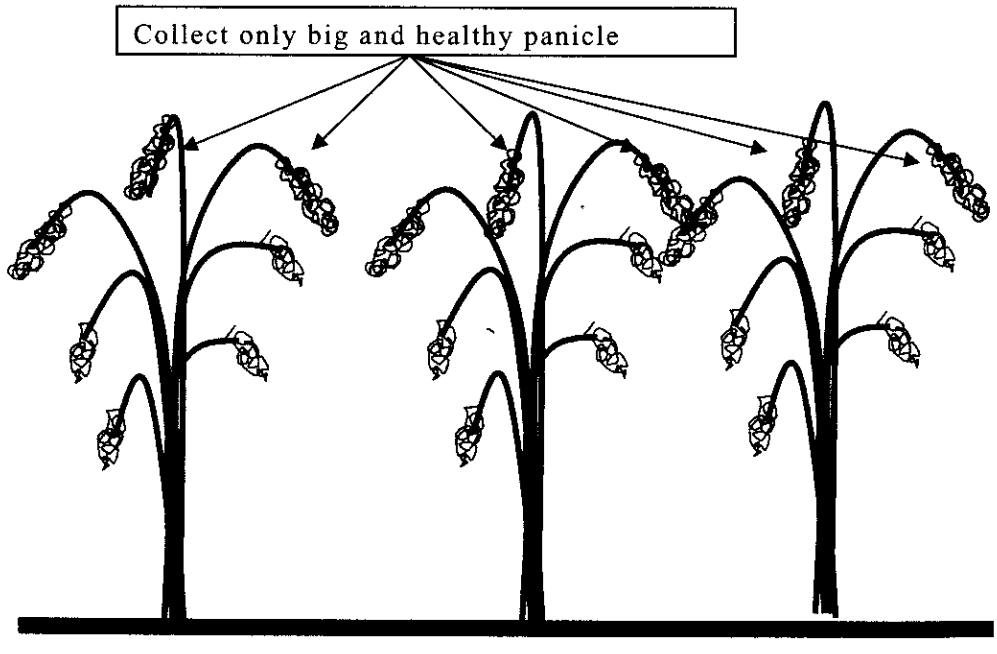


Fig.IX-5 Method of panicle (seed) collection.

Step 8: Drying and threshing

The grain moisture percentage just after panicles collection is around 18% or above, and there is need for fast drying in the sunshine in order to decrease grain moisture down to 13% or even lower. Then, thresh, and keep it in a cool and well ventilated place.

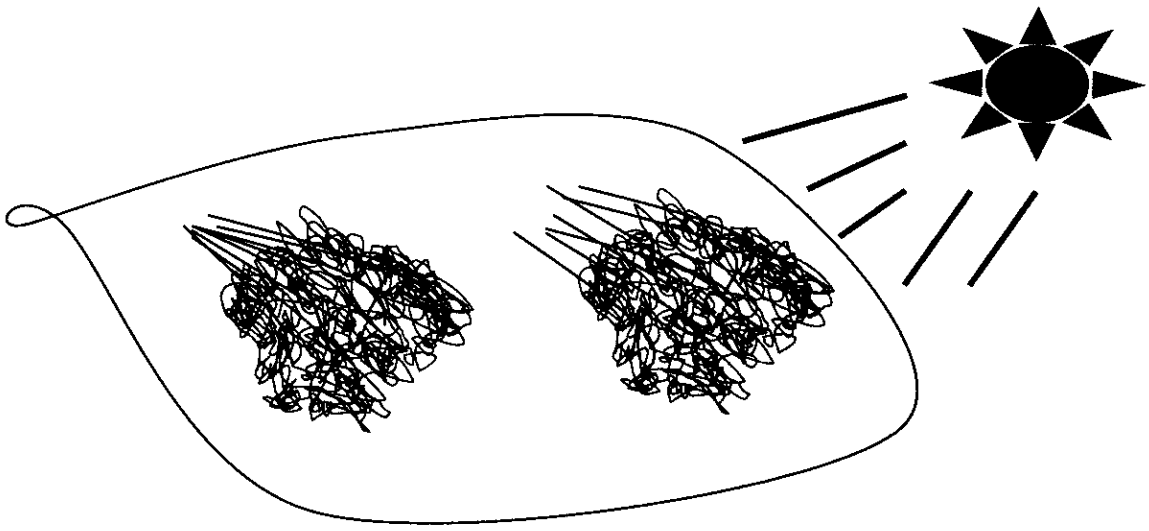


Fig.IX-6 Method of panicle (seed) drying.

Fin.

添付資料 E-3

Training Material / Extension Resource

Transplanting Rice Cultivation Technique

【 REVISED EDITION 】

December, 2009

Farming Section

Integrated Agricultural Development Project
for Small Scale Farmers in Chokew Irrigation Project

Training Material / Extension Resource

Contents

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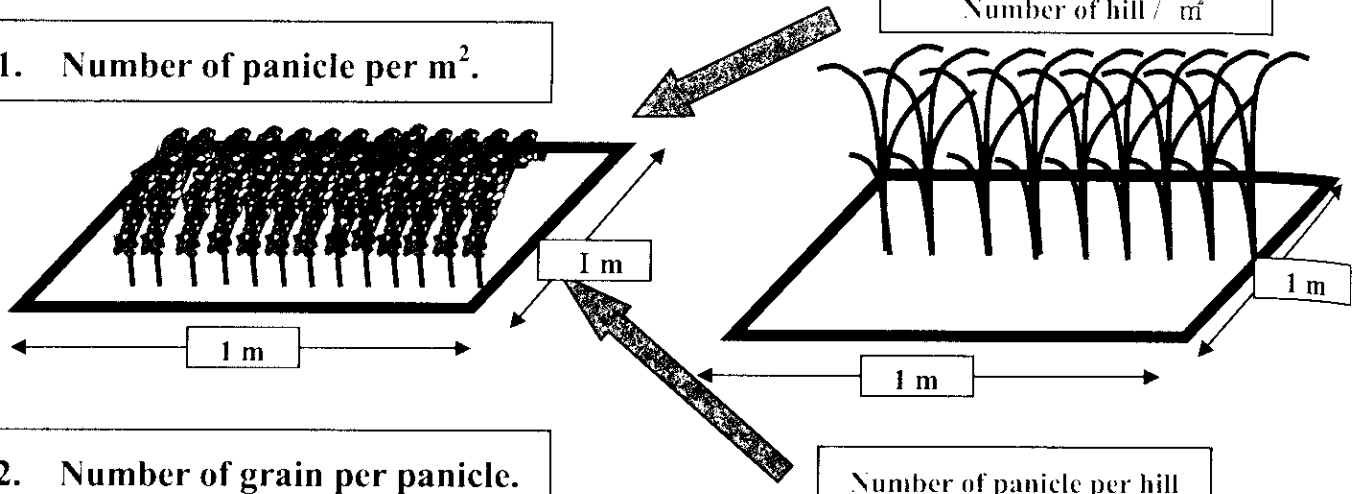
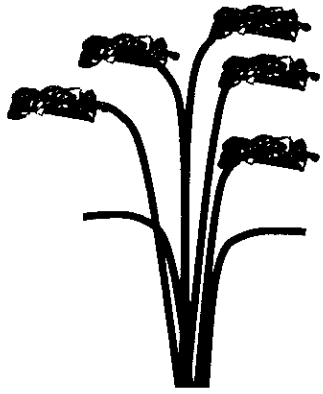
I. Basic Knowledge of Paddy Yield and Four (4) Yield Components.

1. Number of panicle per m^2.



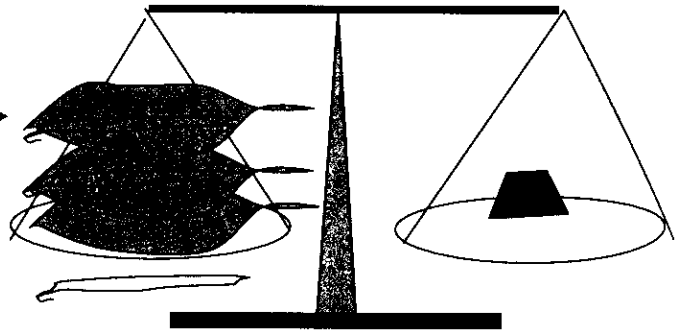
2. Number of grain per panicle.

Number of panicle per hill



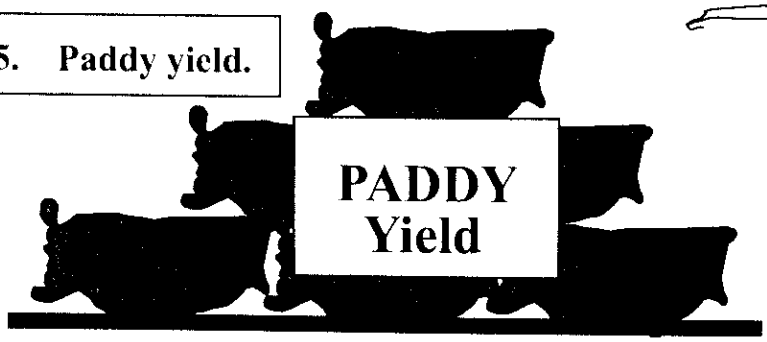
3. Ripening percentage (%).

4. Weight of 1,000 grains.



Weight of 1,000 grains

5. Paddy yield.



II. Results on Farmer's Field Yield Survey

* Change of the paddy yield and yield components in farmer's field at before and after project

Table 1 **Before project (2006/07 year's rice season.** Surveyed at Mar.-April,'07)

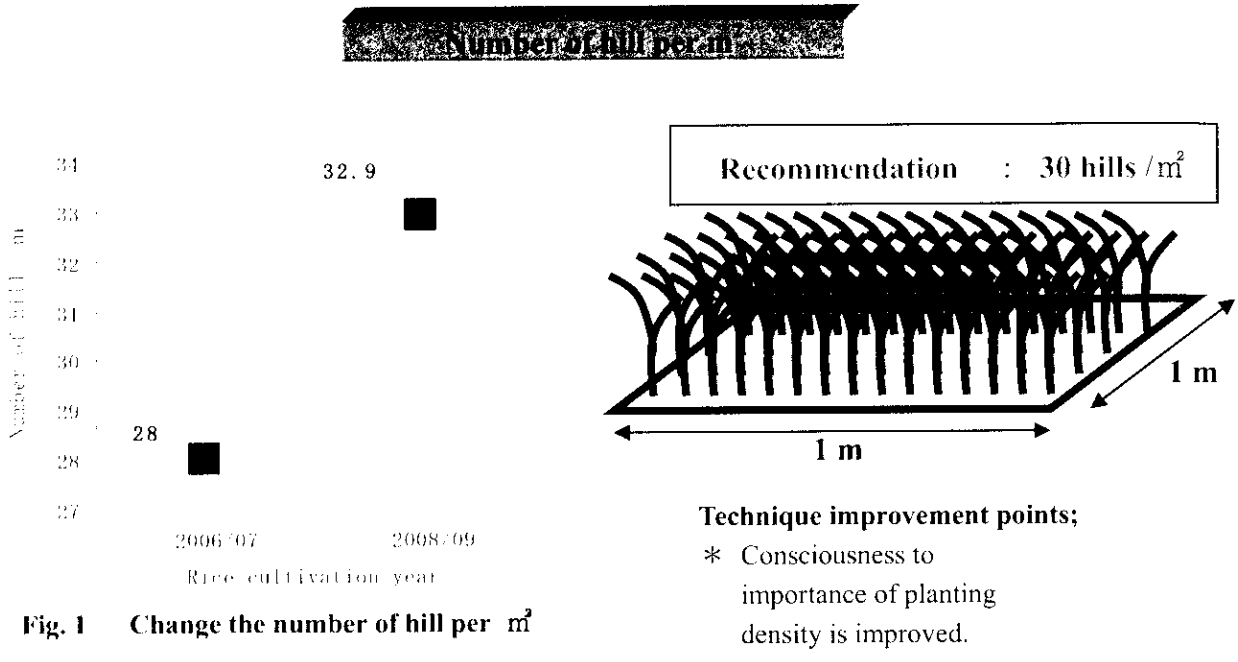
Sample No.	**Paddy yield (t/ha)**	Number of hill/㎡	Number of panicle /hill	Number of panicle /㎡	Number of grain /panicle	Number of grain /㎡	Ripening %	Weight of 1,000 grains (g)
1	2.69	20	6.5	129	99	12,771	83	25.4
2	4.66	38	5.3	200	122	24,400	81	24.2
3	4.23	35	4.5	157	116	18,255	91	25.5
4	2.88	42	4.4	184	79	14,536	88	22.5
5	3.71	22	8.1	179	94	16,826	93	23.7
6	3.57	25	7.0	176	101	17,776	83	24.2
7	4.03	21	7.1	149	120	17,640	94	24.0
8	4.53	16	9.1	146	154	22,484	88	22.9
9	4.27	21	8.0	169	150	25,350	77	21.9
10	3.66	31	5.9	181	122	22,082	70	23.7
11	2.82	40	4.8	191	82	15,662	78	23.1
12	3.36	22	5.9	130	134	17,420	85	22.7
13	2.77	27	5.9	160	83	13,280	88	23.7
14	3.45	38	5.3	201	81	16,281	76	27.9
Av.	**3.61**	**28**	**6.3**	**168**	**110**	**18,197**	**84**	**24.0**

Table 2 **After project (2008/09 year's rice season.** Surveyed at Mar. ~ April,'09).

Sample No.	**Paddy yield (t/ha)**	Number of hill	Number of panicle /㎡	Number of panicle /hill	Number of grain /panicle	Number of grain /㎡	Ripening %	Weight of 1,000 grains (g)
1	4.60	12	19.5	234	91	21,294	82.7	26.14
2	6.49	28	8.4	235	110	25,850	93.3	26.92
3	6.33	20	13.7	273	101	27,573	85.9	26.73
4	6.35	33	7.7	252	102	25,704	88.9	27.90
5	6.51	24	10.4	250	105	26,250	92.2	27.05
6	6.56	45	7.5	339	84	20,076	86.2	26.68
7	5.61	20	11.8	235	102	23,970	88.7	26.37
8	7.28	35	7.8	274	108	29,592	94.2	26.15
9	6.60	37	7.3	270	93	25,110	92.5	28.36
10	7.16	29	10.0	290	92	26,280	93.2	28.97
11	6.82	36	7.1	256	122	31,232	85.4	25.48
12	6.83	44	6.6	290	96	27,840	87.6	27.89
13	6.88	28	8.6	241	122	29,402	88.7	26.53
14	7.01	51	6.3	321	111	25,631	88.0	22.40
15	5.78	55	4.8	264	96	25,344	84.7	27.16
16	4.87	30	5.7	171	112	19,152	93.2	27.39
Av.	**6.36**	**33**	**9.0**	**262**	**103**	**26,986**	**89.0**	**26.75**
Increase/decrease percentage against before project; (%)	**+76**	**+23**	**+43**	**+56**	**-6**	**+48**	**+6**	**+11**

Table 3 The summarized table of paddy yield and yield components at before and after project.

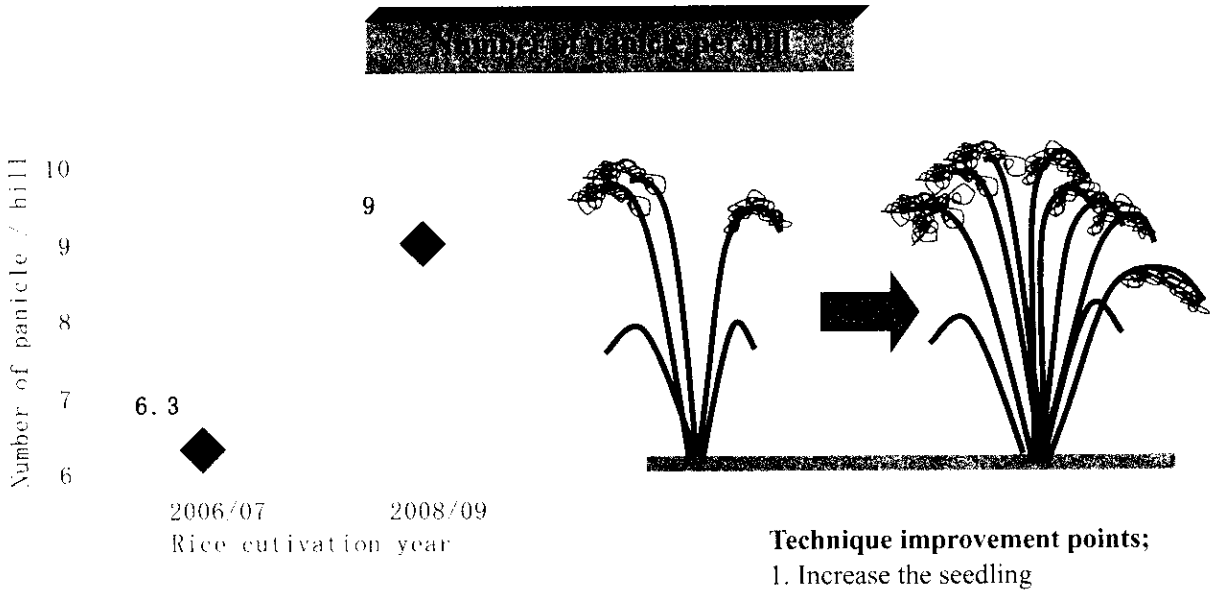
Cultivation year	**Paddy yield (t/ha)**	Number of hill/㎡	Number of panicle /hill	Number of panicle /㎡	Number of grain /panicle	Ripening /㎡	Ripening %	Weight of 1,000 grains (g)
2006/07	**3.61**	28	6.3	168	110	18,197	84	24.0
2008/09	**6.36**	33	9.0	262	103	26,986	89	26.8
The increase/decrease percentage (%) in 2008/09 compared with 2006/07.								
(%)	**↑ 76**	**↑ 23**	**↑ 43**	**↑ 56**	**↓ 6**	**↑ 48**	**↑ 6**	**↑ 11**



Technique improvement points;

* Consciousness to importance of planting density is improved.

Fig. 1 Change the number of hill per ㎡



Technique improvement points;

1. Increase the seedling number per hill.
2. Apply fertilizer.
3. Use young seedling.
4. Weeding.

Fig. 2 Change the number of panicle per hill.

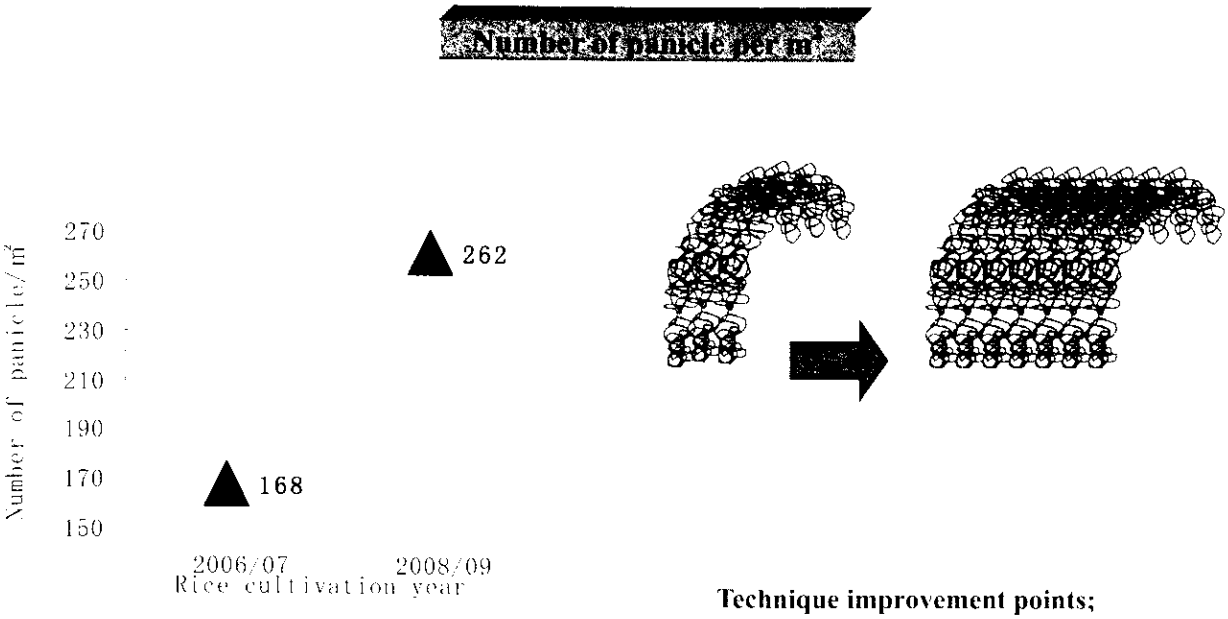


Fig. 3 Change the number of panicle per m^2

Technique improvement points;

1. Increase seedling number per hill.
2. Use young seedling.
3. Apply fertilizer.
4. Weeding.

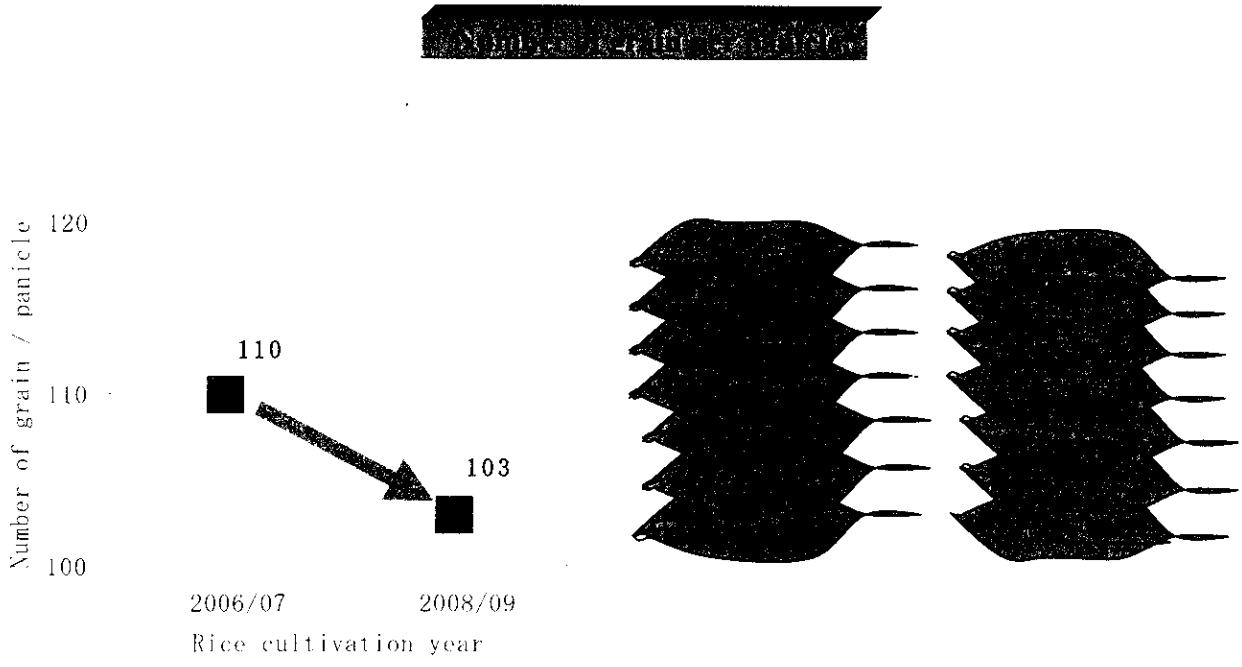


Fig. 4 Change the number of grain per panicle

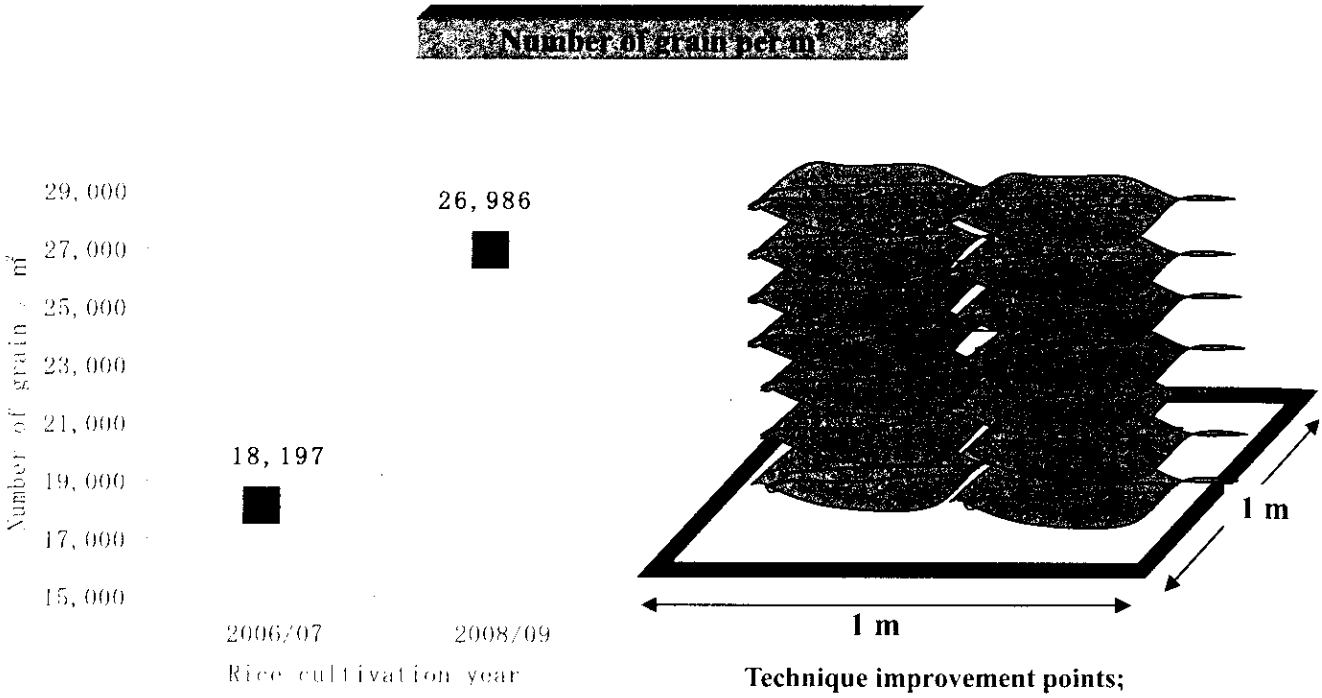


Fig. 5 Change the number of grain per m²

Technique improvement points;

1. Increase the seedling number per hill.
2. Use young seedling.
3. Apply fertilizer.
4. Weeding.
5. Split application of urea.

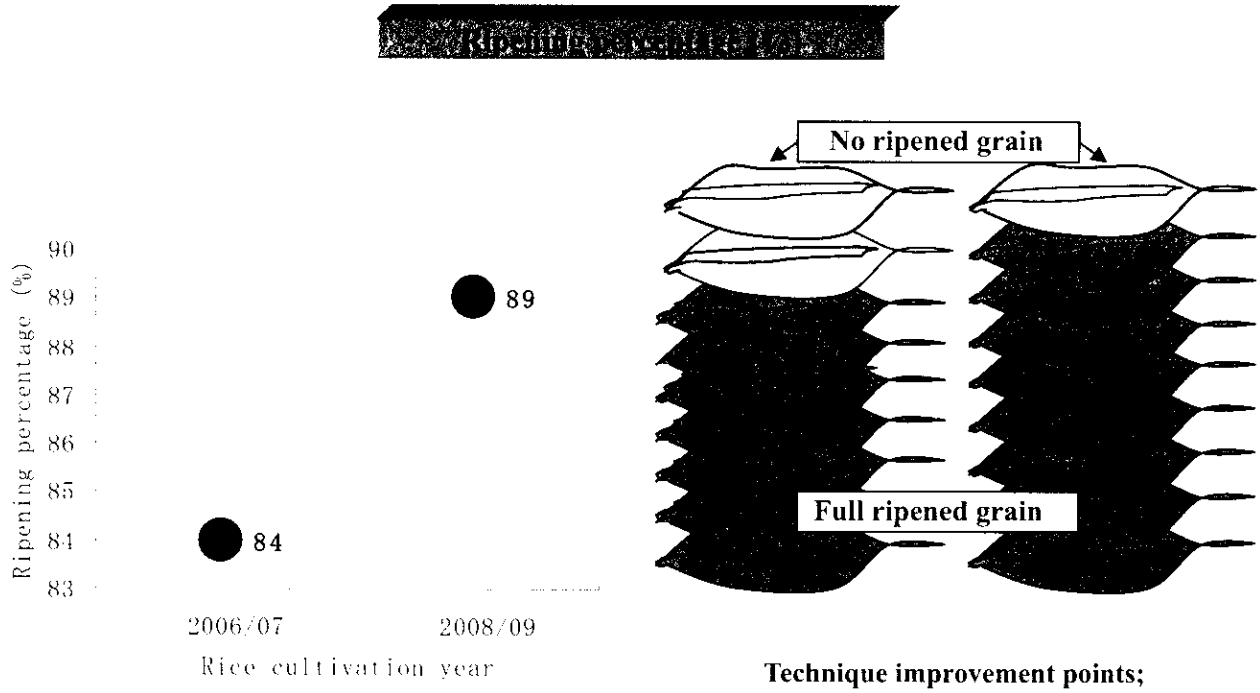
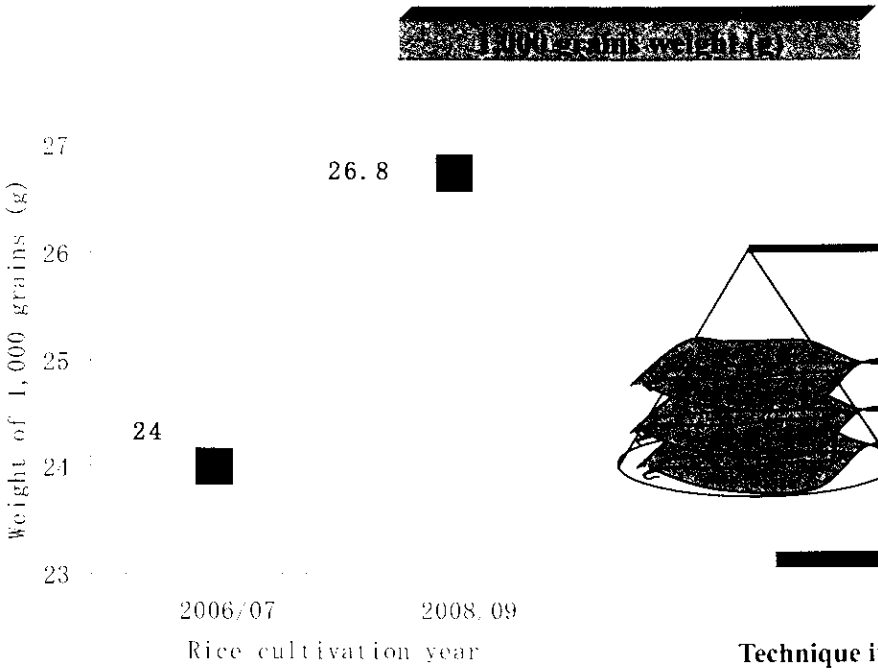


Fig. 6 Change the ripening percentage.

Technique improvement points;

1. No variety mix.
2. Use young seedling.
3. Apply fertilizer.
4. Weeding.



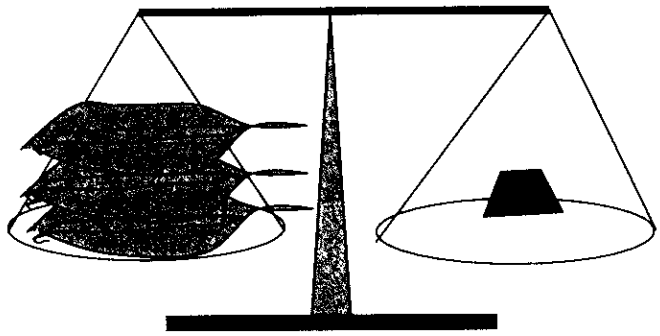


Fig. 7 Change the weight of 1,000 grains

Technique improvement points;

1. No variety mix.
2. Use young seedling.
3. Apply fertilizer.
4. Weeding.

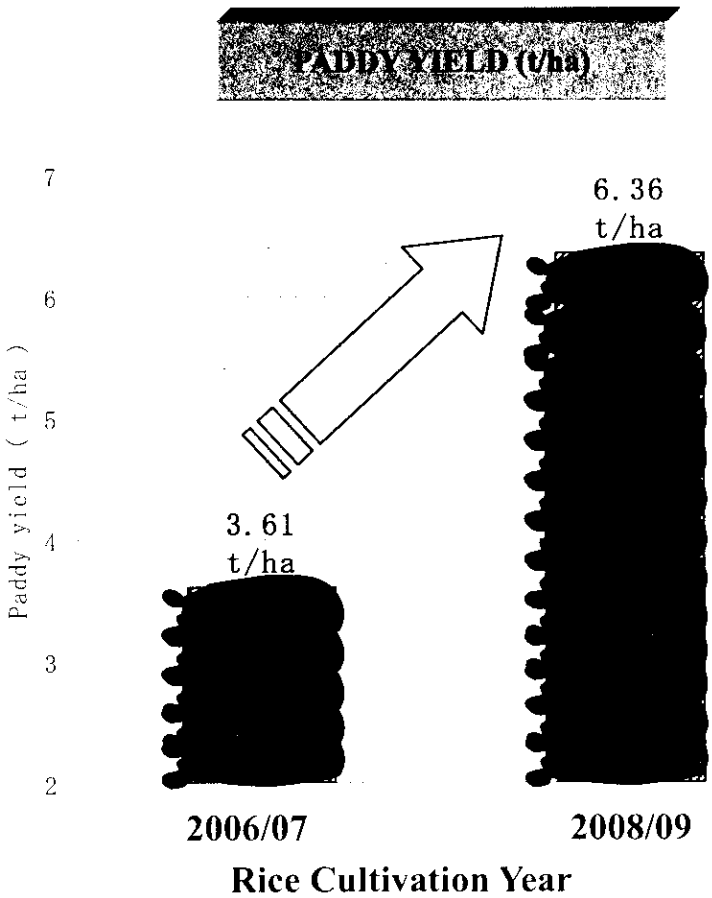


Fig. 8 Change of the paddy yield per ha.

