インドネシア養蚕開発計画
専門家報告書

―桑栽培―

昭和58年2月

国際協力事業団

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はじめに

インドネシア養蚕開発計画は、昭和４７年南スラウェシ州を襲った大旱魃に続いて大発生した微粒子病により大きな被害を受けた同国の養蚕業を建て直す計画に協力して、昭和５１年３月から昭和６０年３月までの予定で、南スラウェシ州にある養蚕センターを中心として実施されている。事業は南スラウェシ州ゴア県の養蚕センター、ソッペン県の副センター及び５ケ所のパイロットユニットにおいて、桑栽培、蚕飼育における実用及び実証試験、蚕種の製造と配布、技術職員及び農民の訓練等を主要な内容としている。

本報告書は昭和５５年１１月１４日から昭和５８年２月２７月まで桑栽培の専門家として派遣された山本　賢専門家が活動の成果を取りまとめられたものであり、今後の技術協力に活されることを願うものである。

最後に本報告をまとめられ山本　賢専門家並びにご指導いただいた外務省、農林水産省および関係各機関の各位に謝意を表する。

国際協力事業団
農業開発協力部

部長　田内　堯

インドネシア養蚕開発計画
―桑栽培―

派遣専門家
山本　賢

私は１９８０年１１月１４日から１９８３年２月２７日までの２年３カ月間、インドネシア養蚕開発計画の桑栽培専門家として派遣された。この間、カウンターパート等の訓練、桑栽培技術を開発するための実用化試験とサブセンターにおける実証試験、農民段階に適応する技術演示計画とパイロットユニットにおける演示指導、奨励桑品種の増殖とさし穂の農民への配付並びに事業用桑園の造成と管理に関する業務に従事した。

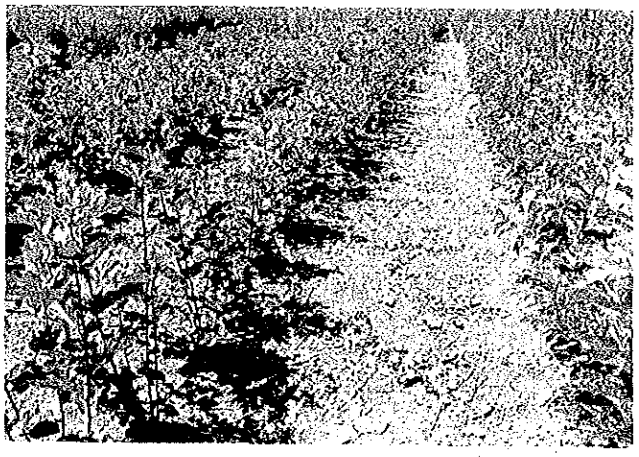
この間の業務の概要については「インドネシア養蚕開発計画専門家報告書、昭和５５年度報ＪＲ８２－１５、ＪＩＣＡ」並びに「同、昭和５６年度報ＪＲ８３－６、ＪＩＣＡ」として報告した。

次に、１９７６年３月に調印されたＲ／Ｄ、ついで１９７８年２月に締結された５カ年間の技術協力期間の業務概要は「総合報告書、１９８３年２月」として、英語とインドネシア語版が作成された。この報告書は主として協定期間内に実施された業務内容、成果、今後の改善対策を提言したものである。桑栽培部門では過去に技術指導書、技術レポート等が報告されていないので、森チームリーダーの勧めによって「総合報告書、１９８３年２月」の日本語版として本報告書に添付した。したがって、主な担当者を明記したうえで、桑栽培部門の業務内容とその背景、成果並びに今後の問題とその対策など、技術協力協定の基本計画に沿って編集した。今後、これらの報告書が本プロジェクトの事業推進に際して、有効に活用されることを希望する。

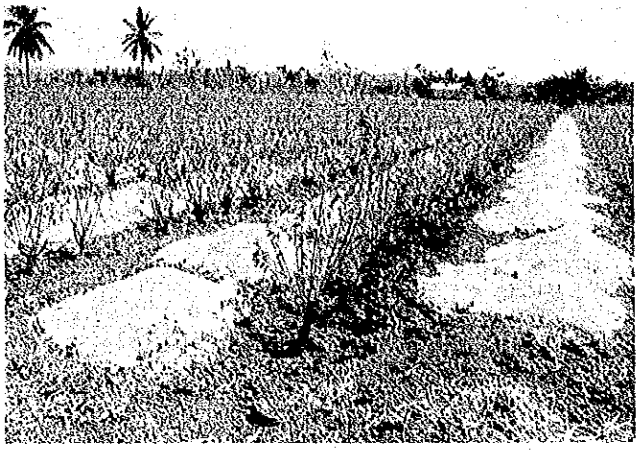
１９８３年２月２４日

奨励品種 Morus alba

接木をする Assistant Counterpart



サブセンター（Luppange）における据え接ぎ法
実証試験　　15a（1600株）最終活着率97%



モミガラマルチング（５㎝の厚さとする）

クワカイガラムシ被害桑園の株下げによる防除

農民実習訓練（サブセンター）

インドネシア養蚕開発計画総合報告書
― 桑栽培編　1983．2 ―

目　　次

1. 桑園の造成と管理（センター，副センター）

(1) 桑園造成

桑園の造成に当たってはインドネシア養蚕開発事業実施設計調査報告書（国際協力事業団、農林５１－５９、１９７６年１０月）に基づく、現場設計によって施工された。したがって、この桑園造成は農家の現場対応と異なり、養蚕開発計画の任務を推進するための基盤事業として実施されたものである。

1）ビリビリ桑園

ウジュンパンダンの東方約３０Km、マリノ街道沿いにあるサリテネ山頂近くの台地（標高２００m）及びこれに連なる山腹の起伏のはげしい地形の中に、テラス状の桑園が２カ所、併せて３カ所に分散して造成された。この地帯は予想以上に埋没岩石が多く、エローション防止の配慮も加わって、当初計画の8ha（採草地を含む）のうち、桑園造成された実面積は３ha となり、計画を大幅に下廻わった。

2）パカトウ桑園

養蚕センターからウジュンパンダン寄り、7.8Kmのマリノ街道沿いに位置し、平坦地と緩傾斜地からなっている。この桑園はビリビリの不足分を補うために設置されたもので、桑園面積は約４ha である。このうち、平坦地の約1.3 ha は隣接する水田と等高で過湿になるため、桑の植溝に竹を埋没して簡易排水処理を施した。

3）タナブランゲ桑園

副センター（ソッペン県タジュンチュ）の主要桑園として、副センターの北西約８Km、標高１２０mのララバタリヤジャに設置された。小川沿いの平坦地であるが、土壌は重粘土で透水性が極めて悪いため、とくに滞水しやすい地域（４ha）はPakatto桑園と同じ手法で、竹を埋没して簡易排水を行なった。

以上、３桑園の年次別植付け面積は第１表のとおりである。

第１表　桑園植付け面積（ha）

年次	センター			副センター
	Bili-Bili	Pakatto	合計	Tanah Bellange
１９７６	2.04	—	2.04	1.50
１９７７	1.03	0.67	1.70	2.00
１９７８	0.33	3.37	3.70	1.50
１９７９	—	—	—	13.50
計	3.40	4.04	7.74	18.50

第２表　採草地造成面積（ha）

年　次	Bili-Bili	Pakatto	計
１９７７	－	0.３８	0.３８
１９８１	1.００	－	1.００
計	1.００	0.３８	1.３８

（伊藤実、藤原茂正、Zito S.）

(2) 桑園管理

1）ビリビリ桑園

山頂近くの標高約２００mの台地及び２カ所の山腹テラス状桑園に分散し、何れも埋没石礫が多いため、トラクター等の農業機械は使えず、もっぱら管理作業員の手作業に依存している。経常的には４名の作業員によるが、地形、土性の関係から、能率は極めて低く、また、桑園周辺から宿根性のアランアラン（イネ科）が侵入し、作業が手遅れとなり勝ちな雨季には雑草が繁茂し、一歩誤れば荒廃化の危険がある。

2）パカトウ桑園

平坦地は粘質土、緩傾斜地は石礫を多少混じえた壌土であって、農業機械が使用できる。現在、小型乗用トラクター、ハンドトラクター及び草刈機を使用し、常用管理作業員４名によって管理作業を行なっており、干季には、概ね、完全な管理ができる体制が整っている。しかし、この桑園には宿根性のアランアランや蔓性のミモサ等、悪性の雑草が多いため、雨季に除草を怠れば、たちまち雑草に覆われ、桑の収穫さえ困難な状態になる。

肥料は両桑園とも共通で、稚蚕用は化成肥料（N.P.K）、壮蚕用は尿素と硫酸アンモニアを使用し、それぞれ年間Ｎ２００Kg及びＮ１００Kg／ha を施用している。

蚕飼育、蚕種製造に供給するための桑園面積は稚蚕用１ha 、壮蚕用4.５ha を切半し、交互に使用して、年６回飼育に合わせた収穫法を実施しており、１９８１／８２年の実績は年間４０箱、桑葉供給量（条桑）は稚蚕用3,３８０Kg、壮蚕用３８,０００Kgであった。

センターのBili-Bili とPakatto 桑園における桑害虫はクワカイガラムシ、コナカイガラ及びクワノメイガが主なものであり、稚蚕用桑園はコナカイガラ、クワノメイガによる被害がみられるので、ＰＡＰまたはＤＤＶＰ乳剤を散布して防除を実施している。

3）タナブランゲ桑園

サブセンターにおける配付用蚕種製造のための主用桑園であるが、重粘土のため、管理作業は困難であり、生産性も低い。現在、乗用小型トラクター、ハンドトラクター、動力噴霧機等の農業機械を使用し、管理作業員１０名と臨時雇用２０～３０名によって作業を進めている。しかし、雨季には土壌が軟弱となり干季には固結してコンクリート状になることが多

いため、桑園管理状態は全般に悪く、約４０％の桑園は半ば荒廃化している。また、Soppeng地方は農家の桑園を含めて、害虫の発生が概して多く、とくにTanah Bellangeではクワノメイガ、コナカイガラの被害が大きい。動力噴霧機を用い、ＤＤＶＰ及びBasdin（インドネシア製）によって防除しているが、雨季には防除適期を逸することが多く、害虫の被害にによって生産力をいっそう低下させている。

（藤原茂正、Zito S.,Endjang K、山本　賢）

(3) 残された問題とその対策

1）桑品種の更新

センター及び副センターの桑園に栽植されている桑品種は収量が少ないM. nigraが大部分である。今後、生産性を高めるには、良質多収のM. albaやM.cathayanaへ計画的な改植によって、品種を更新すべきである。

2）有機物の補給による地力維持

熱帯地方は気温が高く、地力の消耗が激しい。にもかかわらず、殆んど有機質の補給を行っていない。とくに物理性の悪いTanah Bellangeでは、干季に干害を受けやすいので、有機質の補給による土壌改良が望まれる。経済性からみて、モミガラマルチング及びマメ科緑肥の間作が有望と思われる。

3）雑草対策

センター、副センターとも宿根性のアランアランやミモサなどが多く、除草を怠れば、たちまち荒廃化する。除草は雨季に重点をおくべきであるが宿根雑草は、干季に根から除去するようにすべきである。機械力の使えるPakatto、Tanaha Bellangeでは株間の除草を心がける必要があり、時には除草剤の使用も止むを得ない。

4）収穫法の改善

蚕種製造を主要な目的とした現在の収穫法は、桑の生理からみれば乱伐となり、長期的には安定多収は困難であろう。干季の無理な飼育を避け、A、B、Cのローテーションによって、年１回の休養期間を与える収穫法を実施してほしい。

5）害虫の適期防除

クワノメイガ及びコナカイガラの被害を防止するには、薬剤の適期散布以外にない。動力噴霧機の効果的な使用と、注意深い観察による防除適期のは握が肝要である。

6）農業機械の保守管理

機械修理専門家（竹岡氏）の訓練によって、オペレーターの技術は向上している。今後もできるだけ、研修の機会を与える必要がある。現有する農業機械は、ウジュンパンダンにおいて、殆んどのスペアパーツが入手できるので、常に整備と点検に心がけ、桑園管理に支障のないようにすべきである。

以上、問題点をあげたが、桑は生きものであることを再認識し、愛着をもって育てるという概念を持ち、インドネシア専門家、技術スタッフが協力して、計画、実行に当たることが要望される。　　（山本　賢）

2. 桑品種の実用形質調査（センター，副センター）

(1) 南スラウエシにおける栽培桑品種

一般農家で栽培されている桑の大部分はMorus nigraであり、この中にM. australisとM. alba が多少混じって栽培されている。この地方の桑園造成のやり方はさし木によって行なわれるから、発根力が強く、活着しやすいM. nigraが自然な形で導入されたものと考えられ、良質、多収の品種を選んで栽培するという概念は農家に定着していない。

南スラウエシには自生の桑が見当たらない。現在、センター及びサブセンターにある7～8品種はすべてジャワ島より導入されたもので、多くの調査や試験はこれらの品種を用いて実施された。

(2) 桑品種に関する実用化試験

1）多肥栽培による桑品種の比較試験

a. 目　的：南スラウエシでは1977年現在、ha当たり収繭量が約40Kgといわれており、生産性が極めて低い。これを大幅に改善するには、施肥する必要があり、施肥と桑品種との関係を調べた。

b. 方　法：サブセンター（Tajuncu）で、M.nigra ほか5品種を供試、植付け5年目、中刈仕立、植付距離1.5×1.0m（6,670株／ha）、年6回収穫（2カ月間隔）、施肥量N500Kg／ha（収穫毎に分施）、調査は1978年11月～1979年9月までの1カ年間で、枝条、葉の特性と収量などを、各品種10株について調査した。

c. 結　果：葉の大きさではM.nigra、M.australis が小さく、M.cathayana とM.multicaulisは大きかった。M.macroura、M.alba はこの中間の大きさである。収穫後のしおれの速さは伐採後1カ月目では早く、4カ月目では遅かった。収穫1時間後の水分減耗率はM. nigra 21%、M. alba 21%と同じで、M.cathayana 16.5%、M.multicaulis 13%は少なくしおれが遅かった。伐採後2カ月目の枝条長（年6回の平均）はM.nigra より長いのはM. australisであり、短かいのはM.multicaulis であった。1株の枝条数はM. alba、M.macroura が多く、M.multicaulis は少なかった。節間の長いのはM.australis、M. cathayana であり、側枝が発生しやすいのはM.albaとM.nigraであった。

年間の収量がもっとも多いのはM.multicaulis であり、次にM.cathayana、M. albaが多かった。収量のもっとも少ないのはM.nigra であり、収穫時期では1～7月の雨季に多く、9月～11月の干季は少なかった。

d. 要　約：年間N500Kgを投与する多肥栽培によって、品種特性を検定した。M. nigra M. australis は極めて低能率な品種であり、しおれが早い欠点がある。これらに比べ、

M. multicaulis、M. cathayanaは多収性でしおれの遅い品種であり、M. macroura と M. alba はその中間にある。

（藤原茂正，Zito S.，N. Rasyid）

2）少肥栽培による実用品種の選抜

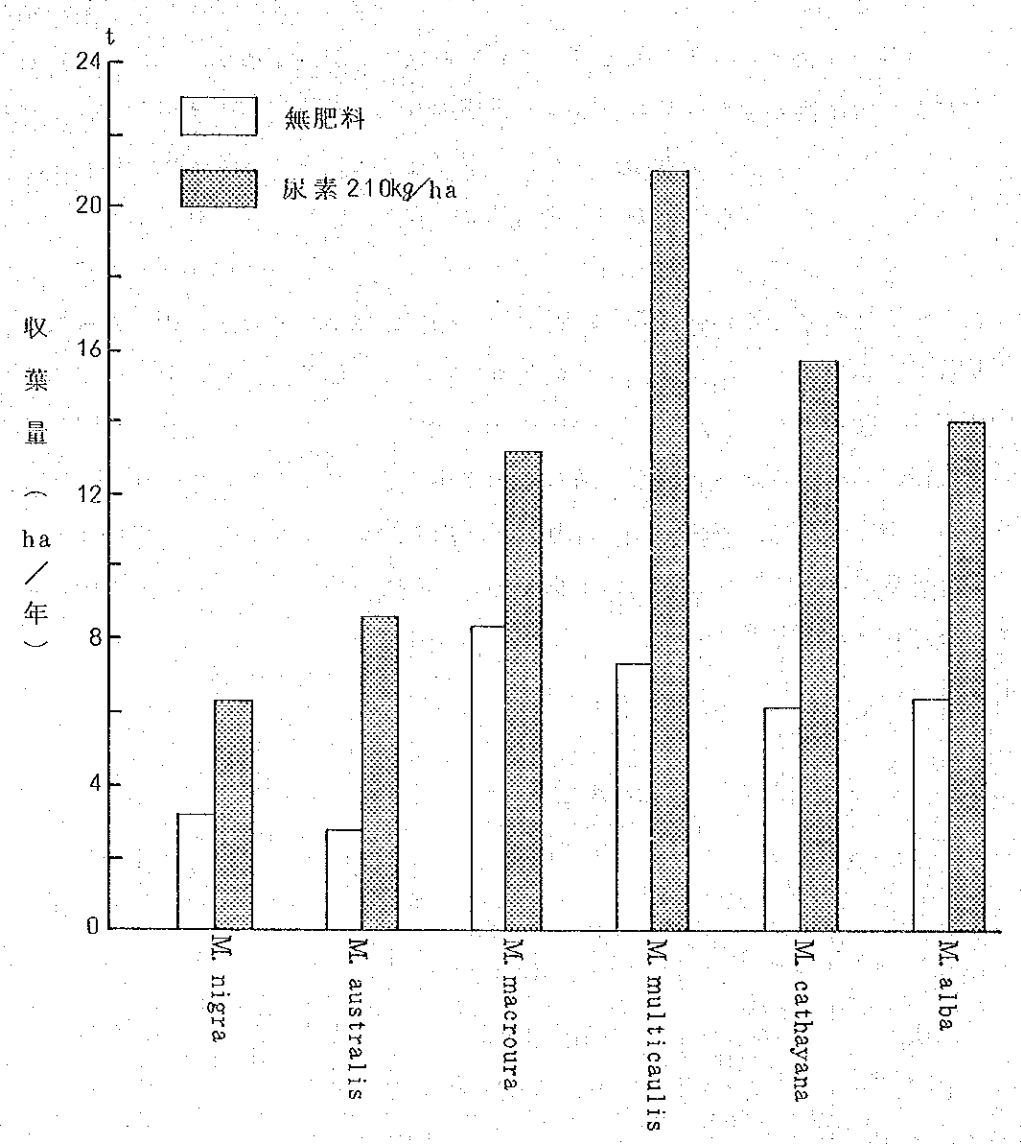
a．目　的：収量の少ないM. nigraに代る実用品種を選抜するため、6品種を用い、実用形質の優劣と施肥による増収能力を検定した。

b．方　法：センターPakatto桑園、樹令3年目、中刈仕立、植付距離2.5×1.0m（4,000本／ha）、年4回収穫（約3カ月間隔）、施肥量N100Kg（尿素N46%、217Kg／ha）を収穫期毎に分施、調査は1981年2月伐採（予備調査）のあと、1982年2月までの1カ年間、枝条、葉の特性と収量を各品種13～26株について調査し、無肥料区と比較した。

c．結　果：枝条が長いのはM. australis であり、他の品種は、ほぼ同じである。下部落葉はM. multicaulis が遅く、短い。枝条数はM. albaが多い。葉の大きさはM. multicaulisとM. cathayanaが大きく、M. nigraとM. australisは小さい。葉の面積重（100cm²/g）はM. multicaulis、M. cathayanaが重く、M. nigraとM. australis は軽い。観察評価による葉の品質はM. albaがよく、M. macrouraは劣る。収量はM. multicaulis がもっとも多く、M. cathayanaとM. albaがこれに次ぎ、M. nigra とM. australis は少ない。また、無肥料区は枝、葉の発育及び収量が尿素施用区より明らかに劣った。（第1図）

d．要　約：実用形質がM. nigraより優れているのは、M. multicaulis，M. cathayana 及びM. albaであるが、M. multicaulisはさし木の発根が劣るといわれており、農家に推奨できるのは、M. albaであり、続いてM. cathayanaであろう。

（山本　賢，Endjang K.）



第1図　桑品種間における尿素施用の効果

3）奨励品種M.alba のさし穂生産方法

a．目　的：M.nigraは収量が劣るのに普及しているのは、さし木の発根力が強く、桑園造成が容易なためであり、発根性の良否が品種普及の重要なカギを握っているといえる。M.albaはM.nigraより発根力がやゝ劣ると考えられるので、M.albaを奨励し、普及に移すに当たり、発根力を高める穂木の生産方法を見出すため、この試験を実施した。

b．方　法：植付4年目のM.albaを用い、１９８１年4月より１カ月毎に８月まで伐採し、穂木となる枝を養成した後、１０月にさし穂を採取した。従って、各伐採時期を異にする枝の発育期間はそれぞれ６カ月、５カ月、４カ月、３カ月及び２カ月である。さし穂は長さ２０cmとし、枝の基部より順次採取し、上限は枝条長の１／２まで使用した。さし木は約１０cmに盛土した苗場で３０×１０cm間隔、直立にさし木し、穂木は１プロット５０本、２連制とした。

c．結　果：枝条は発育期間が長いほど太く、そして長くなり穂木に適した枝数（基部直径１cm以上）が増加した。また、生長期間が長いほど下部落葉率が高く、５～６カ月目では約６０％の落葉率を示した。

発育期間が異なる枝の活着率（さし木３カ月目）は大きな差がみられた。即ち、伐採後２カ月目では殆んど活着せず、４カ月目から枝基部の活着率が高くなり、５～６カ月目では基部から５本目で５０％以上の活着率を示し、枝のエイジングと活着に深い関係のあることが認められた（第２図）。

さし穂の部位（基部より）＼本目	6	5	4	3	2
8	12	18			
7	12	36	14		
6	42	54	30		
5	50	73	40	17	
4	66	82	53	23	
3	77	90	63	39	
2	84	94	83	47	1
1	97	96	95	75	9