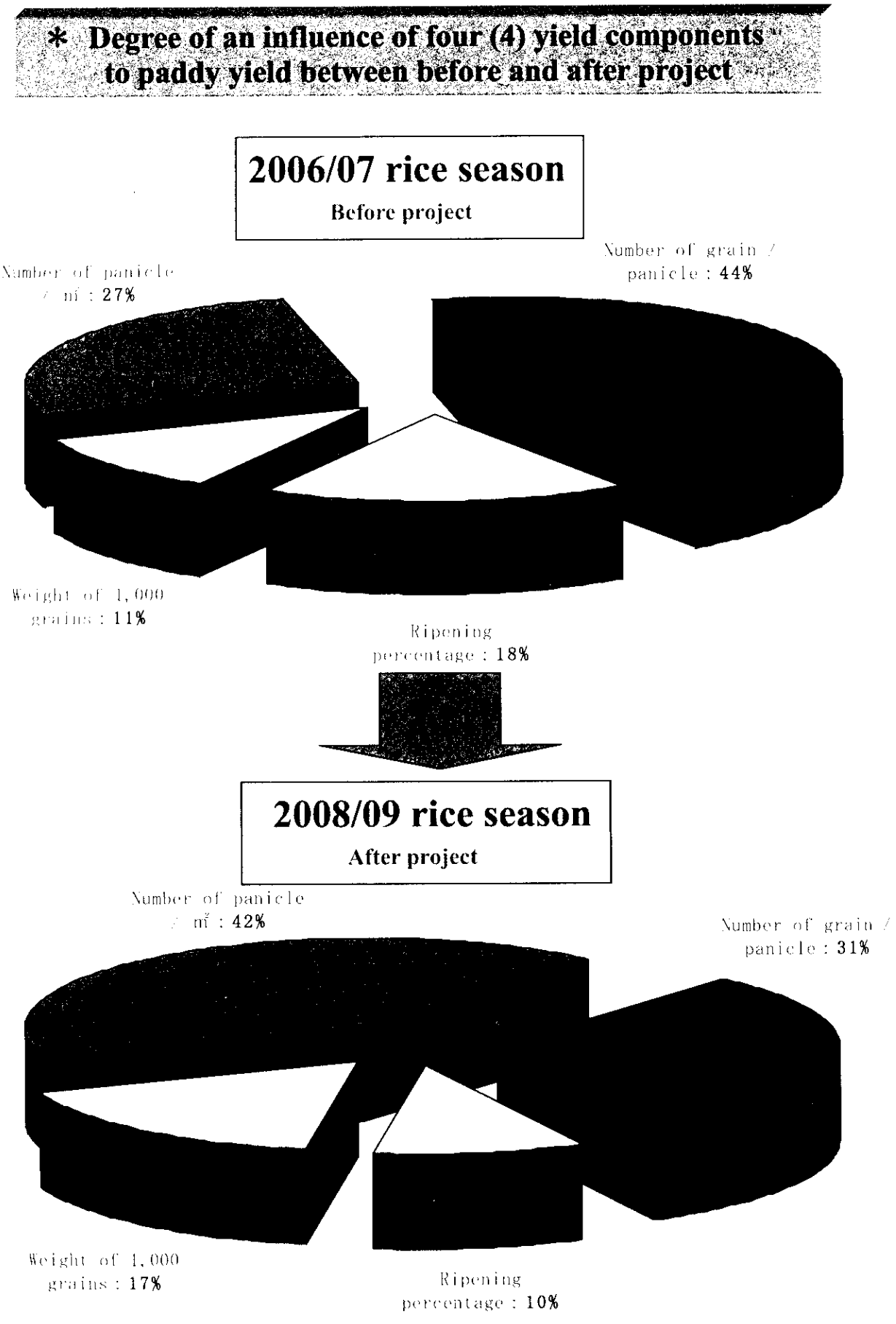


Fig. 9 Strength of the influence of four (4) yield components to the paddy yield

III. Result on variety comparison experiment

* **Total growth duration** (Transplanting cultivation method)

Limpopo	**125 days**
IR 64	**120～125 days**
ITA 312	**130～135 days**

* **Cultivation condition** : (1) Total nitrogen application quantity: **90kg / ha** ≒ **4 bags Urea / ha**
(2) Planting density : **30 hills /** m^2
(3) Number of seedlings : **4 ～6 seedlings / hill**
(4) Weeding : **4 times**

* **Result: Paddy yield and Yield components.**

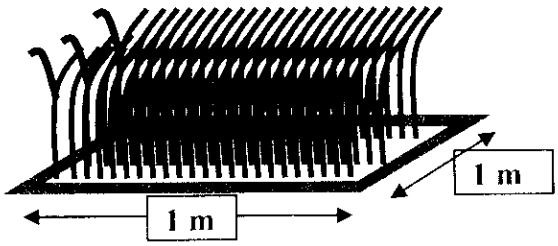
Table 4 Summary table of yield and yield components of each variety.

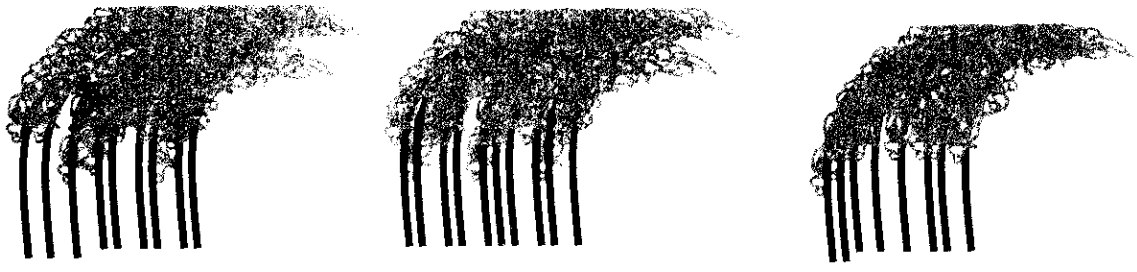
Variety	Paddy Yield(t/ha)	Panicle nos. /hill	Panicle nos. /m^2	Grain nos. /panicle	Ripening %	1,000 grains weight
Limpopo	9.39	**11.4**	**342**	**116**	85.9	27.48
IR 64	7.73	12.7	382	**117**	**80.8**	**21.38**
ITA 312	**6.78**	**9.9**	**298**	128	**69.6**	**25.74**

Note: Red number showed maximum value.

1. Number of panicle per hill and per m^2

The **Number of panicle per hill as well as** m^2 is maximum in IR 64 and Limpopo is second, and smallest is ITA 312. From this result, the tiller outbreak ability is high in IR 64, and Limpopo is medium.





342 panicles / m^2 — **Limpopo** — Much tiller number type variety

382 panicles / m^2 — **IR 64**

298 panicles / m^2 — **ITA 312** — Less tiller number type variety

Fig. 10 Comparison of panicle number per m^2

2. Number of grain per panicle

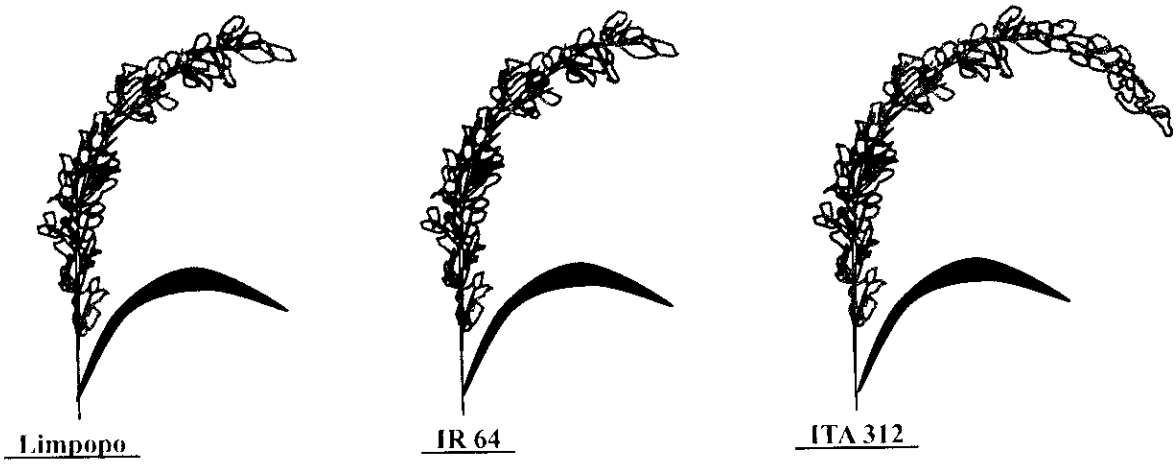


Fig. 11 Comparison of grain number per panicle

3. Ripening percentage (%)

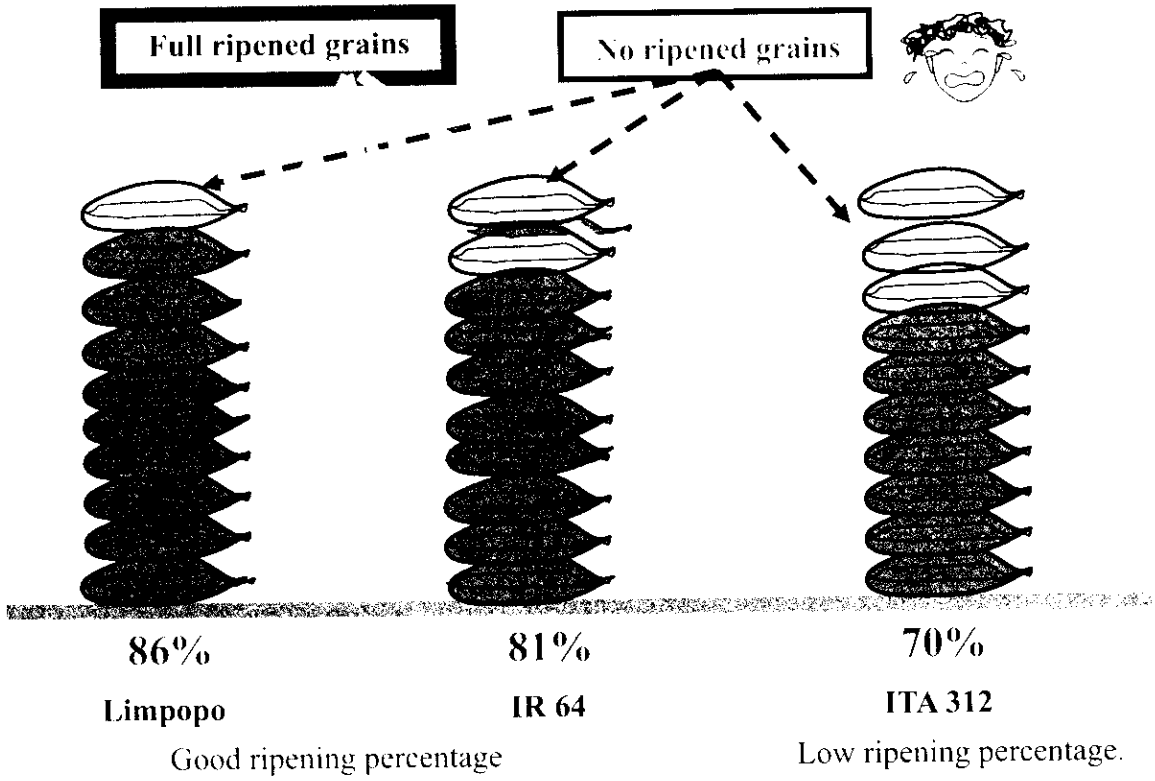
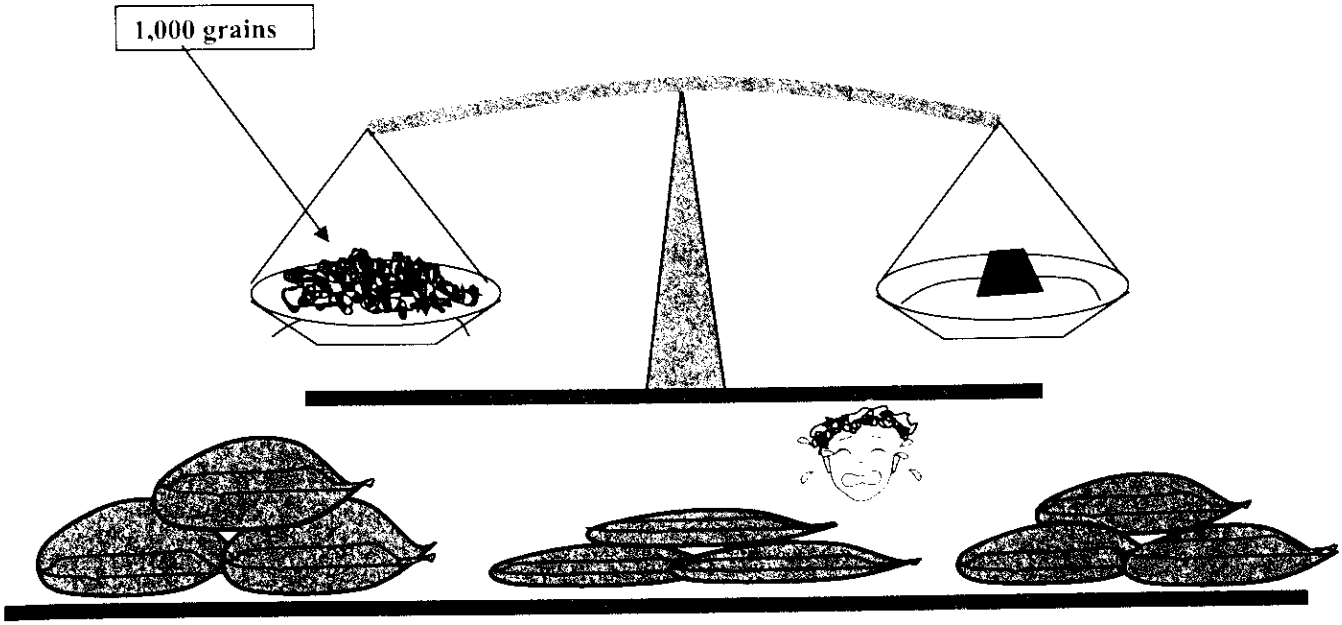


Fig. 12 Comparison of ripening percentage

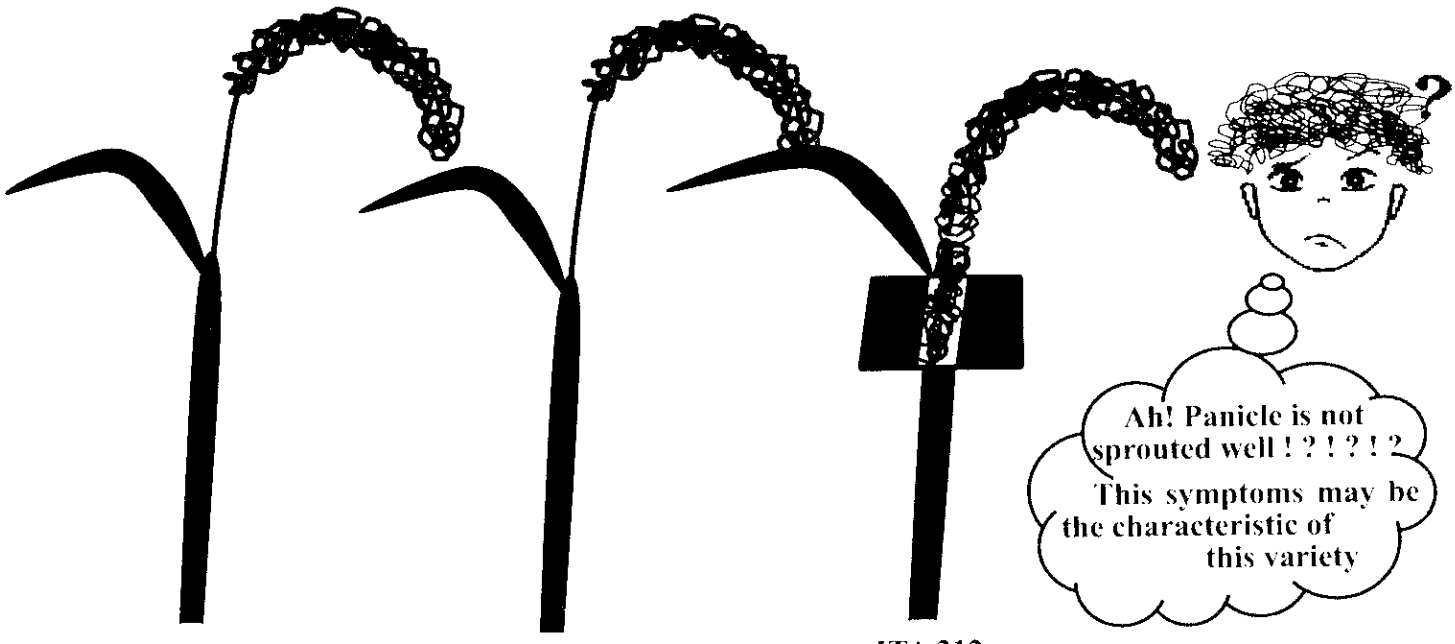
4. 1,000 grains weight (g)



27.5 g / 1,000 grains	21.4 g / 1,000 grains	25.7g / 1,000 grains
Limpopo	IR 64	ITA 312
Big grain	Small grain	Medium grain

Fig. 13 Comparison of 1,000 grains weight

5. Head (panicle) sprouting condition in each variety



Limpopo	IR 64	ITA 312
Perfect head sprouting	Perfect head sprouting	**Imperfect head sprouting**

Fig. 14 Comparison of panicle sprouting condition in respective variety

IV. The important techniques for higher paddy yield.

The important yield component for push up paddy yield is became cleared though above experiment and survey which is conducted in project period.

Influence ratio of each components

PADDY

- Number of panicle / hill 40～50% = Number of hill / m^2 × Number of panicle / hill
- Number of grain / pani. 20～30%

YIELD

- Ripening percentage 10～15%
- 1,000 grains weight 10～15%

Top priority technique for paddy yield increase is;

Increase the number of panicle per m^2.

- ＊Raising quality seedling : Semi flood type nursery bed.
- ＊More perfect paddling and levelling.
- ＊Use young seedling : 21～30 days seedling.
- ＊4～6 seedlings per hill with shallow transplanting, and 30 hills per m^2 of planting density.
- ＊Apply urea 2～3 bags per ha.
  ＊50% at 7-10 days and 25% at 14-21 days, and remaining 25% at 70-75 says after transplanting
- ＊2～3 times weeding in first half of growth period.

V. Nursery bed preparation and seedling quality

1. Healthy and quality seedling is;

- **Increasing panicle number per m^2**
- **Increasing grain number per panicle and m^2**
- **And, ripening percentage also up.**

The condition of good seedling is;

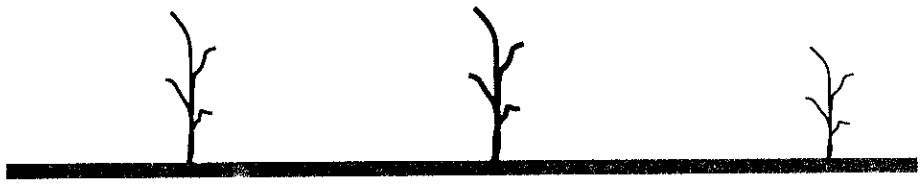
* **Thick and stockily form seedling.**
* **Plant height is not more than 30cm.**
* **Seedling age is less than 30 days.**

2. Nursery bed style and seedling quality

(1) Result of different nursery style experiment.

Treatment: Nursery bed style : BS 1 = Flood type nursery.
BS 2 = Semi flood type nursery.
BS 3 = Upland dry bed type.

Seed bed style	Flood bed style	Semi-flood bed style	Upland bed style



Seedling height (cm)	**27.1** cm	**27.0** cm	**17.3** cm
Green Seedling weight (mg)	**268** mg/plant	**246** mg/plant	**196** mg/plant
Dry matter weight (mg)	**45** mg/plant	**49** mg/plant	**38** mg/plant

A rectangular shaped and semi-wetted seed bed is recommendable.

* Width of each **seed bed is 1.2 m** and each ditch is **30 cm wide.**

* **Seed bed width is 1.2m**

* Ditch width is **30cm wide.**

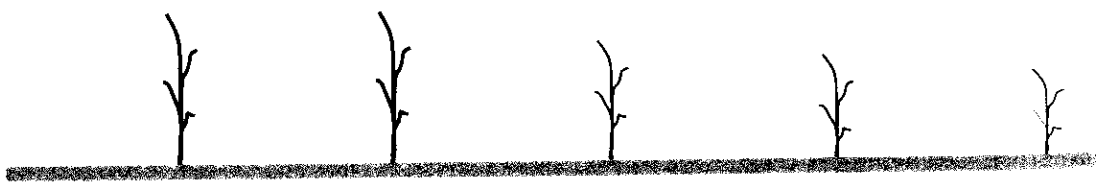
Photo 1. View of good growth seedling with semi-flood nursery bed.

3. Nursery bed area (= Sowing density of seed)

(2) Result of different seeding density on seedling quality.

Treatment: SD 1: 117 g/m^2 (equivalent to 1/17 of the main paddy field area)
SD 2: 140 g/m^2 (〃 1/20 〃)
SD 3: 175 g/m^2 (〃 1/25 〃)
SD 4: 233 g/m^2 (〃 1/33 〃)
SD 5: 350 g/m^2 (〃 1/50 〃)

Seed bed area(m^2/ha)	588 m^2	500 m^2	400 m^2	303 m^2	200m^2
Equivalent against main paddy field	1/17	1/20	1/25	1/33	1/50



Seedling height	26.6cm	26.0cm	25.8cm	25.6cm	23.5cm
Green Seedling weight	273 mg/plant	273	230	257	170
Dry matter weight	52 mg/plant	44	38	44	29

A seed bed area of 400～500 m² is necessary for each 1 ha of paddy field (The seed bed area includes ditch.)

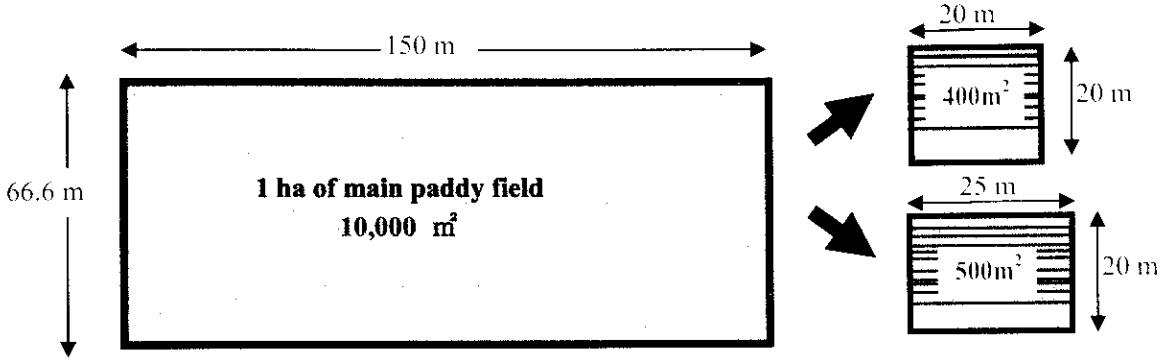


Fig.12 Optimum seed bed area per 1ha of main paddy field.

According to experiment results, the seedlings become shorter and smaller if seed bed area narrows to than 400 m² against 1 ha of main paddy field.

Seed bed area 500 m² (1/20) for 1 ha of paddy field.

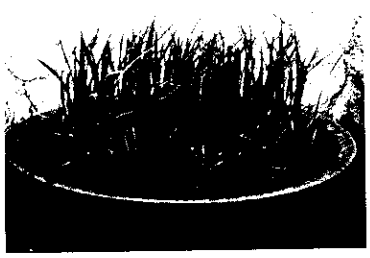
Seed bed area 200 m² (1/50) for 1 ha of paddy field.

Difference of seeds quality. Left: 1/20. Right: 1/50.

Photo 2 Differences in seedling quality between optimum and small seed bed area.

4. Nursing duration (Seedling age)

Nursing duration is very important for ensuring large and healthy tillers as well as big panicle size and big panicle number per unit area. Nursing duration must be between 21days and 30 days. Nursing duration of more than 30 days will usually cause un-seasonal sprouting of panicles just after transplanting, small panicle size and less panicle number per unit area.



← ↑ Most ideal seedling condition.
Leaf age: 4-5 leaf stage.
Plant height: 20-25 cm.

But, it is very common to see many farmers using these 40 or 50 days seedling. These seedling can not secure sufficient tiller number per unit area.

Photo 3 Good quality seedlings(left) and farmer's very old/bad seedling(right)

Following problem will be occurred if seedling age old as above photo 40 to 50 days seedling.

- *** Difficult obtaining sufficient number of tiller per unit area.**
- *** Difficult obtaining big size of panicle.**
- *** Occurring the un-seasonal head sprouting just after transplanting.**
- *** And, paddy yield become low finally.**

5. Cover methods trial for nursery bed.

(4) Treatment: Nursery bed style : CM 0 =No cover.
CM 1 =Mixed with bed surface soil.
CM 2 =Cover with dry soil.
CM 3 =Cover with carbonated rice husk.

Table 5 Effect of cover soil method on germination.

	Germination percentage (%)		
Date of survey / Treatment	3 days after seeding	6 days after seeding	9 days after seeding
CM 0	88	94	98
CM 1	71	86	89
CM 2	83	90	96
CM 3	84	94	98
Statistical significance	**	*	**
CV (%)	4.7	3.7	1.4
LSD .01	3.7	3.2	1.5
LSD .05	2.6	2.2	1.1

Note: **, * is showed significant at 1% and 5% respectively.

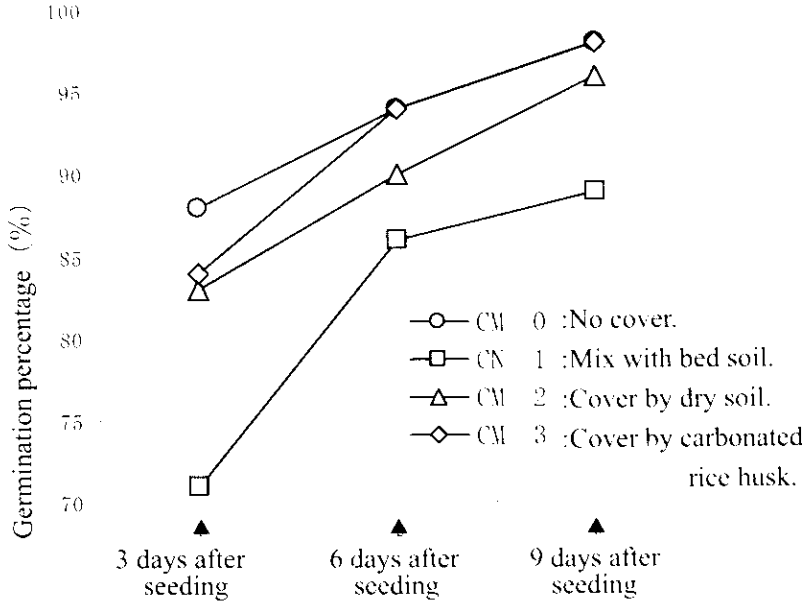


Fig. 15 Change of germination condition by different cover method.

6. Preparation process of seed bed

Photo 4. Measuring the seed bed area.

Photo 5. Making the seed bed and ditch.

Photo 6 . Leveling under dry condition.

Photo 7. Final leveling after putting water.

Order in nursery bed preparation is shown below:

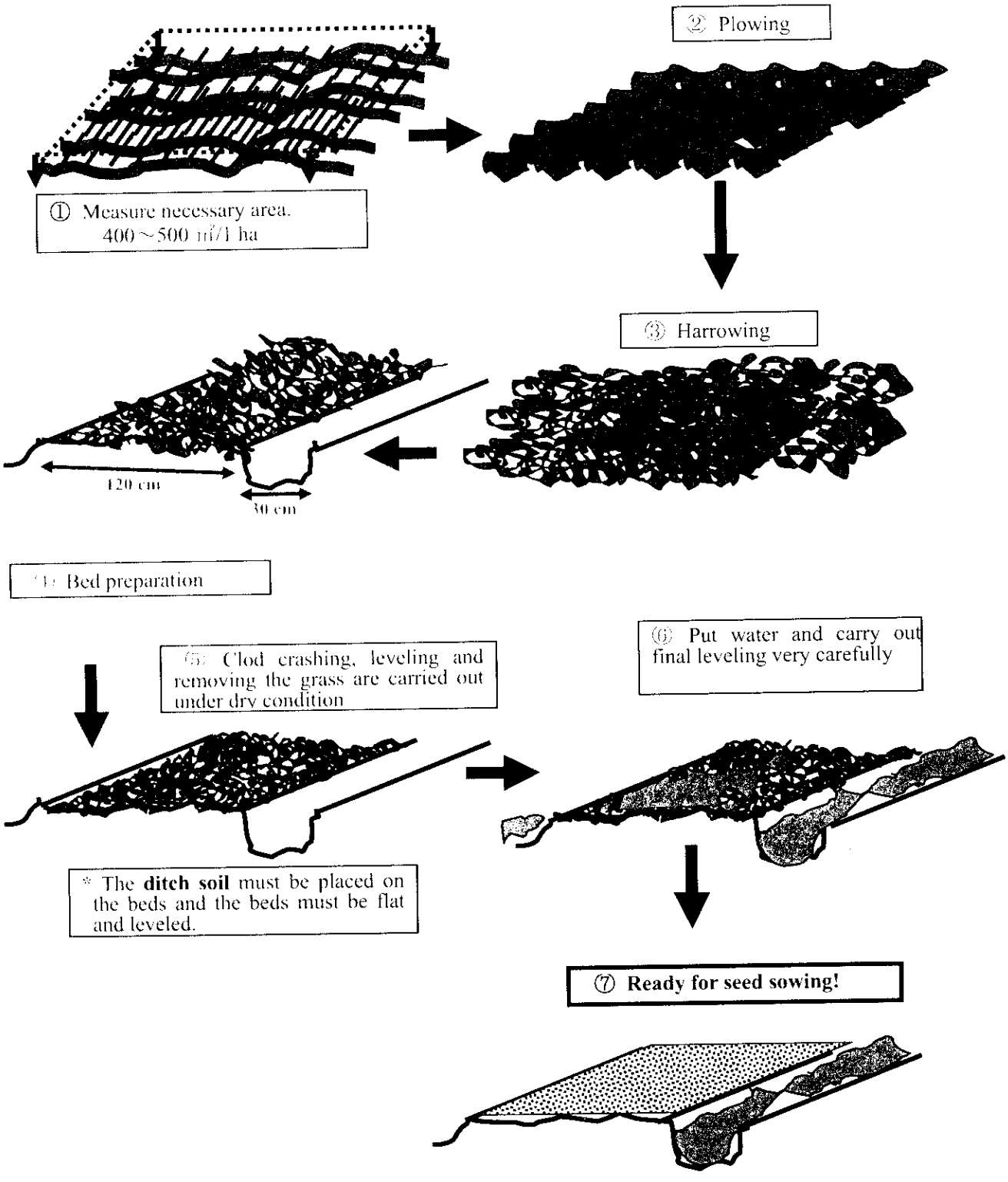


Fig.16 Process of seed bed preparation.

7. Seed sowing and covering method.

The seed sowing process is shown below;

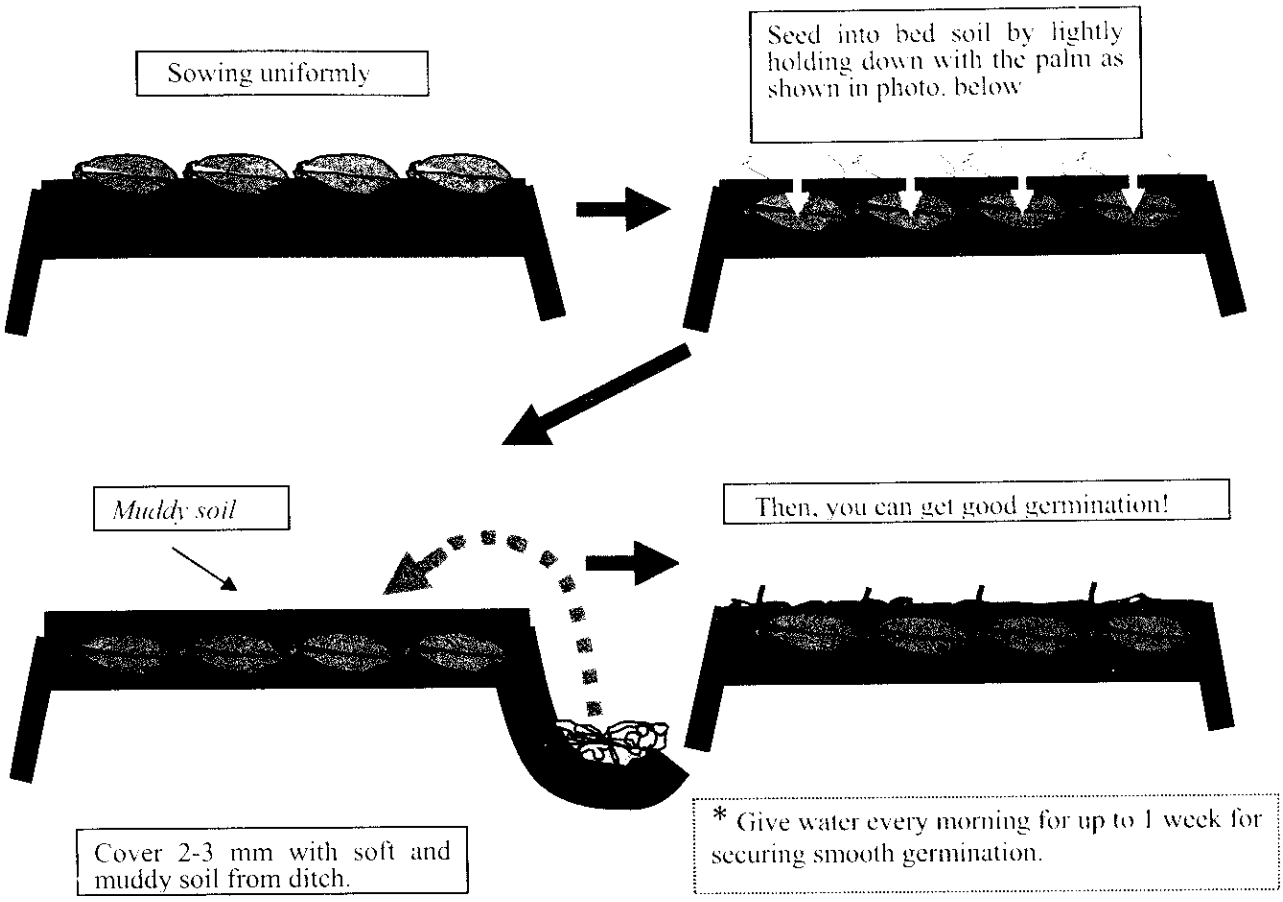


Fig.17 Process of sowing seed to nursery bed and covering method .

Photo 8. Seeding work.

Photo 9. Tapping and covering work by hand.

8. Seed bed management and fertilizer application

(1) Seed bed weeding

Weeding work is needed from time to time during nursing period if weed comes out. If no weeding is practiced, many grass come out, seedling becomes small and tiny, the setting period takes too long which finally results in reduced tiller number/panicle number

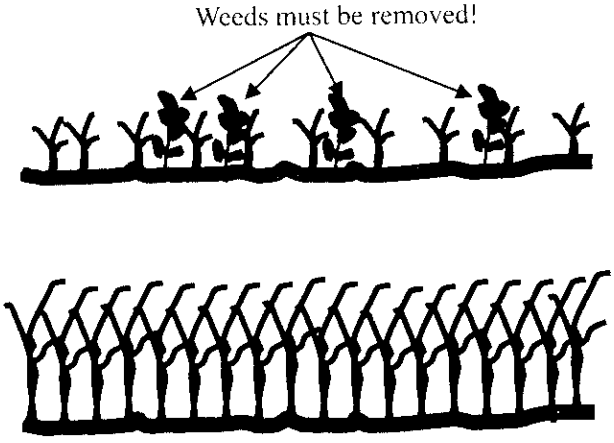


Fig.18 Comparison of weeded and not weeded nursery beds.

(2) Urea top-dressing to seed bed

If leaf color becomes yellow at middle stage, apply urea 3-5 g per m^2 ($400m^2$=2 kg, 500 m^2=2.5 kg). But, don't apply urea later than after half of nursing period.

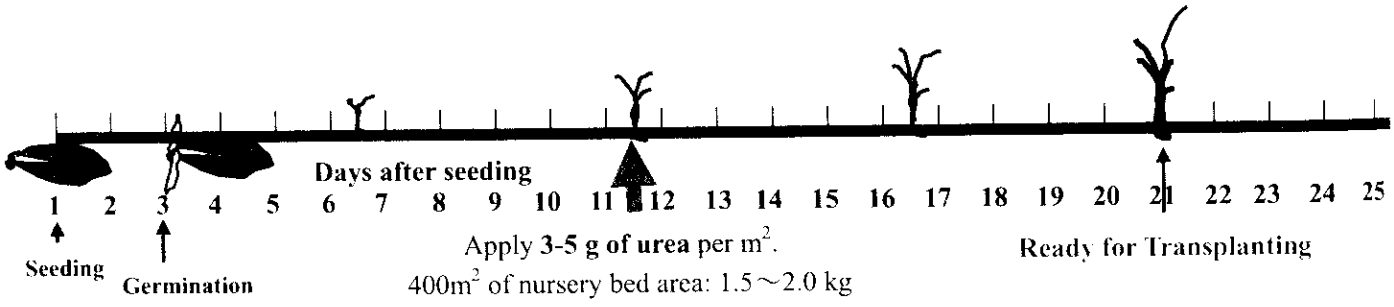


Fig.18 Optimum time for urea top-dressing to seed

(3) Water management of seed bed

* **Just after seeding up to 7 days:** Every morning, give water at about 1-2 cm height from the bed surface
* **7-14days:** Give water every 2-3 days using the same method as above.
* **15days-transplanting time:** Give water every 4-5 days, and give sufficient water 1 or 2 days before seedling uprooting work start.