伐採後の枝条発育期間（月）

第２図　枝の発育期及び枝の部位とさし穂の活着率（％）

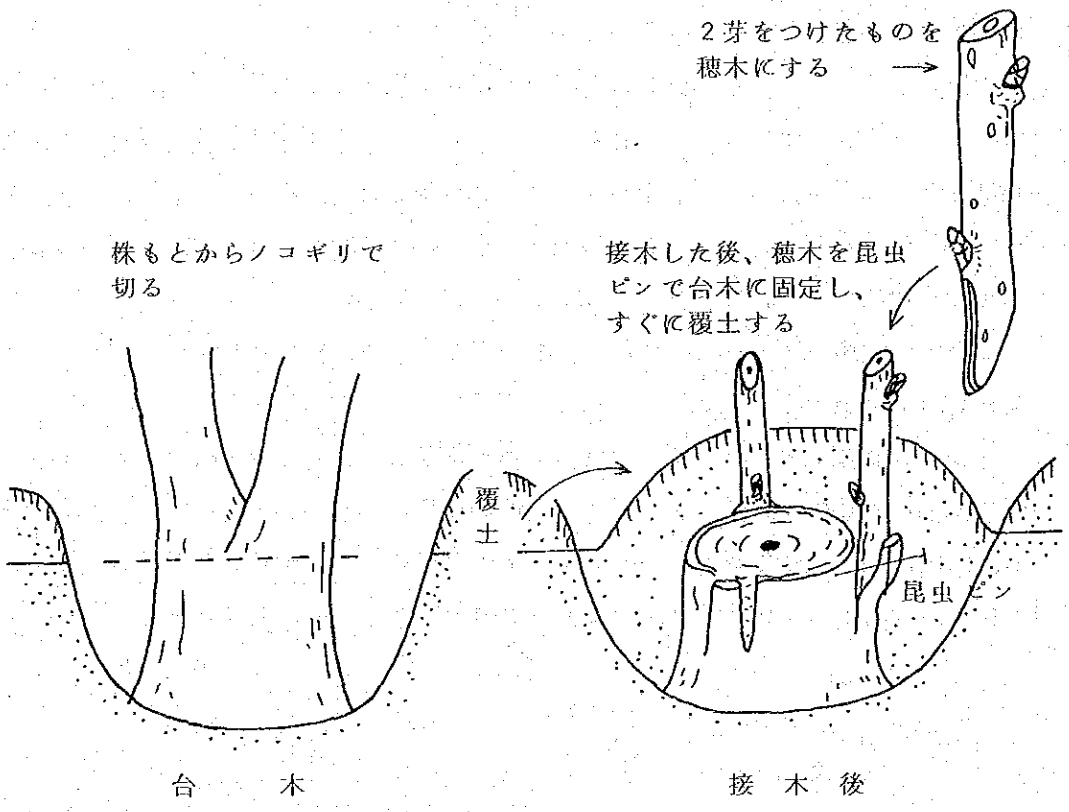
d. 要　約：M. alb のさし木による活着率からみて伐採後５カ月経過した枝がもっともさし穂に適しており、２０cmの長さのさし穂が基部から５本採取できる。この場合のさし穂生産本数は１株約５０本分であり、１ａから約5,０００本分生産できる。従って、１ha の桑園造成には２ａの穂木園が必要であり、年間２回の穂木生産が可能である。

（山本　賢，Endjang K.）

4）据え接ぎによる品種の更新と穂木の速成生産

a. 目　的：奨励品種が選出され、農家へ普及に移す場合、さし木による増殖は時間がかかり、穂木の多量入手も難かしい。この対策として、既存の桑株に目的品種を接木する据接ぎ（ field grafting ）を試みた。

b. 方　法：植付５年目の中刈、M. nigra を地際わで鋸により切りとり、図のように接木した。接木はカウンターパートとアシスタントカウンターパートに接木技術を指導し、個人別に約８０株（１ａ）の接木を行なった。接木は雨季の終期に当たる１９８１年３月中旬である。



第３図　据接ぎのやり方

c. 結　果：気温が高いため、癒合、活着が早く、接木２０日目には新しょう長が約１５cmに伸長し、平均９８％の高い活着率を示した。その後、ほ場の一部に白絹病（Capiticium cetrifugum BRES.）が発生して枯死する穂木があり、３０日後には９１％に低下したが、その後は被害がなく、２カ月後には１m以上に伸長したので、摘芯して分枝させ、倒伏防止と枝数の増加を図った。

個人別の活着率は８３～９８％の範囲にあって、個人差は少なく、技術の習得は比較的容易であることがわかった。

d. 要　約：据接ぎによる活着率は極めてよく、既存の株が生長源になるので、生長が速く、年内に穂木が生産できる。サブセンター（Lupange Soppeng）で１５ａのほ場を用い、実証試験を行なった結果も、1,６００株中で９７％の活着率を示し、１年後の穂木生産量は株当たり４４本分、面積当たり、６9,０００本分に達し、パイロットユニット農家を中心に穂木の配付を行なった。

（山本　賢）

5）桑品種選抜第２次試験

a. 目　的：奨励品種としてM. alba 及びM. cathayanaを選抜し、農民へ穂木を配付する態勢を整えてきた。今後、病虫害抵抗性や地域適応性の違いを考慮すると、実用品種をできるだけ多くすることが望ましい。したがって、後続品種の選抜のため、新たな選抜試験を行なう。

b. 方　法：さし木によって育苗した選抜系統を2.0×0.5m（１0,０００本／ha）に植付けた。植付本数は１系統３０本（２ブロック）で、１９８２年４月植付け、供試ほ場Pakatto桑園。供試品種（系統）は、M. nigra（対照）、M. alba（奨励品種、比較）、M. alba halus（ジャワ島より移入）、Rajah wali（Ujung Pandang市内で採取）、BNK－１、ＢＮＫ－２、ＢＮＫ－３（Nigra halus×国桑第２１号）。

今後、葉、枝の諸形質及び収量を調査し、優良なものは奨励品種に指定して、農家へ普及させる。

なお、ＢＮＫ－１～ＢＮＫ－３の３系統は、山本が蚕試九州支場で１９７９年に交配してF_1実生を育苗し、森リーダーが現地へ持参してZito S. が２年実生を養成。１９８１年、山本によって個体選抜し、センターで系統増殖した。なお、母本のNigra halusは副センター、父本の国桑２１号は蚕試九州支場に保存しているものである。

（山本　賢、Endjang K.）

(3) 開発された実用技術

1）奨励品種の選抜

M. alba を選出し、穂木の生産、配付を実施した。この品種は葉質がよく、稚蚕用桑に適

しており、収量はM. nigra より３０％以上多い。また、M. alba に次ぐ品種として、M. cathayana を選出し、穂木園を造成中である。この品種も収量が多く、M. nigra より３０～５０％多い。

2） M. alba の穂木生産方法

伐採後５～６カ月経過した充実した穂木を使えば、基部から１～５本の穂木が採取でき、発育のよい株では５０本／株の穂木が生産できる。

3） 据接ぎ法による品種の更新

M. nigraやM. australis の既存株を切りとり、M. alba やM. cathayanaの穂木を接木して、短期間に品種の更新ができる。この方法は面積の小さい穂木の生産や稚蚕用桑園で応用できる。

（山本　賢）

(4) 残された問題とその対策

1） 奨励品種の普及：穂木の生産、配付をすべて、センター及びサブセンターで行なうことは困難である。従って、初期段階はセンターより各地方事務所に穂木を配付し、地方事務所で穂木園を造成して、農民へ配付する体制をとる。

2） 桑品種の収集と選抜試験：国の内外から、できるだけ多くの桑品種を収集し、品種保存を行なう。この中から有望と考えられる品種について穂木を採取、育苗して、選抜試験（３～５カ年）を行ない、優良なものを奨励品種に指定する。

3） 桑育種の実施：農家の技術水準が高くなり、面積当たりの収繭量を増やしたいという要望が高まれば、さらに優良な桑品種が必要となる。この段階では交雑育種による新品種の育成が最大の効果を発揮することになろう。桑育種を行なうには日本における技術研修、交配育苗の施設、選抜のための圃場の増設等が必要である。なお母樹の選定、交配、育苗、個体選抜、系統選抜、奨励品種の選定という過程は少なくとも８～１０年（日本では１５年）の年月を要するから、技術協力による通常の専門家派遣方式では対応が難かしい。できるなら、交配または交配。育苗を日本の研究機関で行ない、種子または苗木を現地で育て、育苗、選抜等の育種上もっとも重要な時期に現地へ短期的に専門家が出向いて指導すれば、実効のある育種が行えるものと考える。

（山本　賢）

3　桑園の地力増進と肥培管理（センター）

(1)　農家段階における肥培管理の現状

１９７０年代の前半は、すでに述べたように桑栽培についての技術は殆んど見るべきものがなく、肥培管理も殆んど行なわれていない。ただ、屋敷周りの桑園は雑草もなく、生活廃棄物が肥料となって、桑の発育は良好である。しかし、近年、ヤシとの混植桑園及び単作桑園の規模が拡大しつつあるが、桑園管理技術が伴わないと、桑園は荒廃し、生産性は却って低下する恐れがある。

南スラウエシでは１９７２年より、生糸生産が大幅に減産したが、これは１０年来といわれる干ばつと微粒子病のまん延によるものといわれる（イ国養蚕開発計画調査団報告、１９７３年２月）。以後は蚕種の自家採種が中止され、主として輸入蚕種に依存することになったため、蚕種不足となって、飼育を中断した農家が多い。飼育が中断すると桑園は放置され、たちまち荒廃する。荒廃した桑園は容易に回復しないから、現在でもその後遺症の残っている無収穫に近い桑園が点在している。

主要養蚕地帯のSoppeng は土壌母材が石灰岩を含むことが多く、PHは微アルカリまたは中性であって、燐酸吸収係数は高いという報告もある（高取、１９７５）。しかし、無肥栽培のため、窒素含量が少なく、生産力は一般に低い傾向がある。

（山本　賢）

(2)　土壌及び肥料に関する実用化試験

1）施肥量及び施肥時期と収量

a．目　的：年間、尿素１００Kg（Ｎ４６Kg／ha／年）の少量施肥と施肥回数との関係を調べ、合理的な施肥方法を明らかにする。

b．方　法：M. nigra、植付２年目、植付距離2.5×0.6 m（6,７００本／ha）、中刈仕立、年４回条桑収穫（３カ月１回）、施肥時期年２回（９月、１月）、年３回（９月、１月、５月）、年４回（９月、１２月、３月、６月）、年６回（９月、１１月、１月、３月、５月、７月）各等分施用。調査期間１９７９年１２月～１９８０年９月。

c．結　果：１９８０年は５月末日から無降雨のため、桑の発育が悪く、収量も少なかった。干季の下部落葉割合は施肥回数が少ないほど多くなり、年間収量でも、施肥回数が多いほど多くなった。

d．要　約：尿素１００Kg施用では年間収穫量は少ないが、分施する方が収量が多い。従って、収穫、伐採期ごとに分けて施肥する方がよい。

（藤原茂正，Zito S.，Endjang K.）

2）尿素の施用量、施用回数と収量

a．目　的：南スラウエシの養蚕農家は従来、殆んど無肥料で桑を栽培しており、生産性は極めて低いといわれている。これを改善するため、国内で生産されている尿素肥料を施用した場合の増収効果と施肥方法を明らかにする。

b．方　法：M. nigra、植付４年目、植付距離 2.5 × 0.6 m（６,７００本／ha）、中刈仕立、年３回収穫（３カ月毎に１回）、施肥量は無肥料、Ｎ１００Kg、Ｎ２００Kg／ha／年を尿素で施用、施肥回数は全量年１回と収穫期ごとに年３回分施する区を設けた。調査株１プロット３０株、２連制とし、着手前に予備調査によって、Ａ、Ｂブロックの平均収量が区間で均等になるように区の選定を行なった。調査期間１９８１年５月～１９８２年３月。

c．結　果：無肥料に比べ、尿素施用によって顕著な効果がみられた。すなわち、尿素施用の各区は枝条の伸長がよく、枝条数が増加した。収量は年間Ｎ１００Kg／ha で７０％、Ｎ２００Kg／ha は２倍の増収を示した。施肥回数は、全量投与すると第１回の収量が著しく増加するが、以後は肥料切れで漸減する傾向がある。伐採期毎に分施した区は収穫時期による収量増減幅が小さい。

第３表　尿素施用の効果（Pakatto、1981/82）

	最長枝条長	下部落葉割合	枝条数	葉量割合	条桑量（ha）	同左指数
無肥料	１４０ cm	３０.８ %	１３.１ 本	６２.８ %	１１.７ t	１００
N１００Kg／１回	１６２	３２.９	１５.６	５９.５	２０.０	１７１
〃　／３回	１７２	２８.４	１７.１	５７.０	１９.７	１６８
N２００Kg／１回	１８６	３２.７	１６.８	５８.１	２５.３	２１６
〃　／３回	１８８	３０.７	１８.８	５７.６	２５.７	２２０

注　年４回収穫、２ブロックの年間平均、但し収量は年合計。

d．要　約：尿素の施用による増収効果は極めて大きいので、農家の壮蚕用桑園には年間Ｎ１００Kg／ha（尿素約２００Kg）を施用するように指導する。このことによって、ほぼ５０％の収量増加が期待される。

（Endjang K.，山本　賢）

3）ネピアグラスによる桑園マルチング

a．目　的：センターの採草地に栽培されたNapier grass（P. purpureum）は山野に自生しているものを収集したもので、草丈は２ m 以上となり強じんで、分解が遅く、マルチ材料には適している。しかし、各節からの発根力が旺盛なため、使用を誤れば、桑園内で再

生する。このため、効果的な利用法を検討した。

b. 方　法：雨季明けの６月に刈りとり、１０日及び２０日間、日干したうえで、植付当年（４月植付け）の桑園畦間に５～１０cmの厚さのマルチングを行なった。調査はネピアグラスの再生状況、干季における土壌水分、桑の発育と収量を調べる。

調査期間は１９８２年６月～１９８３年６月の予定。

c. 結　果：未了

（Sucipto S.，山本　賢）

4）主要養蚕地帯の桑園土壌調査

a. 目　的：桑は永年作物であって、いったん植付けると長年にわたって栽培を継続することとになる。したがって、桑園造成前に土質、とくに下層土の構造や土質調査によって、桑園としての適否を知ることが大切である。また、土壌調査の結果は、将来の生産性向上のための土壌改良を行なう場合の指針となる。

b. 方　法：土壌調査はカウンターパートの指導を主な目的とし，短期専門家（早坂　猛）がセンター、副センター及びSoppeng，Wajo，Sidrap 及びEnrekangのパイロットユニット稚蚕用桑園で実施した。

土壌断面調査は深さ１ｍの試坑を作り、土層、土色、礫などの観察調査と採取したサンプルを実験室に運び、P(S.C.)、置換酸度、全窒素、などの理化学的分析が行なわれた。

c. 結　果：データーを三つの地域に分けてみると、第１はGowa地域（Bili-Bili，Pakatto，Malino）で、火山に由来する岩石を母材としており、凝灰岩が含まれ、高標高地では火山灰が加わっており、ともに物理性は悪くない。Mg含量が多く、Nが少ない。

第２はテムペ湖周辺のもので、西側の山地が石灰岩地帯であるため、何れも石灰含有量が多い。物理性には差があって、低地のTanah Bellangeは孔隙の少ない粘質土であり、河川流域のUgi，Wanioや洪積テラス上のLuppangeでは物理性が良い。また，北西部の山麓地帯の高台は草原を形成しており，このような草原地帯はエローションが激しく，表土が失なわれていて耕作地としては適地ではない。第３はエンレカンでサダン河の濁流に象徴されるように、エローションが激しく，加えて重質粘土のため，内部排水が悪い。深根性の桑には適地といい難く、一般に桑の発育が悪く生産性は低いとみられる。

d. 要　約：全体としてはカルシウム、マグネシウム含有が多く、有効態リン酸をかなり多く含む。しかし、窒素含有が著しく少ないので、現状では桑葉の生産力が低水準にあると診断される。

従って、窒素、リン酸、加里の施用効果並びに重粘質の排水不良な土質が比較的多く分布しているので、有機物施用による土壌物理性の改善と地力保全などが今後の検討事項であろう。

（早坂　猛，Sucipto H.）

(3) 開発された実用技術

1) 尿素の施用

枝、葉を収穫する桑栽培では、とくに窒素の収奪が大きく、土壌中の窒素が欠乏状態にある。従って、窒素を施用するだけでも顕著な増収効果があるので、葉質を重視する稚蚕用桑園では年間N２００Kgを施す。これは尿素で約４２０Kg／ha を株直し時に分施するのがよく、年３回施用を基準とすると、１回当たり尿素１４０Kg／ha である。一方、壮蚕用桑園は農家の経済力からみて年間N１００Kg／ha(尿素２１０Kg／ha)を施用する。この場合も年３回収穫を基準とし、株直し時に分施すると１回当たり尿素７０Kg／ha であり、施用方法はバラマキしたあと、土とよくかくはんする。なお、河川に近い桑園で洪水になる地帯は、その時期の施肥は中止する方がよい。

2) 桑園のマルチング

センターではネピアグラス、サブセンターでは稲わらとモミガラを用いたマルチングを試みた結果、干ばつ時に大きな効果がある。したがって、農家で一ばん入手しやすい材料を使って干季のはじめに畦間をマルチングする。殊に稚蚕用桑園には６～７月のマルチングを励行した方がよい。厚さは約１０cmとし、マルチングの前に除草と施肥をする。株直しの時に行なうのがよい。

3) 土壌調査

桑園としての適否を知るためには事前に実施する。試抗を作り、観察と物理性及び簡単な化学分析によって、地力の優劣を知り、できるだけの土壌改良を行なう。この土壌調査によって、桑園適地の選択が容易にできる。

（山本　賢）

(4) 残された問題とその対策

1) 土壌診断と生産力：短期専門家の土壌調査によって、南スラウェシの主要養蚕地帯では三つの異なる土壌型に分類される。今後、さらに類型分布の調査を進め、各地域による土壌の特異性と改善点を明らかにし、桑葉生産の基盤である土壌改善指針を作成し、農民に提示する。

2) 農家の桑園造成法：従来の桑園造成法はプロジェクトの事業推進のためのものが主体であった。農家では機械力を使うことができないから、簡易な基盤整備の方法、農道の整備、事前の土壌改良法、家畜への対策、排水、植付け方法についての検討と研究が必要である。

3) 桑園の雑草対策：高温で雨季と干季に区分される当地方の気象条件では高温多雨の雨季約６カ月の雑草対策が桑園管理の主要なものである。基礎的に桑園雑草の生態研究を行ない、雑草害の実態を明らかにする。これによって、被害の大きい雑草の除草方法と年間の除草体系を作成し、農民へ提示する。

4）有機物の施用：高温多雨で有機物の消耗が激しく、その指標となる腐植は欠乏状態にあるものと推定される。腐植の消耗を防止し、地力を保持するためには、緑肥（マメ科）の間作、モミガラ、稲わらの施用等が効果的であると考えられ、これを実証する必要がある。有機物施用の効果は土壌物理性の悪い副センターを中心に実施すべきであろう。

5）肥料三要素と収量：現在の農家実態からみて、欠乏の激しい窒素の少肥施用（Ｎ１００～Ｎ２００Kg／ha）を奨めることとしているが、さらに高い生産と収益を求めるには、窒素の多用はもちろん、リン酸、カリの施用による増収効果を確認することが必要である。この場合、あくまでも経済性を重視し、みだりに多用するような誤りを犯かしてはならない。したがって、マルチングによる有機物の還元を考慮に入れ、化学肥料と有機物の併用を基本にした施肥方法を確立することが望ましい。

（山本　賢）

4　稚蚕，壮蚕用桑の仕立収穫法の現状（センター）

(1)　農家段階における仕立，収穫法の現状

スラウエシにおける桑栽培技術はレベルが低く、生産性が低い。桑園はヤシ園の中や家の周囲の空地を利用して、発根性の強いM. nigraやM. australisの枝をさし木する。さし木の距離は大体1×1mの方形植えが多い。しかし、とくに測量して植えるわけではないから、不規則な上に、作業道もない。

さし木によって伸長した枝は"なた"で伐採して蚕の飼育に使う。気象条件に恵まれているので、雨さえあれば桑は常に発芽し伸長する。収穫は下部落葉した部分を残して、無計画に伐採収穫するから、桑株は自然に高くなり、一定の形をしていない。なたを使用するので切り口は斜めに裂け、枯れ込みも大きい。しかし、なたで切るのに都合のよい地上0.5～1mの中刈になっているものが多い。伐採には稀に鎌やアニアニを使うものもいる。収穫回数は年間1～6回で平均4回程度である。従来、蚕種の供給が不安定だったので、収穫回数も少なかったが、蚕種の供給が安定すると収穫と伐採を繰り返し、樹勢が低下する恐れもある。最近になって、栽培技術が徐々に浸透し、規則的な単作桑園が増加しているが、仕立収穫法は大きく立ち遅れている。

（山本　賢）

(2)　仕立，収穫法に関する開発試験

1）稚蚕用桑の仕立収穫法

a.　目　的：1～3齢期の良質な適葉用を得るため、伐採の時期、方法、施肥等について試験した。

b.　方　法：M. nigra，植付2、3年目、植付距離1.8×0.7m（7,900株／ha）、中刈仕立、年間N200Kg／ha（年4回分施）、Bili-Bili桑園。調査は伐採の時期と1カ月後の収量、枝の長さと収量、施肥と無施肥、枝の摘葉との関係などについて、1978年～1980年の間、発育と収量を調べた。

c.　結　果：年間の時期別では雨季の収量が多く、干季の末期では少ない。伐採時の枝の長短では、長いと発芽数は多いが、伸長が悪く、伐採長の短い方が伸長が良好で収量が多い。無施肥に比べN200Kg／ha施用では伸長芽が多く良質である。

d.　要　約：稚蚕用桑の伐採は掃立30～40日前に枝の基部10cmを残して行ない、1～3令の適葉桑を順次伐採収穫する。肥料はN200Kg／haを伐採時に分施する。これによって、良質の用桑が得られる。

（藤原茂正，Zito　S.）

2）植付当年の収穫開始時期

a．目　的：桑植付け後の収穫開始適期を明らかにする。

b．方　法：１９７８年３月、さし木によって植付けたM. nigra を用い、植付け後６カ月目、９カ月目および１２カ月目にそれぞれ第１回の収穫を行ない、その後３カ月ごとに収穫し、１カ年間の収量を比較した。また、第１回収穫は地上５０cmから伐採収穫したが、伐採部の枝の太さ（将来の主幹となる部分）を測定した。

c．結　果：第１回目の収量は収穫開始期が遅いほど多くなる。植付当年１カ年間の収量は早期に収穫した方が若干多くなるが、これは収穫回数が多くなるためで、１回当たりの収量は遅く収穫した方が多い。また、将来、幹となる枝の太さは収穫が遅いほど太くなり、株ののの肥大生長が促進される（第４表）。

第４表　収穫開始時期と収量並びに枝の太さ

収　護 開始時期	収穫時期別収量				年間収葉量		条　径 （第１回収穫期）
	１９７８ ９月	１２月	１９７９ ３月	６月	葉量／a	指　数	
植付後６カ月	9.4 kg	39.6 kg	17.3 kg	14.0 kg	80.3 kg	100	8.9 mm
〃　９カ月	—	39.1	16.0	18.2	73.3	91	16.3
〃１２カ月	—	—	49.7	23.2	72.9	91	22.8

注．植付け、１９７８年３月、Pakatto，M. nigra，N２００Kg／ha／４回／年

d．要　約：桑は永年性作物で長期にわたって収穫するので、植付当年は将来、株となる枝の肥大を促進することを心がけ、あまり早く収穫しない方がよい。桑の発育の良否によって、多少異なるが、発育がよい場合は植付後９カ月回から、悪い時は１年後から収穫をはじじめた方がよい。

（藤原茂正，Zito S）

3）株の高さと収量

a．目　的：当地方は中刈または中刈に近い刈桑仕立が多い。主幹の高さは管理、収穫作業、害虫の寄生等に関係する。ここでは主として、株の高さと収量について試験した。

b．方　法：第１回試験（１９７９～１９８０年）は株の高さを１０cm、３０cm、６０cm、９０cmとし、干季（７月）と雨季（１月）に伐採した後、３カ月目に枝条の発育と収量を調査した。

第２回試験（１９８１～１９８２年）は株高を１０cmと５０cmにして、３カ月毎に年４回収量を調査した。品種はM. nigra、肥料はN１００Kg／ha である。

c．結　果：第１回、第２回の試験とも、株が低いと枝は長いが枝条数が少なくなり、収量が少なくなる。また、雨季に比べ干季の減収率は株が低いほど影響が大きい。

d．要　約：桑の収量は枝条数が多くなるような株の高さ、３０～６０cmが適当で、伐採や収穫にも適した高さである。しかし、カミキリやシロカイガラなどが発生しやすい地域は、株が高すぎると、害虫の被害が大きくなる恐れがあるので、低くした方が得策であろう。

（Zito　S.，Munassru　S.，山本　賢，藤原茂正）

4）伐採後の発育期間と収量

a．目　的：年間の収穫回数を決定するには、伐採後の発育期間と桑の発育及び収量の関係を知る必要があり、この試験を行なった。

b．方　法：桑品種M. nigra，樹令植付２年目、植付距離1.8×0.7m、植付本数7,900本／ha，中刈仕立、施肥量Ｎ２００Kg／ha（尿素）年４回分施、試験地Bili-Bili桑園。１９７７年４月に一斉伐採後２カ月、2.5カ月、３カ月、3.5カ月及び４カ月後にそれぞれ収穫。調査株は１プロット２０株。

c．結　果：成績の概要は第５表に示した。収量のピークは３～3.5カ月である。以降は伸長が緩慢となるのに反し、下部の落葉が多くなって減収する。

第５表　桑の発育期間と収量（Bili-Bili）

収穫後の発育期間	最長枝条長	同右側枝発生数	落葉割合	葉量(a)	同右指数
２カ月目	１４１cm	8.5本	４%	38.3Kg	１００
2.5 〃	１８５	21.1	２１	56.7	１４８
３ 〃	２１９	26.8	３０	73.9	１９３
3.5 〃	２３７	27.1	５０	76.4	１９９
４ 〃	２５６	27.4	６５	64.0	１６７

d．要　約：桑の収量からみた壮蚕用桑の収穫の適期は伐採後３～3.5カ月である。しかし、今後は年間を通じた調査によらないと、収穫適期は決定できない。

（藤原茂正，Zito　S）

5）年間収穫回数と収量

a．目　的：壮蚕用桑の効率的な年間収穫回数を知るために実施した。

b．方　法：桑品種M. nigra、植付後２年目、植付距離1.8×0.7m、植付本数7,900本／ha、中刈仕立、施肥量Ｎ２００Kg／ha、年４回分施、試験地Bili-Bili桑園。試験区は年６回収穫（２カ月間隔）、年４回収穫（３ケ月間隔）、年３回収穫（４カ月間隔）とし、１９７７年８月～１９７８年６月までの１カ年間調査した。調査株は１プロット２０株、２連制。

c．結　果：収穫回数が多いほど、枝の発育期間が短かくなるから、枝条長は短かく、１期当たりの収量は少ない。しかし、下部落葉割合は年間平均でみると６回収穫２３%、４回

収穫４６％、３回収穫６４％と発育期間の長いものが急速に高くなる。従って、着葉している枝条長は年平均で６回収穫９０cm、４回収穫９９cm、３回収穫８９cmとなり、発育期間が４カ月に及ぶ場合は桑葉の５０％以上が落葉によって失なわれてしまう。その結果、年間の収量は年６回収穫区がもっとも多く、年３回収穫では少ない。

d．要　約：年間収穫時期を等間隔に設定すると、収量は年６回収穫が最も多く、年３、４回収穫は少ない。しかし、２カ月毎に継続して収穫することは永年作物の場合、樹勢の急速な低下が懸念される。

（藤原茂正，Zito S.）

6）壮蚕用桑の伐採収穫器具の比較

a．目　的：農家では条桑収穫にナタ（パラン）を使用するのが習慣となっているが、桑の仕立と管理を行なううえで問題があるので実態を調査した。

b．方　法：桑品種M. australis、調査場所Pakatto桑園、剪定鋏（日本製）と現地のParangを使用し、枝条を伐採した。伐採後２カ月後に切り口の損傷程度と発芽状況を調べた。

c．結　果：切り口付近の腋芽の発芽率はParangでは５４％、剪定鋏では８３％と大きな差があって、Parangを使用すると切り口が鋭角となり、かつ、裂傷ができるので、枯れ込みにより不発芽となりやすい。

d．要　約：肉眼観察では、発条数には差がなく、収量への影響は少ないと思われる。しかし、裂傷部にはコナカイガラのような害虫の潜伏と産卵場所を与えることになり、被害を助長するものと思われる。よって、剪定鋏による伐採に切り替えることが、樹形を整えるうえからも好ましい。

（藤原茂正）

7）株下げによる樹勢更新法

a．目　的：樹令が古くなると、株頭の枯れ込みや、カミキリ、シロカイガラ等の寄生が多くなり、樹勢が衰えてくる。このような株を若返らせる手段として、枯れ込み部分を切除する"株下げ法"を試みた。

b．方　法：植付４年目、中刈仕立のM. nigraを用い、カミキリの被害が出初めたBili－Bili桑園で、主幹が約７０cmの高さになったものを、地上２０cmの所から１コギリで切除し、地ぎわから新梢を伸長させた。株下げは１９８０年１２月に行ない、発育と収量を３カ月毎に調査し、１カ年後に害虫の寄生状況を調べた。これらの調査は無処理の中刈についても実施して比較した。調査株数は各プロット３０株、４連制とした。

c．結　果：無処理に比べ株下げ区の枝条長は殆んど差がなく、枝条数は減少した。この傾向は１年後も、ほぼ同じ傾向であった。このため、収量は株下げ区が少な目に推移し、年間で約１０％少なかった（第６表）。

しかし、害虫のうち、カミキリの被害は明らかに減少した。シロカイガラは全般に寄生が少なく、株下げの効果は明らかでなかった（第7表）。

d. 要　約：地上70cm以上になった主幹を地上20cmに短かく株を下げた場合、発条数が減少し、株下げ後1年間の収量は10%以上減少した。従って、株の枯れ込みの状態やカミキリ、シロカイガラなどの寄生状況によって株下げの強度を加減することが必要であるが、余り短かく株下げしないようにし、幹の枯損部分及び害虫寄生部分の剪除にとどめる

第6表　株下げ後の枝条の発育と収量（Bili-Bili, 1981／82）

区　別	最長枝条長	下部落葉割合	枝条数	葉量割合	条桑量（ha）	同左指数
無処理	172cm	17.4%	22.1本	50.7%	29.9t	100
株下げ	177	16.7	16.2	51.2	26.0	87

注．年4回収穫、4プロットの平均値、但し、収量は年合計。

第7表　株下げ1年後の害虫寄生状況（寄生株数割合%）

区　別	カミキリの寄生			シロカイガラの寄生		
	無	有	多	無	有	多
無処理	15	20	65	80	10	10
株下げ	97	3	0	95	3	2

注．4プロットの平均値

ことが望ましい。

（Munassar S.，Zito S.，山本　賢）

8）桑の植付密度と収量

a. 目　的：面積当たりの収量は概して植付株数の多少に左右される。植付け距離は桑品種、仕立方、桑園の立地条件などによって決定されるべきであるが、ここではM. nigra を用い、慣行的な1.0×1.0m（10,000本／ha）を対照として、適正な植付け密度を知るために実施した。

b. 方　法：植付密度は10,000～40,000本／ha の範囲で第8表のような植付距離とした。植付3年目、中刈仕立のM. nigra を用い、1981年6月より3カ月毎に伐採収穫し、枝の発育と収量を調査した。施肥量は年間N100Kg／ha を収穫時に分施、調査株数は1プロット24～42株である。

c. 結　果：1981／82年の1カ年のデーターを第8表に示した。枝条の発育は植付株数の多いプロットが若干劣る傾向があり、1.0×0.25mでは発育の不良な株が認められ、株間の競合によるものとみられた。収量はプロット間の差が小さく、単年度の試験では結論付けられない。

第8表　桑の植付密度と発育，収量（Pakatto，1981／'82）

植付距離	植付密度 (ha)	最長枝条長	下部落葉割合	枝条数	葉量割合	条桑量 (ha)	同左指数
1.0×1.0m	10,000本	151cm	36.3%	15.9本	60.2%	20.9t	100
2.0×0.5	10,000	169	37.8	13.8	58.2	18.6	89
1.5×0.5	13,300	145	41.1	15.2	60.7	16.8	80
1.0×0.5	20,000	142	39.6	13.6	61.9	20.7	99
0.5×0.5	40,000	146	40.5	7.7	57.9	24.9	119
1.0×0.25	40,000	137	37.9	8.9	58.8	20.3	97

注．3回収穫の平均値、但し収量は3回合計。

d. 要　約：植付け密度と収量との関係は単年度の調査では明らかにできない。しかし、慣行的な1.0×1.0mは収量の点では問題はない。植付株数を2～4倍に増加しても収量が増加しないのはN100Kg／haの少肥栽培では、ほぼ、10,000本／haが限界点とみられる。何れにしても、さらに継続調査が必要である。

（山本　賢，Endjang K.，Sucipto H.，藤原茂正）

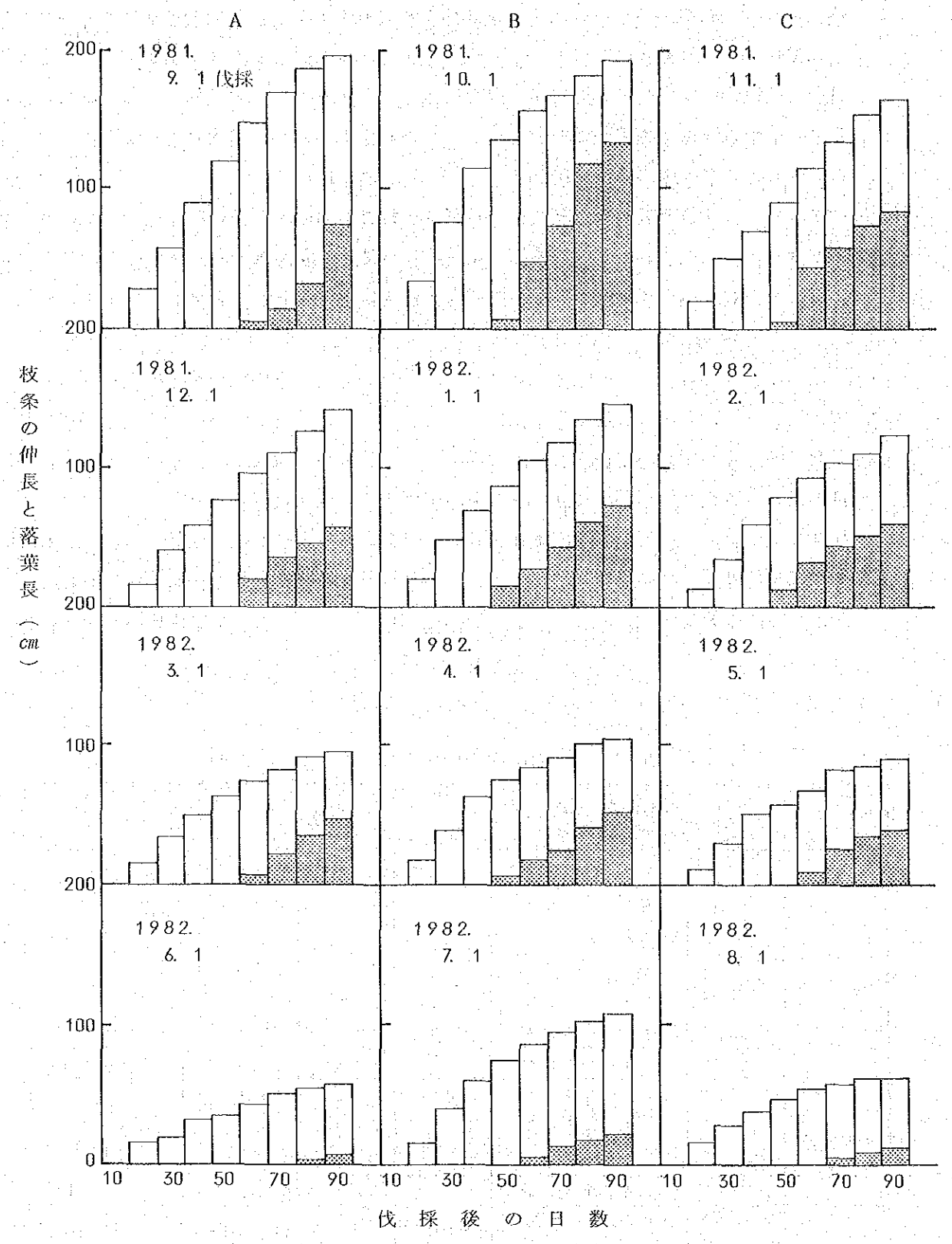
9）桑の伐採時期と枝条の発育特性

a. 目　的：桑の年間収穫体系を組立てるためには桑の発育生態とくに枝条の伸長生長と下部落葉との関係を年間を通して知る必要がある。

このため、3カ月毎に伐採し、枝条の伸長と落葉の推移を調査した。

b. 方　法：植付4年目のM. nigraとM. alba，中刈仕立を用い、9、12、3、6月伐採区、10、1、4、7月伐採区及び11、2、5、8月伐採区の3グループを設け、各月の1日に伐採して、発芽、生長、落葉を10日毎に調査した。調査株は各10株で3カ月目には最長枝の収量を調査した。

c. 結　果：発育及び落葉の傾向はM. nigraとM. albaはほぼ同様な傾向を示したが、伐採後の再発芽及び初期の生長はM. nigraが幾分早い。両品種とも、伸長生長がもっとも旺盛な時期は、伐採後30～60日であり、その後緩慢となる。一方、下部落葉は50～60日目から始まり、その後急増する。このことから葉命は40～50日とみなすことができ



第４図　枝条の伐採時期と生長および落葉の推移

□伸長　▒落葉

M. nigra，中刈，N100kg／ha 分施，Bili−Bili

る。従って、着葉部の長さは８０～９０日より減少するから、収穫の適期は６０～９０日（伐採後２～３カ月）の間にあることが明らかとなった。なお、Ａ～Ｃグループとも３カ月毎に連続して伐採収穫した結果、収穫回数とともに発育が劣る傾向を示した。これは本年４月後半から全く降雨がないため、干ばつの影響もあるが、連続収穫による樹勢の低下によるものと思われる（第４図）。

d. 要　約：伐採後の枝条の生長及び下部落葉の推移からみて、桑の収穫適期は伐採後６０～９０日目の間にあることが明らかとなった。今後の収穫体系はこのような桑の発育消長によって決定すべきであるが、連続収穫は樹勢を低下させるから、休養期間の設定は収量の安定を図るうえで、極めて重要である。

（山本　賢，M. Silaen，Endjang K.）

10) 年６回飼育に適応する収穫体系

a. 目　的：養蚕農家の指導方針に基づき、年６回飼育の養蚕技術体系を組立てる。樹勢維持の面から桑園を切半して交互に３回ずつ収穫する仕立収穫法を確立する。

b. 方　法：約２カ月毎に６回収穫する区を対照とし、約３カ月毎に収穫する年３回収穫(A)及び(B)を設けた。桑品種M. nigra，植付４年目、植付距離 2.5 × 0.6 m（6,700本／ha)、中刈仕立、年間施肥量Ｎ１００Kg／３回分施、１９８１／８２年にPakatto桑園で実施した。

c. 結　果：１年間試験した主要データーを第９表に示した。

第９表　年間収穫回数と桑の発育収量（Pakatto，1981/'82）

	収穫月日	伐採→収穫日数	最長枝条長	下部落葉割合	枝条数	葉量割合	条桑量(ha)	同左指数
年間６回収穫	1981. 6.30	50日	144cm	6.9%	26.2本	47.3%	5.6t	
	8.24	55	85	4.7	29.1	59.6	1.8	
	10.19	56	88	2.3	31.6	57.0	2.7	
	12. 9	51	135	14.8	20.3	51.6	4.9	
	1982. 1.29	51	98	2.0	23.8	54.2	3.3	
	3. 9	40	56	0	25.7	63.1	1.5	
	平均	51	101	5.1	26.1	55.5	19.8	100
年間３回収穫(A)	6.30	100	261	57.1	16.2	24.6	11.8	
	10.19	111	137	54.0	16.5	64.6	2.6	
	1.29	102	221	47.5	20.6	63.5	6.4	
	平均	104	206	52.9	17.8	50.9	20.8	105
同上(B)	8.24	100	196	57.1	20.3	68.8	2.7	
	2. 9	107	208	31.2	21.0	55.6	9.5	
	3. 9	90	172	47.7	22.4	62.0	6.0	
	平均	99	192	45.3	21.2	62.1	18.2	92

注．２ブロックの平均値を示す。条桑量は年間合計。

年6回収穫は発育期間が短いため、枝条長は短かいが、枝条数が多く、下部落葉は殆んどない。これに比べ、年3回収穫（A及びB）は発育期間（約100日）に比例して枝条長は長いが、下部落葉割合が約50％に達するため、収量は両者に殆んど差がみられない。要するに、発育期間が長すぎると、下部落葉が多くなり、着葉しているいわゆる有効条長は増加せず、却って減少する場合もあって、収穫時期の設定は限られた範囲とならざるを得ない。

d. 要　約：年6回収穫は単年度でみた場合でも枝条長は漸次矮小化してきており、樹勢の衰退は明らかである。一方、3回収穫は伐採後100日を超えるような場合、下部落葉が増加し、収葉効率が劣る結果となった。このことは前項の「伐採時期と桑の発育」でも明らかなように、葉命が40～50日であるという、桑の生態に立脚した収穫法に改変して、再試験の予定である。

（山本　賢，Enajang K.，Munassar S.）

(3) 開発された実用技術

1）稚蚕用桑の仕立収穫法：稚蚕飼育に用いる桑葉は、蚕児の健康度を左右するから、良質のものを確保する。仕立法は50～60cmの中刈とし掃立30～40日前に枝の基部10cmを残して伐採、この時、尿素140kg／haを施す。桑は1～3令期に適葉部位から摘梢収穫する。発育のよい桑園では1～3令用桑が雨季200gr、干季100gr／本の収量が得られる。

2）植付け当年の収穫法：永年作物の桑は最初、幹を太らせることに重点をおき、植付後9カ月目ないし1年後から収穫する。第1回の収穫は地上50cmより伐採し、全株が水平で斉一になるように心がける。

3）収穫及び伐採器具

パランを使った収穫は早くて能率がよい。収穫はパラン、アニアニなど使い馴れたものでよいが、そのままでは株が乱れ、害虫の発生も多くなる。従って、収穫後再発芽する前（約10日間）に必ず剪定鋏で枝の基部5cmを残して切りなおしをする。この際、小枝も剪除する。

4）株下げ法

株が古くなって、枯れ込みやカミキリ，シロカイガラムシ等が寄生した場合は、株を切り下げて、新しい強い枝を出す。これによって、カミキリの寄生は少なくなる。

しかし、余り短かく切り下げると収量が減少する。

5）植付け密度

1 ha 当たり10,000本程度がよい。1.0×1.0mまたは2.0×0.5mが標準である。しかし、雑草の多い所はやや密植にした方がよい。

6）壮蚕用桑の収穫方法

同じ桑園から年６回収穫することは樹勢が弱まり，収量が減少する。年６回飼育の場合、同じ桑園からは年３回とし、桑園を切半して交互に年６回収穫する。収穫から次の収穫までは７０～９０日が適当であるが、収穫体系については今後の検討が必要である。但し、桑の発育生態から年間収穫体系の試案を作成し、「農民段階に適応する桑栽培技術の演示計画」の項に示した。

(4) 残された問題とその対策

1）農家桑園の造成法：プロジェクト関係の事業用桑園が専門家の指導と機械力，予算を投じて基盤整備のうえで造成されたのに比べ、一般農家のそれは無計画なものが多い。今後、農家向けの経済的で簡易な桑園造成技術を検討すべきである。

2）稚蚕、壮蚕用桑の年間収穫体系：熱帯地方の桑は休眠がなく、発芽生長を繰り返す。無計画に収穫と伐採を継続すれば、樹勢の低下によって、生産力は低いレベルにとどまるものと思われる。１９８１／８２年に桑の発育生態が一部解明され、これに基づいた収穫体系試案を作成したが、年次変化、品種間差異などを解明し，収穫方法を確立したうえで、年間の蚕期を策定することが、蚕種製造と配付計画との関連においても重要な課題である。