VI. Main paddy field preparation

1. Ploughing and harrowing.

Use a tractor to plough not deeper than 20-25 cm. Ploughing and harrowing timing is very important. Indeed ploughing in September or October is good for killing the weed if there is no preceding crop. Any way, the grass killing effect of plowing and harrowing are long days.

2. Plotting work, if the whole field is not well leveled.

Most of the fields in this irrigation scheme are slightly inclined. Therefore under these conditions, it is very difficult to keep water uniformly spread throughout the whole area. So, land needs to be divided into small plots, which allows good leveling as shown below:

If for example land area has 0.5 ha, divide it into at least 8 small plots; further division would be needed if field is very sloppy.

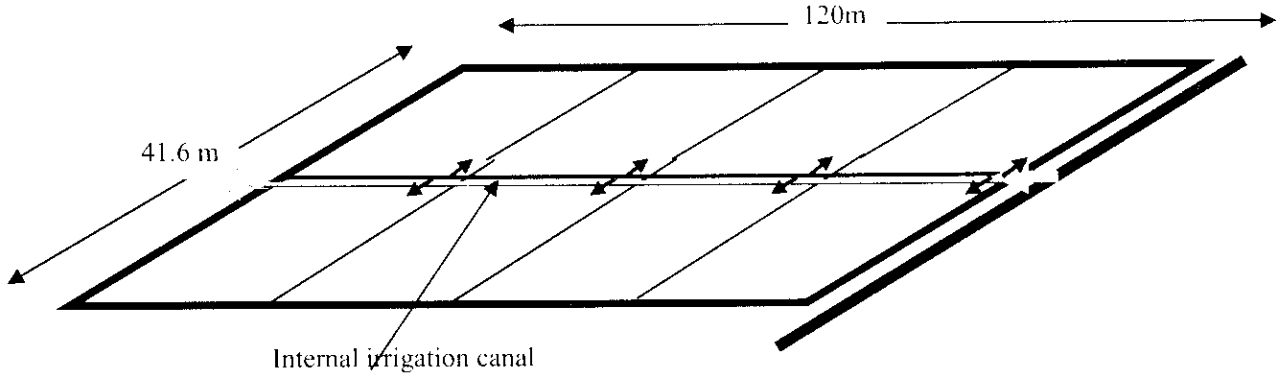


Fig. 19 Unleveled field must be divided into small plots to facilitate good leveling

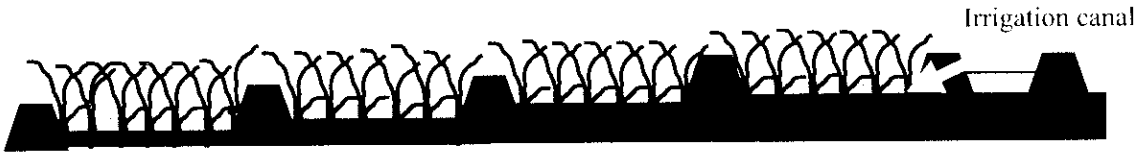


Fig. 20 Good plotted field.

Photo 10 View of plotted small plots and puddling work by hoe.

3. Puddling and leveling.

The purpose of puddling is to make soil soft for easy rooting of the rice plant just after transplanting, and to save irrigation water by minimizing percolation. After the puddling, leveling work is also continuously needed. Rice plants grow well under 10 cm of flooded soil. Flooding irrigation prevents weeds from coming out just after transplanting. Puddling and leveling can be done using cattle as shown below.

Photo 11 View of puddling and levelling work by animal power.

Leveling work is also important as it allows uniform growth of rice plant. Uniform growth is one of the factors that determine high yield. Many grass breaks out where soil is exposed just after transplanting and urea effect also is reduced if field surface is not well leveled.

The view of a well leveled field and transplanting work in D 4, '07/08.

The view of uniform growth of rice at two weeks after transplanted in D 4.

Photo 12 Ideal transplanting work and excellent growth condition after 15 days after transplanting at D 4 in 2007/08 season.

Table 6 Supposition yield if field is un-leveled.

Field condition (1 ha: 10,000m2)	If good leveled condition (Paddy yield: t/ha)	Actual paddy yield (Paddy yield: t/ha)
10% is high and no water.	6	4.5
25%	6	3.5
50%	6	2.5

VII. Transplanting

1. Planting density

The recommended planting density should be of 30 hills per m^2 (hill to hill's space: about 18cm between two neighbor hills). To obtain more paddy yield, increasing seedling population per unit area is very effective and quick.

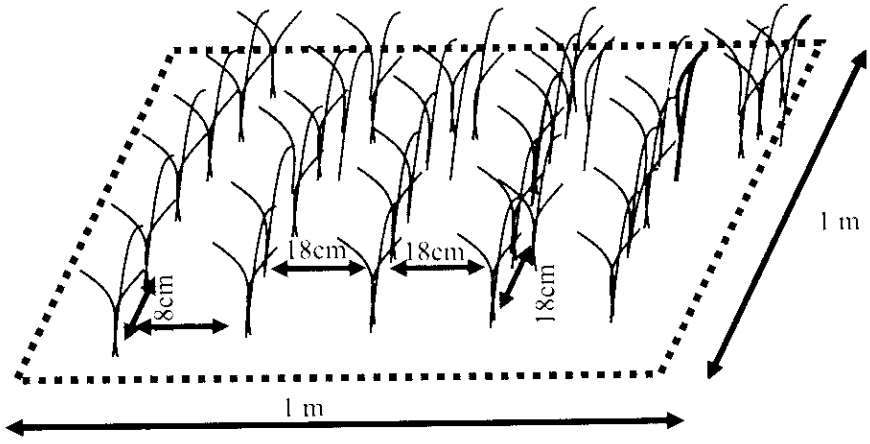


Fig. 21 Image of 30 hills per m^2.

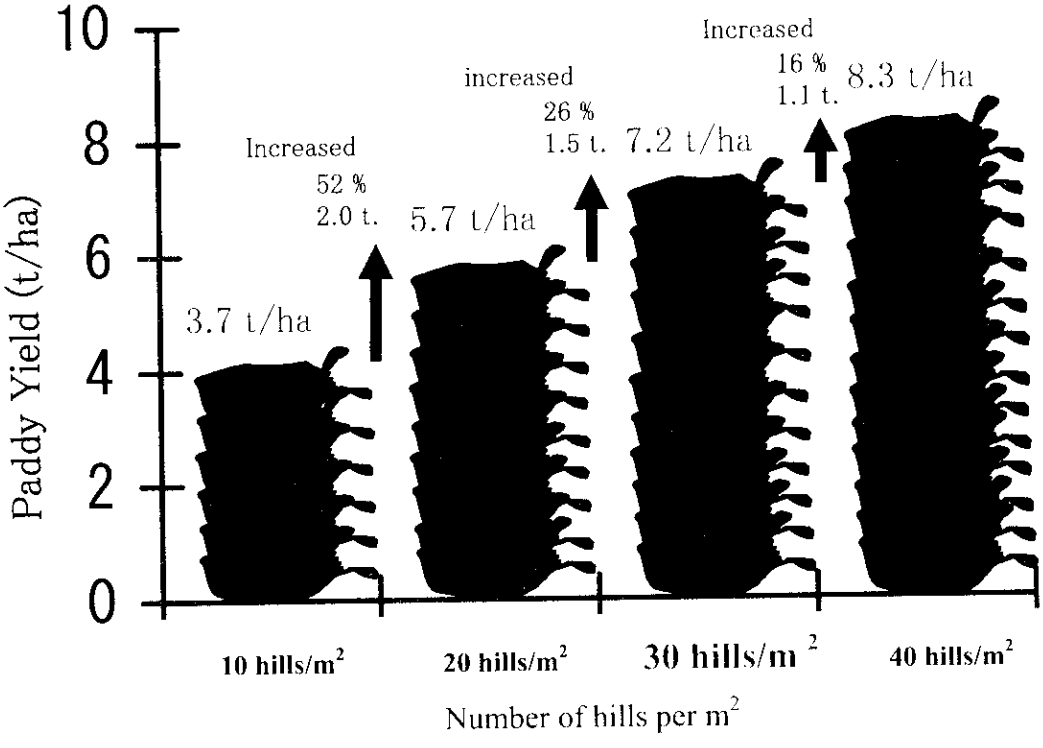


Fig.22 Different planting density and paddy yield.

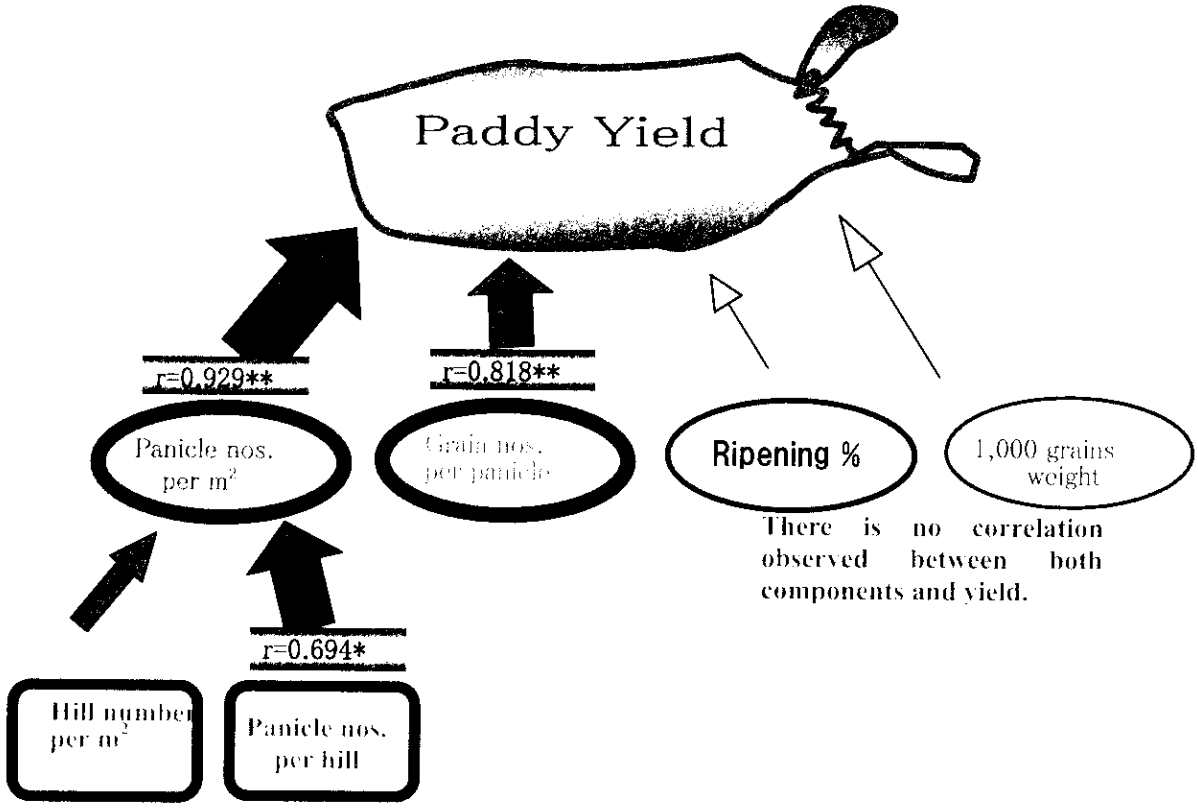


Fig. 23 The relationship between four yield components and paddy yield in different planting density schemes.

2. Number of seedlings per hill

The experiment of "Seedling number per hill has been conducted at Experimental Field in Research Station during 2007/08 season using the method shown below;

1 seedling per hill | 3 seedlings per hill | 6 seedlings per hill | 9 seedlings per hill

Fig.24 Treatment method of seedling number per hill.

Through this experiment, the result was that with 6 seedlings per hill the maximum paddy yield obtained was 8.7 t/ha. With 9 and 3 seedlings, the yield was 8.6 and 7.8 t/ha respectively, while with 1 seedling per hill the maximum paddy yield obtained was only 4.5 t/ha, being the lowest yield in four treatments.

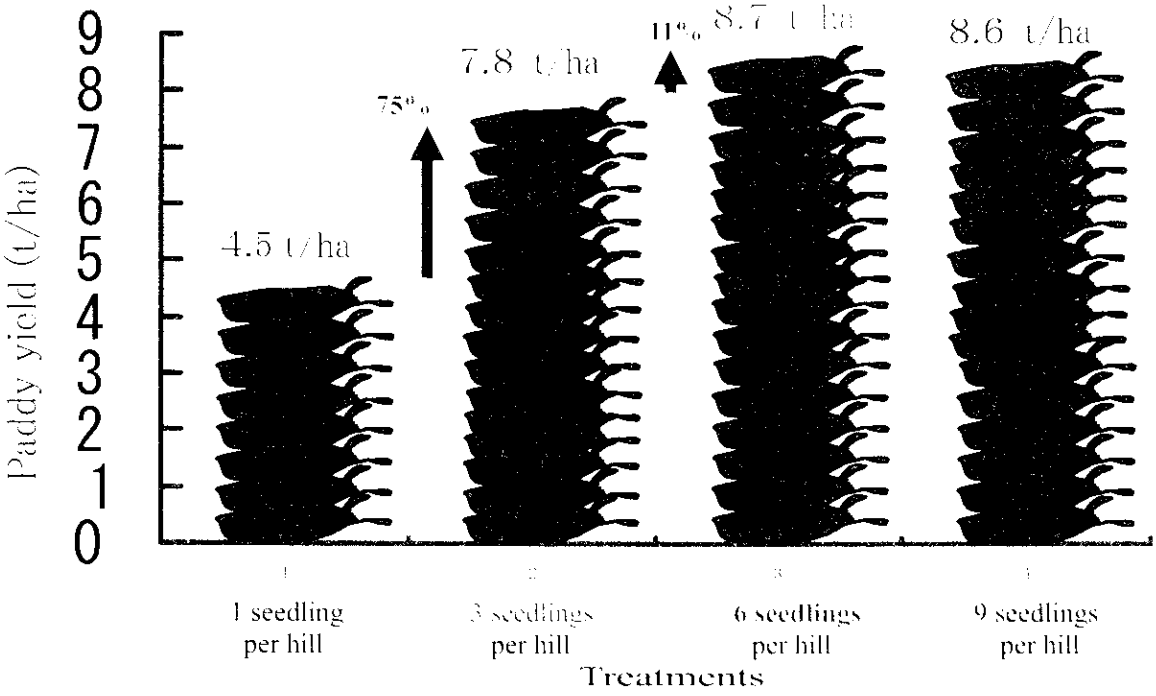


Fig. 25 Difference of paddy yield by different seedling number per hill treatments.

3. Transplanting depth

Shallow transplanting is also an important factor for improving tiller outbreak during the effective tillering period.

If transplanting has been correctly executed, i.e in shallow depth, tiller outbreak is smooth from the rooting (setting) period (about 7 days after transplanting). By the contrary, if transplanting is carried out as deeply as 8-10 cm into soil, first few roots will come out from the bottom, then other roots will come out from upper node near soil surface.

If this occurs, rooting period will take more than 2 weeks, and tiller outbreak will also delay and tiller number will be smaller.

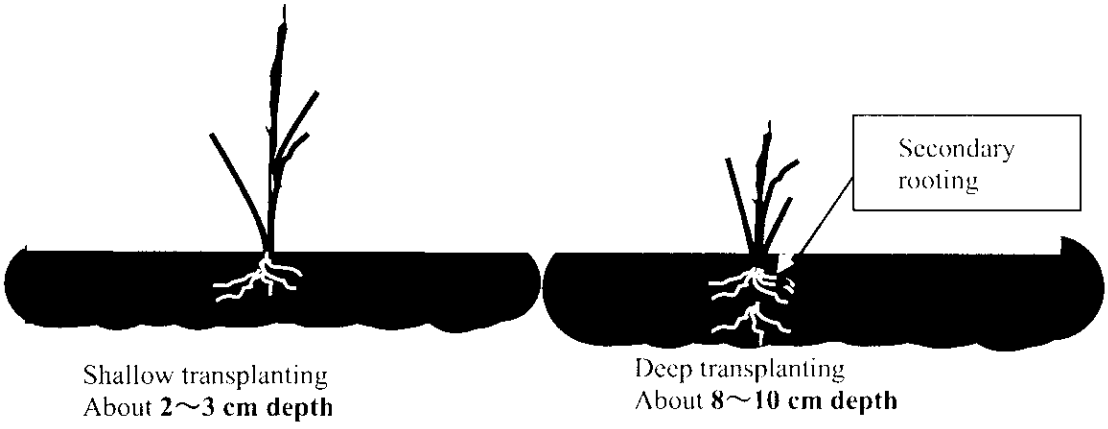


Fig.26 Comparison of shallow and deep transplanting.

In shallowly transplanted hill, new roots come out just after transplanting. But, deeply transplanted hill needs more days to complete the setting period, because in deeply transplanted seedlings secondary rooting occurs from upper node.

This means that effective tillering period becomes shorter which eventually reduces tiller (panicle) number per unit area.

VIII. Fertilizer application

1. Application quantity.

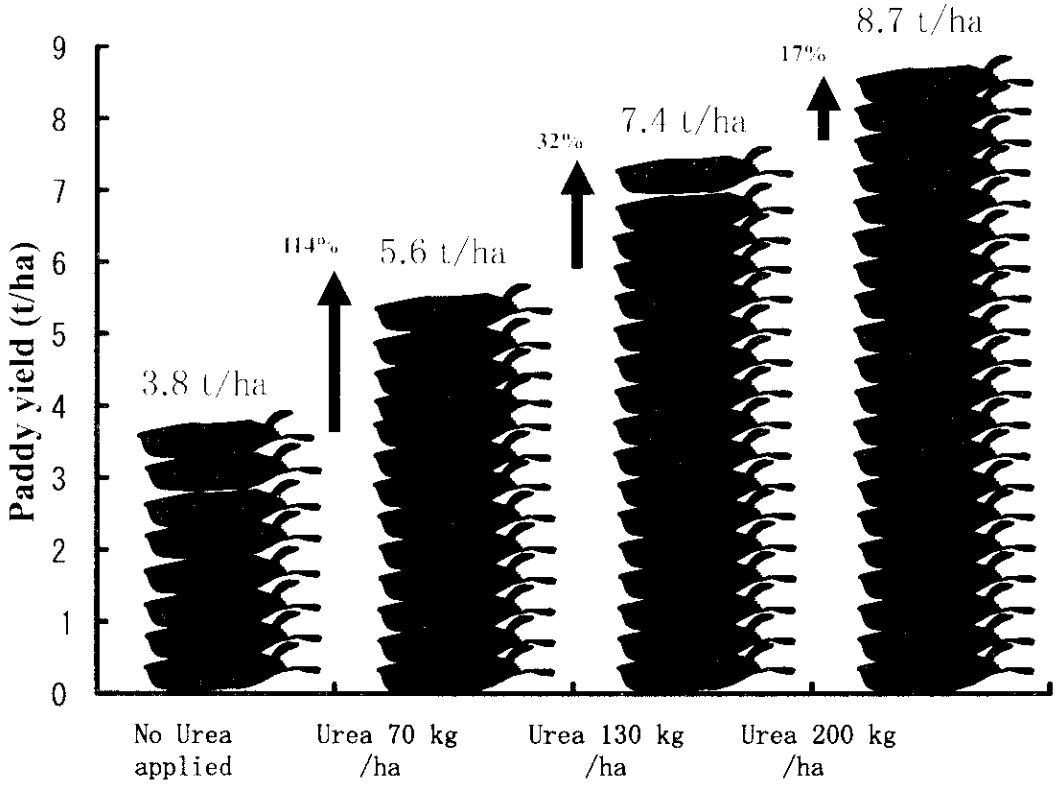
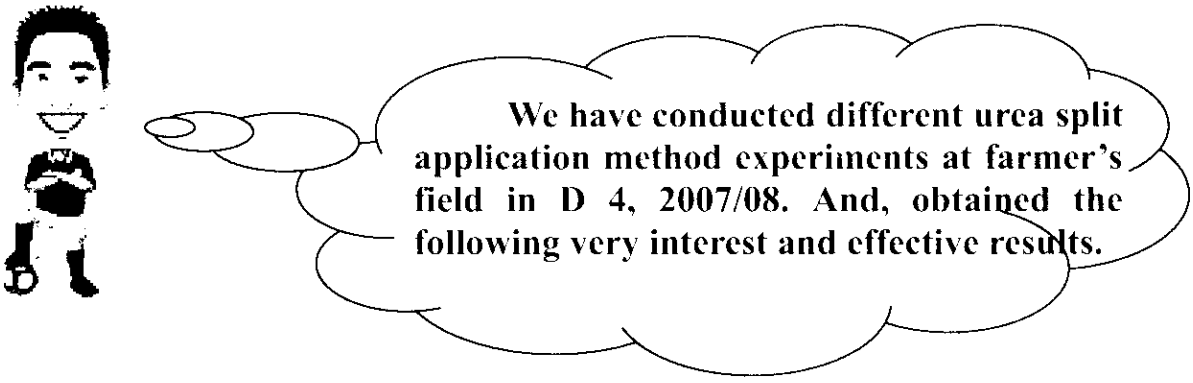


Fig. 27 Paddy yield difference according to the different applied urea quantity.

The minimum quantity of urea needed is **2 ~ 3 bags per ha, if one expects to get** high effect. 1 bag of urea can not be expected to provide high nitrogen effect.

2. Urea split application method.

The Farming Section has conducted trial on "Urea split application method" and its paddy yield at farmer's field during 2007/2008 season.



As a result of the trial, the SA 2 (Split Application Method 2) obtained maximum paddy yield of 7.3 t/ha, SA 3 followed with 6.1 t/ha, and the lowest yield of 5.9 t/ha was obtained with SA 1 application method. From this result, we can recommend 3 times top-dressing method, i.e the 1st top-dressing with 40-50% of total urea quantity 7 to 10 days after transplanting, the 2nd with 20-30% of total urea 15 to 20 days after transplanting, and the 3rd using the remaining quantity of urea just before the Reduction Division Stage (18 to 20days before the heading stage).

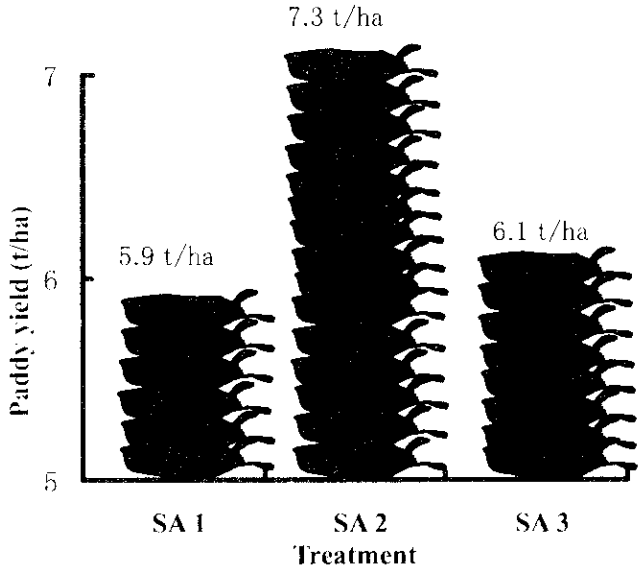


Fig.28 Paddy yield obtained with different urea application methods.

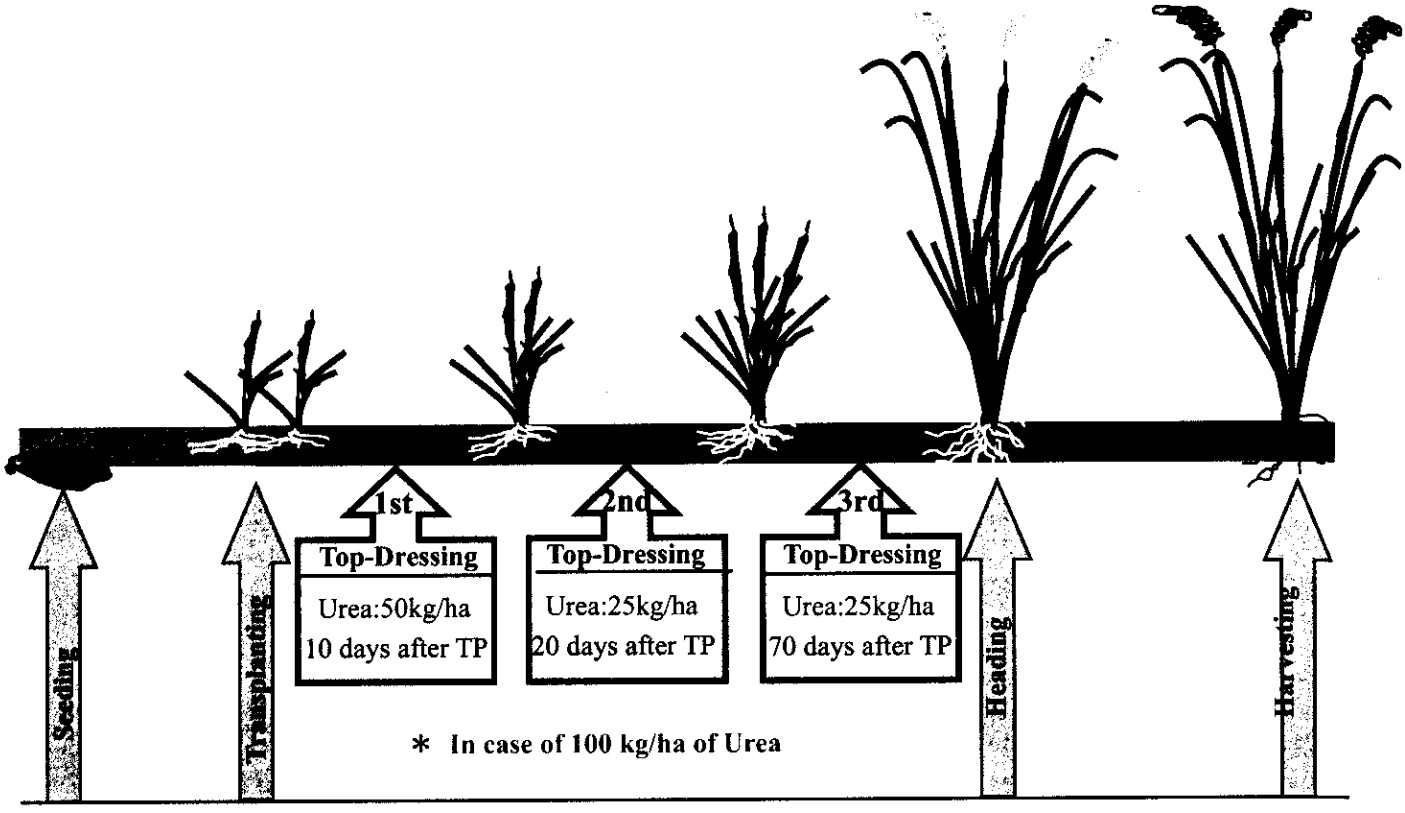


Fig. 29 Timing of top-dressing of urea on Limpopo variety.
Note: Variety is Limpopo (Total growth duration=125 days)
TP=Transplanting

IX. Self seed production method

The farmer is doing home seed production mainly in rice producing countries, and never buys seeds so frequently. Rice varietal characteristics do not change under normal cultivation condition in several years. So, home seed production can be recommended in this area with following procedure:

Step 1: Seed and seed pre-treatment

* Use pure variety seeds at first.
* Strict enforcement of seed pre-treatment, seed selection work is especially important.

Step 2: Nursing

* Nursing by improved semi-dry bed style method.
* Nursing technique should follow improved method as above.
* **During nursing period, extract the different shaped seedlings if there are taller seedlings(Fig. 39).**
* Nursing duration must be respected: 21 to 30 days

Step 3: Transplanting

* Transplanting with normal cultivation method with 4-6 seedlings per hill, 30 hills per m^2 and shallow transplanting.

Step 4: Field management and fertilizer doses

* Weeding must be done from time to time and mixing weed and seed must be avoided.
* Fertilizer doses and water management are the same as for normal cultivation.

Step 5: Extraction of the different mixed varieties

* This **extraction work of different mixed varieties** is crucial for seed production. Extraction work needs to be performed at least 4 times during the total rice growth period as

shown below (Fig. IX-1): during nursery stage, during tillering stage, during panicle initiation stage, and during ripening stage. The point of identification of different varieties at each extraction is that 1st and 2nd is height and leaf color of rice plant, 3rd is mainly height of rice plant, and 4th is maturity condition (Fig. IX-1).

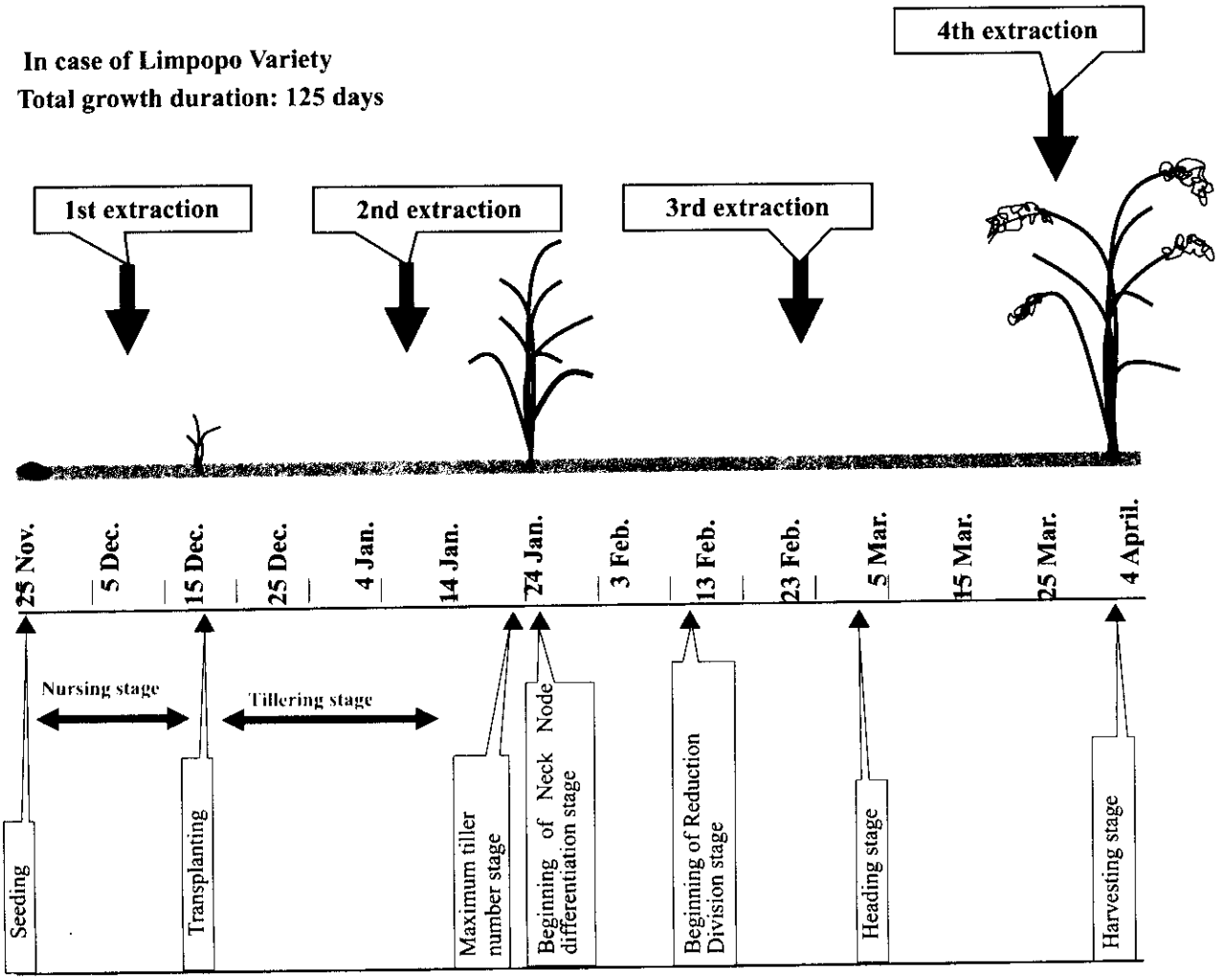


Fig. 30 The extraction timing in total growth stage of rice.

How to identify the mixed different varieties?

① Plant height.

② Leaf blade width and color.

③ Timing of ripening.

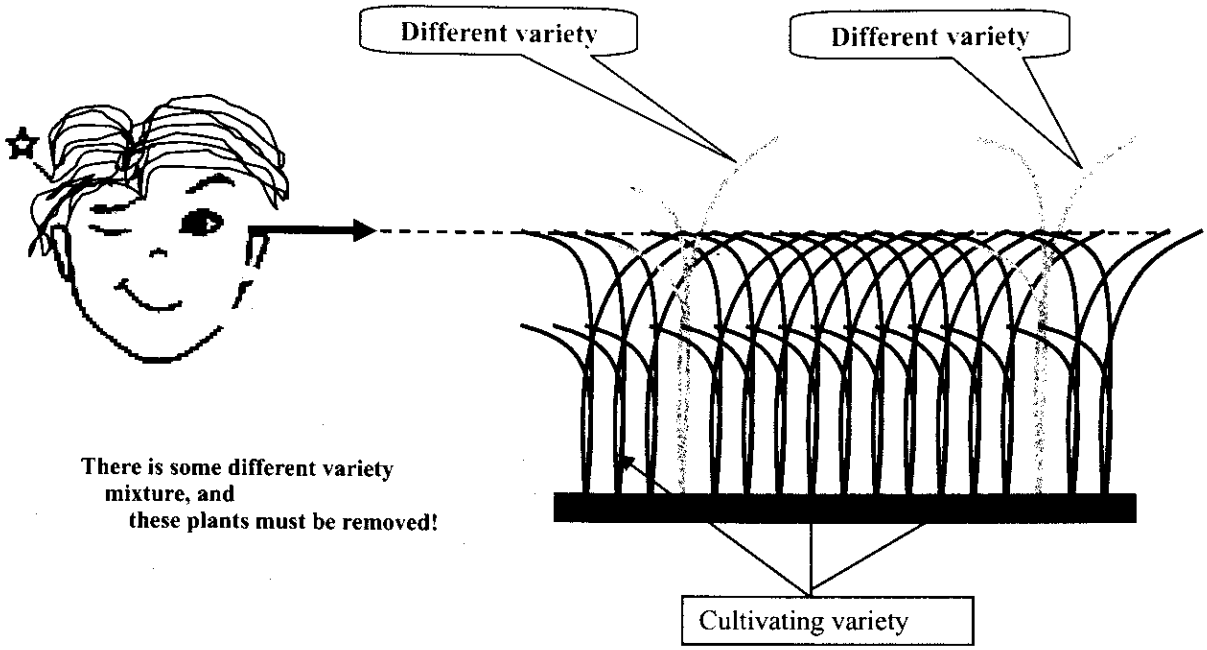


Fig. 31 Method of identification by plant height at seed bed and initial growth stage.