3）桑の植付密度：１０,０００本／ha を標準的なものとしたが、品種間差異、施肥量との関係を逐次明らかにする必要があろう。

4）桑の収量予想：蚕の飼育計画を立てる上で桑の収量予想方法を確立する必要がある。過去の開発試験のデーターから収量予想早見表を作成し「農家段階に適応する桑栽培技術の演示計画」の項に提示した。今後はデーターを集積して、確率の高い予想表に改訂されることが望ましい。

（山本　賢）

5. 桑栽培技術の実証試験（副センター）

(1) 主要養蚕地帯における桑栽培の概況

センターの各項目ですでに述べたように、主要養蚕地帯であるSoppeng，Wajo，SidrapおよびEnrekangの桑栽培は当プロジェクトが開始された１９７６年現在では少なくとも林木視した粗放栽培が一般的で、その生産力は著しく低いものであった。しかし、その後、プロジェクトを通じた新技術が徐々に浸透しつつある。例えば、屋敷桑園程度から規模の大きな単作桑園へ、無肥料放任から尿素施用と除草及び整株へと肥培管理の面で躍進の兆しがみえはじめている。しかし、桑品種、桑園造成、桑収穫、仕立法などの面で不十分な点が多くみられ、桑栽培技術は漸く緒についたといって差支えない。

(2) 副センターにおける実証試験

1） ヤシ混植桑園における照度調査

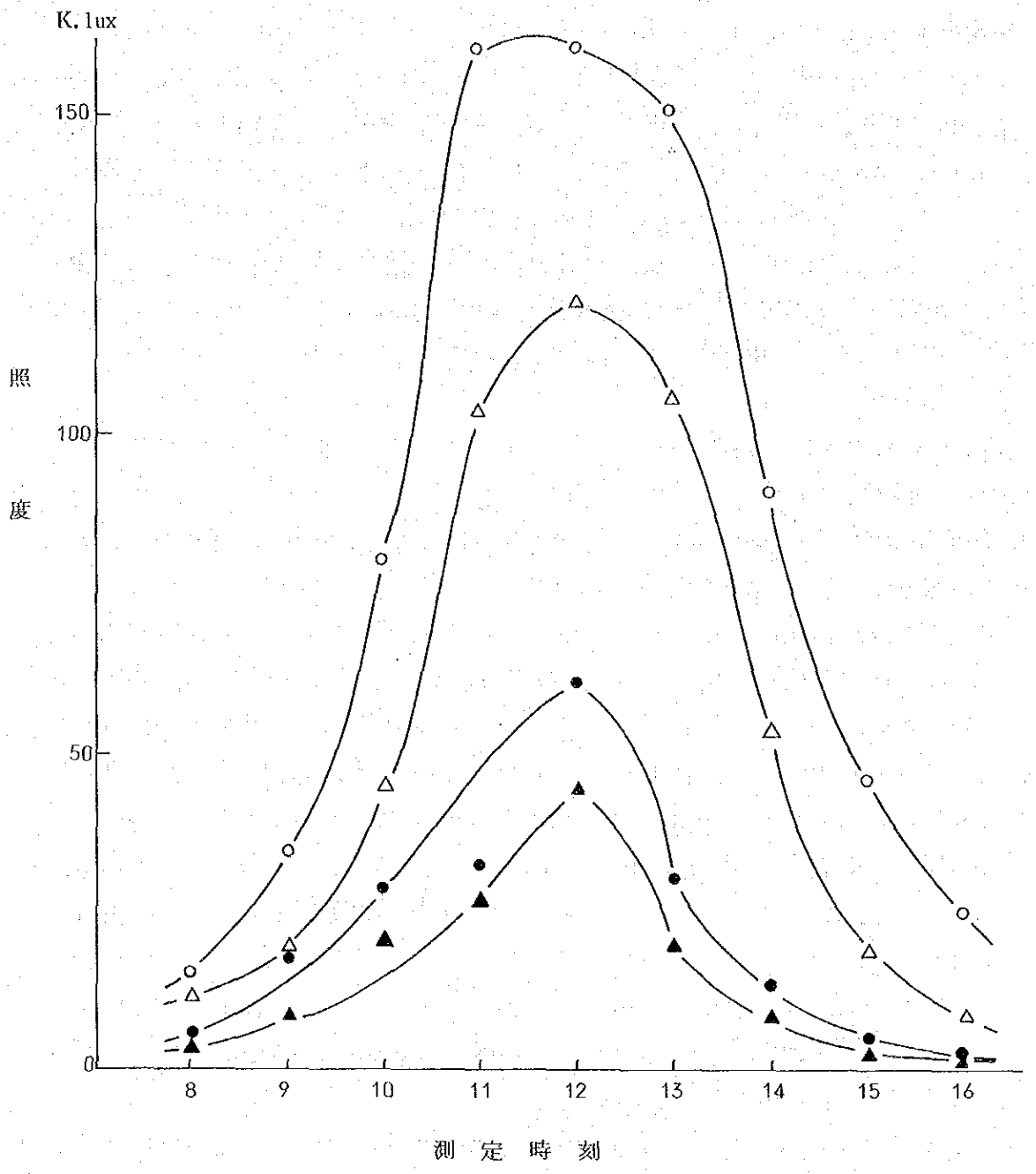
a. 目　的：ヤシとの混植桑園が多いので、桑の発育に必要な照度が確保されているか、その実態を調査した。

b. 方　法：標準的なココナツヤシと桑との混植桑園として、Pissing Lalabata Soppengの一農家桑園１９ａを選定した。ココナツヤシの樹高、樹冠の大きさ、本数を調べた後、ほ場中央部に３×３mの測定点８１点（９×９点）を設け８～１６時までの毎時に水平面照度(Klux)を照度計（東京光電ANA－300）によって測定した。測定時期は干季（９月１７日、晴天）と雨季（３月１９日、曇雨天）の２回である。このほ場のココナツヤシは樹令２０年、平均樹高１４m、樹冠直径8.1m、園内本数１４本（７４本／ha）であり、桑はM.nigra、植付当年で1.5m×0.6m（11,000本／ha）の中刈仕立であり、発育は良好であった。

c. 結　果：晴天時の測定点９１カ所の日平均照度は最高７５Klux、最低１９Klux、平均５４Klux（相対照度６４％）であった。曇雨天時では最高２０Klux、最低１１Klux、平均１６Klux（相対照度７６％）であった。

次に、照度の日変化では、正后頃に最高を示し、晴天時では１２０Klux、雲雨天では４４Kluxを示した（第５図）。

田崎（１９７３）によると、壮葉の飽和照度は３０Klux、光補償点は0.5～0.7Kluxであるという。晴天時（干季）では１０～１４時の間、飽和照度以上に達しており、むしろ、過度の強光をさえぎる効果さえあるものと考える。また、曇雨天（雨季）では飽和照度に達するのは正午付近だけであったが、保償点に達するような光不足はなかった。また、当地方の雨季のピークは１２月～３月であるが終日曇雨天が続くことは少ない。この調査に用いたほ場のココナツヤシの栽植密度（７４本／ha）は１本当り平均１３５m^2



第５図　ココナツヤシ (Cocos nucifera L.) 樹冠下における照度の日変化
（１９８１. Soppeng）

○ 晴天時直射光　　△ 晴天時樹冠下
● 曇天時直射光　　▲ 曇天時樹冠下

（１１.６×１１.６ｍ）、樹冠（直径８ｍ）による遮光率は２０～３０％であって、年間を通じて桑の発育を阻害するような光条件にはならないものと推定される。

d．要　約：ココナツヤシの樹冠直径は約８ｍであり、これの半径に相当する空間、つまり１２×１２ｍの植付密度の場合、桑の生育に必要な光条件が確保できるものと推定される。したがって、これ以上の密度の場合は間伐によって適正なヤシの混植率にすることが好ましい。なお、桑園の周辺に活葉大樹やバナナが群生していることがあるが、むしろ、これらの木かげによる光条件の阻害，肥料の収奪による影響がより大きいと思われる。

（山本　賢，Endjang K.，Sucipto H.，N. Rasyid）

2）収量予想のための桑の発育と収量

a．目　的：計画的に養蚕を行なうためには、蚕期の設定と共に飼育量を事前に決定する必要がある。蚕飼育量は蚕室の飼育容量と桑の収量予測によって決まる。収量の予測は桑の発育（着葉枝条長×枝条数）が基礎となる。桑の発育は桑園の条件によって異なるので一概に論じることはできないが、その基礎となるのは枝条の伸長と落葉との推移を知ることである。これらのデーターは長年の集積が必要となるが、基礎的な発育特性を知るためにこの調査を実施した。

b．方　法：M. nigra ほか５品種を据え接ぎ法によって、Lupange Soppeng のパイロットユニットの稚蚕桑園内に設け、９月１日、１２月１日に伐採、その後の枝条の伸長と落葉の消長を１０日毎に調査し、９０日後に伐採収穫して収量を調査した。

c．結　果：９月（干季）及び１２月（雨季）とも、１９８１年は降雨に恵まれたため発育は良好で、両季に大きな差異はなかった。下部落葉の起生時期及びその進行は伐採後５０日目を中心に始まり、その後急激に増加し、９０日目では９月１日伐採が５０～６０％、１２月１日伐採は３０～５０％に達し、センターでの調査結果とほぼ、同様な結果となり、下部落葉は生理現象であって、地域差異は余りないものと判断された。従って、当地域での収量予想は単に枝条長を基本とせず、（着葉枝条長×枝条数）に基づいて算定する必要がある（第６図）。

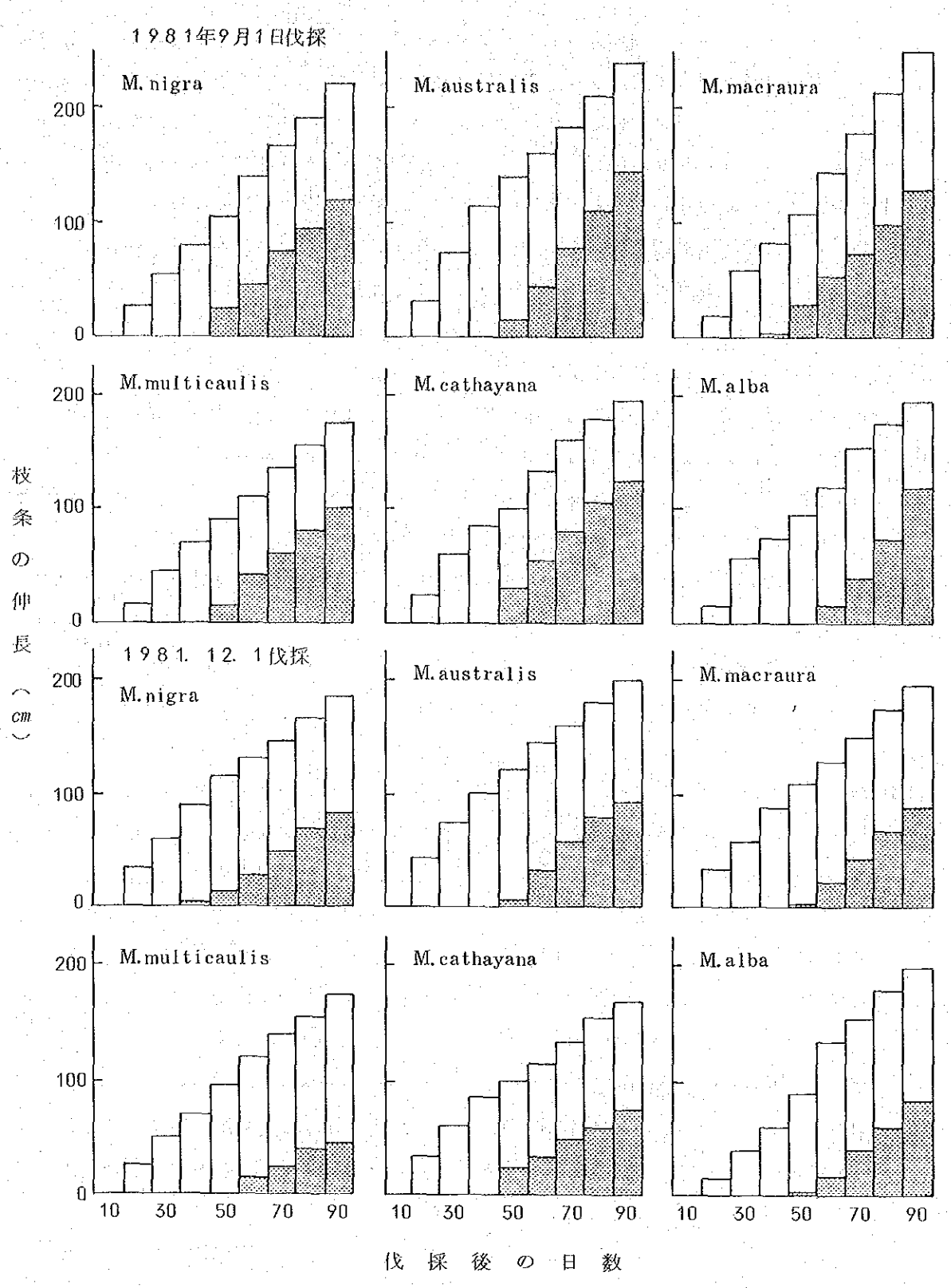
d．要　約：Soppeng (Lupange) における枝条の伸長と下部落葉の経時変化を調べた結果、センター（Bili-Bili）と同じような傾向を示した。従って、今後、着葉条長と収量の関係を季節、桑品種について検討する必要がある。なお、収量予想早見表を試作して「農民段階に適応する桑栽培技術の演示計画」の項に示した。

（山本　賢，N. Rasyid）

3）年６回飼育に適応する桑の収穫体系

a．目　的：同一桑園から連続して伐採収穫を続けることは桑の生理を損い、樹勢の衰退による生産性低下を招くものと思われるので，年３回交互収穫の是非を検討した。

b．方　法：年６回収穫（２カ月１回）を対照に、年３回交互収穫（ＡとＢ）を設けた。桑



第6図　桑品種別、枝条の生長と下部落葉

枝条の生長　　下部落葉

品種M. nigra、植付け4年目、植付距離1.5×0.5m（13,000本／ha）、中刈仕立、年間間施肥量N100Kg／3回分施とした。

第10表　年間収穫回数と桑の発育及び収量

区別	収穫月日	発育日数	最長枝条長	下部落葉率	枝条数	葉量	条桑量	指数
	1981.	日	cm	%	本	%	(ha) t	
年6回収穫	3.15	50	118	5.9	18.7	52.9	7.5	
	4.30	46	103	4.9	20.5	52.7	6.3	
	6.20	51	60	0	15.4	64.6	2.1	
	8.7	48	37	0	9.5	61.9	0.8	
	11.12	97	117	23.1	14.5	53.3	6.7	
	'82. 1.20	69	119	15.1	15.6	61.9	5.3	
	平均		92	8.2	15.7	57.9	28.7	100
年3回収穫(A)	3.15	100	206	50.5	12.7	49.8	12.6	
	6.20	97	140	52.5	17.9	61.4	5.2	
	11.12	145	159	59.1	16.6	61.4	7.8	
	平均		168	54.0	15.7	57.5	25.6	89
年3回収穫(B)	4.30	100	149	27.2	14.9	51.3	8.3	
	8.7	99	97	23.2	15.2	50.6	4.3	
	'82. 1.20	166	200	63.3	17.9	61.2	4.0	
	平均		149	37.9	16.0	54.4	16.6	58

注．2ブロックの平均値、条桑量は年合計値で示す。

b．結　果：年6回収穫に比べ、年3回収穫区は年間合計収量は少なかった。年3回収穫の収穫間隔が1期間90日以上となって、下部落葉が多くなることが減収の主要原因と考えられる。（第10表）。

c．要　約：年3回交互収穫は単年度では年6回収穫より減収した。その主要原因は下部落葉の増大による。今後、桑の生態特性に立脚した収穫体系を検討する必要がある。

（山本　賢，N. Rasyid）

(3)　開発された実用技術

1）ココナツヤシと桑との混植桑園について、照度（Klux）を調査した結果、ココナツヤシの樹間距離は12×12m、70本／ha 以下にすることが好ましい。これ以上の密度でヤ

シが植えられた桑園は間伐した方がよい。なお、バナナ、活葉大樹との混植はさけるべきである。

2）桑の伸長生長及び下部落葉は地域による差異が小さいことが明らかとなった。従って、収量予想のための資料は桑の発育時期と着葉している枝条長及び枝条数を基礎として、収量予想表を試作した。

3）桑の収穫体系を策定するには1収穫期を3カ月以内として、下部落葉による減収を少なくする必要があり、その適期は伐採後60～90日の間にある。

（山本　賢）

(4) 残された問題とその対策

1）収量予想のための桑の発育と収量

収量予想は蚕の飼育計画をたてる上で重要である。収量予想の基礎になるのは単葉重、着葉数、枝の重さ、枝の数であるが、実際の予測は重量を測定できないから（着葉している枝ののの長さ×枝の数）×kとして、kの値をデーターの集積によって決定する。kの値は桑品種、季節（干季、雨季）によって差異があると思われるので、センターと協力して試験を継続すべきである。

2）桑の年6回収穫体系

休養期間を設定した年間3回の交互収穫法を継続して実施し、年6回連続収穫は少なくとも3年以上継続して、桑の生理、収量への影響を明らかにする必要がある。

3）モミガラマルチング及び緑肥栽培による地力増進

地力の増進には有機物施与が欠かせない。当地方では有機物施用の習慣がないので、経費、入手の簡便さから、モミガラマルチングと緑肥栽培の是否を検討する必要があろう。もちろん、センターとの協同研究が前提である。

4）その他

奨励品種として、すでにM. albaを選定し、続いてM. cathayana を予定しているが、Tana Bellange 桑園にも積極的に導入して、実証試験、蚕種製造事業の円滑化のために利用していくべきであろう。

（山本　賢）

6. 桑さし穂の生産と農民への配付（センター，副センター）

(1) さし穂の生産と配付

南スラウエシ州における栽培桑品種の現状及び奨励品種の選定などについては、すでに述べたたとおり、今後、良質多収性の品種を普及させることによって、生産性の向上を図からねばならない。このため、まず、１９８０年１１月、センターPakatto 桑園にM.alba１７.６ａ、M.cathayana７.３ａの穂木園を設置した。その後、１９８１年３月、センターBili-Bili桑園で、既存のM.nigraに据え接ぎ法によって、１０ａを造成し、同じ方法でLupange Soppeng に１５ａのM.albaの穂木園を設置した。従って、現有する穂木園はM.alba４２.６ａ（センター、２７.６ａ、副センター１５ａ）、M.cathayana ７.３ａ（センター）である。

穂木の配付は、すでに奨励品種に決定したM.albaについて行ない、第１回は１９８１年１２月、センターよりTakalar，Bulukumba，Pangkep，Bone及びPolmasの５地方事務所管内に対し約４万本分（４ha）を配付した。第２回は１９８２年３～４月にサブセンターより、パイロットユニット農家に対し２万２千本分、Soppeng，Sidrap，Wajo の地方事務所管内に対して３万２千本分を配付し、その合計は９４,０００本分（約９.４ha分）となった。しかし、その後はセンターMalio桑園造成のために穂木の一般配付は暫時中断せざるを得ない。

(2) 穂木配付規定の作成

奨励品種の迅速な普及と穂木配付を円滑に行なうため、１９８１年１１月、穂木配付規定の試案を作成して、プロジェクトマネージャーに提出した。その骨子は①配付の目的　②配付桑品種の指定　③奨励桑品種名　④配付希望申込み　⑤配付数量の決定　⑥配付の時期　⑦穂木の規格　⑧配付方法　⑨経費

からなっており，付則として、各地方事務所及び各ユニットにおいて穂木園を設置し、養家農家へ速やかに普及させる体制をとることと、桑園造成方法の指導を十分行なうように要望事項を付加した。

(3) 残された問題とその対策

1）奨励品種の増強：一般に作物の栽培品種はいくつかの欠点を持っており，病虫害及び災害に対する抵抗性および地域適応性が異なる。したがって、特定の品種だけを栽培することは思わぬ被害をうける危険性が伴なう。危険性を分散することと、より優良な品種を速やかに普及させるためにも、開発された実用品種を逐次奨励品種に加え、穂木生産と配付できる体制を整える必要がある。現在、M.albaに次ぐものとして、M.cathayanaを準備しており、（Malino桑園２５ａ）、穂木生産の見通しが得られる１９８３年度は奨励品種指定が可能となる。

2）穂木配付体制：桑は永年生作物であるから、米や野菜などの１年生作物のように品種を急速に更新することはできない。したがって、新興養蚕地帯を中心に、新植桑園に新品種を導入できるよう、十分な穂木の生産体制を整えねばならない。そのためには、

a．サブセンターTana Bellange桑園にも順次、M. alba ,M. cathayanaの穂木園、１品種最低２０ａを設置する。

b．各地方事務所及びできれば２ユニットを単位とした穂木園を設置し、農家の需要を充たす。この場合、穂木の増殖率は３０～５０本分／株をめやすとして設置すること。

c．各地方事務所普及担当者は農家の動向、とくに桑園新植計画をはあくし、穂木の供給計画をたてる。

d．新品種の普及に当たっては、桑栽培専門家（インドネシア）より、その特性及び栽培上の注意を十分たしかめたうえで、適地栽培を心がけること。

e．穂木の配付に当たっては穂木配付規程が活用されるよう、十分な行政指導によって対応することが望ましい。

（山本　賢）

7. インドネシア人技術職員の訓練（センター，副センター）

(1) カウンターパートの訓練

1）実技訓練

桑園造成については１９７６年当プロジェクト開設と同時に、すでに述べたBili-Bili，Pakatto並びにTanah Bellange桑園の造成に当たって、基盤整備、基肥施用、植付け、植付け初期の管理と仕立方などの基本技術が指導された。その後、桑の生長に合わせて、年間の仕立収穫法、施肥、除草、害虫防除などの一般管理技術の修得が行なわれた。１９８１年後半からは、管理作業をカウンターパートの責任分担制として、年間の生産計画に基づいて実施している。この中で、問題点のある場合は指摘して助言を与えている。その結果、一般的な桑栽培技術はほぼ、修得されたものと考えられる。

2）試験計画、実施及びとりまとめ

桑の栽培技術開発実用化並びに実証試験等の遂行に必要な能力を付与することに重点をおいた。初期の段階では専門家が自ら立案した試験計画に基づいて、すべての試験を実施してきた。１９７６年１１月～１９８０年１１月（藤原専門家）の実施試験小項目は、センター、サブセンターを併せて２３課題に及んだが、この段階では、主に専門家の主導のもとに行なわれ、試験の実施方法の修得が主体であった。次に、１９８０年１１月～１９８２年２月の実施試験項目は１３項目であった。この段階でも試験項目については専門家によって選択されたが、圃場の設定、計画及びとりまとめはカウンターパート自ら行なうことを原則とし、専門家は助言に止めた。従って、試験項目は各カウンターパートの分担とし、設計からとりまとめまで、各カウンターパートが一貫して実施するようにした。これら、開発試験に基づくデーターは、新技術としてすでに活用されているものもあり、近く８課題について論文発表できる見込みである。

しかし、途中採用となったカウンターパートについては、開発試験の自力による計画と実施及びとりまとめは不十分であり、今後の継続指導と各自の努力が望まれる。

3）技術開発および技術指導能力の養成

初期の段階では桑園一般管理技術の基本修得に努めた。第２段階では開発試験を実施する中で、試験の目的、圃場調査のやり方、データーのとりまとめについて訓練した。第３段階では農家段階での問題点摘出と試験の設計（進め方）をカウンターパートと討議しながら進め、データー解析、レポートの作成をできるだけ自身で行なうように指導してきた。

普及員及び農民の訓練はすべてカウンターパートによって実施してきたが、その訓練には開発試験で得られたデーターを中心にしたテキストブックを作り、インドネシア語にほん訳して使用した。その後、このテキストを骨子に、カウンターパートによって技術普及員向けの綜合テキストブック「PEDMAN PERSUTERAAN ALAM 1981. JICA. JR.

８２－１６」が編集され、刊行された。技術普及員や農民の訓練は実技を主体とするように指導した結果、年間数回実施された短期または長期研修は順調に行なわれ、技術指導能力については，ほぼ、満足できる状態になった。

しかし、農民が必要とする技術、将来の技術レベルを想定した技術開発を自ら考え、試験を実施し、作出していくための能力はいまだ十分ではない。したがって、今後も引続き、日本人専門家による指導が望ましいが、カウンターパートの自覚と努力が何よりも大切である。

（山本　賢）

(2)　センター技術職員の訓練

１９７６年、当プロジェクト開設当時のアシスタントカウンターパートは４名であったが、その後、配置換え、新規採用などによって、現在員は５名である。経験年数は６年から１年未満まであって、それぞれ異なっている。

彼らには一般桑園管理を分担して責任を持たせ、カウンターパートの指示によって現場作業を指揮させている。新規採用当時は実技を中心に専門家及びカウンターパートによって基本技術を指導した。

開発試験の実施に当たっては調査の補助を行ない、新技術及び桑栽培法の修得と理解に役立たせている。

桑栽培の基本技術を修得したアシスタントカウンターパートは将来的にみて、各地域の桑の専門技術普及員のような役割りが与えられるならば養蚕農家への技術普及を行なううえで好ましい。

（山本　賢）

8　農民段階に適応する桑栽培技術の演示計画

(1)　稚蚕用桑園

稚蚕用桑は蚕を強健に育てるためのものであるから、良質の適熟葉が得られることを目的とする。桑園は飼育所に近く、日照、通風が良好で、干季でも伸長するような土壌条件の良好な土地が望ましい。

a．桑品種：良質、多収のM. albaが適している。可能な限り、M. nigraからM. albaに品種を更新する。

b．栽植密度：10,000本／ha を標準とする。管理作業からみると2.0×0.5 *m*がよい。

c．仕立法：株の高さ50～60 *cm*の中刈とする。しかし、洪水によって冠水する所では、より高くする。

d．伐採と収穫の方法：掃立30～40日前に枝の基部10 *cm*を残して、剪定鋏で伐採する。収穫は再発芽した若い枝の適熟葉部位より摘梢収穫する。3令用桑は主に1～2令に収穫した下部を伐採収穫する。

e．肥培管理：伐採時に除草した上、尿素140 Kg／ha／蚕期（約14 *g*／株）を畦間に施し、土とよく混和する。干季には雑草やモミガラでマルチングをして、干害を防ぐ。

f．害虫の防除：メイガ、クワコナカイガラムシの防除は株直しにより小枝を除去する。多発地では掃立15日前にバスジン2,000倍液、10 *ℓ*／aを散布する。

（山本　賢、久保村安衛）

(2)　壮蚕用桑園

農家が実行できる桑栽培技術を導入し、桑園を計画的に運用して、無理な伐採収穫を避け、年間収葉量の安定と増収を図かる。

a．桑品種：当面はM. nigraを使用するが、漸次、良質多収のM. albaへ品種を更新する。

b．栽植密度：10,000本／ha 以上とする。従って、1.0×1.0 *m*でもよいが、管理作業、収量からみると2.0×0.5 *m*または1.5×0.6 *m*がより望ましい。

c．仕立法：株の高さ50～60 *cm*の中刈とする。

d．伐採と収穫法：収穫前60～80日に剪定鋏を用い、枝の基部5 *cm*を残して株直しする。この際、小枝も剪除する。収穫は桑園を切半してA、Bブロックに分け、蚕期毎に交互収穫する。一方のブロックからは年3回、A、Bブロックからは年6回の収穫を行なう。3回収穫した後は桑株を休養させ、樹勢を回復させる。

e．肥培管理：伐採収穫後に除草した上、尿素70 Kg／ha／蚕期（約7 gr／株）を畦間に施し、土とよく混和する。

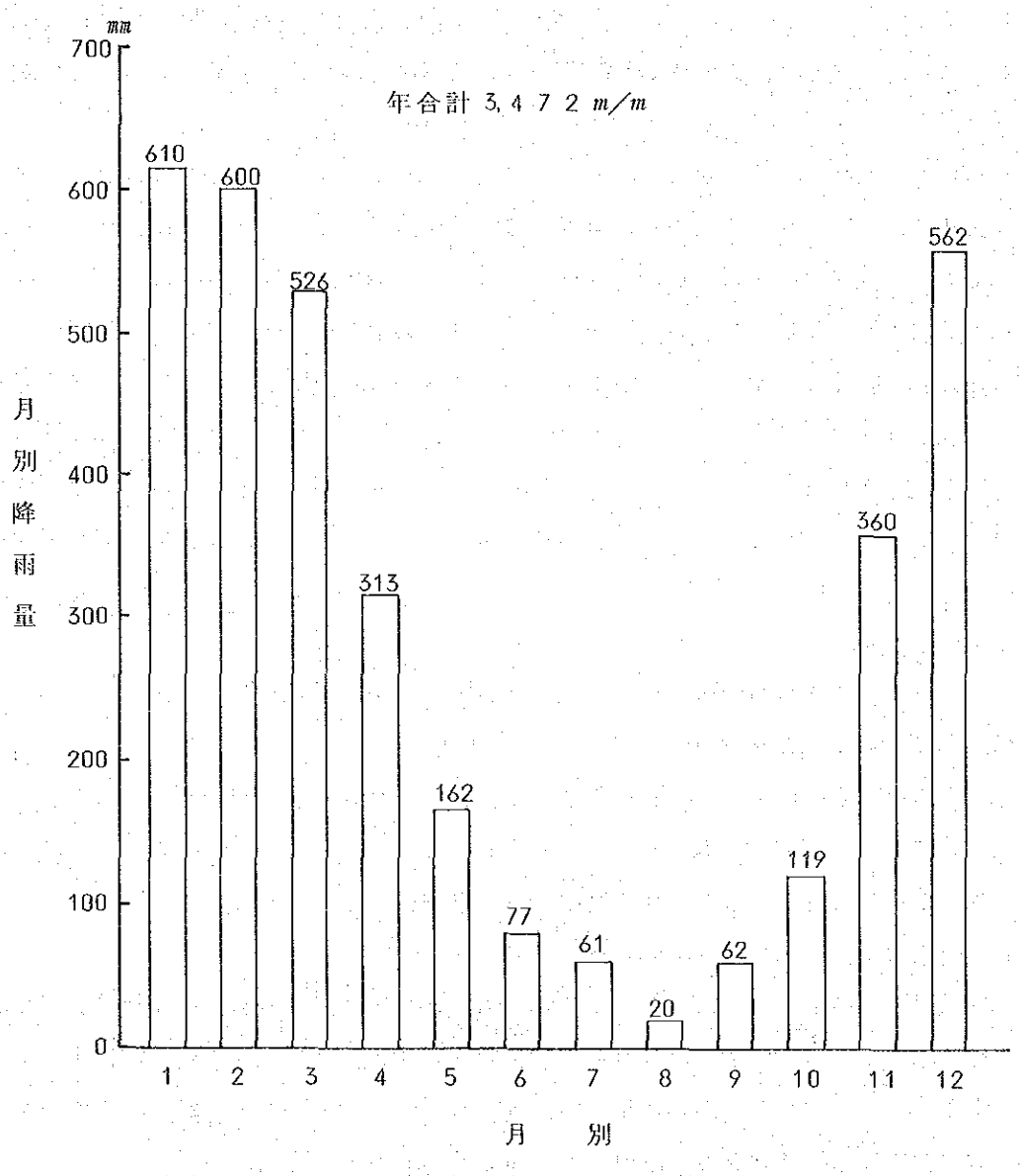
f．害虫防除：除草、株直し等衛生管理につとめる。混作等による陰湿な環境条件を排除する。

メイガ、クワコナカイガラムシの多発地では収穫の１５日前までにバスディン2,０００倍液、１０ℓ／aを散布する。

（山本　賢、久保村安衛）

(3) 年６回飼育に適応する桑の収穫体系試案

1) 試案の基本：当地のクワは休眠がないので、伐採すると直ちに再発芽する。しかし、伐採収穫を繰り返すと、栄養が欠乏し生長が低下する結果として樹勢が次第に衰える。樹勢が衰



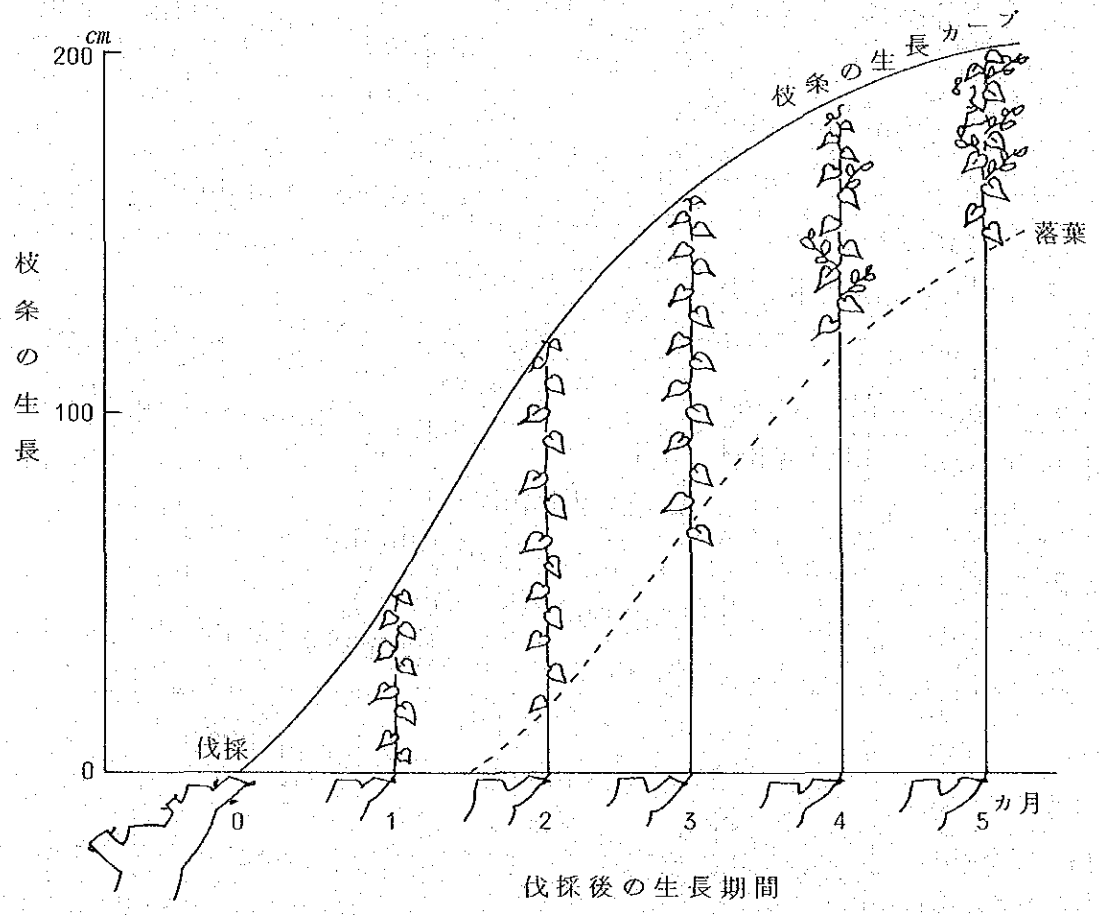
第７図　Bili- Biliの年平均降雨量（１９７０～１９７９年）

観測場所：L.P.P.Maros Sub-station
Bont-Bili Gowa

えると枝の伸長が悪くなり、枝の数が減って収葉量が少なくなり、面積当たりの蚕飼育量が減ってしまう。この対策としては、クワ株に年に一度休養を与え、樹勢を回復させることである。

2）年間の季節からみたクワの休養時期：第7図はBili−Biliの10カ年平均降雨量である。場所によって幾分違うが、南スラウエシでは8月の降雨が少なく、8～10月は干ばつになって、桑が伸長せず、収量が少なくなり、養蚕のできない年が多い。この時期を休養期間にあてる。

3）クワの発育と下部落葉：4項に詳しいデーターを記載したが、クワの発育のようすを模式図にしてみると第8図のようになる。伸長がよくて下部落葉が少ないのは伐採後60～90



第8図　枝条の生長と落葉の推移 (M. nigra)

第１１表　桑の収穫と管理作業の組立て（壮蚕用）

月別	旬別	収穫，株直し A	収穫，株直し B	施肥，除草 A	施肥，除草 B	病虫害防除，株整理 A	病虫害防除，株整理 B
1月		● 第１回飼育					
2							
3			● 第２回飼育				
4		● 第３回飼育					
5			● 第４回飼育				
6							
7		● 第５回飼育		施肥しない			
8		（休養）	● 第６回飼育		施肥しない		
9			（休養）			株整理	
１０		伐採					株整理
１１							
１２			伐採				

● 掃立

日目である。これより遅くなると、落葉が多くなって、収量は急に少なくなる。したがって、壮蚕用のクワの収穫適期は伐採後６０日～９０日になるよう、蚕の飼育計画をたてた。

4）年間の収穫体系：桑の発育に合わせて年６回の養蚕をするには桑園をＡ、Ｂ二つのブロックに分け、交互に収穫する。蚕期の間隔は４０日となる。これに休養期間を組み合わせ、施肥、除草、害虫防除などの作業を加えると、第１１表のようになる。まだ、不十分な点があるので逐次改善されることが望ましい。

（山本　賢）

(4)　桑の収量予想（試案）

蚕飼育を計画的に行なうためには、飼育前に準備した桑園の収量が予想できると便利である。収量は葉の着いている枝の長さと枝の数で、ほぼ、予想することができる。開発試験のデーターに基づいて、株当たりの予想収量を第１２，第１３表に試算した。これは収穫時の収量であるから、なるべく収穫期に近い時期に１０株程度について長さと枝の数を調査し、該当の収量に植付け株数を乗じると、面積当たりの収量になる。この表はまだ、不完全であるから、今後、調査を継続して、修正し、誤差を少なくすることが望ましい。

（山本　賢）

第１２表　雨季（１２－５月）の予想収量（Kg／株、壮蚕用）

平　均＊	枝条数（１株平均）								
枝条長	4	6	8	10	12	14	16	18	20
40cm	0.04	0.07	0.09	0.11	0.13	0.15	0.18	0.20	0.22
60	0.07	0.11	0.14	0.18	0.22	0.25	0.29	0.32	0.36
80	0.10	0.15	0.20	0.26	0.31	0.36	0.41	0.46	0.51
100	0.14	0.20	0.27	0.34	0.41	0.48	0.54	0.61	0.68
120	0.17	0.26	0.35	0.43	0.52	0.60	0.69	0.78	0.86
140	0.21	0.32	0.43	0.53	0.64	0.74	0.85	0.96	1.06
160	0.25	0.38	0.51	0.63	0.76	0.88	1.01	1.14	1.26
180	0.30	0.44	0.59	0.74	0.89	1.03	1.18	1.33	1.48

＊着葉条長

第１３表　干季（６－１１月）の予想収量（Kg／株、壮蚕用）

平　均＊	枝条数（１株平均）								
枝条長	4	6	8	10	12	14	16	18	20
20cm	0.01	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.05
40	0.02	0.04	0.05	0.06	0.07	0.08	0.10	0.11	0.12
60	0.04	0.06	0.08	0.11	0.13	0.15	0.17	0.19	0.21
80	0.06	0.10	0.13	0.16	0.19	0.22	0.26	0.29	0.32
100	0.09	0.13	0.18	0.22	0.26	0.31	0.35	0.40	0.44
120	0.12	0.17	0.23	0.29	0.35	0.40	0.46	0.52	0.58

注．桑品種、M. nigra

9. 農民グループに対する桑栽培技術の演示指導
（パイロットユニット）

(1) 稚蚕用桑園の演示指導

パイロットユニット５カ所のうち、稚蚕用桑園が公有地（プロジェクトの直轄）にあるのはLuppangeとBarakaであり、私有地３カ所のうち、完全な稚蚕用桑園を所有しているのはPisingだけで、Ugiでは一部が稚蚕飼育所に併設されたが大部分は遠隔地にあって専用化していない。また、Wanioでは稚蚕用桑園がなく、余裕のあるメンバー農家から適宜供給を受けている。

稚蚕飼育所に専用の稚蚕用桑園がないと、蚕作が安定せず、パイロットユニットの円滑な運営ができない恐れがある。また、稚蚕用桑の技術指導及び演示ができないので、とくにWanioについては再三にわたって、その設置を働きかけた。しかし、未だに実現していない。

'８１／８２年の技術指導はパイロットユニットのスタートの年であったので、その第１回目'はすべてのパイロットユニットに専門家が同行し、カウンターパートと共に現地指導を行なった。その上、各所の問題点や指導の重点項目を指摘した。地域によっては技術普及員全員が参加して、伐採、整株、施肥等の実技を修得した。技術指導の時期、内容などは第１４、１５表に示した。

第１４表　稚蚕用桑園の演示指導(1)

パイロットユニット	掃立時期	指導の時期	演示内容	指導者
Pising	1982. 3. 16	1982. 2. 9	仕立収穫、施肥、計画面積、害虫防除、除草	専門家、カウンターパート
Luppange	3. 16	2. 9		
Ugi	3. 17	2. 11		
Wanio	3. 17	2. 11		
Pising	1982. 6. 1	1982. 5. 1	仕立収穫、施肥、害虫防除	普及員
Luppange	6. 1	5. 1		
Ugi	6. 2	5. 1		
Wanio	6. 2	5. 1		
Pising	1982. 8. 30	1982. 7. 15	仕立収穫、施肥、害虫防除、計画面積	カウンターパート A. カウンターパート
Luppange	8. 30	7. 15		
Ugi	8. 31	7. 16		
Wanio	8. 31	7. 16		
Baraka	9. 2	7. 18		

第 15 表　稚蚕用桑園の演示指導(2)

パイロットユニット	掃立時期	指導の時期	演示内容	指導員
Pising	1982. 10. 13	1982. 9. 1	仕立収穫、害虫防除、施肥、計画面積	普及員
Luppange	干ばつのため休止	—		
Ugi	〃	—		
Wanio	〃	—		
Baraka	〃	—		
Pising	1982. 12. 20*	1982. 11. 15*	仕立収穫、施肥、害虫防除、計画面積	
Luppange	12. 20	11. 15		
Ugi	12. 21	11. 16		
Wanio	12. 21	11. 16		
Baraka	12. 23	11. 18		
Pising	1983. 2. 20*	1983. 1. 15*	仕立収穫、施肥、害虫防除、計画面積	
Luppange	2. 20	1. 15		
Ugi	2. 21	1. 16		
Wanio	2. 21	1. 16		
Baraka	2. 23	1. 18		

＊ 計画

成果と問題点：第１回の技術演示のあと、掃立に至る間Wanio ではクワノメイガが発生し、その被害によって、収穫ができなかった。この対策としては、事前に農薬を普及員へ配付することにした。

次に、稚蚕用桑園をM. nigraからM.albaに転換する点については既設桑園を使用する限り、早急な転換はできない。この中にあって、桑品種の重要性を認識しているパイロットユニットリーダーがいた。それはPisingのM.Tahir氏で、パイロットユニット実施前に約１ha の稚蚕用桑園を造成し、この時、M.albaの穂木を各所から集めた。センターからも約３０ａ分の穂木を供給した。第１回掃立時にこの桑園について調査した結果は第１６表のとおりである。

第１６表　稚蚕用桑園の発育と収量（Pising Soppeng）

桑品種	最長枝条長	最長枝着葉数	1株枝条数	1株条桑量	ha当たり 収量	ha当たり 稚蚕飼育量
	cm	枚	本	Kg	Kg	Box
M. nigra	77	20.6	12.6	0.22	2,380	40
M. alba	71	13.9	14.3	0.29	3,150	53

注．伐採１９８２．２．１０．伐採後３５日目。植付距離 1.5×0.6 m（11,000本／ha）
尿素１４０Kg／ha施用、1～3令用、１０株調査（３月１８日、１令期）
樹令２年目、Tahir M.氏所有。

すなわち、M.albaの収量はM.nigra より約３０％多く、葉質もよい。今後、これを参考に各パイロットユニットでも、逐次改植方式によって、品種転換を図かるべきである。その他技術定着まで時日を要するものと考えられる、Wanio, Barakaについては重点指導が必要であろう。

（山本　賢，Endjang K.，N. Rasyid）

(2)　技術演示農家の選定

稚蚕飼育所から配蚕を受け、壮蚕飼育をするメンバー農家、２０戸～３０戸の中から1パイロットユニット１～３戸を選んで新技術を演示し、他のメンバー農家へ技術を波及させることを目的としている。