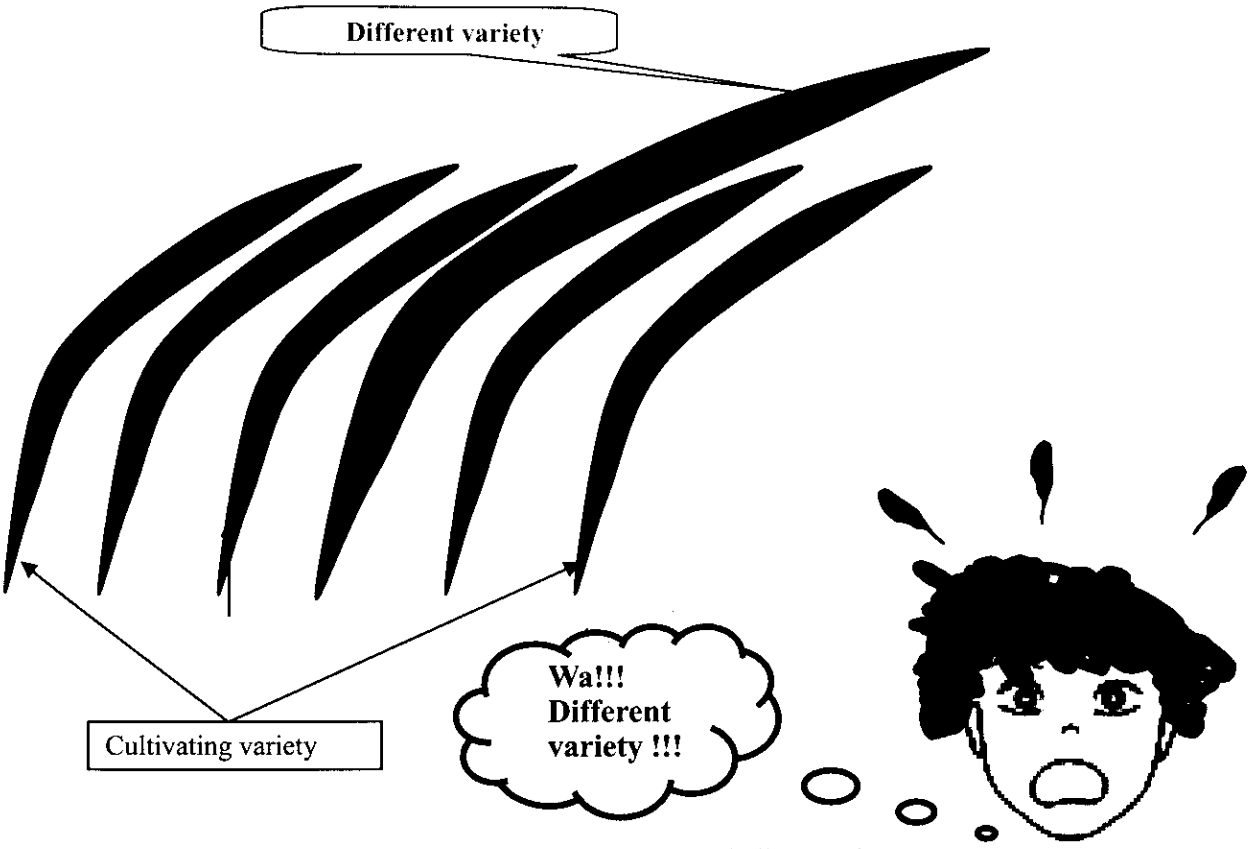


Fig. 32 Method of identifying the different variety at middle growth stage.

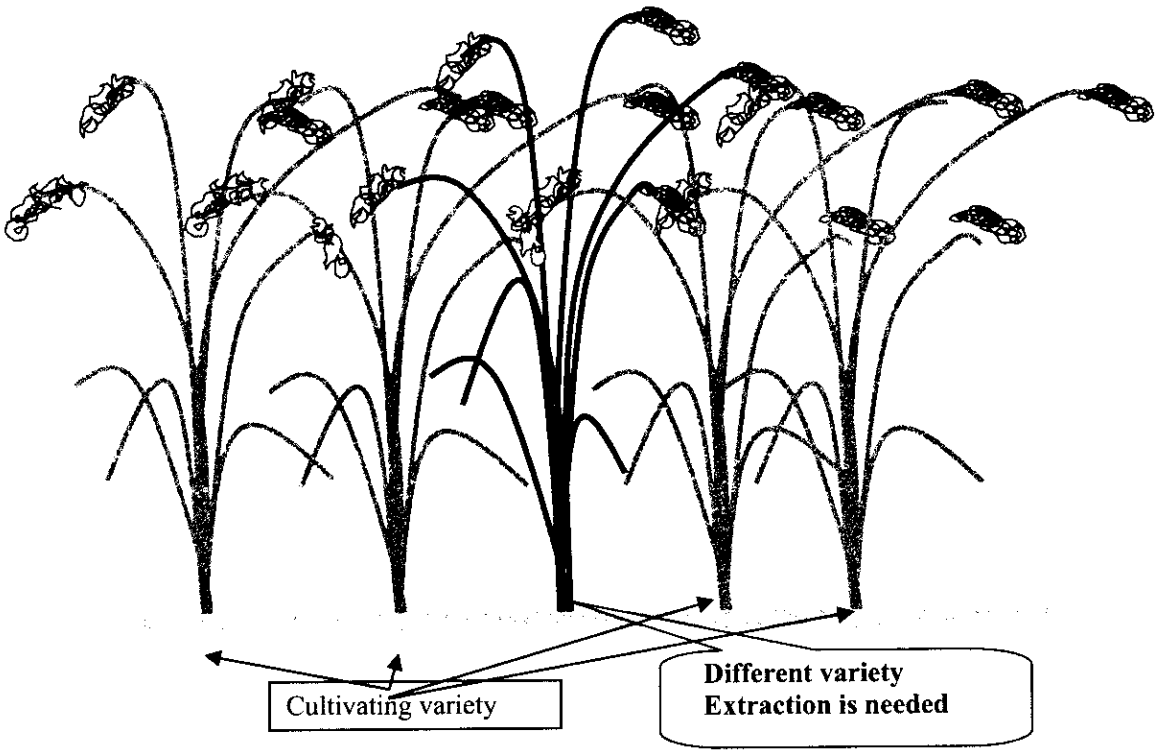


Fig. 33 Method of identify the different variety at ripening stage.

Step 6: Time of seed collection and method

The best period for practicing seed collection is when 80% of panicle is fully ripened (fig.35). The big head (panicle)-selection method is used to collect only big and healthy panicles as shown below. The quantity of seed needed per ha is 80-90 kg at panicle collection time under condition of 18% of grain moisture.

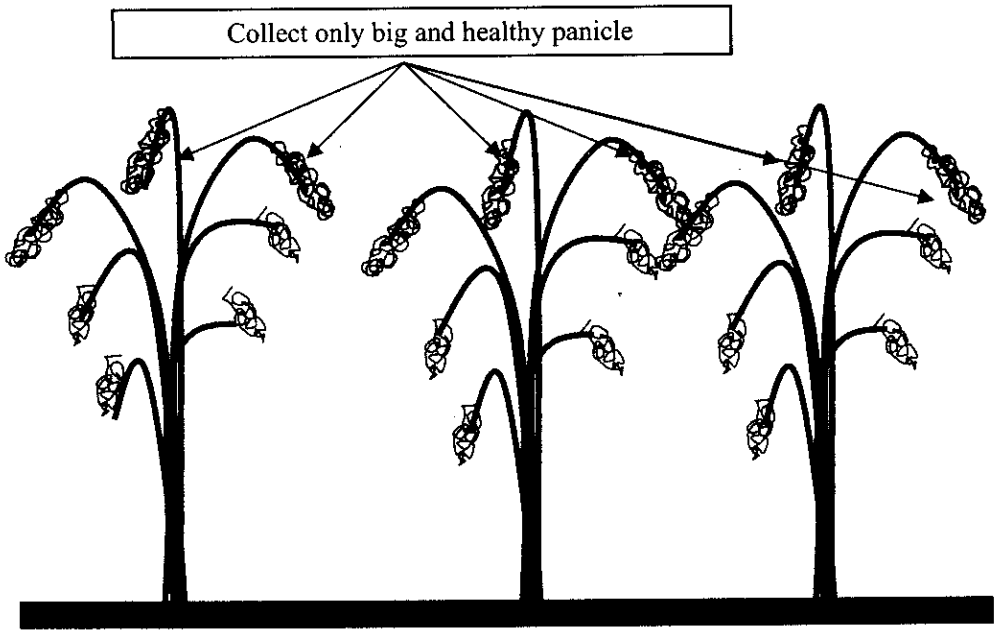


Fig. 34 Method of panicle (seed) collection.

Step 8: Drying and threshing

The grain moisture percentage just after panicles collection is around 18% or above, and there is need for fast drying in the sunshine in order to decrease grain moisture down to 13% or even lower. Then, thresh, and keep it in a cool and well ventilated place.

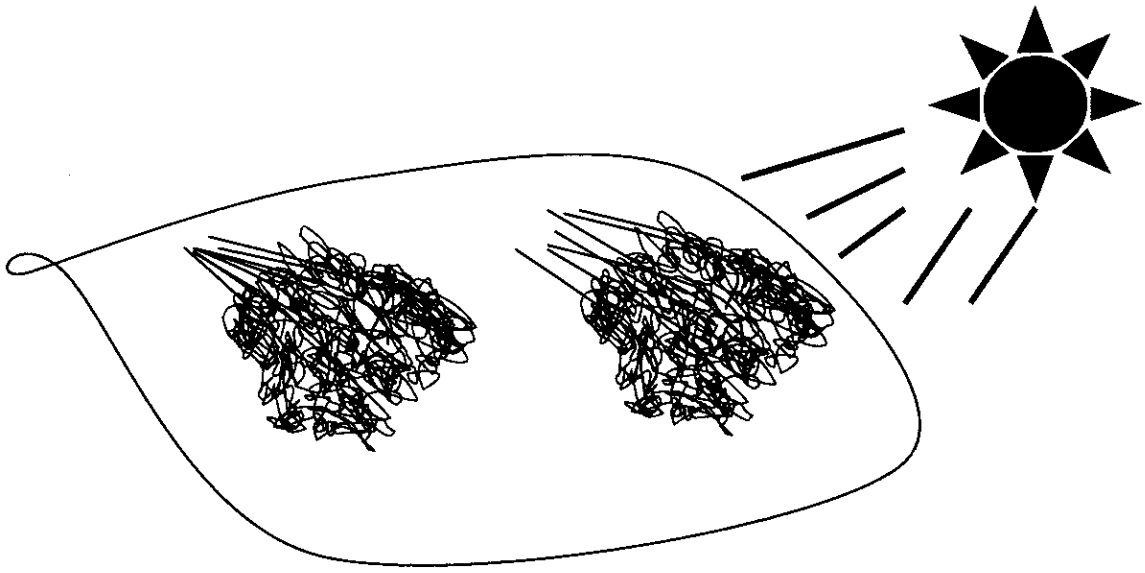


Fig. 35 Method of panicle (seed) drying.

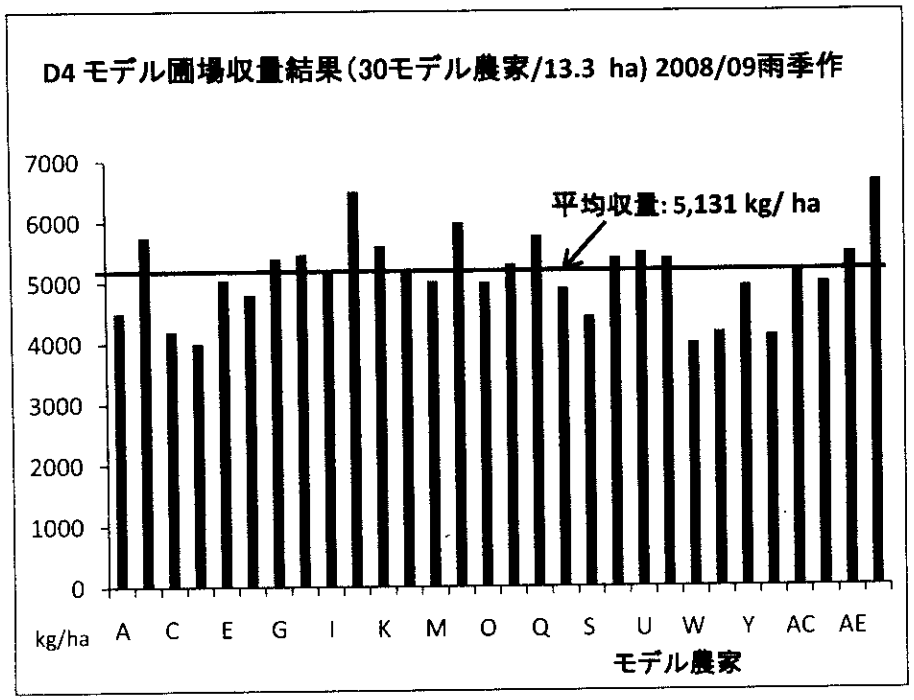
Fin.

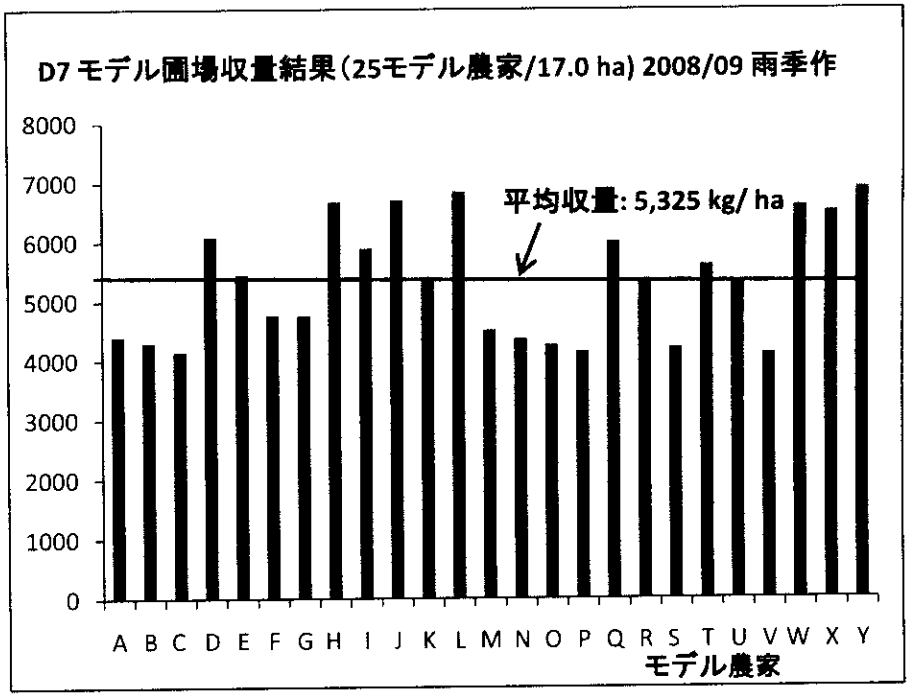
添付資料　H1　モデル圃場の収量調査結果EAC（D4:n=8, D7 n=8）

サンプル番号		籾収量 t/ha	株/m^2	一株穂数 本/m^2	穂数/m^2 本/m^2	一穂籾数 粒/穂	登熟歩合 %	千粒重 g/1000	査定収穫ロス 15%	査定収穫ロス 10%
D-4	67	4.60	12	19.5	234	91	82.70	26.74	3.91	4.14
D-4	68	6.49	28	8.4	235	110	93.30	26.92	5.51	5.84
D-4	69	6.33	20	13.7	273	101	85.90	26.73	5.38	5.60
D-4	70	6.35	33	7.7	252	102	88.90	27.90	5.40	5.71
D-4	71	6.51	24	10.4	250	105	92.20	27.05	5.53	5.86
D-4	72	6.56	45	7.5	339	84	86.20	26.68	5.65	5.90
D-4	73	6.61	20	11.8	235	102	88.70	26.37	4.76	5.05
D-4	74	7.28	35	7.8	274	108	94.20	26.15	6.15	6.55
D-7	75	6.60	37	7.3	270	93	92.50	28.36	5.61	5.94
D-7	76	7.16	29	10	290	92	93.20	28.97	6.09	6.44
D-7	77	6.82	36	7.1	256	122	85.40	25.48	5.80	6.14
D-7	78	6.83	44	6.6	290	96	87.60	27.89	5.80	6.15
D-7	79	6.88	28	8.6	241	122	87.70	26.53	5.85	6.19
D-7	80	7.01	51	6.3	321	111	88.00	22.40	5.96	6.31
D-7	81	5.78	55	4.8	264	96	84.70	27.16	4.90	5.20
D-7	82	4.87	30	5.7	171	112	93.20	27.39	4.14	4.38
Av.		6.36	32.9	9	262	103	89.00	26.75	5.40	5.71

出拠：EAC 営農部門（2008/09モデル圃場収量調査）

添付資料-H2 モデル圃場の収量査定結果(SDAE)

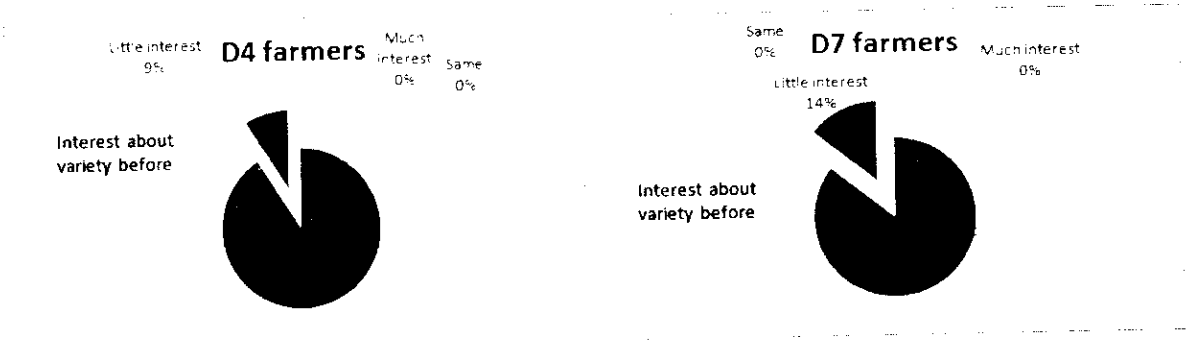




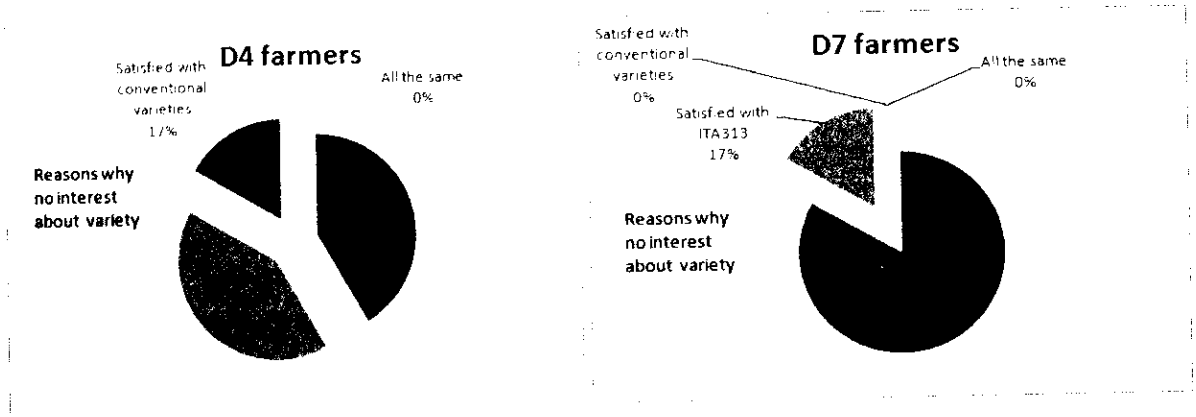
出拠:SDAE 普及/研修部門 (2008/09モデル圃場収量)

添付資料-H3 モデル農家アンケート・インタビュー調査結果

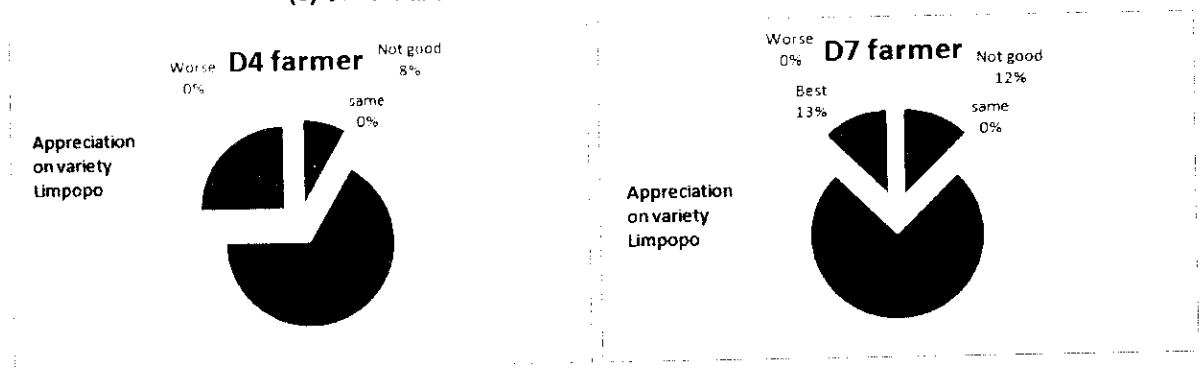
(1)過去に品種についての興味があったかどうかについての回答



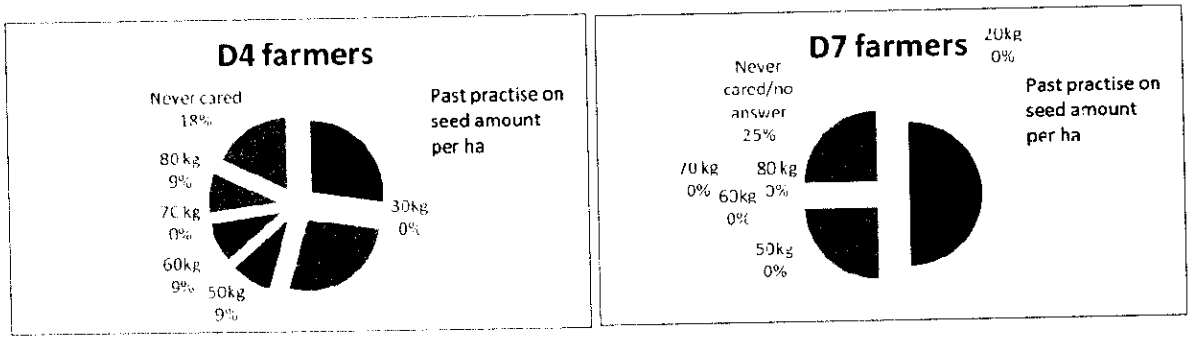
(2)以前は何故品種について興味がなかったのかについての回答



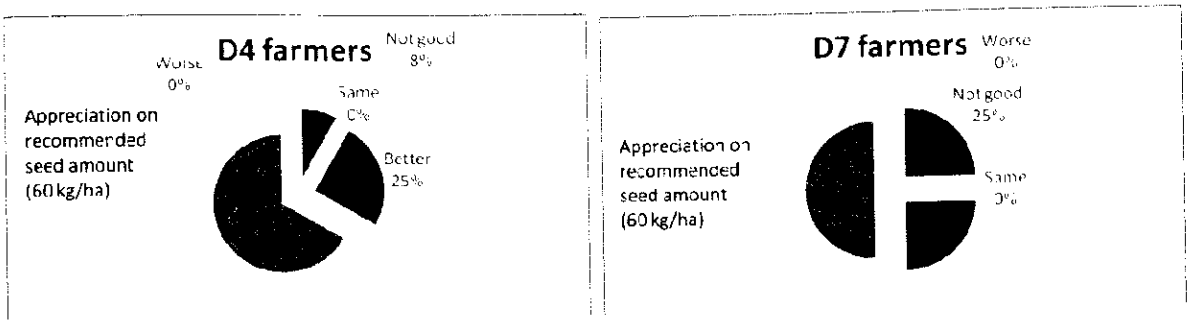
(3) リンポポ品種についての評価回答



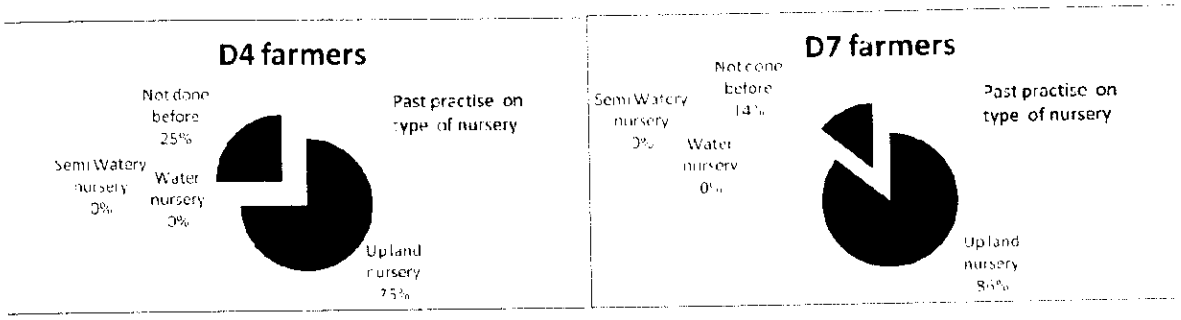
(4)過去の播種量についての回答



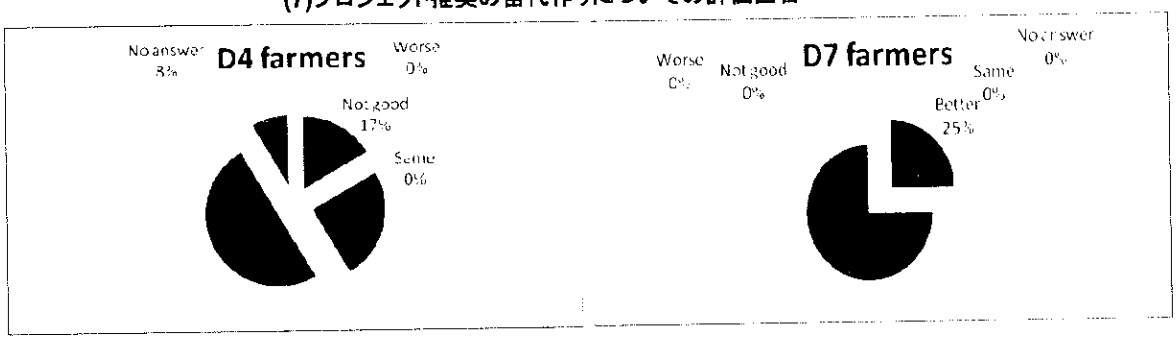
(5)プロジェクト推奨播種量60kg/haについての評価回答



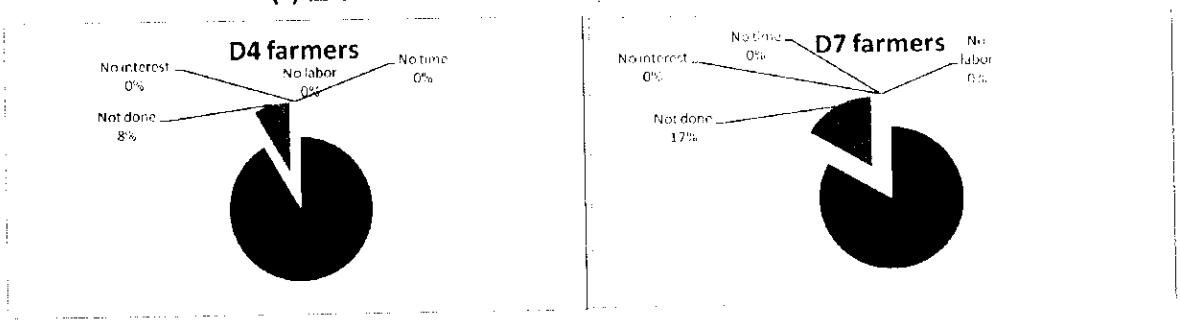
(6) 以前の苗代作りの方法についての回答



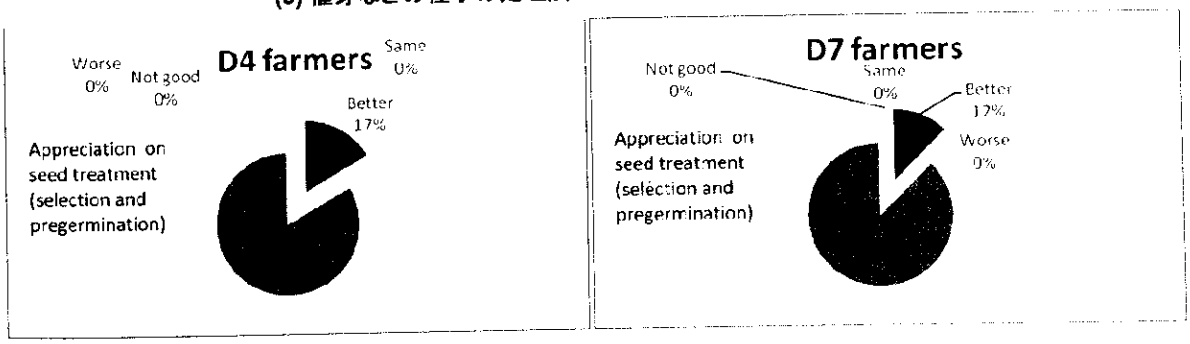
(7)プロジェクト推奨の苗代作りについての評価回答



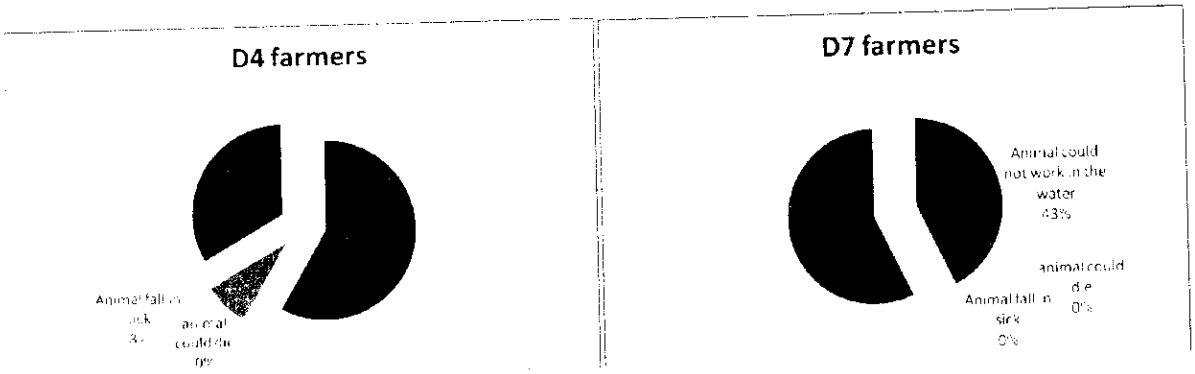
(8) 催芽などの種子処理法についての過去の認識回答



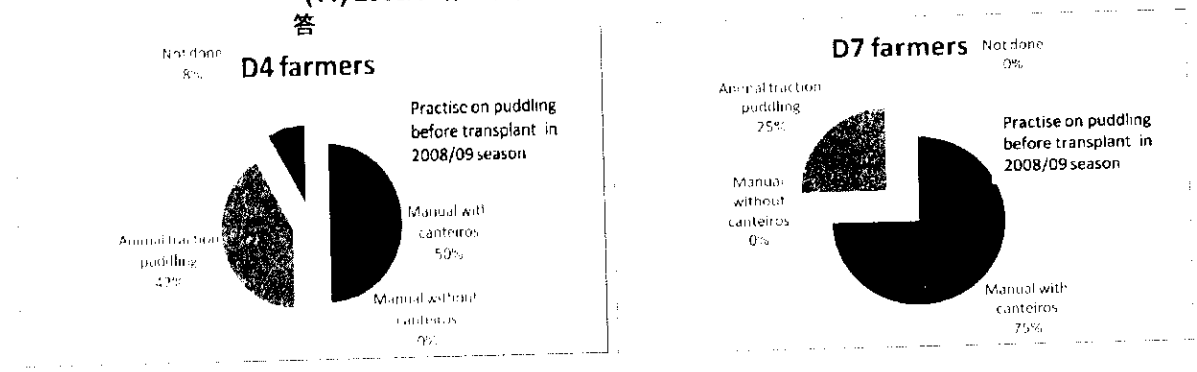
(9) 催芽などの種子の処理法についての評価回答



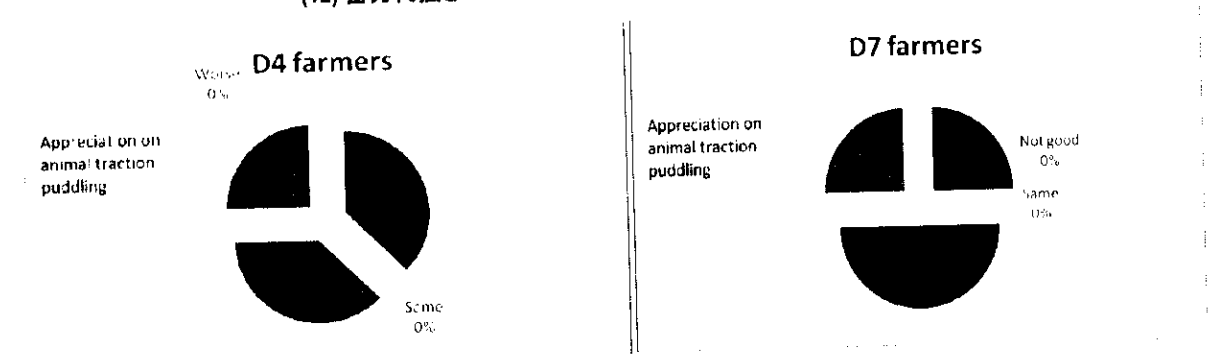
(10)畜力代掻きについて過去の認識



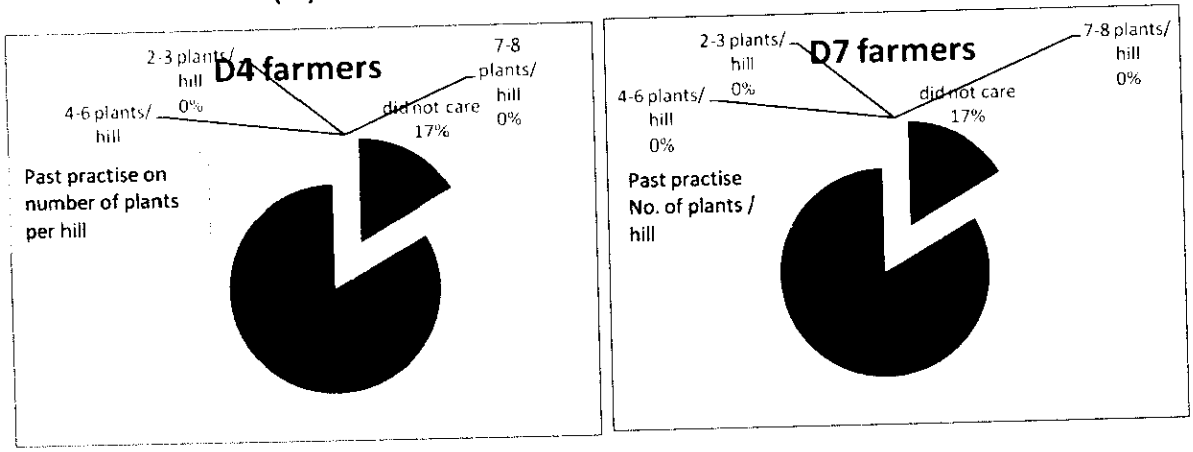
(11) 2008/09作の代掻きはどう行ったかについての回答



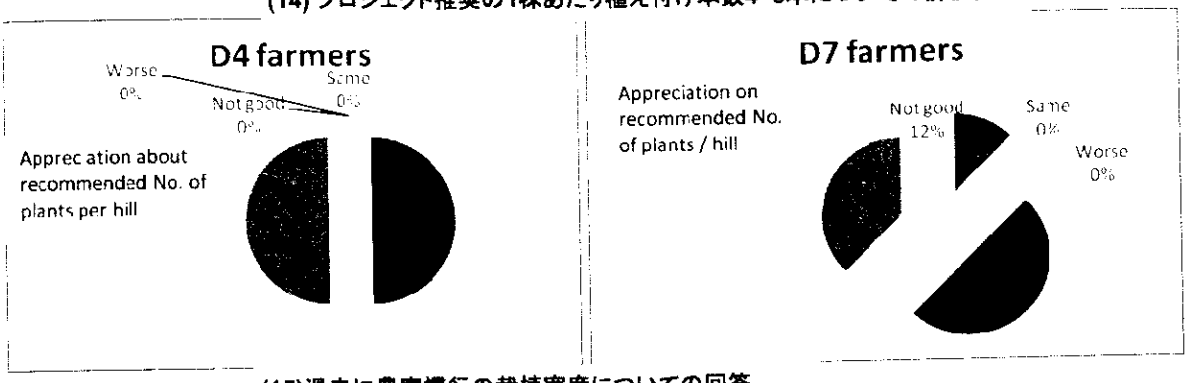
(12) 畜力代掻きについての認識、評価回答



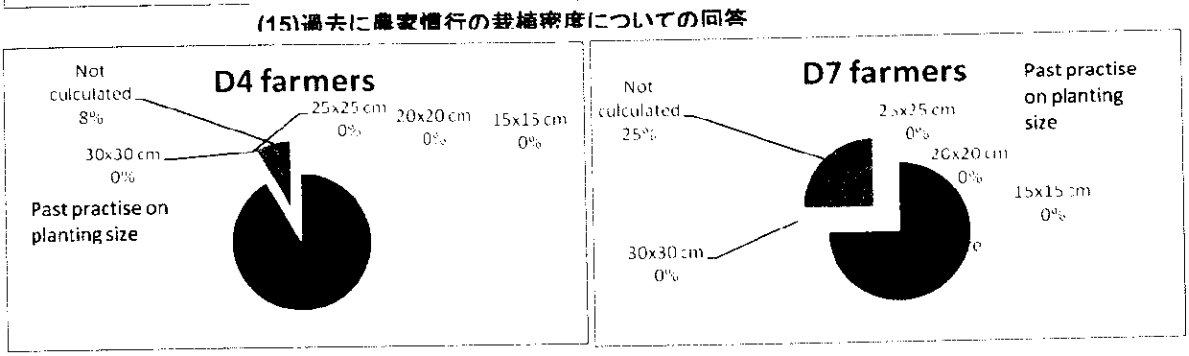
(13) プロジェクト開始以前の移植時の植え付け本数回答



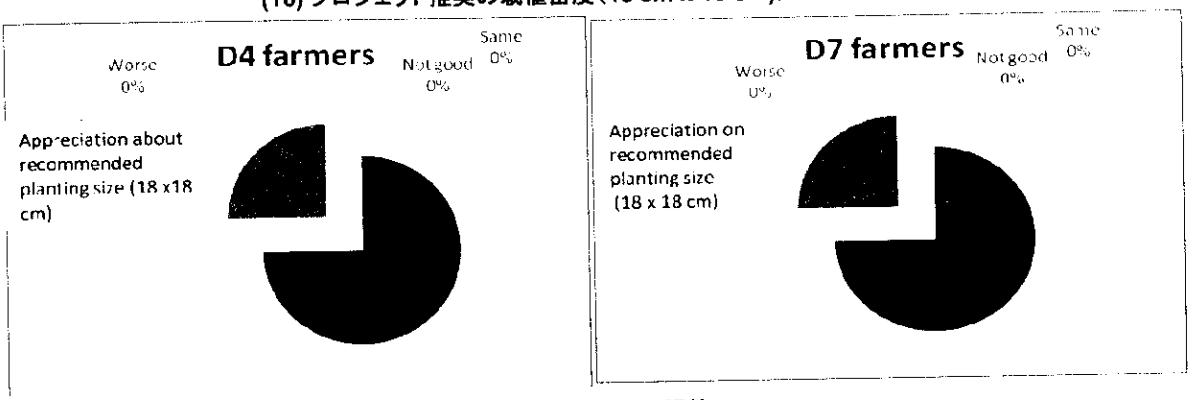
(14) プロジェクト推奨の1株あたり植え付け本数4~5本についての評価回答



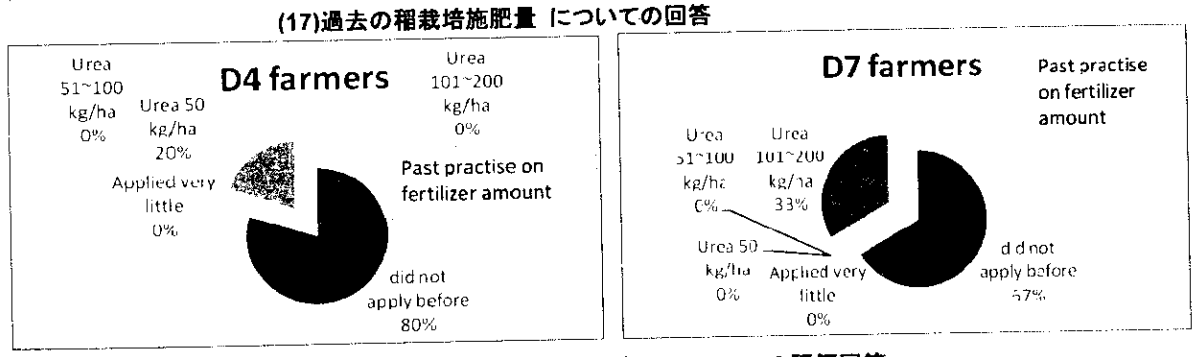
(15)過去に農家慣行の栽植密度についての回答



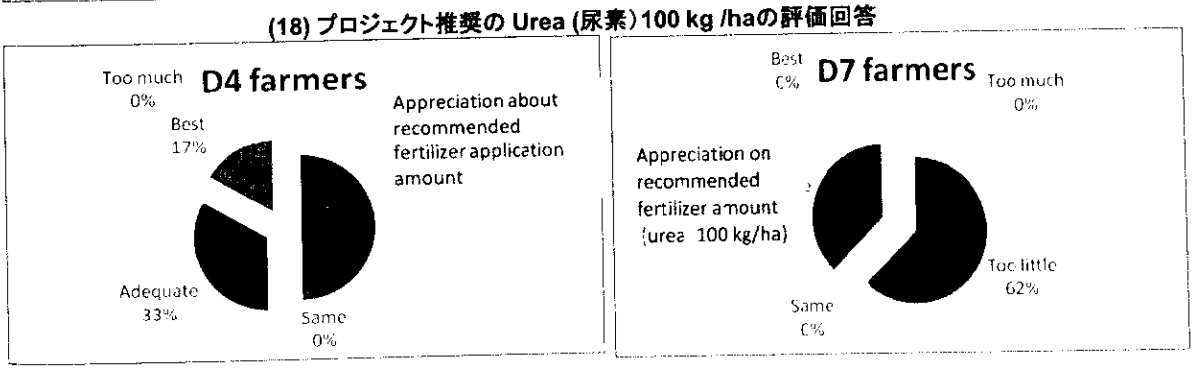
(16) プロジェクト推奨の栽植密度(18 cm x 18 cm)についての評価回答



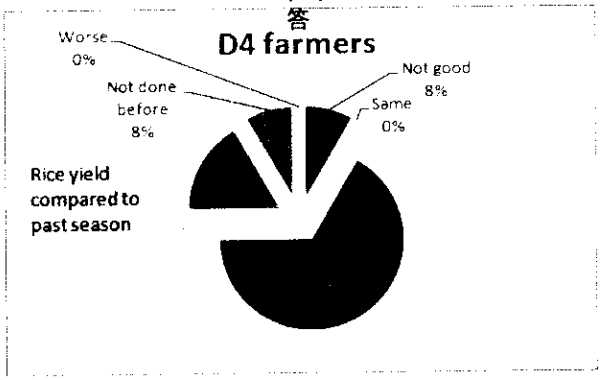
(17)過去の稲栽培施肥量 についての回答

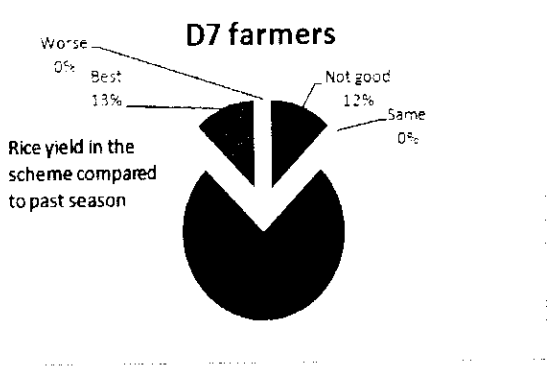


(18) プロジェクト推奨の Urea (尿素) 100 kg /haの評価回答

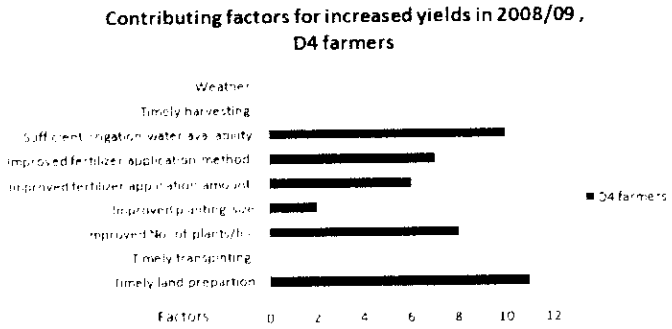


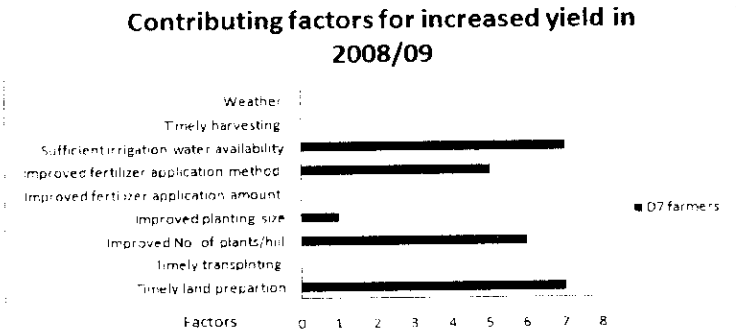
(19)昨シーズンと比較した2008/09 作の稲収量 結果回答



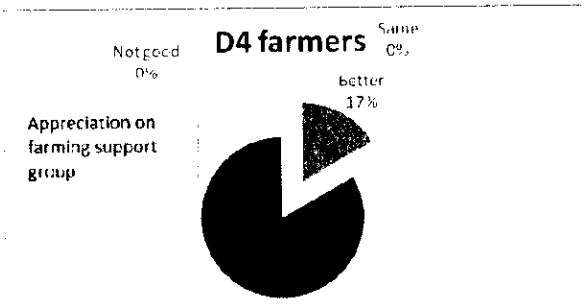


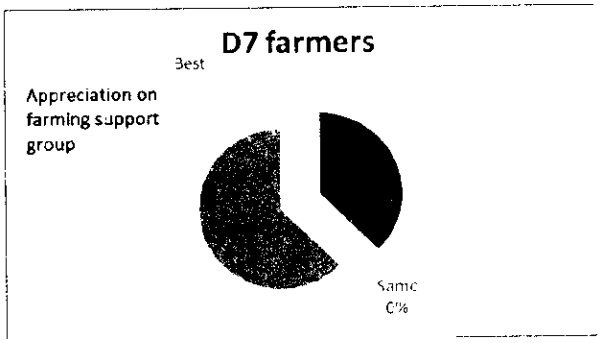
(20)2008/09シーズンで収量が増加したと思う要因についての回答



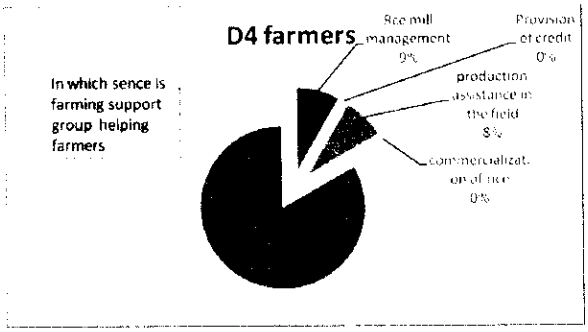


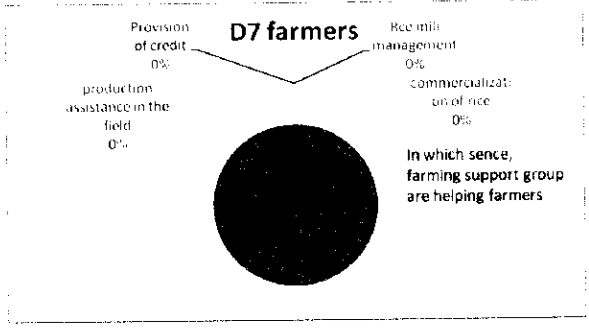
(21) 営農支援グループについての評価回答





(22) 農家を支援していると思う営農支援グループの活動についての回答

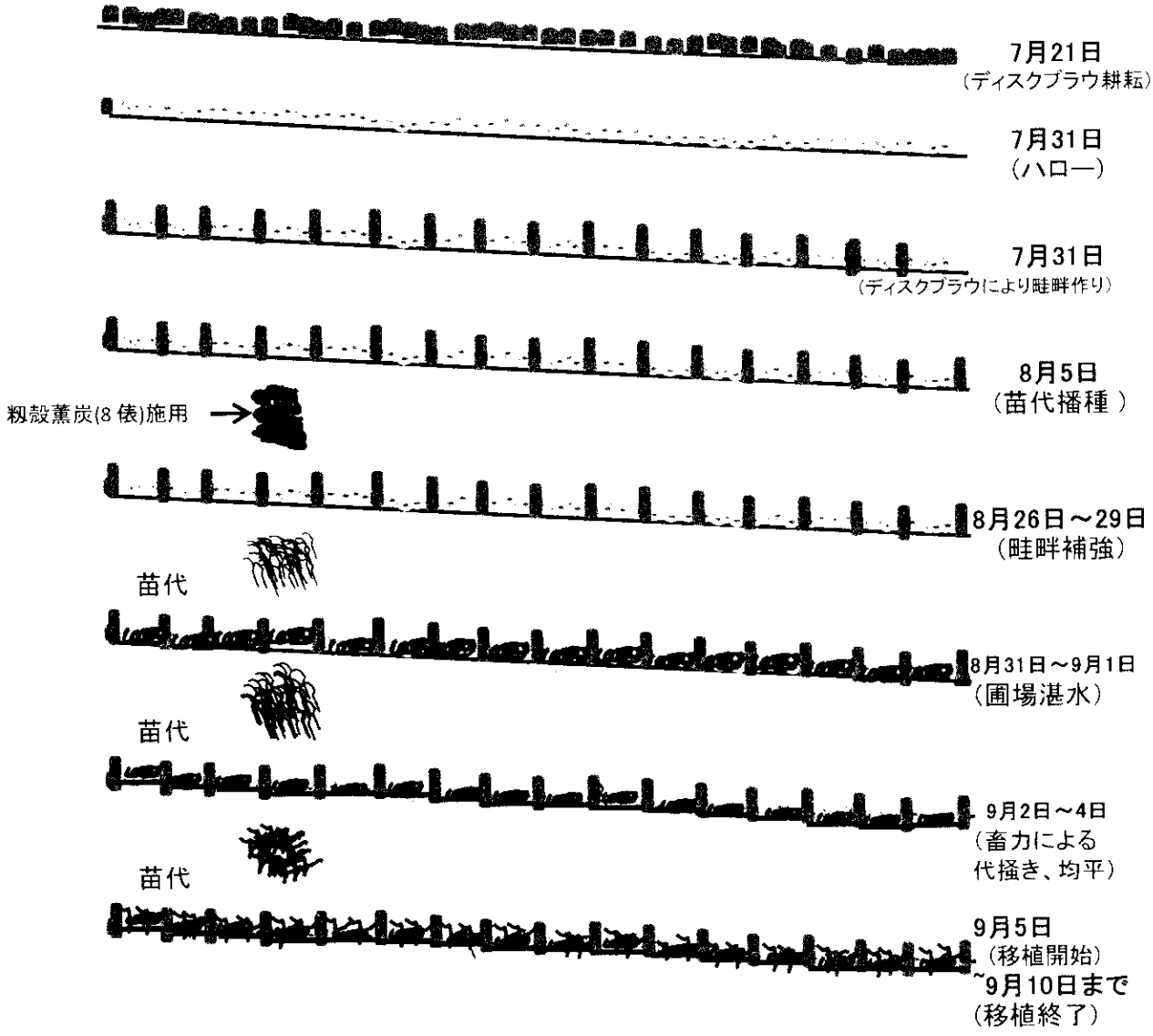




添付資料 H-4 圃場区画設置を組合わせた畜力代掻き、水掛かり改善に係る実証作業図

(1)実証圃場(D7 Mappose氏所有)区画デザイン　1plot =104.2 m2

(2)実証圃場(D7 Mappose氏所有)区画作業要領のCross section



添付資料　H5　D7実証圃場の収量調査結果

2009年8月～12月作季実証圃場の収量構成要素算出表

サンプル番号		籾収量 t/ha	株/m^2	一株穂数 本/m^2	穂数/m^2 本/m^2	一穂籾数 粒/穂	登熟歩合 %	千粒重 g/1000
実証圃場	サンプル1	4.57	33	7.80	257.40	76.79	86.03	26.90
	サンプル2	4.13	38	7.57	287.66	66.28	75.40	28.70
	サンプル3	5.06	34	9.40	319.60	75.40	78.68	26.71
	平均	4.59	35.00	8.26	288.22	72.82	80.04	27.44

出所：SDAE 普及

鳥食害ロスを除いた推定の収量査定値

推定鳥食害ロス15%		推定鳥食害ロス10%	
鳥食害がない場合の一穂籾数 粒/穂	鳥食害がない場合の籾収量 t/ha	鳥食害がない場合の一穂籾数 粒/穂	鳥食害がない場合の籾収量 t/ha
90.34	5.38	85.32	5.08
77.98	4.85	73.65	4.58
88.71	5.96	83.78	5.63
85.67	5.40	80.92	5.10

注）2010年1月15日調査

参考　　2008/09作　収量調査結果EAC営農部門収量構成要素算出表（D4:n=8, D7 n=8）

サンプル番号		籾収量 t/ha	株/m^2	一株穂数 本/m^2	穂数/m^2 本/m^2	一穂籾数 粒/穂	登熟歩合 %	千粒重 g/1000
D-4	67	4.60	12	19.5	234	91	82.70	26.74
D-4	68	6.49	28	8.4	235	110	93.30	26.92
D-4	69	6.33	20	13.7	273	101	85.90	26.73
D-4	70	6.35	33	7.7	252	102	88.90	27.90
D-4	71	6.51	24	10.4	250	105	92.20	27.05
D-4	72	6.56	45	7.5	339	84	86.20	26.68
D-4	73	6.61	20	11.8	235	102	88.70	26.37
D-4	74	7.28	35	7.8	274	108	94.20	26.15
D-7	75	6.60	37	7.3	270	93	92.50	28.36
D-7	76	7.16	29	10	290	92	93.20	28.97
D-7	77	6.82	36	7.1	256	122	85.40	25.48
D-7	78	6.83	44	6.6	290	96	87.60	27.89
D-7	79	6.88	28	8.6	241	122	87.70	26.53
D-7	80	7.01	51	6.3	321	111	88.00	22.40
D-7	81	5.78	55	4.8	264	96	84.70	27.16
D-7	82	4.87	30	5.7	171	112	93.20	27.39
平均		6.36	32.9	9	262	103	89.00	26.75

出拠：EAC 営農部門（2008/09モデル圃場収量調査）

考察：2009.8~12月実証圃場の収量構成要素を2008/09作モデル圃場収量結果と比較すると、1穂籾数が大きく減少している。鳥食害による影響で1穂籾数が大きく減少したと考えられる。その他の収量構成要素は2008/09作と比較して遜色はない。

添付資料H-6. 圃場区画分けを組合わせた畜力による代掻き作業の有利性と実践性

1. Advantages of puddling

(1)Make leveling of the field surface

Before puddling

After puddling

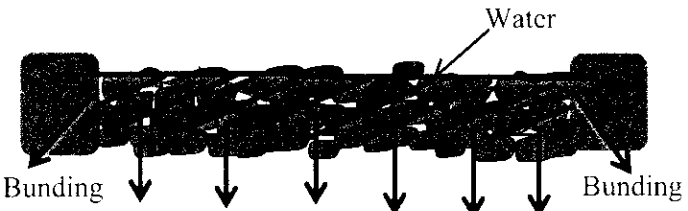
(2)Make soil muddy and soft to facilitate transplanting work

Without puddling

With puddling

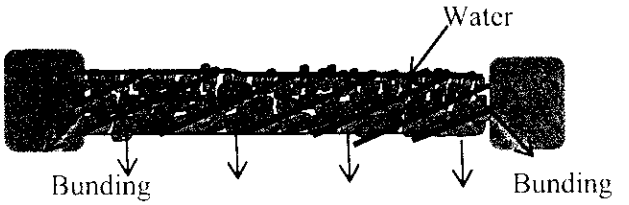
(3) Reduce water permeability in the field (to help keep water in the field)

Without puddling



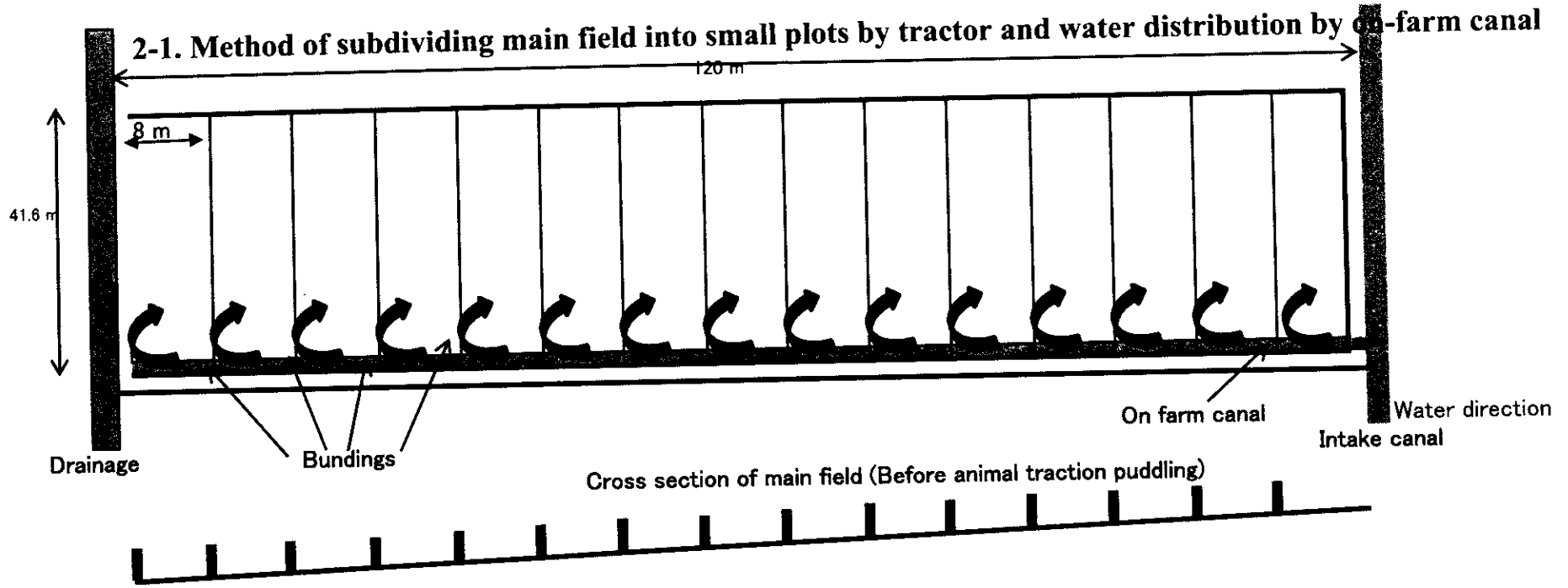
Water loss is high (High permeability)

With puddling

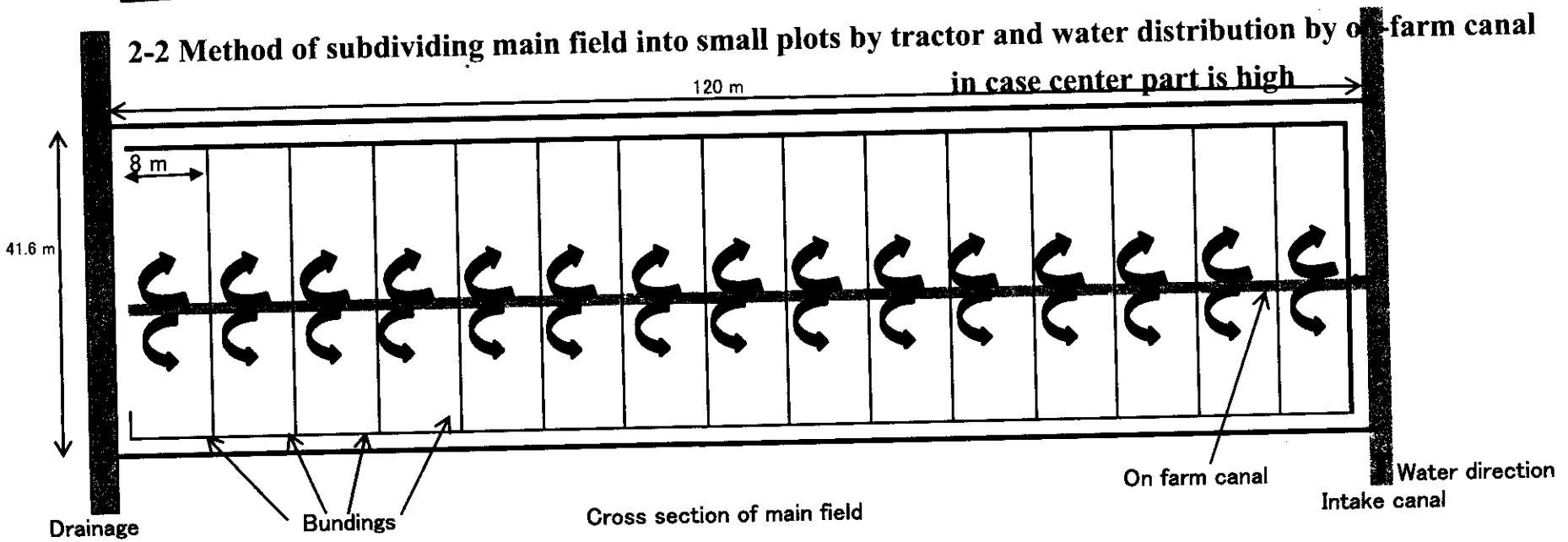


Water loss is less (Low permeability)

2-1. Method of subdividing main field into small plots by tractor and water distribution by on-farm canal



2-2 Method of subdividing main field into small plots by tractor and water distribution by on-farm canal in case center part is high



3. How to proceed with animal traction puddling and leveling (one plot featuring)

1st step Bunding (small plotting) and irrigation

Subdivided plots

2nd step Inundation of main field plot by plot

Bunding Irrigation water

3rd step Start of animal traction puddling

On farm canal

4th step Animal traction puddling & leveling

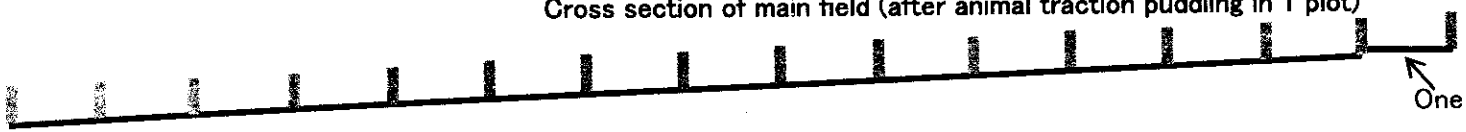
Puddling board with iron tooth

5th step Animal traction puddling & leveling

6th step Animal traction puddling & leveling

One plot completed

Cross section of main field (after animal traction puddling in 1 plot)



One plot completed

4.How to proceed with animal traction puddling and leveling (Overall featuring)

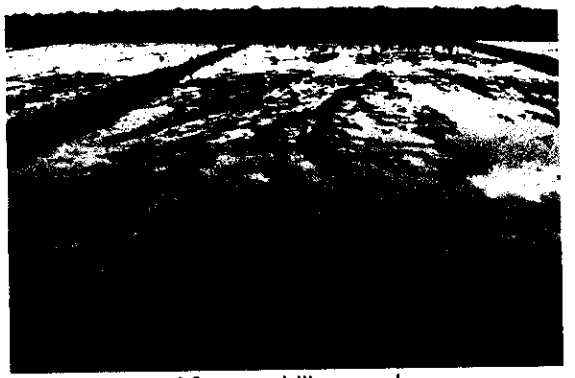
1st step

Before puddling work

2nd step

On going animal traction puddling

3rd step



After puddling work

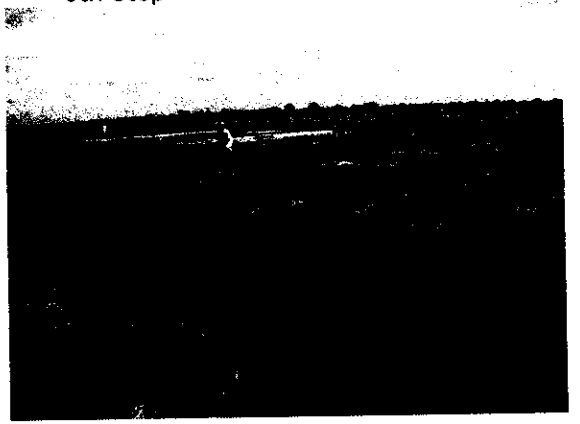
4th step

After puddling work

5th step

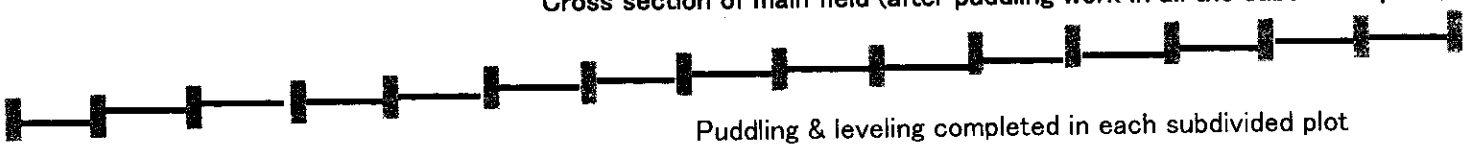
On going transplanting after puddling

6th step



On going transplanting after puddling

Cross section of main field (after puddling work in all the subdivided plots)

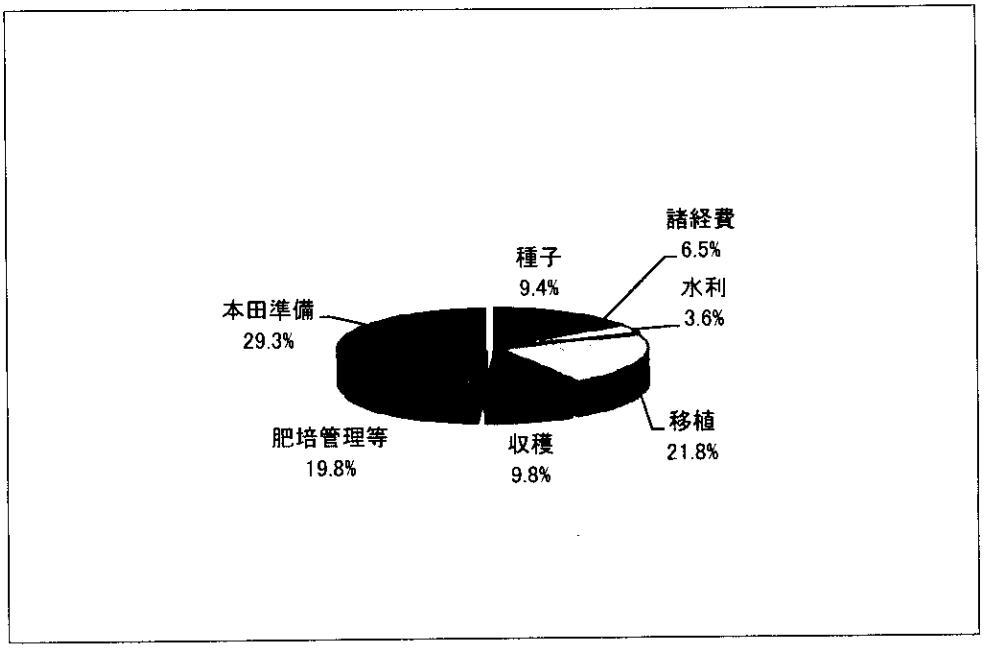


Puddling & leveling completed in each subdivided plot

添付資料 H7 ショクエ灌漑スキーム小規模農家の1haあたりモミ生産費

費目			内訳
資材	種子	1,440	種子購入費　@MT24/kg　60 kg/ha
	肥料	3,280	肥料購入費（尿素 MT1,640 /1俵 x 2 俵）
労賃	苗作り	600	苗代準備と播種作業(15人/日 x MT40)
	本田準備	4,500	本田耕起(トラクターMT1,800 /ha)、本田ハロー(トラクター MT900 /ha)代掻き均平作業(牛、人力)300MT/pair x 6
	田植え	2750	苗取り作業 5人/日 (MT 50 x 5) 田植え作業 (50人/日 x MT 50)
	肥培管理等	3040	施肥、追肥作業 (6人/日)本田管理(除草、その他 (20人/日 x MT50) 登熟期の鳥追い人夫 (40人/日 x MT 50)
	収穫	1,500	刈り取り、脱穀(30人/日/ha x MT 50)
諸経費		1,000	諸雑費
水利		550	水利費
	計	18,660	経費合計

モミ生産費に占める各費目の割合



添付資料H-8 ショクエ灌漑スキーム小規模農家の販売価格による収益の試算表

通貨単位：MT

生産物タイプ	粗収益					変動経費					純収益
	単価 (MT/kg)	精米歩合 (%)	選別歩合 (%)	副産物 (砕米単価MT/kg)	計	生産コスト MT/ha	精米コスト MT3.00/kg	選別コスト MT0.40/kg	輸送費 MT1.00/kg	計	
モミ販売	7.00	0.0	0.0	0.00	37,100.00	18,660.00	0.00	0.00	0.00	18,660.00	18,440.00
白米無選別（ショクエ販売）	18.00	65.0	0.0	0.00	62,010.00	18,660.00	15900.00	0.00	0.00	34,560.00	27,450.00
白米無選別（ショクエ販売）	20.00	65.0	0.0	0.00	68,900.00	18,660.00	15900.00	0.00	0.00	34,560.00	34,340.00
白米選別（ショクエ販売）	25.00	65.0	80.0	10.00	75,790.00	18,660.00	15900.00	1378.00	0.00	35,938.00	39,852.00
白米選別（マプトで販売）	30.00	65.0	80.0	10.00	89,570.00	18,660.00	15900.00	1378.00	2756.00	38,694.00	50,876.00

注）1)1ヘクタール当りのモミ生産量：5.3トン
2)精米歩合：65%
2)精米コスト：MT3.00/kg
3)砕米等選別：MT0.4/kg
4)首都マプトまでの輸送費：MT1.00/kg
5)選別歩合：80%