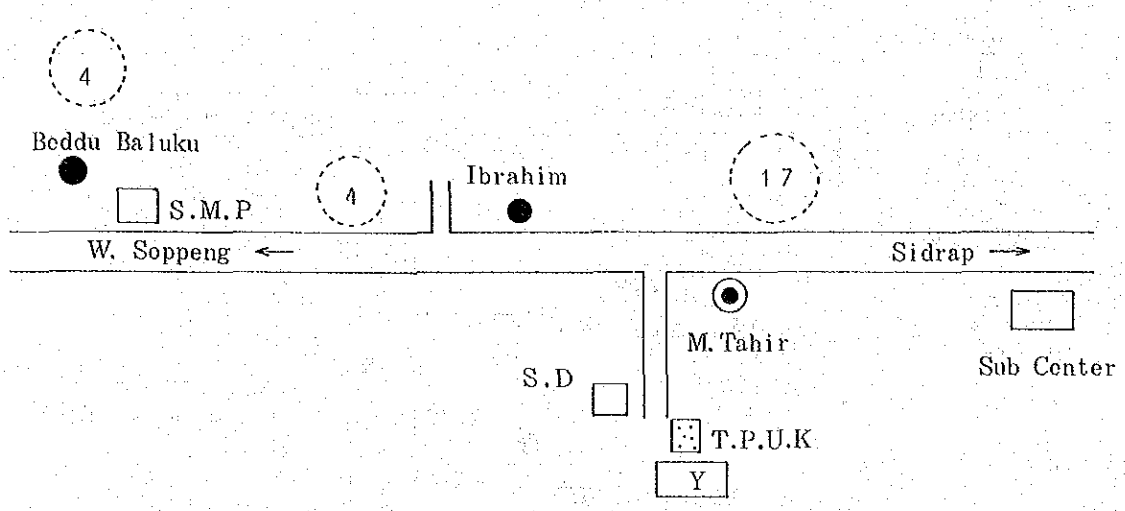
パイロットユニットの略図は第９図～第１３図に示したが、演示農家は0.5ha内外の桑園を持ち、比較的，人目にふれやすい所に桑園があることを条件に選定した。第１回掃立前の１９８１年２月に蚕桑の関係者によって選定された演示農家の桑園概要は第１７表のとおりである。

第１７表　演示農家の桑園概要（１９８２年２月）

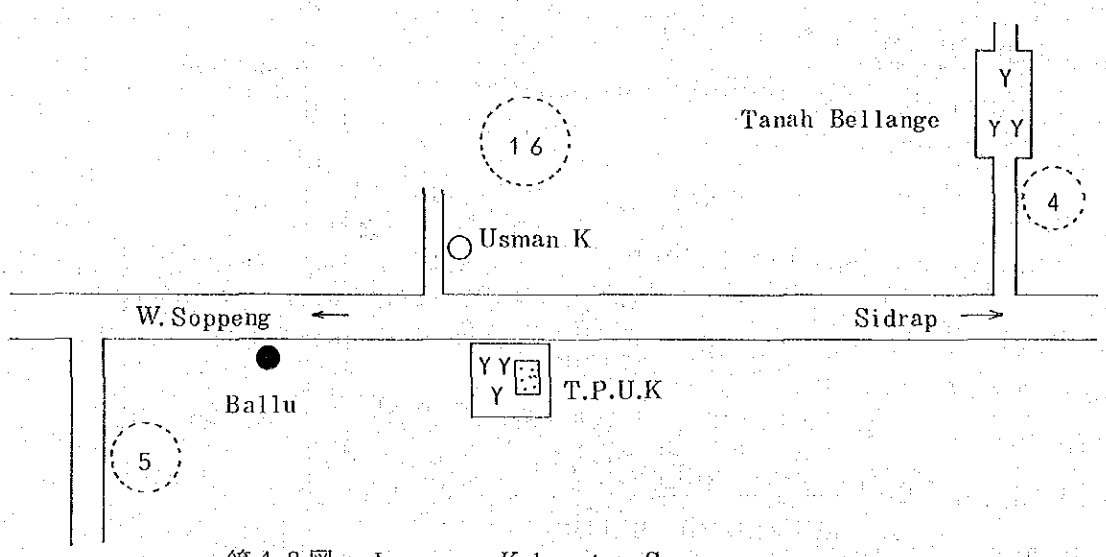
パイロットユニット	農家	桑園面積	植付距離	桑品種	1蚕期の飼育量
		ha	m		box
Pising Soppeng	M. Tahir	4.0*	1×1	M. nigra	3
	Beddu B.	1.5	〃	〃	2
	Ibrahim	1.0	〃	〃	2
Luppange Soppeng	Ballu	0.4	〃	〃	1
Wanio	Aras	0.7	〃	〃	2
Sidrap	Ruslan	0.6	〃	〃	1
Ugi	Usman P.	3.0*	〃	〃	2
Wajo	Balla	1.3	〃	〃	2
Baraka Enrekang	Anbe Mina	0.5	〃	〃	1

＊ 稚蚕用桑園を含む

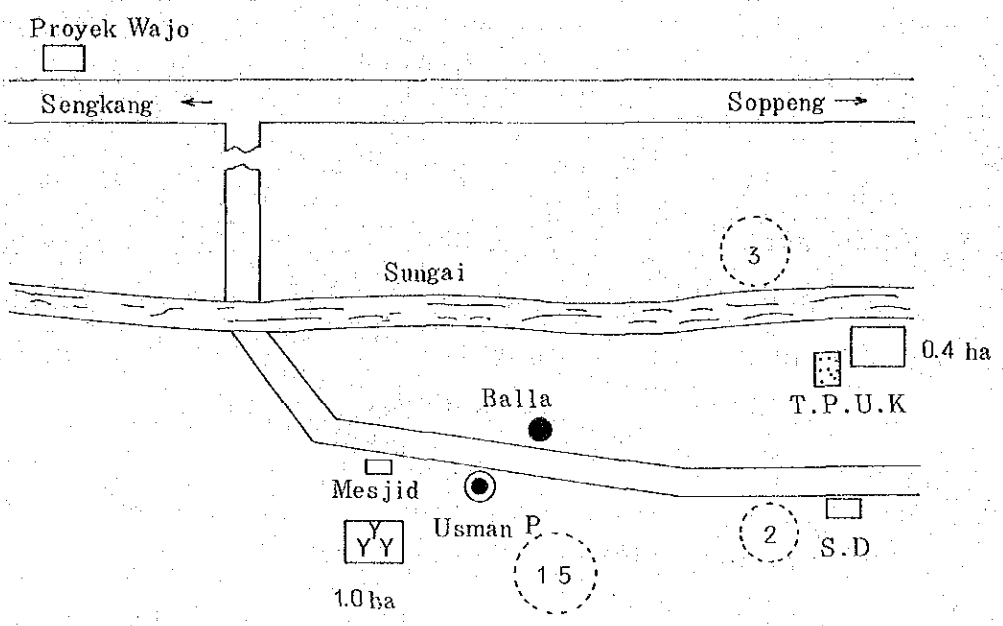
（山本　賢，Endjang K.，N. Rasyid，Baharuddin A.）



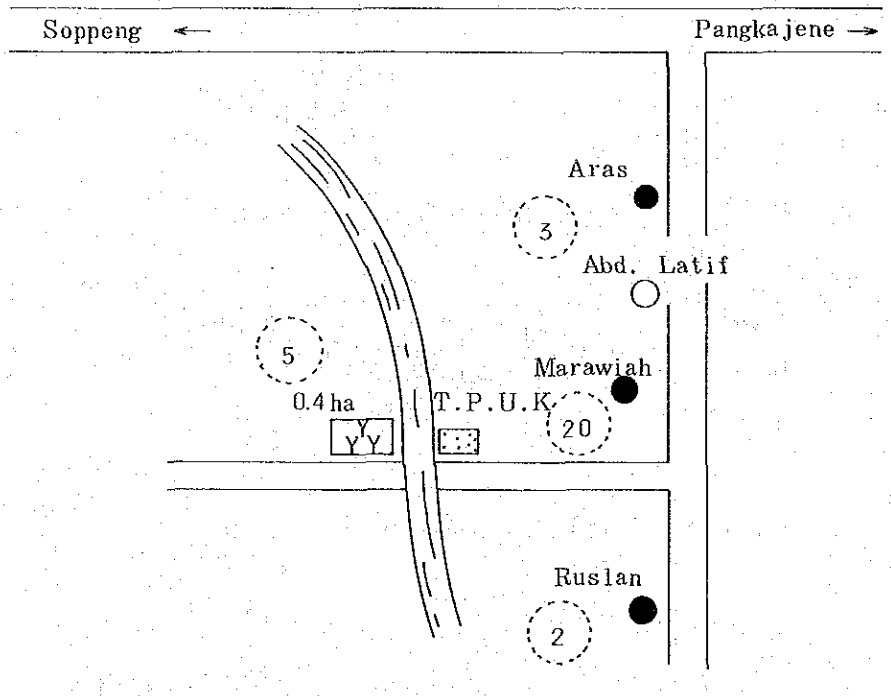
第９図　Pising Kabupaten Soppeng.



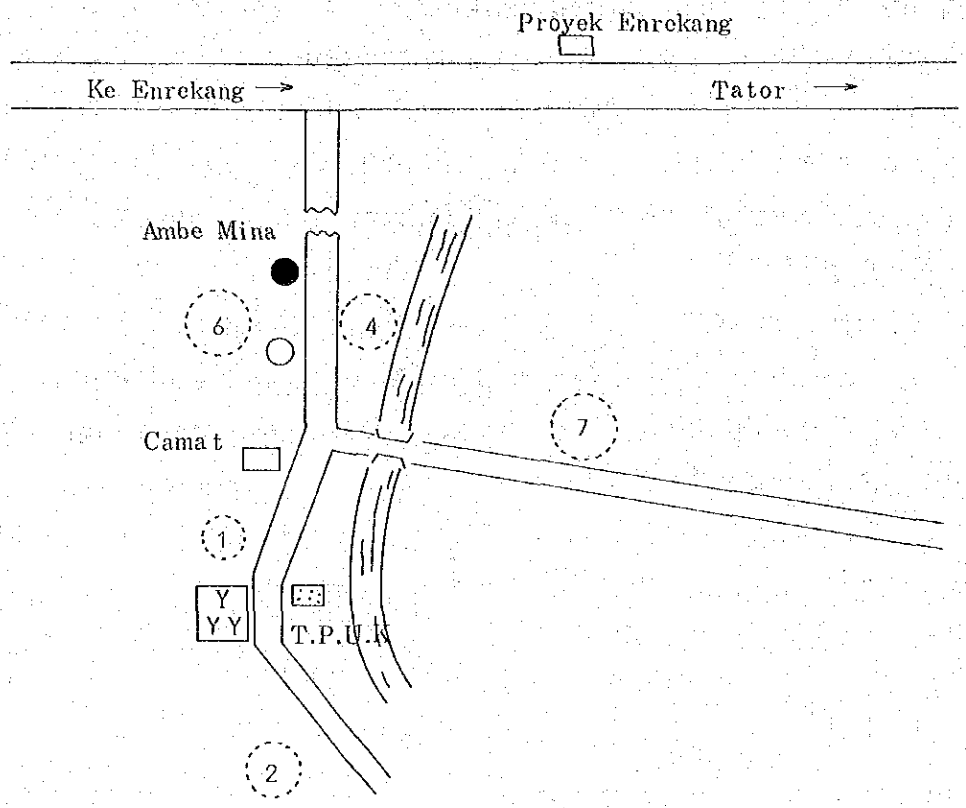
第１０図　Luppange Kabupaten Soppeng.



第１１図　Ugi Kabupaten Wajo.



第１２図　Wanio Kabupaten Sidrap.



第１３図　Barakka Kabupaten Enrekang.

摘　要
Keterangan:

○ Kepala Pilot Unit パイロットユニットのチーフ

● Demostrasi petani 演示農家

YY Kebun untuk ulat kecil 稚蚕用桑園

T.P.U.K 稚蚕飼育所

Angka yang menunjukan jumlah petani, パイロットユニット農家の集落
数字は農家戸数

(3) 演示農家における技術指導

演示計画に基づき、使用桑園の伐採適期（収穫の６０～８０日前）に現地指導を実施した。しかし、第１回飼育（１９８２．３月)は実施計画の遅れから、実技指導は間に合わなかったので、演示農家の選定時に実施計画を説明し、実技指導は第２回飼育（１９８２．６月）のための伐採と施肥時期（１９８２．８月)より実施した。すなわち、専門家がカウンターパートと共に農家桑園に出かけて、普及員も含め演示農家個々に対し、桑園切半による交互収穫法、樹形の整理と剪定鋏による伐採のやり方、施肥量と施肥の方法、害虫の被害と防除法など、桑園の状況に応じた改善策を指導した。

飼育時期と現地指導の詳細は第１８、１９表のとおりである。なお、第２回飼育（１９８２．６月）時の壮蚕期における各演示農家の条桑収量を調査し、第２０表に示した。これによると、都合で伐採時期が早く、伐採後１１０日経過したTahit M.の桑園は下部落葉率が５６％と多くなり、クワノメイガによる被害もあって、最低の収量となった他は4,５００～12,８００Kg／ha を記録した。これらは１回の収量としてはかなりの多収穫であり、連続収穫をさけ、樹勢の維持に努めるならば、年間条桑量２０t／ha、飼育量20Box／ha、収繭量４００Kg／haの生産力は確保できるものと思われる。

第18表　演示農家の指導(1)

パイロットユニット	掃立時期	指導の時期	演示内容	指導者
Pising	1982. 3. 16	1982. 2. 10	演示農家の選定、演示計画の説明	専門家、カウンターパート普及員
Luppange	3. 16	2. 11		
Ugi	3. 17	2. 12		
Wanio	3. 17	2. 12		
Baraka	(未着手)	−	—	—
Pising	6. 1	4. 7	仕立収穫、施肥、害虫防除、整株ほか	専門家、カウンターパート
Luppange	6. 1	4. 7		
Ugi	6. 2	4. 8		
Wanio	6. 2	4. 9		
Baraka	(未着手)	−	—	—
Pising	8. 30	6. 16	仕立収穫、施肥、害虫防除、収量予想	カウンターパート、A. カウンターパート
Luppange	8. 30	6. 16		
Ugi	8. 31	6. 17		
Wanio	8. 31	6. 18		
Baraka	9. 2	6. 19		

第19表　演示農家の指導(2)

パイロットユニット	掃立時期	指導の内容	演示内容	指導者
Pising	1982. 10 13	1982. 8. 9	仕立収穫法、施肥、害虫防除、収量予想	カウンターパート
Luppange	干ばつのため休止	8. 9		
Ugi	〃	8. 10	株整理（休養期の管理）	A. カウンターパート
Wanio	〃	8. 10		
Baraka	〃	8. 11		
Pising	1982. 12. 20*	10. 8*		
Luppange	12. 20	10. 10		
Ugi	12. 21	10. 7		
Wanio	12. 21	10. 9		
Baraka	12. 23	10. 7		
Pising	1983. 2. 20*	1982. 12. 1*		
Luppange	2. 20	12. 1		
Ugi	2. 21	12. 2		
Wanio	2. 21	12. 2		
Baraka	2. 23	12. 4		

＊計画

第２０表　演示農家における条桑収量（１９８２年６月）

パイロットユニット	農家名	植付距離	伐採後の日数	最長枝条長	下部落葉率	平均枝条数	条桑量／株	条桑量／ha	換算飼育量	摘要
		m	日	cm	%	本	kg	kg	Box	
Pising	Tahir M.	1.0×1.0	110	171	56	6.6	0.22	2,200	2	クワノメイガ多い
	Beddu B.	1.5×0.5	80	106	11	7.5	0.51	6,630	6	クワノメイガ発生
	Ibrahim	1.0×1.0	80	114	3	12.2	0.54	5,400	5	
Luppange	Ballu	1.0×0.6	80	127	17	10.0	0.77	12,800	12	
Ugi	Usman P.	1.0×1.0	80	121	13	14.2	0.58	5,800	5	
	Ballu	1.0×1.0	80	109	9	19.6	0.74	7,400	7	クワノメイガ多い
Wanio	Marawiah	0.6×0.6	80	160	14	10.0	0.45	12,500	12	
	Rusulan	1.0×1.0	80	165	7	6.6	0.45	4,500	4	

注．1）５令期、２０株調査。

2）Barakaは稚蚕飼育所が未完成のため開始が遅れており、この調査から除外した。

（山本　賢、Endjang K., Munassar S., N. Rasyid, Sucipto H.）

(4) 養蚕農家の桑園実態調査

5カ所のパイロットユニット、120戸の養蚕農家について、桑栽培の現況を調査した結果の概要は次のとおりであった。(1981年現在)

1) 立地条件：PisingとLuppange及びBarakaは石灰質の丘陵地、傾斜地が多く、とくにBarakaでは平担地が少ない。UgiとWanioは川沿いにあって沖積土の平担地である。

2) 桑園の種類と面積：ココナツヤシとの混植桑園が多い。とくに、BarakaとUgiでは混植桑園が主体であり、Pisingでは単作桑園が多い。農家は平均2ha以上の農地を持っており、水田所有者が多い。農地はほとんどが自作で、借地(小作)は少ない。1戸当たりの桑園面積はPising, Luppange及びBarakaが多く、平均1haである。Ugiは0.6ha, Wanio 0.3ha前後と少ない。

3) 桑品種：M. nigraが主体であって、その中にM. australisが混じっている。奨励品種のM. albaは未だ栽培されていない。

4) 植付法：すべてさし木による。植付距離は1×1mの方形植えが主体で、不規則な植え方がが多い。

5) 桑の仕立収穫法：株の高さは不揃いであるが株の高さは50～60cm以上の中刈である。しかし、Barakaは30cm以下の根刈が多い。収穫回数は年間3～4回であって、桑園を交互に使う者もあったが、毎回同じ桑園から収穫する場合が多い。

6) 桑園管理：無肥料栽培が多く、施肥農家は全体の20%で主としてSoppeng地区であった。肥料は尿素の単用である。除草などの手入れはSoppeng地区とUgiは比較的良く、WanioとBarakaはよくない。

7) 樹勢：桑の発育はPising, Luppange, Ugiは全般に良好であるが、WanioとBarakaは発育が不良で生産性は著しく低いとみられた。これは収穫回数や桑園管理に関係している。

8) 桑の病虫害：主な害虫はクワノメイガ、コナカイガラ、クワカイガラムシ及びカミキリムシであった。カミキリムシはWanioに多く、Barakaでは少ない。クワカイガラはLuppange, Ugi, Wanioに多い。また、クワノメイガとコナカイガラ(ミリバッグ)は全域に分布しており、被害も大きい。病気はウラウドンコ、縮葉細菌病などがみられたが、被害は少ない。

9) 桑の収量：不明である。蚕の飼育量と収量の関係も正確なデーターがない。

(藤井　実、友成　進、Baharuddin　A.)

(5) 養蚕農家の桑栽培技術評価

演示農家を通じて移転した新技術が、普及の第1段階としてパイロットユニットの他のメンバー農家にどの程度波及したかを確かめるため実施した。

1) 方　法：パイロットユニット活動が発足して第2回の蚕期(1982年6月)が終了した時点でアンケート調査票を作り、演示技術を中心にした項目について、パイロットユニット

Barakaを除く全メンバー農家を対象に調査した。調査は担当普及員が戸別訪問して記入した後、集計した。

2）第1回アンケート調査の要約

演示農家で演示した技術を中心としたメンバー農家の実施状況は第21表に示した。要約すると以下のとおりである。

a. 奨励品種を短期間に導入することは困難である。

第21表　1982年6月蚕における桑栽培技術の実施状況

主要な技術	P.ユニット略名	農家戸数 実施	農家戸数 未実施	実施率(%) 各ユニット	実施率(%) 平均
奨励品種（M. alba）の導入	P	0	24	0 %	%
	L	1	24	4	1
	W	0	27	0	
	U	0	20	0	
適期伐採（収穫前60～80日）	P	19	5	79	
	L	23	0	100	93
	W	25	2	93	
	U	20	0	100	
桑園切半による交互収穫	P	2	22	8	
	L	8	15	35	17
	W	1	26	4	
	U	4	16	20	
株直しの励行（株整理）	P	8	16	33	
	L	19	4	83	53
	W	18	8	69	
	U	5	15	25	
株直し用具として剪定鋏の使用	P	3	21	13	
	L	18	5	78	43
	W	15	12	56	
	U	5	15	25	
尿素の施用（株直し時、70Kg／ha）	P	19	6	76	
	L	12	12	50	60
	W	17	12	59	
	U	11	9	55	
除草の励行（株直し時）	P	20	4	83	
	L	20	3	87	88
	W	22	5	81	
	U	20	0	100	
クワノメイガ、コナカイガラ発生時における Basdin の散布（Dibron）	P	16	8	67	
	L	16	7	70	59
	W	23	4	85	
	U	3	17	15	
各項目の平均実施率	P	—	—	45	
	L	—	—	63	52
	W	—	—	56	
	U	—	—	43	

b．飼育前の適期伐採は実施率が高い。収穫までの発育期間が長いと落葉によって減収することを「生活の智恵」として知っているものと思われる。

c．桑園の交互収穫による使用は樹勢維持のため必要であるが、実施率が低い。今後、重点指導が必要である。

d．株直しは、全くなかった技術であるが、実施率はかなり高い。剪定鋏の普及（１０～８０％）が関係していると思われる。

e．施肥は前年の２０％（実態調査、藤井ほか）から、６０％へと大幅に実施率が高くなった。除草も８８％の農家が実施しており、粗放栽培から管理栽培へと前進していることが認められた。

f．クワノメイガ、コナカイガラの被害がほとんど全域に及んでいることがわかった。本年は４月以降、無降雨の天候であったことも大きな原因であるが、薬剤使用は欠かせない技術と考えられる。害虫の発生に当たって約６０％の農家が薬剤による防除を実施した。これは技術指導の徹底とともに、先進技術である稲作を併せて行なっている農家が多く、すでに手動型の噴霧器を持っていることがあげられる。

g．将来的な希望として、肥培管理の改善、剪定鋏の利用を全農家が希望しているのに反し、桑品種、収穫法（交互利用）については、いまひとつ関心が少なく、理解と認識に欠けている。

以上のような評価は年間を通して行ない、技術改善、問題点の摘出、普及活動への提言を行なうための資料として活用すべきであろう。

（山本　賢、Endjang K.，Baharuddin A.）

CHAPTER OF MORICULTURE
IN
REPORT ON THE OVERALL REVIEW
OF
Indonesia-Japan Sericultural Development Cooperation Project
As of
Feburuary 1983

Edited by
Masaru Yamamoto

CONTENTS

VIII-2 MORICULTURE

VIII-2-1 Establishment and maintenance of mulberry field (Center and Sub-center).