添付資料 H-9　ショクエ米限界収益率(MRR)の試算

A.　経費と収益の分析表

プロット番号		収量(t/ha)		粗利益									変動コスト							純利益(MT/ha)				
				単価(MT/kg)					粗利益(MT/ha)											籾	白米			
		籾	収穫時損失15%	籾	白米				籾	白米														
				MT6.5/kg	MT18/kg	MT20/kg	MT25/kg	MT30/kg	MT6.5/kg	MT18/kg	MT20/kg	選別MT25/kg＋砕米10MT/kg	選別MT30/kg+砕米MT10/kg	生産費	精米費	選別とパッケージ費(*1)	輸送費(*2)	選別なしの場合の全コスト(1)	手動選別/パッケージ費込みの全コスト(2)	手動選別/パッケージ費、輸送費込みの全コス	MT6.5/kg	MT18/kg	MT20/kg	MT25/kg(*3)	MT30/kg(*4)
D4	67	4,600	3,910	6.50	18.00	20.00	25.00	30.00	25,415	45,747	50,830	55,913	66,079	18,660	7,820	1,017	2,033	26,480	27,497	29,530	6,755	19,267	24,350	28,416	36,549
D4	68	6,490	5,517	6.50	18.00	20.00	25.00	30.00	35,857	64,543	71,715	78,886	93,229	18,660	11,033	1,434	2,869	29,693	31,127	33,996	17,197	34,850	42,022	47,759	59,233
D4	69	6,330	5,381	6.50	18.00	20.00	25.00	30.00	34,973	62,952	69,947	76,941	90,930	18,660	10,761	1,399	2,798	29,421	30,820	33,618	16,313	33,531	40,526	46,121	57,313
D4	70	6,350	5,398	6.50	18.00	20.00	25.00	30.00	35,084	63,151	70,168	77,184	91,218	18,660	10,795	1,403	2,807	29,455	30,858	33,665	16,424	33,696	40,713	46,326	57,553
D4	71	6,510	5,534	6.50	18.00	20.00	25.00	30.00	35,968	64,742	71,936	79,129	93,516	18,660	11,067	1,439	2,877	29,727	31,166	34,043	17,308	35,015	42,209	47,963	59,473
D4	72	6,560	5,576	6.50	18.00	20.00	25.00	30.00	36,244	65,239	72,488	79,737	94,234	18,660	11,152	1,450	2,900	29,812	31,262	34,161	17,584	35,427	42,676	48,475	60,073
D4	73	5,610	4,769	6.50	18.00	20.00	25.00	30.00	30,995	55,791	61,991	68,190	80,588	18,660	9,537	1,240	2,480	28,197	29,437	31,916	12,335	27,594	33,794	38,753	48,671
D4	74	7,280	6,188	6.50	18.00	20.00	25.00	30.00	40,222	72,400	80,444	88,488	104,577	18,660	12,376	1,609	3,218	31,036	32,645	35,863	21,562	41,364	49,408	55,844	68,715
		6,216	5,284						34,345	61,821	68,690	75,559	89,296	18,660	10,568	1,374	2,748	29,228	30,601	33,349	15,685	32,593	39,462	44,957	55,947
D7	75	6,600	5,610	6.50	18.00	20.00	25.00	30.00	36,465	65,637	72,930	80,223	94,809	18,660	11,220	1,459	2,917	29,880	31,339	34,256	17,805	35,757	43,050	48,884	60,553
D7	76	7,160	6,086	6.50	18.00	20.00	25.00	30.00	39,559	71,206	79,118	87,030	102,853	18,660	12,172	1,582	3,165	30,832	32,414	35,579	20,899	40,374	48,286	54,615	67,274
D7	77	6,820	5,797	6.50	18.00	20.00	25.00	30.00	37,681	67,825	75,361	82,897	97,969	18,660	11,594	1,507	3,014	30,254	31,761	34,776	19,021	37,571	45,107	51,136	63,194
D7	78	6,830	5,806	6.50	18.00	20.00	25.00	30.00	37,736	67,924	75,472	83,019	98,113	18,660	11,611	1,509	3,019	30,271	31,780	34,799	19,076	37,653	45,201	51,238	63,314
D7	79	6,880	5,848	6.50	18.00	20.00	25.00	30.00	38,012	68,422	76,024	83,626	98,831	18,660	11,696	1,520	3,041	30,356	31,876	34,917	19,352	38,066	45,668	51,750	63,914
D7	80	7,010	5,959	6.50	18.00	20.00	25.00	30.00	38,730	69,714	77,461	85,207	100,699	18,660	11,917	1,549	3,098	30,577	32,126	35,225	20,070	39,137	46,884	53,080	65,474
D7	81	5,780	4,913	6.50	18.00	20.00	25.00	30.00	31,935	57,482	63,869	70,256	83,030	18,660	9,826	1,277	2,555	28,486	29,763	32,318	13,275	28,996	35,383	40,493	50,712
D7	82	4,870	4,140	6.50	18.00	20.00	25.00	30.00	26,907	48,432	53,814	59,195	69,958	18,660	8,279	1,076	2,153	26,939	28,015	30,168	8,247	21,493	26,875	31,180	39,790
		6,494	5,520						35,878	64,580	71,756	78,932	93,283	18,660	11,039	1,435	2,870	29,699	31,134	34,005	17,218	34,881	42,057	47,797	59,278

注)

1) 搗精歩合 65%. ショクエで選別なしで18MT. 20MTで販売の場合

2) 手動選別、パッケージ費がかかる場合 (ショクエで25MTで販売)

3) 手動選別、パッケージ、輸送費がかかる場合(マプトで30MTで販売)

(*1) 選別、パッケージ費 200 MT(4 man day x @50 MT)/500 kg

(*2) マプトまでの輸送費 1 MT/kg

(*3) ショクエで販売の場合(ただし選別後の20%砕米は10MT/kg で販売)

(*4) マプトで販売の場合(ただし選別後の20%砕米は10MT/kg で販売)

B. 限界収益率(MRR)データー(表)

プロット番号	収量(t/ha)		単価 (MT/kg)		粗利益 (MT/ha)		変動経費 (MT/ha)						純利益(MT/ha)	
	籾	損失15%	籾	白米	籾	白米	生産費	収穫費	精米費	全体(1)	全体(2)	全体(3)	籾	白米
D4	6,216	5,284	6.50	18.00	34,345	61,821	18,660	0	10,568	29,228			15,685	32,593
D7	6,494	5,520	6.50	18.00	35,878	64,580	18,660	0	11,039	29,699			17,218	34,881
D4	6,216	5,284	6.50	20.00	34,345	68,690	18,660	0	10,568	29,228			15,685	39,462
D7	6,494	5,520	6.50	20.00	35,878	71,756	18,660	0	11,039	29,699			17,218	42,057
D4	6,216	5,284	6.50	25.00	34,345	75,559	18,660	0	10,568	29,228	30,601		15,685	44,957
D7	6,494	5,520	6.50	25.00	35,878	78,932	18,660	0	11,039	29,699	31,134		17,218	47,797
D4	6,216	5,284	6.50	30.00	34,345	89,296	18,660	0	10,568	29,228		33,349	15,685	55,947
D7	6,494	5,520	6.50	30.00	35,878	93,283	18,660	0	11,039	29,699		34,005	17,218	59,278

C. 限界収益率グラフ

限界収益率MRR(18 MT/kg で白米販売の場合)

地区	処理	純収益	変動コスト	△純収益	△変動コスト	MRR
D7	米販売	34,881	29,699	17,663	11,039	1.6
D4	米販売	32,593	29,228	16,908	10,568	1.6
D7	籾販売	17,218	18,660	-	-	-
D4	籾販売	15,685	18,660	-	-	-

限界収益率MRR(20 MT/kg で白米販売の場合)

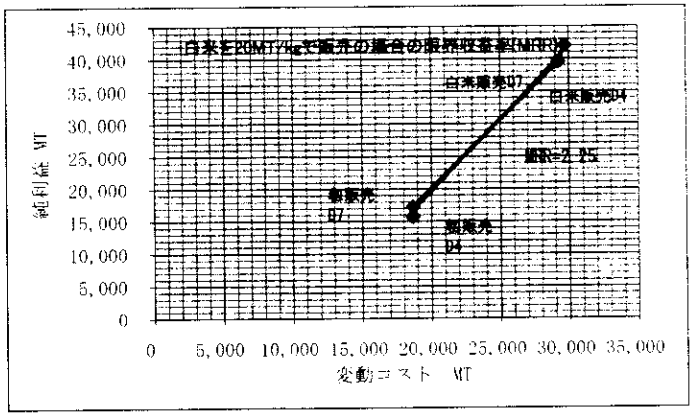
地区	処理	純収益	変動コスト	△純収益	△変動コスト	MRR
D7	米販売	42,057	29,699	24,839	11,039	2.25
D4	米販売	39,462	29,228	23,777	10,568	2.25
D7	籾販売	17,218	18,660	-	-	-
D4	籾販売	15,685	18,660	-	-	-

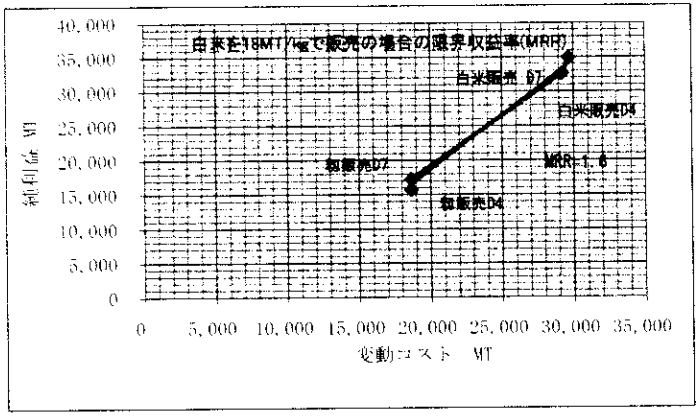
限界収益率MRR(25 MT/kg で白米販売の場合)

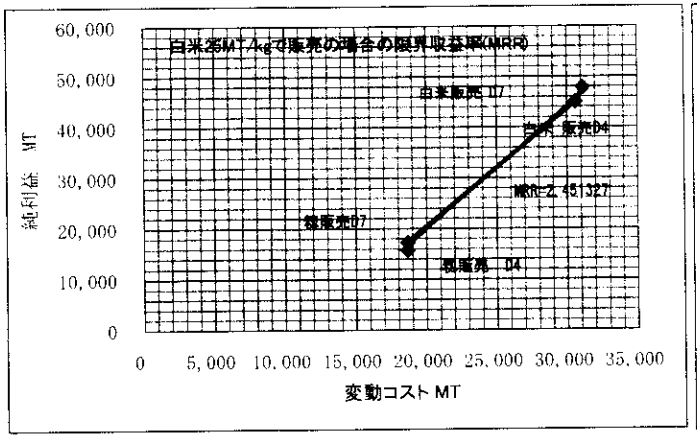
地区	処理	純収益	変動コスト	△純収益	△変動コスト	MRR
D7	米販売	47,797	31,134	30,579	12,474	2.45133
D4	米販売	44,957	30,601	29,272	11,941	2.45133
D7	籾販売	17,218	18,660	-	-	-
D4	籾販売	15,685	18,660	-	-	-

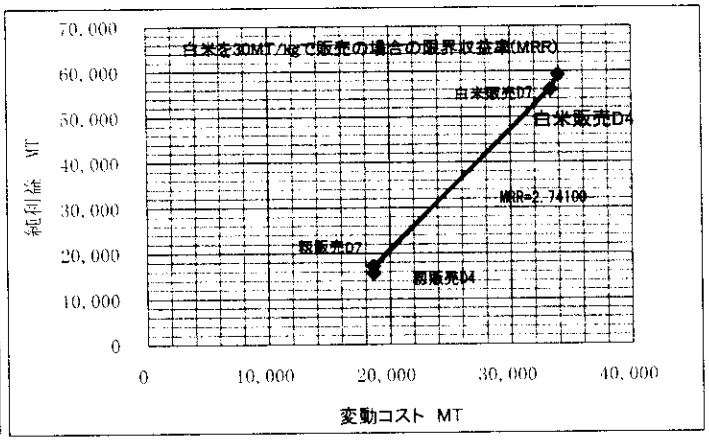
限界収益率MRR(30 MT/kg で白米販売の場合)

地区	処理	純収益	変動コスト	△純収益	△変動コスト	MRR
D7	米販売	59,278	34,005	42,060	15,345	2.74101
D4	米販売	55,947	33,349	40,263	14,689	2.74101
D7	籾販売	17,218	18,660	-	-	-
D4	籾販売	15,685	18,660	-	-	-









添付資料H-10 D4、D7精米機の週・月ごとの精米量の推移（2008年6月～2009年12月）

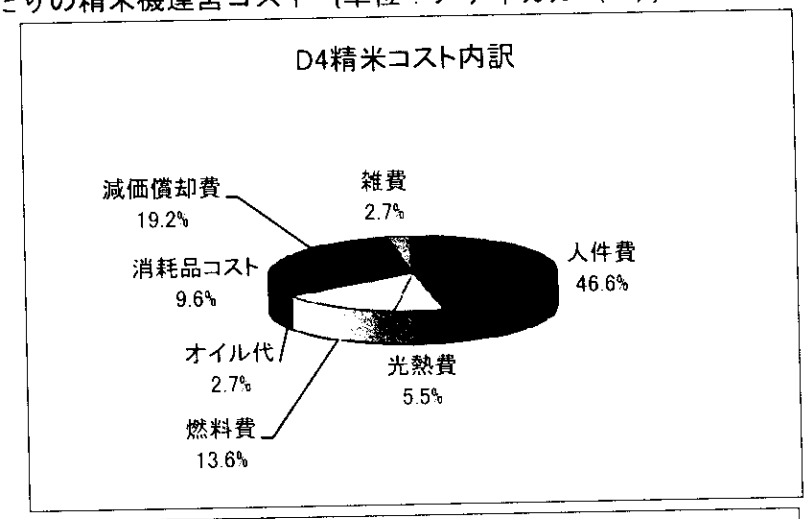
月	週	水利組合 精米機 D4 営農グループ管理		水利組合 精米機 D7 営農グループ管理		特記事項
		2008年6月～2009年5月	2009年6月～2009年12月	2008年6月～2009年5月	2009年6月～2009年12月	
		精米量(Kg)	精米量(Kg)	精米量(Kg)	精米量(Kg)	
6月	1週目	*181.0*	*4,273.0*	*280.0*	*648.0*	2008年6月5日精米開始　精米手数料 D4: 2.5MT/kg（会員）　3.0 MT/kg（非会員） D7　3.0MT/kg（一律）
	2週目	*1,407.0*	*3,091.0*	*3,964.0*	*1,076.0*	
	3週目	*2,567.0*	*2,570.0*	*2,757.0*	*817.0*	
	4週目	*3,112.0*	*4,186.0*	*2,935.5*	*2,829.0*	
	5週目	*694.0*		*0.0*		
	小計	*7,961.0*	*14,118.0*	*9,936.5*	*5,370.0*	
7月	1週目	*1,340.1*	*3,982.00*	*1,836.5*	*3,509.0*	通常精米営業
	2週目	*2,979.5*	*3,300.0*	*1,783.0*	*2,584.0*	
	3週目	*2,787.5*	*2,318.0*	*2,504.0*	*2,701.0*	
	4週目	*2,069.0*	*2,273.0*	*1,609.0*	*2,566.0*	
	5週目	*2,200.0*		*1,609.0*		
	小計	*11,376.1*	*13,507.0*	*9,341.5*	*11,360.0*	
8月	1週目	*1,056.0*	*1,272.0*	1,598.0	*2,731.0*	通常精米営業 2009年8月より隣接した精米場のオペレーションが始まり、それに伴いD7の精米手数料の引き下げ D7: 2.5MT/kg（一律）
	2週目	*2,841.0*	*0.0*	1,133.0	*1,612.0*	
	3週目	*2,259.0*	*2,251.0*	904.0	*1,288.0*	
	4週目	*1,277.0*	*1,876.0*	406.0	*1,280.0*	
	5週目	*1,186.0*		406.0		
	小計	*8,619.0*	*5,399.0*	4,447.0	*6,911.0*	
9月	1週目	*3,398.0*	676.0	1,052.0	964.0	通常精米営業
	2週目	*1,002.0*	1,633.0	899.0	754.0	
	3週目	*1,172.0*	568.0	898.0	550.0	
	4週目	*1,993.0*	882.0	737.0	996.0	
	小計	*7,565.0*	3,759.0	3,586.0	3,264.0	
10月	1週目	284.0	*1,268.0*	929.0	956.0	通常精米営業
	2週目	1,704.0	*622.0*	504.0	243.0	
	3週目	799.0	*1,816.0*	579.0	679.0	
	4週目	483.0	*1,614.0*	0.0	114.0	
	5週目	704.0		0.0		
	小計	3,974.0	*5,320.0*	2,012.0	1,992.0	
11月	1週目	254.0	931.0	491.0	546.0	通常精米営業
	2週目	779.0	816.0	201.0	927.0	
	3週目	326.0	0.0	270.0	141.0	
	4週目	725.0	683.0	394.0	625.0	
	5週目	2,084.0		1,356.0		
	小計	4,168.0	2,430.0	2,712.0	2,239.0	
６ヶ月集計	6カ月合計	***41,579.1***	***42,103.0***	30,679.0	28,897.0	
	1ヶ月平均	***6,929.9***	***7,017.2***	5,113.2	4,816.2	
	1週間平均	***1,732.5***	***1,754.3***	1,278.3	1,204.0	

月	週	水利組合 精米機 D4 営農グループ管理		水利組合 精米機 D7 営農グループ管理		特記事項
		2008年6月～ 2009年5月	2009年6月～ 2009年12月	2008年6月～ 2009年5月	2009年6月～ 2009年12月	
		精米量(Kg)	精米量(Kg)	精米量(Kg)	精米量(Kg)	
12月	1週目	787.0	333.0	280.0	406.0	通常精米営業
	2週目	701.0	635.0	339.0	487.0	
	3週目	367.0	1,134.0	377.0	580.0	
	4週目	302.0	969.0	672.0	475.0	
	小計	2,157.0	3,071.0	1,668.0	1,948.0	
1月	1週目	377.0		227.0		精米機稼働日の減少、1週間に2日の精米営業に変更
	2週目	200.0		271.0		
	3週目	0.0		341.0		
	4週目	0.0		211.0		
	小計	577.0		1,050.0		
2月	1週目	0.0		192.0		精米機稼働日の減少、1週間に2日の精米営業に変更
	2週目	0.0		522.0		
	3週目	0.0		475.0		
	4週目	0.0		360.0		
	小計	0.0		1,549.0		
3月	1週目	553.0		82.0		精米機稼働日の減少、1週間に2日の精米営業に変更。
	2週目	182.0		179.0		
	3週目	340.0		192.0		
	4週目	358.0		10.0		
	小計	1,433.0		463.0		
4月	1週目	0.0		265.0		通常の精米営業に戻る。
	2週目	133.0		366.0		
	3週目	930.0		227.0		
	4週目	433.0		381.0		
	小計	2,116.0		1,239.0		
5月	1週目	*1,957.0*		1,073.0		通常の稼働に戻る。1週間に7日の精米営業。
	2週目	*0.0*		1,011.0		
	3週目	*1,183.0*		1,295.0		
	4週目	*3,160.5*		771.0		
	小計	*8,062.0*		4,150.0		
6ヶ月集計	6ヵ月合計	14,345.0		10,119.0		
	1ヶ月合計	4,716.0		3,310.0		
	1週間合計	1,179.0		827.0		
	1年間合計	55,924.1		40,798.0		

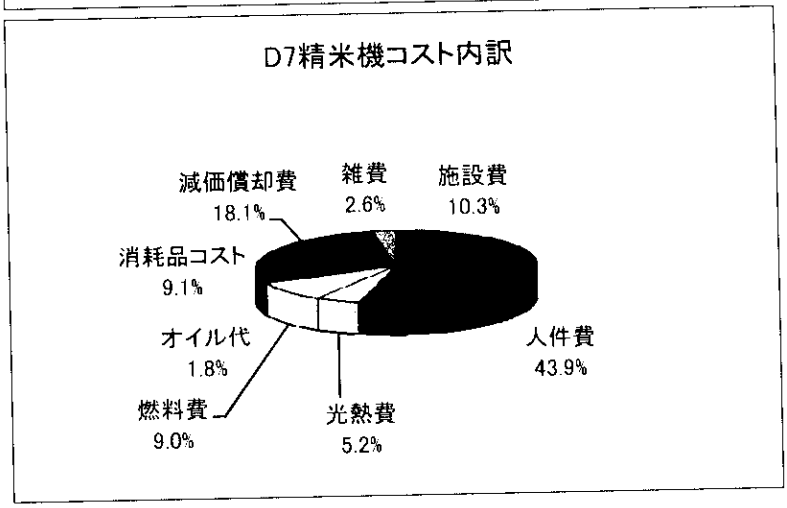
注）営農支援グループがモデル農家から回収した籾の精米量分（推定D4で10 トン、D7で15トン）は本数値にはカウントされていない。斜字は採算ベース精米量を達成した月

添付資料-H11 D4、D7精米機の1ヵ月あたりの精米機運営コスト〔単位：メティカル（MT)〕

費目	D4精米機
施設費	0
人件費	8,500
光熱費	1,000
燃料費	2,476
オイル代	500
消耗品コスト	1,754
減価償却費	3,500
雑費	500
計	18,230



費目	D7精米機
施設費	2,000
人件費	8,500
光熱費	1,000
燃料費	1,745
オイル代	350
消耗品コスト	1,754
減価償却費	3,500
雑費	500
計	19,349



添付資料H-11B　D4、D7精米機の1kg精米コスト〔単位：メティカル（MT)〕

	D4精米機	D7精米機	
施設費	0	2,000	
人件費	8,500	8,500	
光熱費	1,000	1,000	
燃料費	2,476	1,745	
オイル代	500	350	
消耗品コスト	1,754	1,754	
減価償却費	3,500	3,500	
雑費	500	500	
1ヶ月経費合計	18,230	19,349	
6か月精米量（2009年実績ベース）	42,103	28,897	
1ヶ月精米量（2009年実績ベース）	7,017	4,816	
1kgあたり精米コスト（2009年実績ベース）	2.60	4.02	D4,D7の平均＝3.16

添付資料-H12 2008/09作モデル農家へのマイクロファイナンスの貸付額と8月末までの回収額(D4)　単位:MT

	名前	種子	プラウ耕起	ハロー	畦作り	代掻き	肥料	移植労賃	除草労賃	貸付額	支払義務額量(kg)	支払済額量(kg)
1	L. Macheque		900	450	225		1,560	500	500	4,135	591	591
2	Pedro Mucavele		900	450	225	600	1,560	500	500	4,735	676	676
3	Graca Henrique	675	1,575(cash)			500	1,560	500		4,810	687	687
4	Victoria Roberto	675	900	675(cash)		500	1,560	500		4,810	687	687
5	Pedro Machava	675	900	675(cash)			1,560	500		4,310	616	616
6	Fernando Matusse		900	450	225			500	500	2,575	368	368
7	Julieuta Jose Sitoe		900	450	225	500	1,560	500	500	4,635	662	662
8	Manuel Tivane		900	450	225	600	1,560	500		4,235	605	-
9	F. Checo		900	450	225	600	1,560	500	500	4,735	676	676
10	Pedro Manjate(Elsiria		900	450	225					1,575	225	32
11	David Ngoveni		900	450	225	600	1,560	500	1000	5,235	748	748
12	Maida Augusto Matusse	675	900				1,560			2,460	351	351
13	Felisina Isac Tivane	675	900	450	225		1,560	500	500	4,135	591	591
14	Raela Mucavele	675	900	450	225		1,560	500	500	4,810	687	687
15	Olinda Muchanga	675	900	450	225		1,560	500	500	4,135	591	591
16	Joao Muchanga		900	450	225		1,560	500	500	4,135	591	591
17	Messe Cossa	675	900	450	225		1,560	500		4,310	616	616
18	Alfonço Sitoe	675	900	450	225		1,560	500		4,310	616	616
19	Regina Muchope	675	900	450	225		1,560	500		3,635	519	519
20	Beatriz Sitoe	675	1,750(cash)			500	1,560	500	500	5,485	784	784
21	Alexandre Rafael	675	900	450	225	600	1,560	500	500	5,410	773	773
22	Flora urnest Ngovene	675	900	450	225	600	1,560	500	500	5,410	773	773
	Vasco Sitoe(self			450	225					675	96	96
	Jaime Cuna (Self help)			450	225			500		1,175	168	168
23	Jaime Cuna	675	900	450	225	600	1,560	500	500	5,410	773	773
24	Julieta Mazimba	675	900	450	225	600	1,560	500	500	5,410	773	773
25	Jose Musundu Sitoe	675	900	450	225	600	1,560	500	500	5,410	773	773
26	Vasco Sitoe	675	900	450	225	600	1,560	500	500	5,410	773	773
27	Palmira Churuque	675	900	450	225	600	1,560	500	500	5,410	773	773
28	Elisa Mucavele	675	900	450	225	600	1,560	500	500	5,410	773	773
29	Defelimo Cossa		900	450	225		1,560	500		3,635	519	-
30	Celestina Cossa Tivane		900	450	225		1,560	500		3,635	519	519
31A	B.Ngome		900	450	225	600	1,560	500	500	4,735	676	676
31B	B.Ngome		900	450	225	600		500	500	3,175	454	454
32	A.Sitoe		900	450	225		1,560	500		3,635	519	519
33	Betewel Chongo							500		500	71	71
	total									147,650	21,093	19,776

Novo Agricultores (新規モデル農家)　返済率　93.8 %

添付資料H-12　2008/09作モデル農家へのマイクロファイナンス貸付額と8月末までの回収額(D7)　単位:MT

	名称	種子	耕起	砕土	畦作り	代掻き	肥料	人夫賃	貸付額	農家ごとの貸付額	初支払い時の重量(kg)	積回収額(kg)	キャッシュ支払	不足額(MT)
1A	Domingo Mucavele	450	900	450	225	600	1,560	-	4,185	8,370	1,196	1,096	7,672	698
1B	Domingo Mucavele	450	900	450	225	600	1,560	-	4,185					
2A	Domingos Mbudzu(Salfina	450	900	450	225	600	1,560	-	4,185	8,370	1,196	1,110	7,770	600
2B	Domingos Mbudzu	450	900	450	225	600	1,560	-	4,185					0
3A	Raphael Moiane	450	900	450	225	600	1,560	1,500	5,685	11,370	1,624	1,410	9,870	1,500
3B	Raphael Moiane	450	900	450	225	600	1,560	1,500	5,685				0	0
4	Catalina Mozuze	450	900	450	225	600	1,560	2,000	6,185	6,185	884	718	5,026	1,159
5A	David Ubisse	450	900	450	225		1,560	1,860	5,445	22,980	3,283	1,418	9,926	13,054
5B	David Ubisse	450	900	450	225		1,560	1,860	5,445					0
5C	David Ubisse	450	900	450	225	600	1,560	1,860	6,045					0
5D	David Ubisse	450	900	450	225	600	1,560	1,860	6,045					0
6A	Qulione Maposse	450	900	450	225		1,560	-	3,585	34,795	4,971	-	8,500	26,295
6B	Qulione Maposse	450	900	450	225		1,560	2,500	6,085					0
6C	Qulione Maposse	450	900	450	225		1,560	2,500	6,085					0
6D	Qulione Maposse	450	900	450	225		1,560	-	3,585					0
6E	Qulione Maposse	450	900	450	225	600	1,560	1,750	5,935					0
6F	Qulione Maposse	450	900	450	225	600	1,560	1,750	5,935					0
6G	Qulione Maposse	450	900	450	225		1,560	-	3,585					0
7A	Celso Dleke	450	900	450	225	600	1,560	1,690	5,875	11,750	1,679	1,331	9,317	2,433
7B	Celso Dleke	450	900	450	225	600	1,560	1,690	5,875				0	0
8	Calros Macarringue	450	900	450	225		1,560	-	3,585	3,585	512	512	3,584	0
9	Rosita Sitoe	450	900	450	225		1,560	1,600	5,185	5,185	741	741	5,185	0
10	David Mandlane	450	900	450	225		1,560	1,650	5,235	5,235	748	747	5,229	0
11	Leonardo Mandlhate	450	900	450	225		1,560	1,650	5,235	5,235	748	747	5,229	0
12A	Mateus Maccaringue	450	900	450	225	600	1,560	1,650	5,835	11,670	1,667	1,581	11,067	603
12B	Mateus Maccaringue	450	900	450	225	600	1,560	1,650	5,835					0
13	**Henrique Mandevo**	450	900	450	225		1,560	-	3,585	7,170	1,024			7,170
14A	**Carolina Cossa**	450	900	450	225		1,560	-	3,585					0
14B	**Carolina Cossa**	450	900	450	225		1,560	-	3,585	7,170	1,024			7,170
15	**Imonio Mande**	450	900	450	225		1,560	-	3,585					0
16	**Antonio tristeza**	450	900	450	225		1,560	-	3,585	3,585	512		3,585	0
17	**Mario Nguenha**	450	900	450	225	600	1,560	1,600	5,785	5,785	826			5,785
18	Moniz Macuacua	450	900	450	225		1,560	-	3,585	3,585	512	512	3,584	0
19	**Eugenio Zobera**	450	900	450	225	600	1,560	3,600	7,785	7,785	1,112	1,112	7,784	0
20	**Noemia**	450	900	450	225	600	1,560	-	4,185	4,185	598	519	3,633	552
21	**Fostino Emuher**	450	900	450	225		1,560	-	3,585	3,585	512		3,585	0
22	**Jeremia Mambo**	450	900	450	225		1,560	-	3,585	3,585	512	422	2,954	631
23	**Micas Bila**	450	900	450	225		1,560	-	3,585	3,585	512		2,000	1,585
24	Pene Sitoe	450	900	450	225		1,560	1,640	5,225	5,225	746	746	5,222	0
25	Melita Sitoe	450	900	450	225		1,560	1,640	5,225	5,225	746	746	5,222	0
26	Narita Sitoe	450	900	450	225		1,560	1,640	5,225	5,225	746	641	4,487	738
Total	20.5	18,450	36,900	18,450	9,225	10,800	63,960	42,640	200,425	200,425	28,632	16,109	130,431	69,973

Novo Agricultores（新規モデル農家）　　返済率　65.1 %

添付資料 H-13　　D4, D7 水利組合全体総会の協議内容

(1)D4 水利組合 Samola Machel の全体総会(2009 年 9 月 8 日実施)

総勢 100 人強の水利組合会員が参加した。水利組合長 Betwel 氏による挨拶があった後、営農支援グループ長の Ngovene 氏の司会で会議が進められた。まず経理部長より 2009 年の会計の報告（2009 年 1 月から現在までの支出と収入、現在の銀行残高）発表され、総会の了承を得た。この後、Ngovene 氏より「農業生産（営農）グループとして新たな規約のもとに正式会員を募り、会員制で運営するようにしたいこと、そのための規約が全員で作成された。」ことが報告された。新規会員になると精米機の精米単価が安いこと、マイクロファイナンスなどへのアクセスの権利を有すこと、また会員になるための手続き方法についても説明がおこなわれた。全体の話し合いが進むと、すでにメンバーの中での根回しが進んでいたと思われ、モデル農家以外の多くの参加者より会員になりたいとの声が相次ぎ、グループの規約については全体の賛同を得、承認を得た。

この後グループ長 Ngovene 氏より水利組合長 Betwel 氏、生産組合部長 Mucavele 氏および経理部長 Vitoria 氏が総会で紹介され、全体総会の承認を得た。総会の締めとして HICEP 代表（Banguine 土地管理部長）、PDAI 代表（田村）、D4 水利組合長（Betwel ）の挨拶があり、全体総会を終了した。

写真：D4 水利組合全体総会の様子

(2) D7 水利組合 Edward Mondlhane の全体総会(2009 年 9 月 9 日実施)

総勢 30 人余りの水利組合員が参加した。水利組合長 Zobera 氏による挨拶があった後、会計担当の Mappose 氏より 2008 年 3 月～2008 年 12 月までの会計報告があった。詳細な会計報告があげられたが、この時に参加者より「会計報告の内容は自分たちの全く知らないことで、全然関係のない話しではないのか、何故今回の全体総会が開かれたのか。」という素朴な疑問が発せられた。多くの参加者がモデル農家以外の参加者であったので、今回の会議が何故招集されたのかについての根回しが不足していたようである。今回の総会は「水管理と水路維持管理を担当する水利組合とは別に、D7 水利組合員の全体総会により規約の

承認に基づき農業生産（営農）グループを正式にオーソライズするための会合である。」ことが説明され、会議参加者からやっと了承を得た。しかし他の灌漑ブロックの水利会員によるD7水利組合執行部に対する不満が相当にあることが推察された。この状況を生み出したのは水利組合執行部の組合員とのコミュニケーション不足にあるのは明白であり、他の灌漑ブロックからの批判的な意見が相次いだ。長い協議を経て最後に総会参加者がD7農業生産（営農）グループを規約に基づき承認したので、D7農業生産（営農）グループでは早速正式メンバーの入会手続きを開始することとなった。尚、グループ長Zobera氏、会計部長Mappose氏、生産部長Carlos氏、流通部長Mucavele氏、監査部長Reonaldo氏が当面グループの執行役員として機能することが決定した。

写真：D7水利組合全体総会の様子

D7営農グループに対する提言

以下提言をD7営農グループ執行役員に対し行った。

(1)会員の特権は自分の籾を精米した際に糠の持ち出しが自由であること、規約にある様々なグループの権利を有すことである。だが、現在のグループの予算制限より全会員が必ずマイクロクレジットを裨益できるものでないことを入会時に全会員にきちんと説明する必要がある。入会時に必ず規約を1部持たせ、規約を熟読することを薦めること、さらにグループの規約を乱すものは会員を剥奪されることも説明する必要がある。

(2)予算の制限から何Haまでグループがマイクロファイナンス貸与可能かを検討すること。

(3)他灌漑ブロックに支援する場合は、灌漑ブロック単位で最低5人の会員の申請要請が必要あり、予算が許せば可能である旨を明確とする。その場合に必ず、支払義務を果たさない人に対する罰則を設ける、会員の剥奪と以後のグループサービスの禁止など。

(4)マイクロファイナンスの場合には100%の返済率を目指すこと。止むを得ない状況の場合の措置（例えば2年間の返済据え置き1%の利子など。）

(5)栽培品種についてはリンポポ品種を強制しない。ITA312でもよい。その場合もプロジェクト推奨の栽培技術を遵守するよう指導する。ITA312の場合買い上げ価格を下げる。Palmeira価格をITA 312に採用する。しかしLimpopoについては、0.5MT上乗せした価格をグループは提供する。これはクレジット回収分に限る。

添付資料 H-14

Statute of constitution of the Group of Agricultural Production

CHAPTER I

Of the denomination, characteristics, activity period, objective

Article 1 - The Group of Agricultural Production is a private Group, whose duration is of uncertain time, with offices and origin in Chokwe/Lionde, and it has this Statute as the Statute of the Group of Agricultural Production.

Article 2 - The " Group " is constituted fundamentally for singular people of he age above 18 years, who are farming members or family of members of the Association of irrigators of the Chókwè irrigation system in Gaza Province, who exercise agriculture in the area of Irrigators, D4/D7 Associations.

Article 3 - The " Group " has as objectives:

1. To promote the development of agricultural production and activities related to trade and distribution of useful products to members of the Group of Agricultural Production and members of the Association of Irrigators, D4/D7 of Chokwe irrigation System.
2. Publicity and Extension of the Group of Agricultural Production, through the transmission and providing of information regarding agriculture, prices of products, micro-financing, distribution etc., in the area of Irrigators Association of Chókwè Irrigation System.

CHAPTER II

Of the members

SECTION I

The way of admission and taxes

Article 4 – In principle, Members of the "Group ", are member producers of the Irrigators Associations, D4/D7, and who practice agriculture in the Irrigators' Association area D4/D7, who were admitted officially as members of the Group of Agricultural Production, based in the Statute of the Group of Agricultural Production.

Article 5- Admission of the members

1. It is done through a proposal signed by candidate.
2. In the proposal applicants must attach proof of identity and residence.

Article 6 - Registration and monthly fees

1. Registration fee is 100 MT.
2. Monthly fee after the registration is 50 MT.

Article 7 - Payment of the registration fee and the emission of associate's wallet

1. By the evaluation, when a candidate's admission is approved, he/she will be obliged to pay the membership registration fee within 10 days after the official report of approval of the registration;
2. After the payment of the jewel the candidate will receive, a diploma, associate's wallet and a copy of the Statute of the Agricultural Production, and finally approved as an effective member of the Group.

SECTION II
Of the Rights

Article 8 - The Rights of the members

1. A member is entitled to choose and to be chosen or designated to exercise the functions of a member of the Administrative Body, for the accomplishment of the functions based on the Statute and in the Regulations of the Group of Agricultural Production.

2. T o actively participate in the meetings of the Group and in the Annual General Assembly (or Extraordinary)
3. To examine the books (Minutes) and registrations of the Group.

Article 9 - Members who do not execute their social duties such as the monthly fee and expenses, lose the vote right, and they cannot be chosen as members of the Administrative Body.

SECTION III
Of the Duties

Article 10 - Duties of the members

1. To accomplish and enable the accomplishment of the present Statutes and their regulations, to obey the resolutions of the Management and the deliberations of the organs of administration of the Group;
2. To cooperate with the solidarity spirit and creativity in the integral and perfect accomplishment of the objectives of the Group;
3. To persistently accept and exercise the positions into which they could have been elected or nominated, except for excuses considered legitimate by the table of the general meeting, and to satisfy all social obligations on time;
4. To care for the conservation of the heritage of the Group;
5. To pay the subscription fees regularly;

SECTION IV
Of the Sanctions and Penalties

Article 11 - the dismissal of the member will be made when:
1. They do not execute the social duties consigned in the paragraphs of Section 1 of the Chapter 3, and when the administrative Body approves the dismissal of the member.
2. They offend the prestige of the Group and disturb or they implicate the free exercise of their functions;
3. They cause moral or material damage to the Group;
4. They have practiced clear incompatible acts with the farmer's moral and professional dignity;

CHAPTER III
Administrative body
SECTION I
Constitution and Operation

Article 12 – The Group of Agricultural Production is governed by the Management that administrates 3 specific departments, which are:
1. Department of Production / Promotion of animal traction;
2. Department of Shelling / Commercialization
3. Department of Micro-financing

Article 13 - The activities and the function of each department
1. Production / Promotion of animal traction
(1) Planning of cultivation of rice every year and support towards its production.
(2) Support for the Group of animal traction and funding.

2. Department of Shelling and Commercialization
(1) Businesses of rice shelling;
(2) Selection of rice and packing;
(3) To promote the commercialization and sales

In reference to business administration of rice shelling, to obey the Supplementary Regulation, a regulation of use of rice shelling machine.
3. Department of Micro-finance;
(1) Plan and achievement of Micro-financing in each Agricultural year for the members.
(2) Collection of funds during harvesting.
In what is referred to as Business administration in Micro financing, one has to obey the Supplementary Regulation; "Regulation of Funds and Micro-finance management."

CHAPTER IV
Of the Administrative Body

SECTION I
Of the constitution

Article 14 - The Administrative Body of the Group of Agricultural Production is:

1. General Assembly
2. Administrative body of the Group
3. Departmental Leadership;
4. Treasury

Article 15 - The Administrative Body is constituted by 5 people, which are: the Manager, 3 departmental Heads {(Production/Promotion of animal traction (Head of Agricultural Production), Shelling and Commercialization (Leader of Rice Shelling and commercialization), Micro-finance (Head of Accounting)}, whose mandate is of 1 year.

Article 16 - Reelection is allowed (the election of the same members is not allowed for more than 3 consecutive mandates)

Article 17 - It is not allowed for members to accumulate managerial positions of the Group.

SECTION II
General assembly

Article 18 – The effective members in full satisfaction of their rights constitute the General Assembly, in which powers of the group reside. The General Assembly continues to be a sovereign organ of the Group, its deliberations, as long they adjust to the laws effectively and the statutory dispositions, which are obligatory for all.

Article 19- Meetings of the General Assembly are ordinary (or extraordinary) and Meetings of Group are carried out AD-HOC.

Article 20 – Healthy ordinaries should take place until the end of August of every year, the meetings summoned to discuss the report and annual bills and for election of the Administrative Body.

Article 21 - The General Assembly gathers extraordinarily for the decision of the Manager or for the request of the Department leadership or of the controller.

Article 22 - General Assembly is competent for:
1. To discuss and to deliberate on all of the subjects of interest for activities that the Group acts on;
2. To discuss and to vote for the report and annual bills, the District attorney proposals;

3. To deprive the Administrative Body of the Group or any of their members, being indispensable for this effect, that the deliberation is voted for by the present partners' two thirds;

Article 23 - The Administrative Body will make the convocation for the General Assembly

Article 24 - The President of the General Assembly and the clerk will be chosen on the same day of the Assembly, among the effective members excluding the Administrative Body.

Article 25 -Function and the competence of the President of the Assembly.
1. To preside over the Assembly
2. To chair the meeting to debate on the subjects related to the order of work that they are called for.

Article 26 - The Clerk's function (Secretary)
1. To write and to sign the Minutes of each meeting
2. To act in the counting of votes etc.

Article 27 - the consummation of the General Assembly
The General Assembly is legally constituted when at least half of the total number of members is present.

SECTION III
Meeting of the Group

Article 28- The Administrative Body or SDAE (Supervisor of Extension / Extension officer) can summon for a meeting of the Group, when there is a specific subject. A meeting can be deliberated even when most of the members are not present.

Article 29 - The Meeting of the Group has the purpose of discussing problems and specific subjects, seeking the resolution or improvement of a problem. An Extension Officer or a Manager will preside over the meeting, with a clerk chosen among the present members.

SECTION IV
The Manager's attributions

Article 30 - To guide and to supervise the activities of each Group of Agricultural Production, based in the Statute.

Article 31st - The mandate and the consecutiveness;

In principle, The Manager's mandate is of a period of1 year, but is allowed to have a consecutive mandate until 3 years at most if reelected. (Election of the same members is not allowed for more than 3 consecutive years)

Article 32 - In the assumption of the Manager's death
In the event of the death of the manager, a temporary Manager will be chosen among the Administrative Body, who will carry out the Manager's functions temporarily until the next Annual General Assembly.

Article 33- Manager's competence:
1. To represent the Group.
2. To establish in the beginning of each exercise, the general directives of the action of the Group.
3. To coordinate the activities of the Group;
4. To sign the documents related to the activities of the Group, and to represent the group in the exhibitions of activities of other groups and organs;
5. To present to the appreciation of the ordinary General Assembly the report and bills of the exercise.
6. To sign the diplomas of the effective members.

SECTION V
Head of Production and animal traction

Article 34 – The responsibility of the Head of Production and Animal Traction are as follows:
1. To coordinate the activities of the department of Agricultural Production and promotion of animal traction;
2. To promote the annual planning and its achievement, in cooperation with the extension officer;
3. To collect funds of the promotion activity of animal traction, as well as promoting the use of animal traction.
4. The responsibility of handing the collected funds to the Head of Accounting.

SECTION VI
Head of Rice Milling and Commercialization

Article 35 – Responsibility of the Head of Shelling and Distribution:
1. To supervise the activities of the business of Shelling;
2. To cooperate with the extension officer to promote the activities of commercialization of the members of the Group, for the sale of the white rice of the Association of Irrigation Farmers.

SECTION VII

Head of Accounting

Article 36 – Responsibilities of the Head of Accounting

1. The administration of the accounting of the daily activities.
2. To cooperate with the Inspection;
3. To control the bookkeeping of the incomes and expenses, to emit payment cheques;
4. To make the monthly accounting and to organize the finances;
5. To render to the Management of the Group and the District attorney, the relative information to their administration and financial situation;

6. To elaborate the annual report about the financial situation of the Group, documented with the swinging, the inventory and the relative bills to the exercise.
§ The Head of Accounting will also take the responsibility for the administration of heritage of the Group, mentioned in the Article 39 of Chapter 5.

SECTION VIII
Control/Inspection.
Article 37th – Responsibilities of the Controller,
1. To give judgment about the report on bills presented by the Head of Accounts every end of month. The report will be that which includes the necessary documents such as receipts and vouchers of payments;
2. To control the accounting and the financial administration of the funds of the Group of Agricultural Production being achieved.

Chapter V
Heritage of the Group and its administration

Article 38 - The income of the Group
1. The incomes of the movable and immobile goods (Shelling machines, leasing of the heritage of the group);
2. The monthly fees and membership fees
3. The donations, legacies and donations;
4. Any other funds mentioned in the statute (collected to protect the statutes).

Article 39th - the Administration of the Heritage
The administration of the Heritage of the Group is exercised by the Head of Accounting.

CHAPTER VI
Of the remuneration of the Administrative Body and the dividends for the members of the Group

Article 40th - The Administrative Body receives the following symbolic remunerations monthly, apart from the real expenses for the transport and other necessary items for execution of the work,

Manager: 500 MT Treasurer: 500 MT
Head of Production: 200 MT
Head of Shelling and commercialization: 200 MT
Fiscal: 200 MT

However, when profit generated goes above the certain value, the issue will be taken to the annual General Assembly for discussion and to establish the necessary measures to be considered on the remuneration and the dividends for the effective members.

CHAPTER VII
Membership and Monthly fee

Article 41 - the membership fee and the monthly fee are established accordingly in this Statute.
And, it will be possible to improve the value of the membership and the monthly fees, giving appreciation to the General Assembly.

Article 42- As for the form of payment (Annual, Half-yearly or Quarterly) it can be reformed in the General Assembly.

Article 43 – To Create Special Fund.
This Special Fund should be deposited every year to cover up for the depreciation of the Shelling machine, for provide the continuity of the activities of the Group. (Estimated value 35, 000 MT)

CHAPTER VIII
Other

Article 44 - The Statute can be reformed or altered by the approval of the General Assembly. (To establish the conditions)

Article 45- In the case of making any reform or alteration of the statutes, all members should be requested to give the reform proposal or alteration, to be taken for evaluation.

Article 46 – Article for the evaluation of proposals for the reform or alteration, general appreciation and determination.

Supplement: Regulation of Administration of Funds and Micro Financing

I. Micro - financing

1. The objectives

The Micro-financing of the Group of Agricultural Production will have the practical use in form of financing to enlarge the agricultural production of the effective members of Agricultural Production Group, in the area of Irrigation D4'S Association and D7 of the irrigation system of Chókwè.

2. The beneficiaries of the Micro-financing.

The beneficiaries are fundamentally, the effective members of the Group of Agricultural Production, who exercise agricultural activities (Cultivation of rice and other agricultural products), and who are registered associates in Irrigation D4/D7'S Association in the irrigation system of Chókwè. The beneficiaries of the Micro-financing for every year of cultivation will be selected for the Administrative Body, in a necessary and impartial way. The Administrative Body should communicate to the other effective members, the beneficiaries of the micro-financing selected every year of cultivation (Name and number of people), mentioning the reason for the selection, the foreseen value of the loan per hectare, the reimbursement obligation etc, to guarantee the transparency of the business.

3. The white products of the Micro-financing support.

The Target products of the Micro-financing, fundamentally, rice. In reference to corn and green vegetables, this will depend on whether the extension officer of the area recommends them as target products of orientation and followed by a unanimous approval by the Administrative Body that it can become a target product of micro-financing.

4. Target area limit for each effective member

1 hectare is the maximum area of micro-finance, and any area above this cannot be allowed.

5. The items of support of the micro-finance.

1) Seeds, fertilizers.

As for the seeds and fertilizers, the Administrative Body of the Group should obtain them for an appropriate value, through collection of budgets of several companies / organs, before the cultivation, and to give them to the beneficiaries before beginning each cultivation.

2) Land preparation by tractor (tilling, harrowing, ridging)

In reference to soil preparation by tractor (tilling, harrowing, ridging), the Administrative Body should evaluate the proposal of tractor rentals from several civil entities and from the government, to select the best tractor for the year in exercise, considering, inclusively, the quality of the operator and the business of harrowing. In reference to the selection of the tractor, it will be necessary to have the approval of all the members of the administrative Body.

In the same way, in reference to the bovine for the animal traction puddling, it will be necessary to have approval of all the members of the administrative Body

for selection and hiring of the proprietor of the bovine that it will execute the harrow.
The administrative Body (Manager of Financial Administration) will make the payment for the harrowing expenses, on behalf of beneficiary.
3) Funds for the Agricultural Production
In reference to agricultural funds, related to the expenses of recruiting of labors for planting, weeding and harvesting, all of the years before the cultivation, the Administrative Body should do the calculations of the value of the fund to be attributed per hectare and to be discussed and approved by all members of the Administrative Body. The value of the established agricultural fund per hectare should be communicated to all members of the Group, notifying the value and the details of the benefits, and the beneficiary should receive the value in cash, from the responsible of accounting, before beginning each cultivation period.

5. Interests from Micro-financing
The interests on the total value of the Micro-finance refers to items 1),2) and 3) of the number above, it is from 1% a month.

6. Original Fund
Original Fund of the Macro-financing is as follows.
a) The membership fees and monthly fees that the members pay to the Group
b) The taxes of rice shelling
c) Incomes on the sale of white rice and bran of rice
d) Income on the activities of traction promotion the bovine, and machinery.
e) Reimbursed Money of Micro-finance.

7. The book of agreement between the Administrative Body (represented by the Manager of the Group) and the beneficiary of the personal Macro-finance.
It is necessary to make a contract of mutual agreement in the designed format, annex, (vide), related to the Micro-finance, among the Administrative Body (represented by the General Manager) and the Beneficiary of every year, before the cultivation. In the contract of mutual agreement they should comprise the following:
(1) The content of the breeze and material per 1ha and the cost that will be the object of the loan, and the content of the production fund and the value of the provision.
(2) Period of loan and the interests
(3) Form of payment (In the case of using the shelling machine, the beneficiary of the Micro-finance will basically make the payment of the value of the loan, after the harvest, through deduction of the value of their grain (humidity percentage to 14%). as for the value of the purchase of the grain, this should be covered in the contract of mutual agreement (mentioned in separate)
(4) Penalties in the assumption of the non-execution of the payment obligation.
(5) The middleman, in the case of having problems between both.

8. Collection of funds for Micro-financing

The beneficiary of the Micro-finance, after becoming a micro-finance object, should pay after the harvest of the interested product, the value of the loan (mentioned in the items 1), 2), 3) of 4) + the interests, basically through deduction of the value in grain. In this case, the value of purchase of the grains made by the Group should be established for the Administrative Body, all of the years before beginning the cultivation. This value is that which should be considered the market value and stipulated with the approval of all members, which should be mentioned in the agreement document.

II. Administration of Funds

Administration of Funds for the Group

The administration of funds for the Group of Agricultural Production should be made by the Responsible of accounting, under the Manager's supervision.

1. Obligatorily create funds to cover up for the depreciation of the shelling machine.

Taking into account the importance of the businesses of shelling rice, it is necessary if to have an obligation to save and to make deposits into the account of the Group every year to maintain the funds to cover the expenses of depreciation of the rice-shelling machine.

2. Administration and monthly monetary policy of the cashbook related to the bank account of the Group and of the money in cash.

In reference to the daily supervision of the funds of the Group, the head of accounting will do his/her administration through the cash books of the bank account and of the money in cash. The accounting head should organize all of the months, these cash books, and also the receipts and verifying documents of bank account, and to present them all at the end of every month, to the Extension officer responsible for the area.

The responsible Extension Officer will have the responsibility to control all end of months, the cashbook presented by the accounting head. At this moment he/she has the responsibility to inform about the results of monetary policy of all of the months, to SDAE (extension supervisor) and HICEP (Director of support of the Association of Irrigators)

Under the Extension officer, SDAE (extension supervisor) and HICEP (Director of support of the Association of Irrigators), to guide and to give accessory to the Administrative Body of the Group, when there is need, on the administration of monthly funds of the Group of Agricultural Production.

3. Approval of the annual financial result

As for the related annual trial balance the administration of funds of the Group, the accounting boss should organize the finances and to elaborate in July of every year, the annual trial balance. Under the Head of Accounts, to take the annual trial balance to the appreciation of the General Assembly of the Group taking place in August of every year, and to supply the information on the trial balance through the session of questions and answers.

Members of the Group should debate the annual financial balance, in the occasion of the General Assembly each year, and to be approved by the majority. If the annual financial balance not approved by the majority, the Administrative Body should mark a new date for the next General Assembly, to make the necessary process to obtain the approval from most of the members of the Group. The problems and pointed themes during the section of questions and answers in relation to the annual trial balance, the Administrative Body should make it a point that an effort is made to improve the situation starting from the next year.

ANNEX: Memorandum of Agreement between the Administrative Body and the beneficiaries of the Micro-finance (Revision of the concept)

Memorandum of Agreement between the Project of Agricultural Development Integrated for the Small Producers in the irrigation system of Chókwè (PDAI) irrigators /Association in D4 (D7) and the selected model farmers in campaign 2008/09.

Objectives

The present memo is to establish an understanding agreement between The Development Project of Integrated Agricultural for the Small Producers in the irrigation system of Chókwè (Irrigators PDAI)/Association in D4 (D7) and the model farmers in D4 (D7), in relation to the activities that will be implemented by the model farmers to reach the following results:

a) To improve the technology of agricultural production of small producers,
b) To strengthen the administration and irrigation means in the system and
c) To strengthen the system of support services towards production, getting better income for the small producers in the irrigation system of Chókwè.

Content of the agreement:

1) Development Project for Integrated Agriculture for small producers in the irrigation system of Chókwè, here known as (PDAI) elaborated the general plan of activities based on the results of the basic enquiry (baseline survey) and technical analysis of the production system. Several encounters had room in D4/D7) in the end of which some model producers were selected to promote the activities of the project. Lacking production means, the farmers requested technical and financial support from PDAI and Irrigation association in D4/D7). PDAI with Irrigation Association in D4 /D7) decided to offer the requested assistance to the model producers who consist in the associations:

1.1) Assistance to improve the technical production by small-scale producers. (To set up fields of demonstration of the cultivation of rice)

The type of attendance given to the farmers will be:
a) Land preparation (farming and harrowing)
b) Puddling and leveling of the earth for the animal traction.
c) Provision of certified seeds (if it is necessary)
d) Fertilizer (2 sacks of urea/ha)
a) Orientation and technical training for the models farmers

2) Mainly, Model farmers who received assistance mentioned above for the previous campaign of PDAI are going the receive the same assistance of the

irrigators Association in D4 /D7) for this campaign and only new Model farmers who were chosen will receive assistance of PDAI for this campaign.

3) During the period in which the model farmers are being assisted by the Project or Irrigators Association in D4/D7), they have to accept to work hard, in collaboration with SDAE, PDAI and Irrigators association in D4/D7), also to accept to reimburse the costs incurred by PDAI / Irrigators association in D4/D7) to the Association (in the form of unshelled rice or money) just after harvesting. The Association will shell the rice and sell it, thereby creating a rotative fund that it will be used in the next rice season. If calculated, the minimum price of unshelled rice would be of 6,00 Meticais/kg.

The costs to be reimbursed by the model farmers are:

a) Cost of land preparation

1,800 Mt/ha (farming)
900 Mt/ha (harrowing)
Sub total: 2,700 Mt/ha

b) Puddling and leveling of the land by animal traction.
200 MT / day x 5days /0.5ha=1,000 MT x 2 /1ha=2,000 MT

c) Cost of seeds

22.5 Mt/kg x 60 kg = 1,350 Mt/ha

d) I Cost of fertilizer (2sacks urea/ha)

1,560 Mt x 2 = 3,120 Mt/ha

Total cost per hectare will be 9,170 Mt/ha.

3) In case of any problem between PDAI/Irrigators Association in D4/D7) and the Model farmers in the implementation of the present agreement, they are encouraged to carry out mutual consultations between themselves, the two should try to find a friendly solution to resolve their differences.

4) In case of problems between PDAI / Irrigators association in D4/D7) and the model farmers in the course of the execution of the agreement, and that the two don't find favorable solutions for the parties, they should request the intervention of the three institutions:

SDAE, EAC and HICEP to help to solve or to arbitrate the conflict.

5) Keeping in touch with the possibilities foreseen in n°s 3 and 4, and if the model farmers don't accept the recommendations given by PDAI Irrigators association in D4/D7), PDAI / Irrigators association in D4/D7) reserve to right of ending the agreement with the Model farmers.

Chókwè, September of 2008

REGULATION OF THE RICE MILLING MACHINE FOR

GROUP OF AGRICULTURAL PRODUCTION D4/D7

I. OBJECTIVES

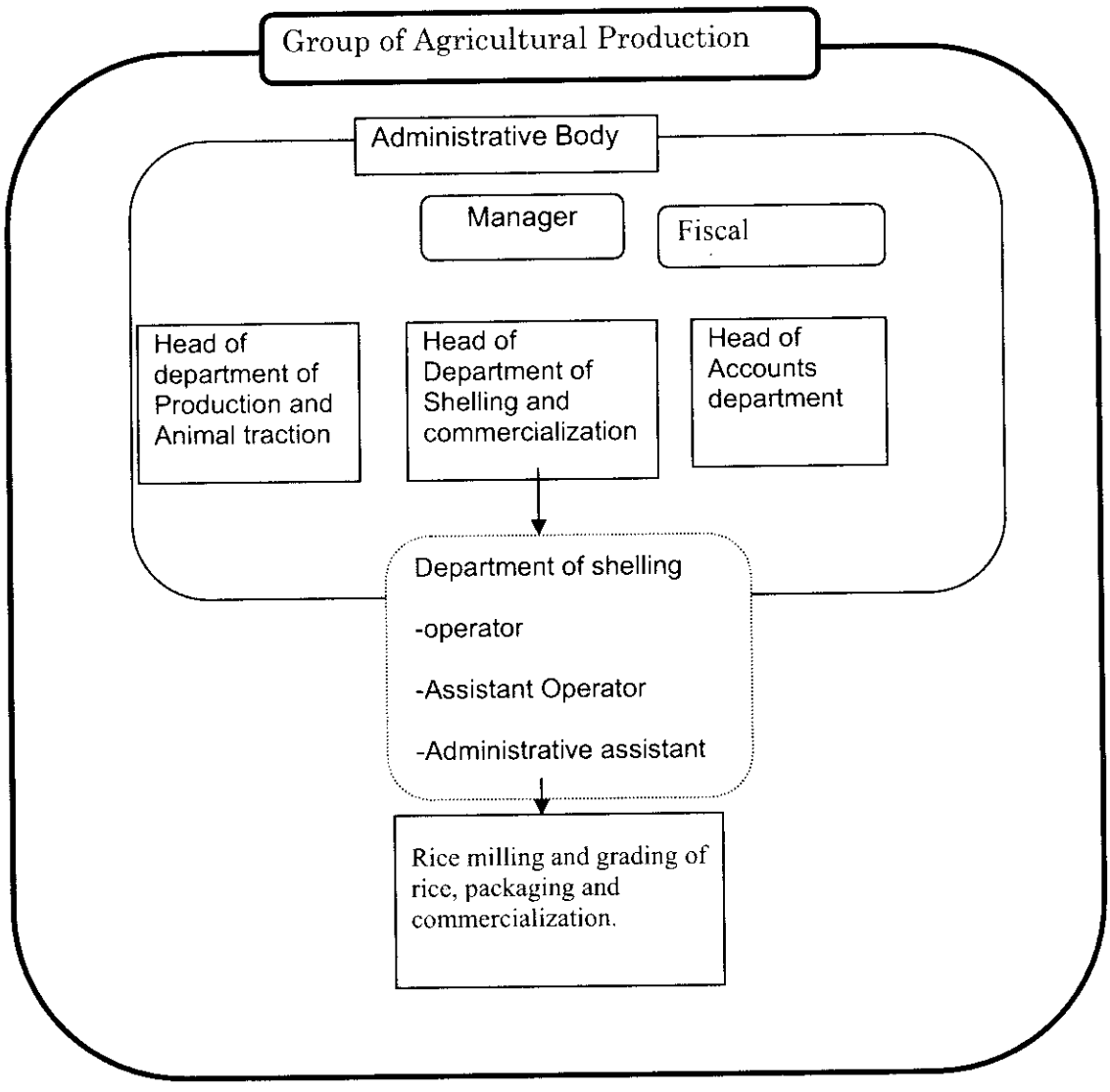
The administration of the rice shelling machine was entrusted to the association of Irrigators of D4 and D7 by SDAE through an agreed contract on November 15, 2007, among the director of SDAE (District Services of Economic Activities, Chókwe) and the Chief counselor of PDAI (Project of Integrated Agricultural Development for farmers of Small scales in the Irrigation System of Chókwe; JICA) and the presidents of AUA of D4 and D7.
With this, the group of agricultural production manages the rice-shelling machine that they were entrusted to, in agreement with the mentioned Regulation.
This regulation doesn't just define the way of using the machine and administration of the Rice-shelling machine, to give ability to plan and transparency in administration of the machine and the administration of funds, but it also defines on the form of investment of the income obtained in the business of shelling of rice and of the incomes obtained in activities related to the Group towards agricultural production.

II. FORM OF ORGANIZATION

1. Form of organization
The organizational form of the Group of agricultural production of the association of Irrigators is demonstrated accordingly below:

Organization chart of the Group of Agricultural Production (D4/D7)

Model D4/D7 Irrigators Association



2. General assembly

- It is entitled to do a general assembly with all models of the Irrigators association once a year, with an aim to review the situation of the supporting group of farmers of production pillars and select other new members for the group of agricultural production.

3. Meeting of the Administrative Body

- The meeting of the administrative body, once for every two months, in the sense of reviewing the activities and to discuss the largest calendars concerning the operation of the Shelling machine and about funds.

4. Meeting of the Group

Summoned by the administrative Body or by the Fiscal Officer, accomplished in an extraordinary way (as mentioned in the Statute)

5. Department of Shelling and commercialization

(1) The constitution of the Department of Shelling
The Administrative Body should hire the operator, with the Leaders orientation of Shelling and commercialization, as follows:

i. Operator
ii. Administrative assistant
iii. Assistant Operator

(2) The function of the department
The Irrigators Association entrusts the Department to operate the machine, to manage the Shelling of rice and to help increase the agricultural production for the members of the Irrigators association D4 and D7.

(3) Objectives of the department
The Group has the objective of increasing the production of the members of the association, through the effective operation of the machine and administration of the funds, and to provide better marketing opportunities.

The role of the administrative body and workers in relationship to the operation of the shelling machine

1. Administrative body (manager)
The Manager decides on the alteration of items and adding issues of importance.
Also makes the final decision on the quantities and the selling price of the rice obtained by the association, as well as the amount of the stock of the unshelled rice and seeds for the following campaign.

2. Department of shelling and commercialization (Head)
Works as Manager; does the daily supervision of the rice machine, as well as the administration of the rice machine and the commercialization. However, the deliberations of important subjects should be made through the approval of the Manager of the group.

3. Department of Accounting (Head)
The accounting Head has the task of controlling and registering all income and expenditure regarding the operation of the machine and all of the profits generated by the project PDAI such as the financial returns, sale of the rice and several products in the association's account.

4. Administrative assistant
The administrative assistant is responsible for the daily operation of the machine, doing the payments and maintenance of registers. He/she also administers daily activities such as incomes, expenses in relation to daily operation of the machine in the presence of the accounting.

5. Operator
The operator is responsible for the Shelling machine, for the starting, adjustment and maintenance of the machine.

6. Assistant operator
The assistant operator is responsible for the weighing and transporting of unshelled rice brought by the members of the association or customers. He also participates in the operation and maintenance of the machine.

7. Extension officer as FISCAL of the group
The extension personnel participates in the meetings of the management committee and he gives necessary technical pieces of advice to the management committee in relation to administration of the machine, market and financial subjects.

8. REMUNERATION
The remuneration values for the members of the group will be resolved after consultations among the Administrative Body. And as appreciated and approved, it the following values were considered:
Operator..... 3,000 MT
Administrative Assistant..... 2,500 MT
Assistant operator..... . 2,500 MT

9. Office allocation and place for meetings

The office for the group of agricultural production is allocated where the machine will be mounted and all meetings such as the ones by the administrative bodies and General Assembly you are held in this building.

III. OPERATION AND MAINTENANCE OF THE MACHINE

1. Irrigators (customers)
Priority is given to Irrigators (customers) who are members of the associations of Irrigators D4/D7. It is awaited that the Irrigators request the use of the machine from the administrative assistant of the group of agricultural production. The administrative assistant inspects the condition of the unshelled rice (removes dirt) in the presence of the operator and he/she gives permission to the customer to shell, if the rice is in the expected conditions. Then, he will give instructions to the operator or assisting operator to shell the customer's rice. The customer should agree in paying the value stipulated for the shelling when the job is finished. Only ready payment is accepted.

2. Control of payments and records
The administrative assistant should maintain the daily records of the shelling machine according to the hours of operation, amount of oil used, amount of shelled rice, amount of money received, expenses for oil and others. He is entrusted in the control of daily the values of the work and submit the whole amount in receipts to accounting department in every two days of work.

3. Control of cash values in the Association account to avoid risks.
The administrative assistant should maintain the record of the incomes in the daytime to day and expenses in the record book while the accountant has to verify and control the flow of the amount (received) every week. The accounting is also encouraged to deposit money once a week in the account of the association or twice when it's necessary to avoid robbery risks.

4. Daily inspection and periodic maintenance of the machine
The operator should make a daily inspection of the machine before beginning with the operation; inspect the amount of the remaining oil, condition of the diesel, water and the necessary condition of the chain, using the enclosed manual of inspection.
Any fault identified during the inspection should be reported to the administrative assistant for the important measures to be taken.
Serious defects or faults of the machine should be communicated to the project immediately PDAI through the administrative assistant or extension officer for a maintenance and effective preparation. The vehicle mechanic based at Lionde or in Chókwe should be requested at any moment necessary.

5. Shelling Charges.
The amount charged for shelling is of 2.5 meticais for 1Kg of rice with shells, Starting August 2009, for the members of the association who paid their membership fees and membership contributions, and 3 meticais for the odd ones. Also the cost for bran is of 0.5 meticais for 1 kg.
The administration committee should review the shelling costs, regularly. The administrative assistant maintains the daily records of the shelling operations in accordance with the control sheet attached to the machine.

IV. ADMINISTRATION OF FUNDS

1. Receipts of the business of Shelling.
All the incomes or all of the receipts are registered and controlled by the accounting department and -----to the auditor and manager in the meeting of the administration committee and general assembly.
Summarized, to be clear the Regulation of Micro financing plays a part.

2. Receipts of shelled rice sold
The rice with shells repaid by model farmers can be shelled by farmers of the Production Group and sold out on the basis of experimental regime as way of researching the best market. For the accountant to improve on the exploration of the market in the future he/she should very well register the total income in unit prices of the quantity sold at market places. All incomes should be introduced to the auditor and the manager, periodically.
Summarized for being established in contract to the part

3. Administration of Funds
The rotative funds can be used to help in several activities of the crop field. The assumed items of the use of amounts of rotative funds are listed below:

1) Purchase of Diesel, Oil and other necessary items for a smooth operation and repairing of the shelling machine
2) Payment of remuneration to people who operate the shelling machine including the guard.
3) Payment of the transport tax for the members of the administration committee, for departure to the bank for their transactions or for exploration of the market.

4) Purchase of instruments for land preparation, rates for the payment of model farmers including purchase of sacks and other necessary items for the crop field.
5) Developmental repair of the irrigation instruments
As for the procedure of administration of the funds, any payment within the first priority activities a request must be done to the management for approval.

After the payment, all receipts should be put together and submitted to the accountant for transparence in accounting.

6. Report on the activities of shelling and commercialization and interests.

The annual financial Report independent of the businesses of shelling should be taken for approval by the General Assembly of the Group, together with the annual trial balance of the Group of Agricultural Production.

Also in the same way, it will be obligation to take to the approval of the Assembly, the independent annual financial report of the commercialization activities (As established in the Regulation of administration of the micro-financing).

The annual profit generated in the activities of shelling and commercialization should not be distributed to the members and administrative bodies. As the rule states, this should be applied in the micro-financing activity, as financial support towards the agricultural production addressed to the members of the Group.

For assumption sake, if the activities of shelling and micro-financing generate profits to a certain level, it can be taken to the approval of the General Assembly, in a form of shares, the percentile of dividends for the members, the decision can be altered by a vote superior to 2/3.

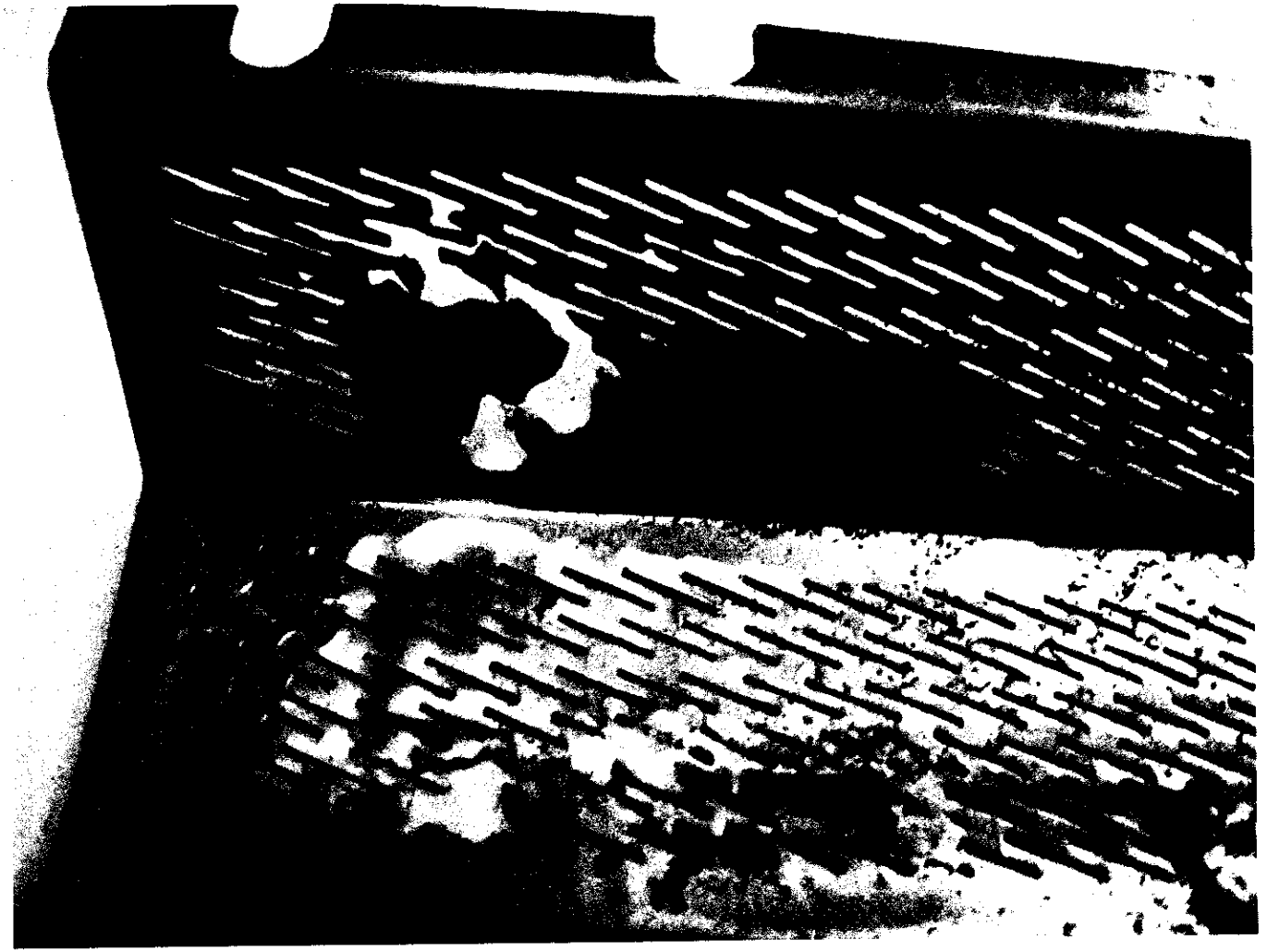
Annex-1. Inspection Sheet of the Machine (for the operator or assistant operator)

Items of control/verification	**Content**
Starting time	
1. Name of inspector	
2. Date	
3. Amount of remaining Diesel	
4. Amount of water in the radiator de água no radiator	
5. Amount of oil/level of burnt oil	
6. Degree of tension of the belts	
7. Condition of the screen	
8. Position of the regulators	
9. Condition of the engine at ignation/any noise or vibration through out operation	
10. Any strange noise, vibrations or acceleration.	
11. Need for the addition of diesel or water	
FINALLY	
12. Work finishing time	
13. Working hours	

Annex-2. Control sheet for machine use. (for administrative assistant)

Items of control	Content
1. Date of operatiion	
2. Name of customer	
3. Weight of unshelled rice	
4. Water contento f some grains	
5. Condiçtion of the grain (good, regular, mixed dirty)	
6. Starting and finishing time for shelling of rice	
7. Weight of white rice	
8. Weight of broken rice	
9. Condition of shelled rice (percentage of broken rice and of shell mixture by looking; write good, fair or bad)	
10. Amount received	
11. Utilization of shells and bran	