(1) Establishment of mulberry field.

The establishment of mulberry field at the sericultural development project was stated in (Sericultural Development Project in Indonesia, final study report October 1976, JICA Japan). This work was the establishment of mulberry field at the sericultural development project, not for the farmer.

1) Bili-Bili mulberry field.

Bili-Bili is situated on the hill of Saritene at an elevation of 200 to 215 meters above sea level, 30 km to the east of Ujung Pandang on the way to Malino. Being situated on a rocky hilltop, the soil is highly erosive, and thus the field establishment is divided into 3 sites, two of which are traced. According to the original plan, the mulberry field to be established will be 8 ha large including a grassland. Due to the rocky, erosive nature of the soil, only 3 ha of the field was established, thus less than the schedule.

2) Pakatto mulberry field.

It is situated at about 7.5 km point from the Center on the way to Ujung Pandang. This field was established make up the lacking mulberry field at Bili-Bili, which still needed 4 ha including grassland. The land has gradual slope, and about 1.3 ha of it is flat. This flat area is adjacent to paddy field, therefore field establishment technique employed bamboo stalks as underground drainage.

3) Tanah Bellange mulberry field.

It is situated at village Lalabata Riaja, 8 km to the west of the Sub-center, at an elevation of 120 m above sea level. The field belongs to the Sub-center, Tajuncu, Soppeng. At the edge of the field flows a river, the field is flat, the soil consist of heavy clay, which drainage is extremely poor and is of poor condition for mulberry growth. About 4 ha of

it has been often flooded. The method of its establishment is same as that in Pakatto, i.e. by constructing underground drainage.

The planting year of those three fields are shown in table 9-2-1 and the maps of the field are shown in figures 5-1, 5-2 and 5-3.

Table 8-2-1 Year and acrege of mulberry field establishment (ha).

Planted Year	Center			Sub-center
	Bili-Bili	Pakatto	Total	Tanah Bellange
1976	2.04	-	2.04	1.50
1977	1.03	0.67	1.70	2.00
1978	0.33	3.37	3.70	1.50
1979	-	-	-	13.50
Total	3.40	4.04	7.74	18.50

Table 8-2-2- Year and acrege of Napier grass land establishment (ha).

Planted year	Bili-Bili	Pakatto	Total
1977	-	0.38	0.38
1981	1.00	-	1.00
Total	1.00	0.38	1.38

(M. Ito, S. Fujiwara, Zito S., N. Rasyid).

(2) Field maintenance.

1) Bili-Bili mulberry field.

It is situated at a hilltop approximately 200 m above sea level, the field is divided into three parts on different places at different elevations. One field lies on the highest part, while the two others situated lower. Due to the rocky soil and the unfavorable topography, agricultural machinery such as hand-tractor, lawn mower and other equipments are not usable, hence the employment of manpower (daily laborers).

The above mentioned condition makes the employment of four laborers inefficient. The yield is low, both in quality and in quantity. In addition, there are bushes and weeds around the field. The weeds penetrate the field and encircle mulberry trees, and they flourdish rapidly during the rainy season. Therefore a delayed weeding will endanger the field.

2) Pakatto mulberry field.

The land has gradual slope, the soil is rocky and clayish. The establishment employed small agricultural machinery supplied from Japan. Four laborers do regular maintenance works. These laborers can perform their job well in the dry season, but not during the rainy season, because mulberry trees are encircled by plenty of weeds such as Mimosa sp. Which makes it difficult to harvest leaves.

Fertilizer application at Bili-Bili is same as that of Pa Pakatto, i.e.: the field for young silkworm rearing with the application of compound fertilizer (16 N-10 P_2O_5-10 K_2O) at a dosage of 200 kg N/ha/Year. For the one for grown silkworm, Urea or Amonium sulphate is applied at a dosage of 100 kg N/ha/Year. The field for yound silkworm rearing is 1 ha and that for grown silkworm rearing is 4.5 ha.

The field is divided into two blocks, and the leaf harvesting system changes each rearing season. There are 6 rearing seasons a year, and leaf harvesting is adjusted to the condition of the site. In 1981-1982 40 boxes of "hakitate" have been performed. Leaf (mulberry shoots with leaves) production for young silkworm is 3,880 kg a year and for grown silkworms is 38,000 kg a year.

Main insect pests in the mulberry fields are mulberry scale, mulberry pyralid and mealy bugs. The mulberry field for young silkworms at Bili-Bili and Pakatto may be damaged when attacked by mulberry pyralid and mealy bugs. DDVP and Papithion are sprayed in case of the occurrence of these pests.

3) Tanah Bellange mulberry field.

This field supplies leaves for the rearing parent silkworm used of for the production of F_1 silkworm eggs that are distributed to sericultural farmers through the Sub-center.

Its maintenance activity employs agricultural machinery such as mini-tractor, hand-tractor, engine sprayer etc. Full-time workers number 10, and daily workers number 20 - 30 a day.

The soil texture is heavy clay; it gets stiky in the rainy season and gets hard in the dry season. Consequently the effectiveness of performance is much adversely affected. At present the productive, part of the field is approximately 60 %, while 40 % of it is unproductive due to improper maintenance.

Mulberry pyralid and mealy bugs attack mulberry plants severely in the field at Tanah Bellange. The project personnel conduct pest control, applying DDVP and PAP (Papthion) using sprayer. In the rainy season spraying cannot be performed appropriately, so the plants are attacked by those pests showing declining leaf yield.

(S. Fujiwara, Zito S., N. Rasyid, Endjang K., M. Yamamoto and Munassar S.).

(3) Problems and Solutions.

1) Conversion of mulberry variety.

The variety planted the Center is mainly Morus nigra, which yields relatively low leaves. In order to obtain a higher leaf yield, better varieties such as Morus alba and Morus cathayana ought to be planted. These two varieties give higher yield. It is expected that M. nigra will be gradually subtituted by those two varieties.

2) Application of organic matters to improve and maintain soil fertility.

As the temperature in the tropical zone is constantly high, soil fertility decreases rapidly, and unless organic matters are applied to the soil, nutrients would not be balanced. In the dry season, soil moisture content decreases due to the evaporation both from soil surface and mulberry trees. Particularly at Tanah Bellange where the soil is of poor condition organic matters should be applied, and so is it with Bili-Bili and Pakatto. In order to increase leaf yield, mulching is necessary, by using paddy husk or by growing

legumes between the rows to serve as green manure.

3) Weed control.

At the Center and the Sub-center, the species of weeds that disturb most are Imperata cylindrica, and Mimosa sp. Which grow very rapidly particularly in the rainy season, unless weeding is performed earlier, weeds will damage mulberry trees. Weeding should be carried out well and persistently. In the dry season, weeding is performed by uprooting them.

Agricultural machinery can only clean between rows and cannot clean between plants, so hand weeding should be performed. The use of herbicides for weed control is feasible when it has no adverse effects on mulberry field. In the rainy season, herbicide is applied on the ridges between the rows.

4) Improvement of harvesting method.

Repeated and irregular pruning cause poor mulberry rotation condition and disturb the steady leaf yield. Pruning system, planing the blocks A, B and C alternately for two harvest and one time rest a year is an ideal harvesting method.

5) Pest control.

Mulberry pyralid and mealy bugs should be controlled at the right time spraying insecticides. The timing of spray should be accurate, otherwise there will often be failures in control.

6) Maintenance of agricultural machinery.

Machinery technicians have upgraded their skills with the guidance from Japanese expert Mr. TAKEOKA. Repair works for agricultural machinery are thus the responsibility of those technicians. Machinery at the project supplied from Japan have the spare parts available at Ujung Pandang. The machinery should therefore be inspected for the smooth operation in the field.

Above matters are all to be reconsidered, and Indonesian expert and technicians should cooperate closely, and arrange between working plan in order to improve the condition of mulberry cultivation.

(M. Yamamoto).

VIII-2-2 Investigation on the economical character of mulberry varieties.

(1) Mulberry varieties planted in South Sulawesi.

Sericultural farmers in South Sulawesi generally use leaves of M. nigra to feed their silkworm S. Besides this variety, M. alba and M. australis are seen in a relatively small amount, mixed up with M. nigra in the fields. Mulberry is planted by means of cuttings. The most popular variety among the existing mulberry varieties is M. nigra, and this variety is the most prevailing one grown by farmers. Sericulture farmers in selecting mulberry varieties hitherto have not applied any standard measures such as leaf yield, leaf quality etc.

Naturally growing mulberry varieties are hitherto not found in South Sulawesi. The sericultural Development Project, both at the Center and at the Sub-centers, has 7 to 8 varieties, all of them originating from Java. For the experiments being conducted now, these varieties are being used.

(2) Inverstigation into economical mulberry varieties.

1) Effect of high dose fertilizer application on different mulberry varieties.

a) Objectives.

The cocoon productivity per hectare of mulberry field was said to be as low as 40 kg in South Sulawesi in the year 1977. To increase the productivity, the optimum dosage of fertilizer application to the existing mulberry varieties should be known.

b) Materials and Methods.

Six varieties were observed with 5 years age, trunk height 60 cm and planting intervals of 1.5 m x 1.0 m (6670 trees/ha). Leaves were harvested 6 times a year. Dosage of fertilizer application was 500 kg N/ha/Year, and it was applied each time pruning.

The experiment lasted from November 1978 to September 1979, taking place at Tajuncu Sub-center. Shoot growth and leaf yield were observed. Ten trees were taken as sample of each variety.

c) Result.

M. nigra and M. australis have the smallest size of leaves, and the varieties with the largest leaves are M. multicaulis and M. cathayana. M. alba has medium-sized leaves. The phenomenon of easily withering leaves indicates a low moisture content in the leaves.

Observation of moisture percentage, conducted one hour after harvesting, shows that moisture content of M. nigra and M. alba decreases by 21 %, M. cathayana by 16.5 % and M. multicaulis by 13 %. So leaves of M. multicaulis not wither so rapidly. Length of shoot in six observations a year shows that M. australis is the longest and M. multicaulis the shortest one. M. alba and M. macroura have the largest number of shoots, while M. multicaulis has the least. Internode distances are longest in M. australis and M. cathayana. The largest number of lateral branch occur in M. alba and M. nigra.

Highest yield of leaves per hectare come from M. multicaulis, followed successively by M. cathayana and M. alba. The lowest yield comes from M. nigra. Highest yield of leaves is obtained during the months from January to July, while September to November shows the lowest yield. This is because the rainy season occurs from January to July while the dry season lasts from September to November.

d) Conclusion.

In the experiment on the effect of fertilizer dosage of 500 kg N/ha/Year, it is recognized that M. nigra and M. australis have many disadvantage as compared with other varieties. Leaves of M. multicaulis and M. cathayana do not wither easily. Leaf yield of M. multicaulis is the highest.

(S. Fujiwara, Zito S., N. Rasyid)

2) Selection of economical varieties at low dose fertilizer application.

a) Objectives.

Selection of economical varieties which can subtitute M. nigra, a low productive variety and most widely distributed in South Sulawesi at present. The economical varieties are

required to have higher responses to the low dose fertilizer application in leaf productivity.

b) Materials and Methods.

Six mulberry varieties were observed, with 3 years age, trunk height 60 cm, and planting interval of 2.5 x 1.0 m (4000 trees/ha). Dosage of fertilizer application 100 kg N/ha/ ear or 217 kg Urea/ha/ ear is applied each time after pruning. The experiment lasted from February 1981 to February 1982, taking place in the mulberry yield of Pakatto. Items observed are plant growth and leaf yield. 13 or 26 trees were taken as sample from each variety. The area of experiment was divided into two blocks as Urea applied plot non-fertilizer plot.

c) Result.

Among 6 varieties, M. australis had the longest shoot, M. multicaulis had the fewest leaf defoliation, and M. alba had the largest number of shoots. M. multicaulis and M. cathayana had the largest leaves, while M. nigra and M. australis had th the smallest ones. Leaf areal weight per 100 cm^2 was the highest in M. multicaulis and M. cathayana, while M. nigra and M. australis showed the lightest weight.

Leaf quality from morphological viewpoint: best was M. alba, and the worst was M. macroura. Largest amount of leaf field came lowest yield came from M. nigra and M. australis.

Fertilizer application to all mulberry varieties showed improved growth as compared with those non-fertilized. Yield was also better (See Fig. 8-2-1).

d) Conclusion.

M. multicaulis, M. alba and M. cathayana had better growth characters as compared with M. nigra, but cuttings of M. multicaulis showed very low rooting percentage (S. Fujiwara).

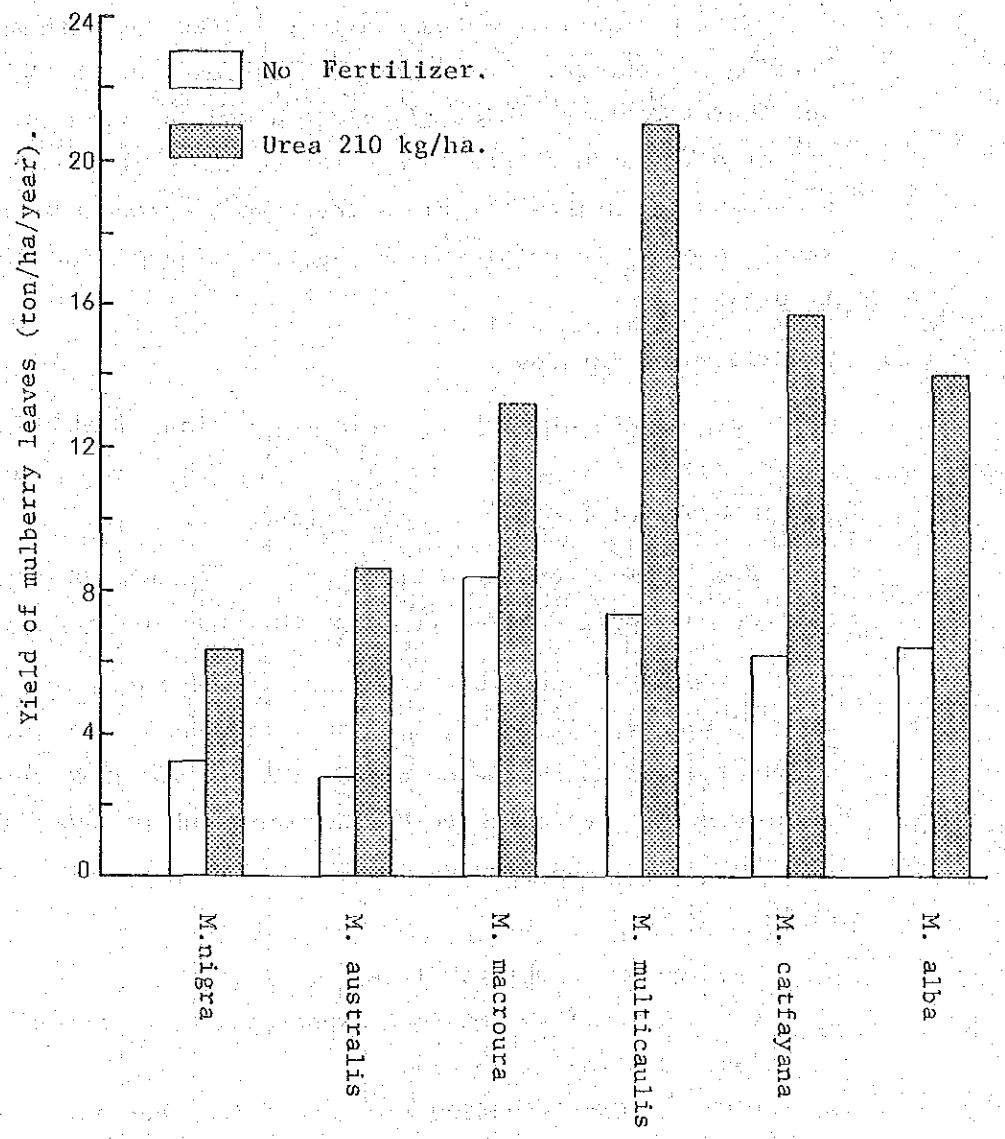


Fig. 8-2-1. Effect of Urea fertilization on different mulberry varieties at Pakatto.

M. alba produced good quality leaves and high leaf yield. Therefore this is the variety that can be recommended to farme farmers in the first priority followed by M. cathayana.

(Endjang K., M. Yamamoto, S. Fujiwara).

3) Method to produce scions of M. alba.

a) Objective.

To the farmers the best variety is the one with high rooting percentage. This character is possessed by M. nigra, and therefore this variety is planted most by farmers. Hitherto it has not been made clear to the best age of the shoot and the number of scions that can be grown from one shoot in order to obtain the highest rooting percentage for M. alba.

b) Materials and Methods.

For this experiment the mulberry variety used was M. alba, at the age of 4 years and trunk length of 60 cm, and at planting interval of 1.8 x 0.7 m (7900 trees/ha).

Pruning was conducted from April to August 1981, and fertilizer was applied after pruning, that was 200 kg N/ha/year.

Scion were taken in October 1981, when there were various ages of shoots, i.e. 6, 5, 4, 3 and 2 months respectively. Scion size was 20 cm, scion diameter taken was more than 1 cm. From every shooots age 2 to 8 scion were taken successively from bottom up, and planted in nursery beds at plant intervals of 10 x 30 cm.

Two item were observed:

1. At the scion farm (maximum shoot length, height of defoliation and scion diameter).
2. At the nursery (budding time and scion rooting percentage).

The scion rooting percentage was observed during 4 months after planted. The place of observation was in the field of Bili-Bili.

c) Result.

The order shoot of M. alba, the longer its length and larger its diameter, and thus more scions can be taken from one tree. The economical limit of rooting percentage is above 50 %. This percentage was obtained from scion aging 4 - 6 month old shoots was below 50 %. In 5 - 6 month old shoots, the percentage above 50 % was obtained until the 5th scion from bottom. In 4 month old shoots, the good rooting percent-

age was obtained until the 4th scion from bottom (see Fig. 8-2-2).

The relation between the budding time and the rooting percentage of scions taken at an early age (2 months) was that budding was early but shoots would die soon, as it had not rooted yet. Whereas at an old scion, the buds appear late but the roots grow at the same time, thus making the shoot survive and the percentage high.

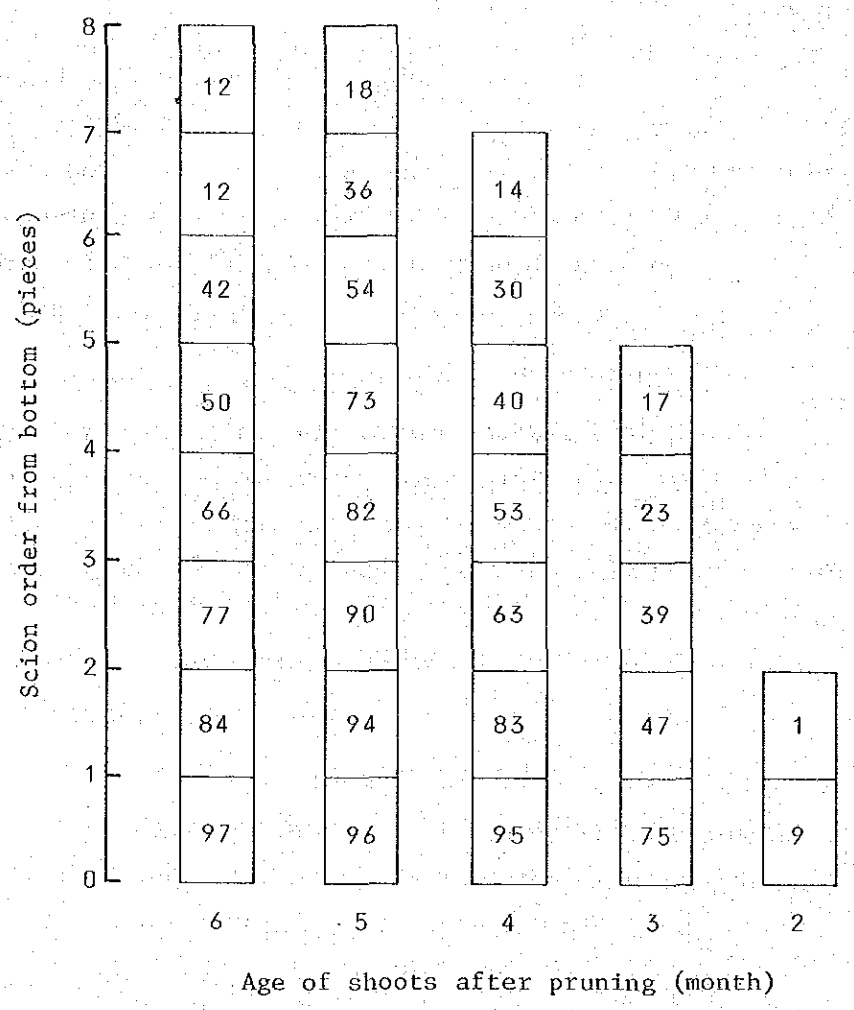


Fig. 8-2-2. Relation between rooting percentage and the age of scions and order of shoots.(%)

d) Conclusion.

Morus alba scions reached a rooting percentage of over 50 % when they were obtained from 4 - 6 month old shoots. At such age, only 5 scions may be taken from one shoot. Since there were average of 10 shoots in one tree, 50 scions may be taken from one tree.

(Endjang K., M. Yamamoto).

4) "SUETSUGI" grafting - conversion to the superior variety by grafting.

a) Objectives.

A superior mulberry variety (M. alba) having been found, its distribution to farmers is required. The difficulty for planting lies in the fact that scions are few, and when the whole field is to be converted to M. alba by planting scions, it takes too long to harvest shoots. To slove this problem, plant conversion was performed by "Suetsugi grafting".

b) Materials and Methods.

The variety grafted was M. alba while the original plant was M. nigra. M. nigra was 5 years old by the time grated, the trunk height was 60 cm, at planting intervals of 1.8 x 0.7 m. The M. nigra was sawed at the ground surface. (See Fig. 8-2-3).