添付資料-R-1



添付資料R-2

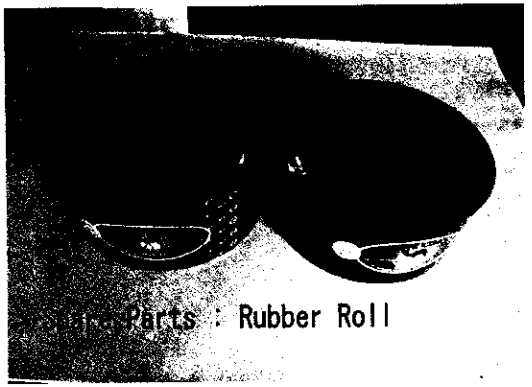
精米機補修部品の交換数と在庫残数

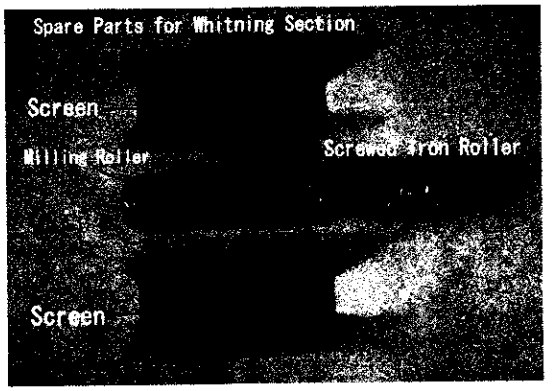
2009,6,8

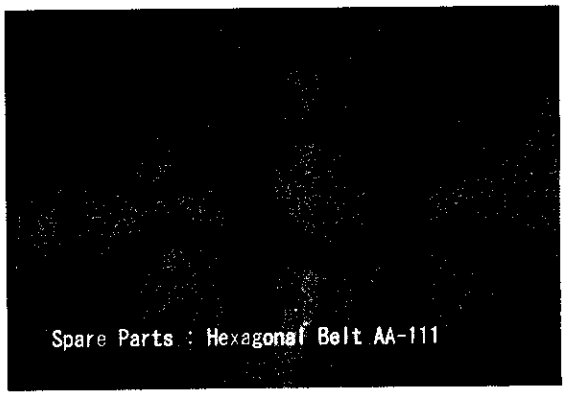
部品在庫場所 D4精米機分：ＰＤＡＩ事務所（ＳＤＡＥ） D'7精米機分：リヨンデ倉庫

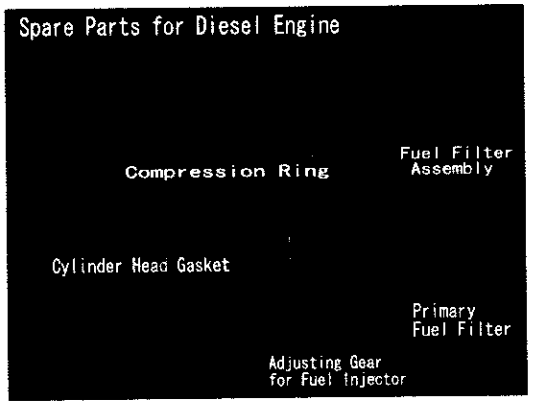
No	部品名称	当初在庫数	交換使用数		現在庫残数	在庫場所		6月追加発注数	在庫予定数合計	備考	
		(a)	D 4 (b)	D 7 (c)	(d)=a-(b+c)	PDA事務	ﾘﾖﾝﾃﾞ倉庫	(e)	(f)=d+e		
1	Rubber Roll	40	6	3	31	14	17	10	41		
2	Screen	20	9	4	9	1+2	6	20	29	2個はマプトで購入(09,6,5 中国製)	
3	Milling Roller	4	0	0	4	2	2	2	6		
4	Screw Iron Roller	4	0	0	4	2	2	2	6		
5	Hexagonal Belt AA-111	10	0	0	10	5	5	6	16		
6	Cylinder Head Gasket	4	0	2	2	2	0	2	4		
7	Compression Ring Set	4	0	0	4	2	0	2	6		
8	Fuel Filter Element	4	0	(1)	3	2	1	2	5	D7で1個交換した可能性あり	
9	Primary Fuel Filter	4	(2)	1	1	1	0	2	3	2個不明(交換後記帳忘れ)	
10	Adjusting Gear for FuelInjector	4	(1)	1	2	1	1	0	2	1個不明(交換後記帳忘れ)	
11	V-belt B-102(Connect Engine to Rice mill)	4+8	4	0	8	8	0	0	8	旧村氏8本追加持参	
12	Air Filter Cartridge							2	2	6月に新規発注	
13	Fuel Injection Pump Assembly							2	2	6月に新規発注	

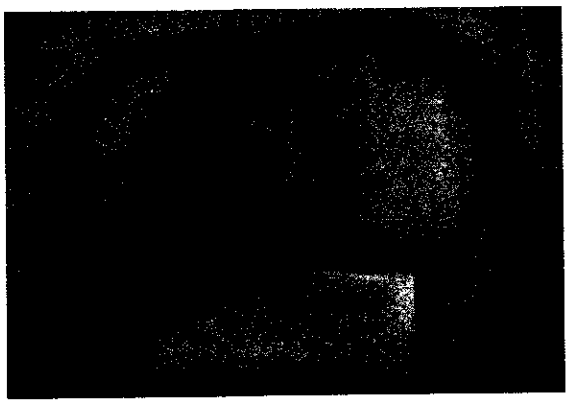
追加発注数（e）はＲＤＩ事務所に８月頃入荷予定。専門家が次回赴任時に分担してショクエに手荷物持参する


Parts : Rubber Roll


Spare Parts for Whitning Section
Screen
Milling Roller
Screwed Iron Roller
Screen


Spare Parts : Hexagonal Belt AA-111


Spare Parts for Diesel Engine
Compression Ring
Fuel Filter Assembly
Cylinder Head Gasket
Primary Fuel Filter
Adjusting Gear for Fuel Injector



添付資料-R-3

添付資料R-4　**D4,D7精米機操作・精米選別テストの結果**　09.6.10

1 テスト実施日　09.5/29 - 5/30

2 場　所　リヨンデ(D7)精米機

3 供試籾　(1) 品種　LIMPOPO
(2) 計量　50 Kg
(3) 籾含水率測定　12.9 %　13.0 %

4 脱芒機　使用後の籾重量:48kg(芒は2Kg除去)

5 機械運転設定　各部調節箇所はD4、D7精米機での通常運転状態と同じ

8 則定結果

	D4	D7	D4 -D7	
(1) エンジン回転数(rpm)	2160	2270	-110	D7が5%多い
(2) 精米機主軸回転数(rp	920	970	-50	D7が5%多い
(3) 精米所要時間(min)	8.7	6.0	2.7	D7が2.7分早い
1時間当りの籾精米量換算 (kg/hr)	345	500	-155	D7が155Kg多い

(4) 各部排出量

	D4	D7	D4 -D7	
	重量kg(構成比%)	重量kg(構成比%)	重量kg(構成比%)	
a 精米(1番口)	32.0 (64.0)	31.7 (63.4)	0.3 (0.6)	D4が0.3Kg多い
b 屑米等(2番口)	1.0 (2.0)	0.9 (1.8)	0.1 (0.2)	
c 糠	6.3 (12.6)	7.7 (15.4)	-1.4 (-2.8)	D7が1.4Kg多い
d 終了時米(混米)	1.9 (3.8)	1.3 (6.2)	0.6 (-2.4)	
e 籾殻・芒 50-(a+b+c+d)	8.8 (17.6)	8.4 (16.8)	0.4 (0.8)	
合計	50.0 (100)	50.0 (100)		

(5) 篩による選別

		D4	D7	D4 -D7	
篩の種類	区分	重量kg(構成比%)	重量kg(構成比%)	重量kg(構成比%)	
金網(大):10mesh	正常米	10.5 (78.4)	9.5 (73.1)	1.0 (5.3)	D4が1Kg多い
	砕米・屑米	2.9 (21.6)	3.5 (26.9)	-0.6 (-5.3)	D7が0.6Kg多い
	小計a	13.4 (100)	13.0 (100)	0.4	
金網(中):11mesh	正常米	9.7 (94.2)	9.5 (95.0)	0.2 (-0.8)	
	砕米・屑米	0.6 (5.8)	0.5 (5.0)	0.1 (0.8)	
	小計b	10.3 (100)	10.0 (100)	0.3 (100)	
竹 かご (従来使用の竹篩)	正常米	7.7 (92.8)	7.5 (86.2)	0.2 (6.6)	
	砕米・屑米	0.6 (7.2)	1.2 (13.8)	-0.6 (-6.6)	D7が0.6Kg多い
	小計c	8.3 (100)	8.7 (100)	-0.4	
	合計(a+b+c)	32.0	31.7	0.3	

添付資料　R-5

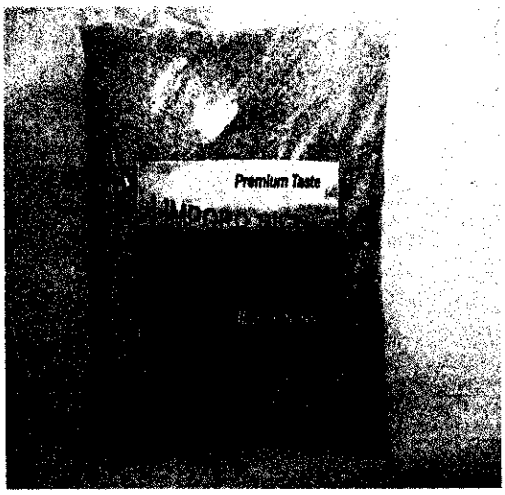
ARROZ LIMPOPO

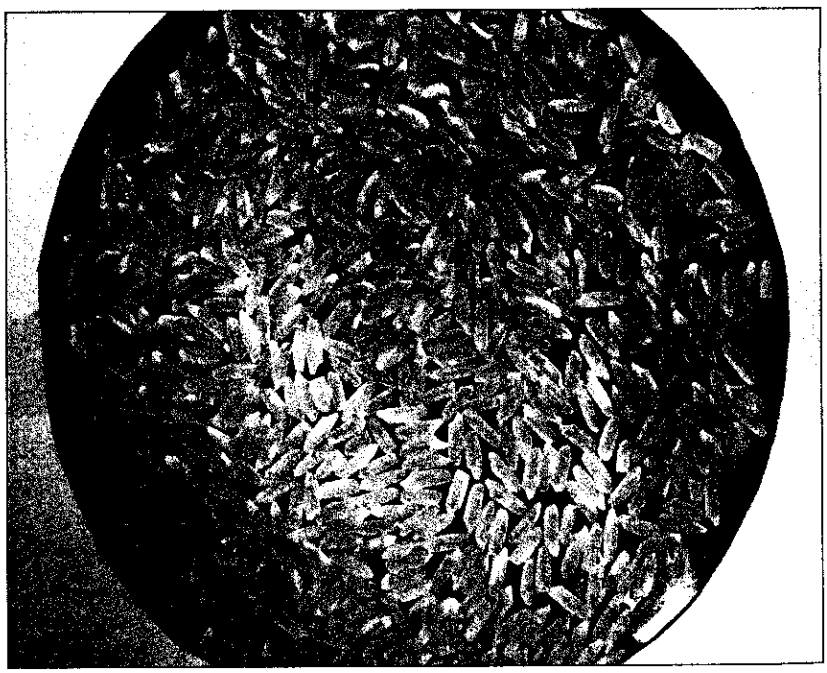
Novo Arroz　Saboroso

Produzido em Chókwè

"ARROZ LIMPOPO" é um novo arroz pruduzido este ano estremamente delicioso que os produtores do Chókwè produziram com menos quimico e bastate cuidado.

Por favor, Saboreia !





Contacto : David Ngovene
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Eugenio Zubera
Telf: 826007250

Promotor : SDAE –Chókwè
PDAI- JICA

添付資料R-6 マプト市での精米販売価格（小売価格）調査結果

No	調査先名称	精米パック包装表示内容	産地表示	重量（kg） a	表示価格 b（MT） b	1Kg当り価格（MT）	1Kg当りの価格（MT） ランク			
							～30	30～60	60～90	90～
1	スーパーマーケット WOOLWORT	organic long grain brown rice	CALIFORNIA （米国）	1	165	165.0				○
		organic long grain rice	CALIFORNIA （米国）	1	165	165.0				○
		Japanese sushi rice	Japan	1	233	233.0				○
		TASTIC BONNET(FINEST WHITE RICE)		3	139	46.3		○		
2	スーパーマーケット SHOPRITE	TASTIC BONNET(FINEST WHITE RICE)		0.5	25	50.0		○		
		〃		1	45	45.0		○		
		〃		2	99	49.5		○		
		TASTIC JASMINE (FRAGRANT THAI RICE)	THAILAND	1	65	65.0			○	
		TASTIC (BALLOONS ROUND MATALLIC SILVER 10'S)		1	49	49.0		○		
		TASTIC BASMATI(AROMATIC INDIAN RICE)	INDIA	1	149	149.0				○
		〃	INDIA	2	199	99.5				○
		TASTIC (OPENING INSTRUCTION)		10	369	36.9		○		
		Surprise Rice (Long Grain Parboiled)		1	35	35.0		○		
		〃		2	69	34.5		○		
		SASSEKA(First choice ARROZ)	AFRICOM.Lda	1	29	29.0	○			
		SASSEKA(Arroz De 1a qualidade)		5	159	31.8		○		
		RITEBRAND RICE(Parboiled)		2	75	37.5		○		
		DONA ANA (LONG GRAIN WHITE RICE)		1	32	32.0		○		
		〃		5	149	29.8	○			
3	O Vosso Supermercad	DONNA ANNA		1	36	36.0		○		
		DONNA ANNA Sun Rice (Thai Fragant Rice)	THAILAND	10	290	29.0	○			
		FALAK BASMATI RICE		4	160	40.0		○		
		FALAK Indian Basmati (The Authentic Flavour og Punjab)	INDIA	5	410	82.0			○	
		SASSEKA(First choice ARROZ)	AFRICOM.Lda	1	27.5	27.5	○			
		SASSEKA(Arroz De 1a		5	162.3	32.5		○		
		DONZAO ARROZ 100% Inteiro		1	40	40.0		○		
		〃		3	105	35.0		○		
		ASHOKA Indian Basmati Rice(Premium Matured)	INDIA	5	420	84.0			○	
		ARCO-IRIS (WHITE RICE ARROZ BRANCO)		5	185	37		○		

No	調査先名称	精米パック包装表示内容	産地表示	重量(kg) a	表示価格b(MT) b	1Kg当り価格(MT)	1Kg当りの価格(MT) ランク			
							～30	30～60	60～90	90～
4	食材店	IMPORTED SUSHI RICE (PILISHED SHORT GRAIN)	Japan	0.5	124	248				○
		Basmati Rice (gluten free suitable for vegetarian	INDIA	0.75	113	151				○
5	MERCADO MUNICIPAL	MR.DUCK (Long Grain Rice)		25	465	18.6	○			
		DONA ANA		25	590	23.6	○			
		LEAO ARROZ		25	500	20	○			
6	Super mares	Estvil (100% extra long grain WHITE RICE)		1	86.8	86.8			○	
		〃		2	173.6	86.8			○	
		PALMEIRA (NATIONAL)		1	24.6	24.6	○			
		ARROZ 100% Inteiro (Qualidade Super)]		3	96.4	32.1		○		
		〃		5	161.4	32.3		○		
		TASTIC BONNET(FINEST WHITE RICE)		2	98.9	49.45		○		
		〃		4	197.8	49.45		○		
		TASTIC(Perfect Every time)		1	65.8	65.8			○	
		DONA ANA (LONG GRAIN WHITE RICE)		1	34.5	34.5		○		
		FALAK Indian Basmati (The Authentic Flavour og Punjab)	INDIA	5	377	75.4			○	
						○計	8	22	7	7

添付資料 R-7

精米機補修部品の追加購入方法

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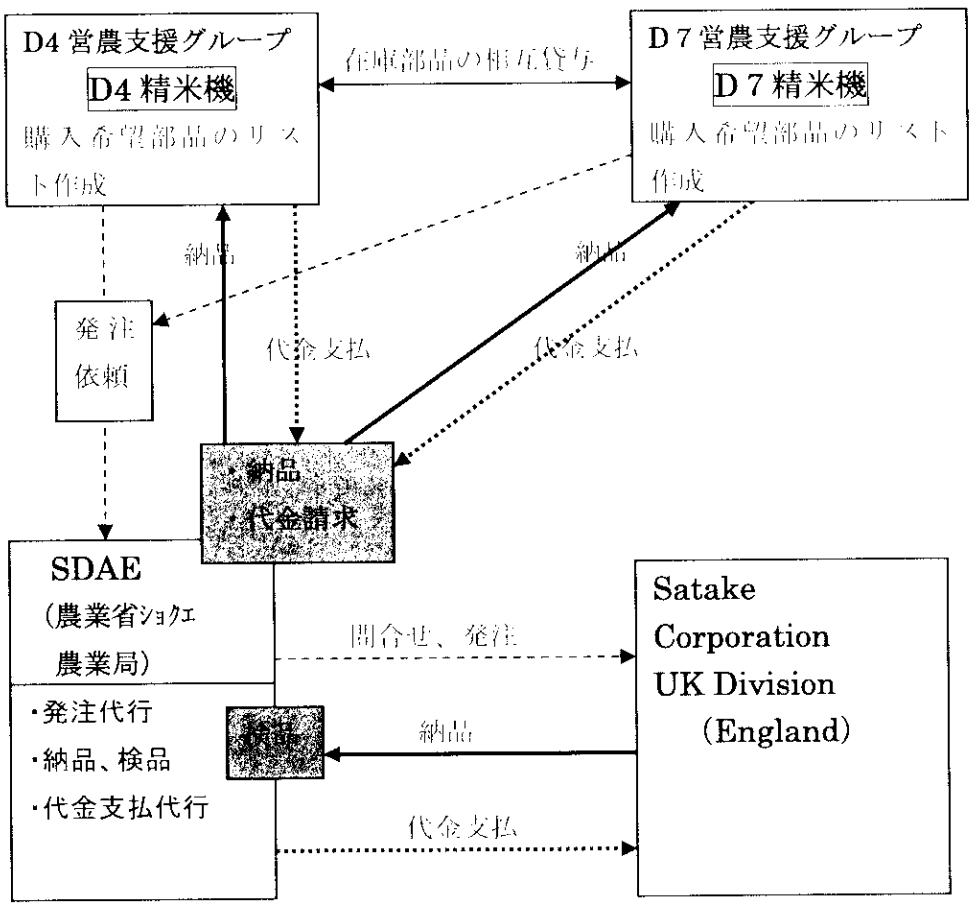
ホームページ：　http://www.satake.co.uk/flash.html
(Satake UK 店が扱っている商品、サービスの記載もある)

[部品発注から代金決済までの流れ]（案）



添付資料KO-1

PDAI Newsletter

Projecto de Desenvolvimento Agrícola Integrado Para os Agricultores do Sector Familiar no Sistema de Irrigação de Chókwè, Moçambique

Nº 6, Agost de 2009
MINAG JICA

Introdução

O Projeto entrou na 4ª fase de Maio 2009 até Março 2010. Esta é a ultima fase do projeto.

[redacted]

No dia 11 de Junho de 2009, realizou-se em Maputo, uma reunião do Comité de Coordenação Conjunta, que teve como agenda discução do Plano de Actividade na sua quarta fase de implementação, discução do Plano de Operação e aprovação destes. A reunião foi dirigida pelo Director Nacional de Extensão Agrária, o Eng. José António Gaspar, e contou com a presença dos representante da JICA Moçambique. Os dois pontos da agenda mereceram atenção e aprovação dos participantes.

Encontro de JCC no Hotel VIP

No dia 21 de Julho, realizou-se em Chokwé, uma reunião de monitoria a qual teve como convidados DPA Gaza e três instituições: SDAE, EAC e HICEP. O progesso das actividades do projecto foram monitoradas pela entrevista, visita ao campo e visita a moagem das Associações de Regantes no D4 e D7. A Equipe de monitoria ficou satisfeita com resultado do projecto.

Reunião de monitoria

[redacted]

os seguntes treinamentos Foram levados a cabo pelo projecto PDAI durante o periodo de Maio a Julho de 2009.

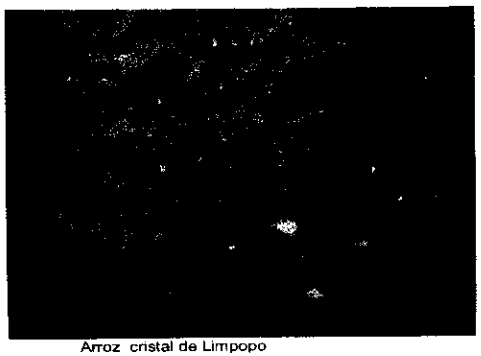
1) Treinamento de agricultores modelo das associações de regante
(2) Treinamento de extensionistas
(3) Treinamento de grupo de apoio a proudução
(4) Treinamento de lideres de das associações sobre operações obras hidraulicas de facilidades e distribuição de agua

foi realizado um treinamento de grupo de apoio a produção junto com extensionistas para fazer promoção de venda de arroz Limpopo no mercado de Maputo. O Resultado de promoção de venda de arroz foi muito positivo.

Promoção da mercadoria arroz Limpopo

[redacted]

O Gropo de apoio a produção D4, D7, esta a vender ARROZ LIMPOPO. Esta variedade tem de alta qualidade, bom gosto é delicioso e aromático. é produzido em Moçambique pelos agricultores do regadio do Chókwè. Já esta a venda no armazem em Lionde proximo do Dimas e no 2º bairo perto da cova. Venha e compre o ARROZ LIMPOPO a um preço baixissimo. 1kg de ARROZ LIMPOPO custa so 25Mts.



Arroz cristal de Limpopo

[redacted]

O projecto leva a cabo a reciclagem de pulverização de bovinos contra carraça aos seus 10 beneficiários como forma de influênciar toda a comunidade a fazer o controlo da carraça que tem sido a causa principal pelo indice de mortalidade do gado bovino. Por sua vez, o extensionista fez a demostração de reciclagem de sanidade de bovinos.

Demonstração de pulvização condusida pelo extensionista

[redacted]

A Boca de entrada na caleira foi expandida e foi colocado uma grande adufa para passar mais quantidade de água, tambem a drenagem foi melhorada pela gestão participativa dos agricultores modelo no D4, com apoio em assistência tecnica e meteriais.

Antes do inicio da obra, foram conduzidas muitas reuniões com agricultores para mobilizarem as pessoas que ainda não tinha interesse de participar na obra.

A obra participativa de melhoramento da boca e drenagem correu muito bem, resultando no acabamento do trabalho em poucos dias .

Encontro com agricultores

Melhoramento de drenagem com obra participativa

[redacted]

Obtido maximo rendimento na variedade "Limpopo"

O Teste de comparação de variedade foi conduzido na Extação Agriaria de Chokwe e machamba modelo no D4. As variedades usadas para o teste foram , IR64, ITA312. O rendimento do limpopo superou outras as variedades produzindo 9.4 ton/ha, seguido por IR64 Produzindo 7.7 ton/ha e ITA312 com mais baixo rendimento 6.8 ton/há, como mostra –se a seguir.

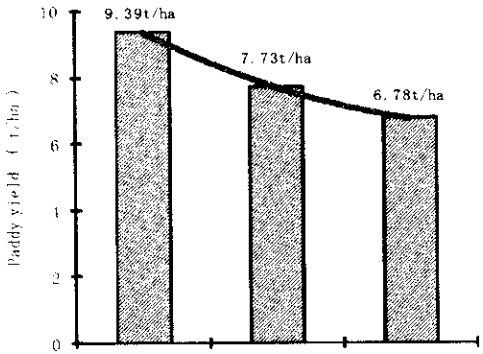


Fig. 1 Rendimento de cada variedade

O periodo de crescimento de limpopo e IR64 foi 125 dias e ITA312 foi 135 dias. Com remarcavel caracteristicas em cada variedade testada, limpopo não tinha segregação com o estavel crescimento, possuindo arista por sua particularidade, que reduz os danos de passaros. Ao cotrario deste, o caule do IR 64 é susceptivel para o acame tendo menos 1.000 graus de peso. Quando comparado aos 1.000 graus de peso entre as três variedades de limpopo, ITA312, e IR64, foi 27g, 26g e 21g respectivamente. E menos peso de 1000 graus caracteristico de IR64 pareceu um constrangimento limitando o alto rendimento. Em outras terras, ITA312 tem uma caracteristica de imperfeita espigação em que parte do botão de paniculo resta dentro da bainha da folha durante o período da espigação,que eventualmente baixa a percentagem de maturação(69%) comparado ao limpopo e IR que escede mais que 80%. Estas caracteristicas de ITA312 tem tambem desvantagens de atingir alto rendimento.

Com estes resultados limpopo apareceu com mais alta potencialidade em rendimento nas variedade.

Reportado por Eng. Namba sector de *agronomia.*

PDAI Newsletter

Projecto de Desenvolvimento Agrícola Integrado Para os Agricultores do Sector Familiar No Sistema de Irrigação de Chókwè Em Moçambique

Nº 7, Fevereiro de 2010

MINAG JICA

Introdução

O Projecto entrou na 4ª fase de Maio 2009 até Março 2010. Esta é a ultima fase do projecto.

[redacted]

No dia 28 de Janeiro de 2010, realizou-se em Maputo, uma reunião do Comité de Coordenação Conjunta, que teve apresentação final dos resultados da Actividade. A reunião foi dirigida pelo Director Nacional de Extensão Agrária, o Eng. José António Gaspar e contou com a participação dos representantes da JICA Moçambique e suas contraparte. Os dois pontos agendados foram discutidos e mereceram especial atenção por parte dos convidados que posteriormente foram aprovados e assinados pelos participantes, nomeadamente Eng. José António Gaspar, Sr. Chukonobe, e o Sr. Masato Tamura.

Após as discussões, visto os resultados alcançados, espera-se num futuro próximo melhorar ainda mais as condições dos agricultores.

[redacted]

No dia 18 de Setembro, realizou-se em Chókwè, uma visita de vice presidente da JICA que foi acompanhado pelos embaixador do Japão, representante de escritório da JICA Moçambique, representante da ABC do Brasil e assessores do Ministério de Agricultura. A equipe visitou o campo modelo e a moagem das Associações de Regantes no D4 e D7. A Equipe ficou satisfeita com o grande resultado do projecto.

[redacted]

A Missão de avaliação final conjunta foi liderada por Sr. Sumi Direcção adjunto do Desenvolvimento Rural no JICA, o qual Visitou Chókwè de 1 ~ 9 de Dezembro de 2009 e fez um preciso estudo de avaliação através de varias entrevistas e visitas de campo em relação as actividades do Projecto.

O Relatório de avaliação final perante a performance do projecto foi bastante positiva considerando os resultados em PDM.

O Relatório de avaliação final conjunta foi apresentado na 7ª reunião do JCC e aprovado pelos seus membros.

Discussão sobre actividades de grupo de apoio a produção

[redacted]

Nos dias 8/9 de Setembro houve um encontro separadamente com as associações do D4 e D7 para discutir a questão de um estatuto de constituição das associações através do qual as associações podem se guiar e tornar transparente as suas actividades. O mesmo servira de regulamento para o funcionamento da máquina de descasque, regular como serão geridos os fundos das associações, e dar a continua transparência dos restantes conteúdos do mesmo.

Todos os membros das associações concordaram e aprovaram o estatuto pois este tornara fácil as suas actividades.

Assembleia geral que aprovou estatuto do grupo de produção agrícola

[redacted]

De acordo com as questões feitas pelo Projecto, os agricultores modelos, dizem-se bastantes satisfeitos com os resultados que estão a obter devido ao melhoramento das técnicas do cultivo e produção do arroz introduzida pelo Projecto, que aumentou consideravelmente o rendimento da produção do arroz. Satisfeitos estão também pelos tantos apoios que tem recebido por parte do Projecto com maior destaque para a maquina de descasque que trouxe melhorias e facilitou o descasque da produção em quantidades significativas, poupando deste modo o tempo que seria gasto e melhorou a qualidade do arroz.

[redacted]

O Projecto começou em Maio 2007.

Cerca de 3 anos se passaram.Eu pessoalmente estou muito agredecida por ter aprendido muita coisa em Moçambique. Os nossos sinceros agradecimentos vão para todos aqueles que colaboraram directa ou indirectamente com o projecto, contribuindo deste modo para os bons resultados e sucessos alcançados pelo projecto. A distacar o Director, DNEA, MINAG Eng. Gaspar, aos Chefes das instituições parceiras no Chokwe Sr. Matsule, Sr. Mugabe e Sra. Celestina, aos contrapartes das instituições parceiras no Chokwé, aos representantes da JICA em Moçambique o Sr. Shukunobe e Sr. Hirashima e a tudos colegas e produtures o nosso muito obrigado.

ARROZ LIMPOPO

添付資料-P-1

Implementation results and output of Annual Plan of Operation (APO)

Project title : Integrated Agricultural Development Project for Small Scale Farmers in Chokwe Irrigation Scheme

	Activities (written in PO)	Sub-activities	Target / Indicator	Responsible / Supported by	Japanese Fiscal Year (JFY) 2006 M	2007 AMJ JAS OND JFM	2008 AMJ JAS OND JFM	2009 AMJ JAS OND JFM	Outputs	Achievement/ condition
0	Conduct baseline survey								Base line survey report	100%
1.Techniques for small scale farmers in the target area are improved.										
1-1	Train extension workers in agricultural technology	1-1-1 Prepare manuals on technical guidance for extension workers	No. of manuals prepared	SDAE, EAC, JICA					No. of manual prepared: 5	100%
		1-1-2 Train extension workers in agricultural technology	No. of extensionists trained	SDAE, EAC, JICA					No. of extension workers trained : 8	Demonstration continues 95%
1-2	Establish model farm	1-2-1 Train small scale farmers in model WUAs in agricultural technology	No. of farmers trained	SDAE, EAC, WUAs, JICA					No. of model farmers trained : 59	
		1-2-2 Monitor activities and extension achievements of model farmers	No. of monitors implemented	SDAE, EAC, WUAs, JICA					Number of farmers trained: 10 No. of monitoring: 2	100% 100%
1-3	Promote animal traction	1-3-1 Train extensionist and model farmers of animal traction	No. of personnel trained	SDAE,WUAs, JICA					No. of animal traction training: 3, No. of beneficiaries: 16	100%
		1-3-2 Implement revolving fund of animal traction	No. of farmers utilizing it	SDAE, WUAs, JICA					Recovery of revolving fund: over 90%, No. of beneficiaries: 59	100%
		1-3-3 Adaptate/improve animal traction techniques	No. of farmers utilizing it	SDAE, WUAs, JICA					No. of farmers used for AT puddling : 22	100%
1-4	Strengthen capacity of EAC	1-4-1 Transfer rice cultivation techniques to research staff in EAC	No. of techniques transferred	EAC, JICA					No. of techniques transferred: 11	100%
		1.4.2 Enforce field experiment at research station	No. of experiments enforced	EAC, JICA					No. of experiments at EAC: 6	100%
		1-4-3 Transfer experiment and management methods	No. of methods transferred	EAC, JICA					No. of experiment methods transfered at EAC: 6	100%
		1-4-4 Transfer data analysis and management methods	No. of methods transferred	EAC, JICA					No. of experiment methods transfered at EAC: 6	100%
1-5	Examine and establish rice cultivation techniques for small scale farmers	1-5-1 Discuss improvement points	No. of points discussed	EAC,JICA					No. of points discussed : 5	100%
		1-5-2 Collect and analyze data	No. of data collected	EAC, JICA					No. of data collected: over 10	100%
		1-5-3 Implement verification trial	No. of trials implemented	EAC, SDAE,WUAs, JICA					No. of verification implemented: 6	100%
		1-5-4 Prepare manuals on agricultural technology for extension workers	No. of manuals prepared	EAC, SDAE,JICA					No. of manuals prepared: 5	100%
		1-5-5 Transfer outputs to extension organization	No. of outputs transfered	EAC,JICA					No. of output transferred to extension section: 3 extension material and 5 manuals	100%
1-6	Examine and improve up-land crop cultivation techniques for small scale farmers	1-6-1 Examine and establish improved techniques for manual preparation	No. of manual prepared	EAC, SDAE, JICA					No. of manuals prepared: 5	100%
		1-6-2 Examine and develop proper cropping patterns and transfer them	No. of cropping patterns adapted	EAC,JICA					No. of up land crop examined: 5	100%
1-7	Improve rice seed multiplication techniques	1-7-1 Train EAC personnels for seed multiplication	No. of personnel trained	EAC, JICA					No of EC staff trained: 3 C/P and 3 field staff	100%
		1-7-2 Prepare manuals for seed multiplication	No. of manuals prepared	EAC,JICA					No of manuals prepared: 1	100%
2. Management of irrigation facilities and water use is improved.										
2-1	Conduct survey on management of the irrigation facilities		No. of survey conducted	HICEP, WUAs, SDAE, JICA					No of survey conducted : over 3	100%
2-2	Rehabilitate canals in model plots	2-2-1 Implement contraciting work	No. of works implemented	HICEP, WUAs, JICA					No. of contracted work: 1	100%
		2-2-2 Implement Participatory work	No. of works implemented	HICEP, WUAs, SDAE, JICA					No. of participatory work: over 6	100%
		2-2-3 Implement field preparation	No. of works implemented	HICEP, WUAs, SDAE, JICA					No. of field preparation work: 2	100%
2-3	Prepare manual on irrigation facility management and water supply management	2-3-1 Review existing AFD manuals	No. of AFD manuals reviwed	HICEP, WUAs, SDAE, JICA					No. of AFD manual reviewed: 1	100%
		2-3-2 Prepare manual on irrigation facility management	No. of manuals prepared	HICEP, WUAs, SDAE, JICA					No. of manual prepared: 3	100%
		2-3-3 Prepare manual on water supply management	No. of manuals prepared	HICEP, WUAs, SDAE, JICA					No. of manual prepared: 1	100%
2-4	Train HICEP personels and leaders of model water user associations in use and management of canals [3-11(3)]		No. of personnel trained	HICEP, WUAs, SDAE, JICA					No. of personnel trained: 79	100%
2-5	Monitor management of irrigation facility and water supply in the target area		No. of monitors implemented	HICEP, WUAs, SDAE, JICA					No of monitoring implemented: over 2 (monitoring seminar)	98%
3. Farming support activities provided by extension officers and WUAs for small scale farmers in										
3-1	Review existing farming support activities (AFD, IFAD, NGO etc)		No. of activities reviwed	SDAE, EAC, HICEP, WUAs, JICA					No. of activities reviewed: 5	100%
3-2	Train farming support groups of model WUAs		No. of groups trained	SDAE, EAC, HICEP, WUAs, JICA					No. of group trained : 9	100%
3-3	Carry out farming support activities by extension workers and WUAs	3-3-1 Prepare manuals on operation of rice mills	No. of manuals prepared	SDAE, JICA					No. of manual prepared: 1	100%
		3-3-2 Train personnels on operation of rice mills	No. of personnels trained	SDAE, JICA					No. of personnel trained: 10	100%
		3-3-3 Promote joint purchase of agricultural materials and joint sales of agricultural products	No. of instruction sessions, Amount of improved incomes	SDAE, WUAs, JICA					2.5 tons and 3 tons rice sale to Mapulo by D7 and D4 farming group respectively	100%
		3-3-4 Promote access to micro-credits	No. of farmers accessed	SDAE, WUAs, JICA					No. of farmers accessed to micro credit : 59	100%
3-4	Monitor farming system support activities conducted by extension staff and model WUAs		No. of monitors implemented	SDAE, JICA					No. of monitoring implemented: over 2 times (monitoring seminar)	100%
4. Collaboration among SDAE, EAC, and HICEP is strengthened.										100%
4-1	Hold periodic meetings to mutually review activities of EAC, SDAE and HICEP		No. of meetings held, and attendees	SDAE, EAC, HICEP, JICA					No. of periodical meeting held: 10	100%
4-2	Conduct workshops for reinforcing the collaboration among EAC, SDAE and HICEP [3-1(1)]		No. of workshops conducted	SDAE, EAC, HICEP, JICA					No. of work shop held: 7	100%
4-3	Conduct activities to promote collaboration among SDAE, EAC, and HICEP, and strengthen the extension system		No. of activities conducted	SDAE, EAC, HICEP, JICA					No. of activities : workshop (6) and monitoring(2)	100%
4-4	Monitor the status of collaboration among SDAE, EAC, and HICEP		No. of monitors implemented	SDAE, EAC, HICEP, JICA					No. of monitoring conducted : 2	100%
4-5	Prepare The Action Plan for agricultural production through collaboration between SDAE, EAC, and HICEP		Plan of Action	SDAE, EAC, HICEP, JICA					Revised action plan: 1	100%
4-6	Carry out each activity conducted by EAC, SDAE and HICEP, according to The Action Plan		No. of activities conducted	SDAE, EAC, HICEP, JICA						98%


ジャイカ
JICA