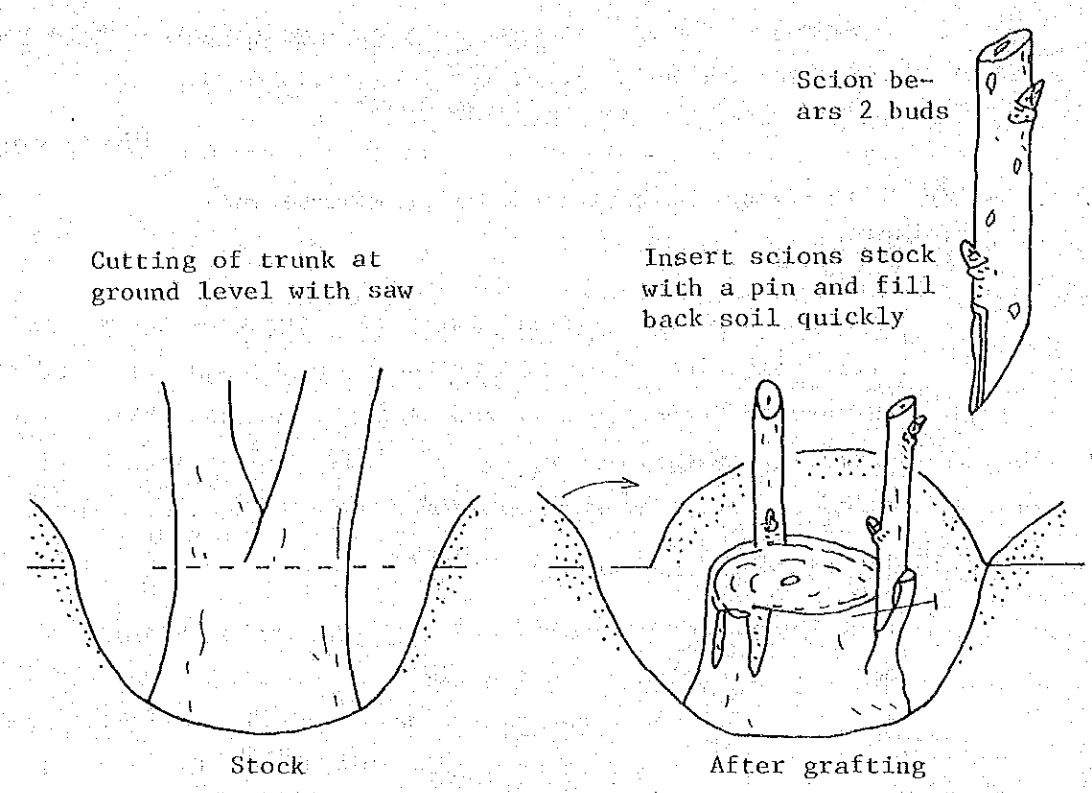


Fig. 8-2-3. Operation method of field grafting "Suetsugi".

This grafting method has been taught to Indonesian experts and their assistants. Each performed grafting was performed in March 1981, exactly at the end of the rainy season. It took place at the field of Bili-Bili Center.

c) Result.

Due to the hight temperature, the callus developed rapidly. In 20 days after grafting, the length of the new shoot become about 15 cm. With rooting percentage of 98 %. Death was caused by the invasion of Corticium centrifucum. 30 days after grafting, survival ratio dropped to 91 %. The shoot became over 1 mether long 2 month after grafting. Rooting percentage attained by each grafter ranges between 83 % and 98 %. So it became clear that this grafting may be conducted by anybody easily.

d) Conclusion.

Grafted plants grew more rapidly, when the trunk of the original plant had bigger diameter, as there is more reserved

nutrient whitin the trunk. This grafting technique can be recommended to be performed in fields which have not large area, for instance fields for young silkworms.

(M. Yamamoto).

5) Second stage selection of mulberry varieties.

a) Objectives.

Two superior mulberry varieties were selected at the first selection, i.e. M. alba and M. cathayana. To find a variety resistant to pest and disease, and adaptable to the climate of a certain region, a second stage selection of mulberry varieties was called for.

b) Materials and Methods.

The variety selected was grown at the nursery bed for 6 months, then planted to the field at planting intervals of 2.0 x 0.5 m. Fifteen plants were taken from one variety, from two blocks. Planting time was April 1982, Selected varieties consist of M. nigra (as standard variety), M. alba (recommended variety), Alba halus (from Java), Rajawali (from Ujung Pandang), BNK 1, BNK 2, BNK 3 (cross-breed between Nigra halus and KOKUSO 21, which are the result of the selection of cross-bread filial). Crossbreeding was conducted by M. Yamamoto at Kyushu Branch Station, Japan. When the offspring was one year old, it was taken to Indonesia by Dr. Mori and grown by Mr. Zito S. for 2 years. In 1981, it went under strain selection, and three strains were found in 1982.

c) Result.

As of the time of reporting, no data are found yet. Items observed in this selection are the characters of each strain, rooting percentage and leaf yield. From these results, it is expected to obtain a superior mulberry variety.

(M. Yamamoto., Endjang K.).

(3) Techniques developed on mulberry varieties.

1) Mulberry variety selection.

The selection has found M. alba for the recommendation to farmers. Scions of this variety are being distributed to farmers at present. Leaves of M. alba are fit to be fed to young silkworms. Leaf yield is more than that of M. nigra. M. cathayana was also found to be suitable as a recommended variety. Its leaf yield is 30 - 50 % more than M. nigra. M. cathayana is now planted in the scion production field.

2) Method of the scion production of M. alba.

The best rooting percentage of M. alba scions can be obtained by scions taken from 5 - 6 month old shoots (from pruning to scion harvesting). At such age of the shoot, 5 scions, 20 cm long, may be taken. On normally growing plants, 50 scions may be taken from one tree.

3) Conversion to the new variety by "Suetsugi grafting".

The original mulberry variety was M. nigra, and the variety grafted on was M. alba. The plant to be grafted was sawed at the ground level. The shoot to be grafted on was sliced and grafted on. M. alba field will be established which can yield scions quickly. This method can be applied in fields such as for young silkworm rearing.

(M. Yamamoto).

(4) Problems and solutions.

1) Propagation of recommended variety.

Since there is not enough scion field of recommended variety (M. alba), it cannot meet the demand of all farmers. So each district office established a field of this variety, scions of which were taken from the Center and the Sub-center. Farmers can thus request for their scion from each district office.

2) Collection and selection of mulberry varieties.

Effort have been made to collect mulberry varieties, both domestically and from abroad, and to grow them in the Center's

collection field. And selection is conducted among those collections. The best one will be selected, and its scion will be taken for the observation of its character. Examination is performed for 3 - 5 years, and thus it is expected to obtain the superior variety.

3) Mulberry breeding.

When farmers way of thinking is advanced, they demand to acquire a superior mulberry variety both in quality and quantity. A knowledge of mulberry breeding is required in order to find such variety mentioned above.

The best way to obtain a new variety is throught hybridization (cross breeding). Indonesian experts have not acquired the knowledge of breeding. So they need to study this in Japan. Adequate device and means are called for, such as expansion of mulberry fields, improvement of equipment etc.

Successive performances for mulberry breeding are: mulberry variety collection, parent variety selection, individual selection, strain selection and superior variety selection. Hybridization requires 8 to 10 year's period (in Japan it takes about 15 years). Recommended to be performed in Indonesia is parent selection, while hybridization is best performed in Japan Nursery bedding, individual selection, and strain selection can be performed in Indonesia. With this system it can accelerate the breeding of new variety like what was performed in BNK strain (in Bili-Bili, Nigra halus x KOKUSO 21).

(M. Yamamoto).

VIII-2-3 Promotion of soil fertility and technique of the field maintenance of mulberry field (Center).

(1) The present condition of mulberry field maintenance at farmers level.

From 1962 to 1965, farmers' technique in mulberry cultivation and field maintenance was still at low level. But mulberry was grown around the house, and food waste and gerbage were thrown into the field as fertilizer for the plants. The ground being covered, weeds or grasses did not grow, so the mulberry plant grew well. Some mulberry fields are purely planted with mulberries, while some are mixed with coconut. The two kind of fields are anticipated to be developed by sericulture farmers. Good maintenance of the field should be considered, since a poor cultivation will lead to a decline in leaf yield.

In 1972 raw silk production in South Sulawesi declined. This was due to a prolonged dry season. Such a season occurs once in a decade. The decline was also brought about by pebrine disease (Report on Preliminary Survey for South Sulawesi Sericulture Development, February 1973, JICA). There after farmers were prohibited to produce silkworm eggs themselves, and instead thereof, silkworm eggs were imported from Japan. The amount of eggs was practically insufficient to meet the entire need of farmers, so part of the farmers could not rear silkworm. Their fields were abandoned and then devastated due to lack of care. It became difficult to improve the condition of the field, and hitherto many fields are not productive any longer.

The main sericultural region, Soppeng is situated on lime-containing soil, which leads to near neutral in pH and high absorbing coefficient for phosphates (Takatori, 1975).

As farmers did not apply fertilizers, Nitrogen in the soil was gradually depleted, thus leading to a declining productivity.

(2) Experiments to develop techniques on soil and fertilizer.

1) Relation between frequency of fertilizer application and leaf yield.

a) Objective.

To determine the most effective application frequency of Urea at a dosage of 46 kg N/ha/year for the highest productivity of mulberry field.

b) Materials and Methods.

The mulberry variety used was M. nigra, 2 years old, 60 cm trunk height, planting interval 2.5 x 0.6 m (6,700 trees/ha) and harvesting frequency 4 times/year.

Frequency and time of fertilizer application:

2 applications a year (September and January).
3 applications a year (September, January and May).
4 applications a year (September, December, March and June).
6 applications a year (September, November, January, March, May and July).

Fertilizer amount applied was same, i.e. 46 kg N/ha/year in all plots. Observed from December 1979 to September 1980. Place of observation was the field at Pakatto. Items observed were: shoot growth, mulberry shoots yield, and 10 trees per plot were observed.

c) Result of experiment.

With more frequent fertilizer application, plant growth was better, and leaf yield per year was bigger. In May 1980 being a dry season, shoots growth was poor and thus a little leaf yield.

d) Conclusion.

Urea application at dosage of 100 kg Urea/ha/year, at a higher frequency, leads to a larger amount of leaf yield. Application should be best performed every time after pruning.

(S. Fujiwara, Endjang K., and Zito S.).

2) Effect of applied amount and time of Urea application on leaf yield.

a) Objective.

Farmers in South Sulawesi generally have not applied fertilizer to their mulberry fields, which brought about a low yield. Urea application can increase leaf yield, so the method of Urea application and its dosage ought to be learned.

b) Materials and Methods.

The mulberry variety used was M. nigra, 4 years old, 60 cm tall, planting interval of 2.5 x 0.6 m (6,700 trees/ha), with three time harvests a year. The experiment consisted of 3 plots treated differently. No fertilizer was applied to the first plot, 100 kg N/ha/year to the second plot, and 200 kg N/ha/year to the third plot. There were two kinds of frequency in application: once a year and 3 times a year. Thirty trees in each plot were observed, divided into two blocks. The experiment started in May 1981 and lasted until March 1982, taking place at the field of Pakatto.

c) Result of experiment.

Plant to which Urea was applied produced taller and larger number of shoots. The plot fertilized at a dosage of 100 kg N/ha/year had a 70 % higher leaf yield than no fertilizer plot. The one fertilized at a dosage of 200 kg N/ha/year had a 100 % higher leaf yield than no fertilizer plot. At a frequency of the application of once a year, leaf yield was very high at the first harvest but declined at the following harvest. When the frequency of fertilizer application was 3 times a year, that is after each pruning, leaf yield was nearly the same amount in every harvest (See Table 8-2-3).

d) Conclusion.

Urea fertilizer application to mulberry trees will increase the amount of leaf yield, farmers are thus recommended to apply Urea to their mulberry fields. Optimal dosage of Urea in the mulberry field for young silkworms 200 kg N/ha/year, so that leaf yield will rise by 50 % or more.

Table 8-2-3. Effect of Urea on shoot growth a and leaf yield.

Plot	Maximum shoot length	Percentage of defoliation	Number of shoots	Leaf percentage	Mulberry shoot yield/ha.	Incex of mulberry shoot yield.
	cm	%		%	t	
Non fertilizer app.	140	30.8	13.1	62.8	11.7	100
100 kg N/once	162	32.9	15.6	59.5	20.0	171
100 kg N/3 times	172	28.4	17.1	57.0	19.7	168
200 kg N/once	186	32.7	16.8	58.1	25.7	216
200 kg N/3 times	188	30.7	18.8	57.6	25.7	220

(Endjang K., M. Yamamoto).

3) Mulching with the use of Punnisetum purpureum (Napier grass)

a) Objective.

Napier grass (P. purpureum) has been planted on the field at the Center. This grass usually grows wildly in the forests. The plant grows up to a height of over 2 m. The stalks and leaves do not root easily, so they are suitable for mulching. Rooting ability of this grass is very strong, as roots emerge freely from each node. Consequently when mulching is performed at the wrong time, the mulberry field will be over grown by this. The experiment was performed to know the best method and best time for mulching with the use of this grass.

b) Materials and Methods.

Napier grass to be used for mulching is cut down at the begining of the dry season (June). The cuttings are sun-dried for 10 - 20 days, and then used as mulching between plant rows, at a thickness of 5 to 10 cm. Mulching is conducted on young plants. The mulberry plants were planted in April 1982, at a planting interval of 2.0 x 0.5 m (10,000 trees/ha). Items observed are: soil moisture content and shoot growth. Observation lasts from August 1982 to June 1983.

c) Result.

No data yet.

(Sucipto H., M. Yamamoto).

4) Soil survey at the main areas of Sericultural region in South Sulawesi.

a) Objective.

To identify the structure, texture, physical and chemical properties, and nutrient content of the soil. As mulberry is a perennial crop, it is difficult to replace it any time. Therefore physical and chemical properties of the soil should be known. In this case it will be identified as to its different productivity, and thus the way to improve its productivity.

b) Materials and Methods.

Soil survey was performed at the Center and at some places in Soppeng, Wajo, Sidrap and Enrekang. It was performed by digging holes measuring 2 x 1 x 1 meter, so the horizon, color, structure and texture of the soil may be identified. From each horizon about 2 kg of soil is taken for laboratory analysis on physical and chemical properties such as pH, pF, total N content Ca, K and Mg contents, and exchange acidity level. Sampling is expected to represent some soil of these areas.

c) Result.

After observation, the soil may be classified into 3 region:

Gowa region: consisting of Bili-Bili, Pakatto and Malino. The soil is derived volcanic rock (tuff), quite much volcanic ash is contained in the soil of Malino, and has good physical properties. These soil contains much Mg and little N..

Tempe lake region: Mountainous and limy. On flat parts the soil has small pores (Tanah Bellange). Lands adjacent to the river such as in Ugi (Wajo), Lupange (Sub-center) and Wanio (Sidrap) are alluvial sediments with good physical properties. Maseppe which lies to the west of this region has good physical properties. The mountain foot is much grown by Imperata cylindrica and much eroded, so the top soil is washed off and not suitable for farming and quite unworkable.

Enrekang region: Clay soil with poor drainage, representing mud flow from Saddang river, mulberry grows poor here.

d) Conclusion.

The soil in South Sulawesi contains abudant Ca, Mg and Phosphate while N is little available. At present mulberry productivity is low due to lack of N, P and K. It is recommended to study soil fertility and to apply organic ferti lizers.

(T. Hayasaka, Sucipto H.).

(3) *Develop techniques related to soil and fertilizer application.*

1) Urea application.

At harvesting time, leaves and shoots are cut. Nitrogen in the soil depletes gradually, so it is deemed necessary to add this element in order to increase shoot and leaf yield. Good quality leaves are needed to feed young silkworms. Therefore fertilizer application is required at a dosage of 200 kg N/ha/year or 420 kg Urea/ha/year, at a frequency of 3 times a year at the time of pruning. So one application requires 140 kg Urea/ha. To feed grown silkworms, the dosage is 100 kg N/ha/year. This dosage is adjusted the economical conditions of farmers dividing application into 3 times a year, thus 70 kg Urea/ha per application. Fertilizer is placed between mulberry rows and mixed with soil. Fields located on floody riversides should never be fertilized at flooding seasons.

2) Soil investigation.

Before a field is established, the soil should be investigated. It is useful to identify the suitable soil for mulberry. Investigation is carried out by making a cut of the land profile, and every horizon is scrutinized on its physical and chemical properties. With the result of investigation it will be identified whether the soil is or is not suitable for mulberry cultivation. In case of unsuitable soil, a method of its improvement can studied.

3) Mulching at mulberry field.

No data have been obtained of the experiment in mulching at the mulberry field. As soon as data are collected, a manual on mulching can be compiled.

Rice husk mulching has been carried out on the field in Tanah Bellange. Observation has shown that soil humidity in the dry season can be maintained and improves the physical properties of surface soil. Farmers are suggested to use rice husk for mulching, because rice husk is easily available and cheap. Mulching is manly recommended in the mulberry field for young silkworm rearing.

(M. Yamamoto).

(4) Problems and solutions.

1) Soil investigation.

Soil investigation and soil productivity test need to be performed soon in the entire sericultural regions. Its use is to arrange a soil map or mulberry distribution map for the entire South Sulawesi. By making the characteristics of soil and the method of soil improvement clear, recommendation is made to farmers.

2) Establishment of mulberry field technique for farmers.

Development of simple techniques is necessary for farmers in mulberry field establishment, farm road making, soil improvement, mulberry planting etc.

3) Weed control.

Weeding is mainly carried out in rainy season, because it is the time when weeds flourish. The method and the timing for weeding ought to be studied. First of all, weed ecology should be studied, so a better guidance could be established toward the right method and the right time to control it.

4) Application of organic fertilizer.

The average temperature in South Sulawesi is high, thus accelerating the decomposition of organic matter in the form of humus. To maintain soil fertility, mulching or application of green manure between mulberry rows should be considered.

These experiments a long time.

5) Relation between the three main elements of the fertilizer and leaf yield.

Farmers are hitherto capable of applying only 100 kg to 200 kg N/ha/year. In the future when farmers' income has increased, application of phosphorus and potasium fertilizers will be necessary. Consequently experiments on the effect of N, P and K on leaf yield should be carried out, at dosages corresponding to farmers' ability. And in fertilizer application to mulberries, there should be an alternation between organic and inorganic fertilizers.

(M. Yamamoto).

VIII-2-4 Training and harvesting method of mulberry for young and grown silkworms.

(1) Present condition of training and harvesting method at the farmers level.

The sericultural farmers present technique on mulberry cultivation is very poor leading to a low leaf yield per unit of area. Many mulberry fields are mixed cultivation with coconut, and the fields lie close to the house. Mulberry varieties much cultivated are Morus nigra and M. australis, as their scions have high rooting abilities. Farmers grow mulberries by planting scions planting intervals of 1 x 1 m. Rows are not straight because planting is not pertormed with correct measurement, and no passage is made. Leaf harvesting and pruning are carried out with the use of a chopping knife. Natural condition, with abundant rainfall, is favorable for mulbarry, which grows throughout a year. Shoot harvesting above defoliation is perfcrmed using a chopping knife, and the plants are never repruned so they grow in irregular shapes. Cut ends of the trees after pruning are cracked because of the utilization of chopping knife. This causes branches to dry and die back. The trunk is 50 - 100 cm tall. Besides using a chopping knife, farmers also use sickle and ani-ani to pick leaves. Frequency of harvesting varies from 1 to 6 times a year, average is 4 times. This is because imported silkworm eggs do not come in regularly.

As the project-made silkworm eggs are available at any time, reraing may be carried out at any time, so mulberry is pruned repeatedly with out rest leading to poor leaf yield. Farmers ar are so far guided in good mulberry cultivation technique, principles of plant cultivation including the technique of good pruning.

(2) Experiments to develop techniques for training and harvesting method.

1) Methods of training and shoot harvesting for young silkworms.

a) Objective.

To know the timing, method of pruning, and fertilizer application, in order to gain bigger quantity of better ability leaves for young silkworms (stage I through stage III).

b) Materials and Methods.

The mulberry variety used was Morus nigra, two to three years old, about 60 cm tall. Planting space 1.8 x 0.7 m. (7900 trees per ha.), at fertilizer dosage of 200 kg. N/ha./year. Fertilizer is applied four times. Observation started in 1978 lasted in 1980. Place of observation was the field at Bili-Bili Center. Observed were: Shoot growth and leaf yield at the age of 1 month. Treatments were classified as fertilized & non fertilized and harvested & non harvested.

c) Results.

Leaf yield in the rainy season was more than the leaf yield in the dry season. The higher the pruning height, the shorter the shoots grown but the number of shoots was more. The lower the pruning height, the higher the branches grown but in smaller number. Leaf yield was more in lower pruning. Where fertilizer was applied, leaf yield was better than where no fertilizer was applied.

d) Conclusion.

Pruning of mulberry for young silkworm rearing is performed 30 - 40 days before hakitate, at the height of 10 cm above main trunk. Harvesting for young silkworms is performed in the way that adeguate portions of grown shoots are harvested for first to third stage successively from the top. Fertilizer application at a dosage of 200 kg. N/ha./year is done after pruning.

(S. Fujiwara, Zito S.).

2) First harvesting after planting of mulberry.

a) Objective.

To decide the most appropriate time for the first harvesting of mulberry trees in relation to leaf yield.

b) Materials and Methods.

The variety used was Morus nigra, planting time was March 1978. Planting was performed by cutting. First harvesting time was respectively 6 months, 9 months and 12 months after planting. During one year, leaf yield was observed one in 3

months after each harvesting and first pruning was as hight as 50 cm from the ground. At such a height, the trunk diameter was measured. Plant interval was 2.5 x 0.6 m (6,700 trees per ha). The place was the field at Pakatto Center.

c) Result.

Shoot/leaf yield of first harvest becomes bigger as the first harvest delays. But total annual yield becomes bigger if harvesting is started earlier, because of more frequent harvesting, though the yield per hervesting is smaller.

Table 8-2-4. Relation between the time of first pruning and annual leaf yield and increase in trunk diameter.

First pruning	Leaf harvest time				Annual leaf yield		Trunk ϕ at harvest time
	1978		1979		Leaf weight /are	Leaf weight index	
	Sept	Dec.	Mar.	June			
	kg.	kg.	kg.	kg.	kg.		cm
6 mth. after planted.	9.4	39.6	17.1	14.0	80.3	100	0.89
9 mth. after planted.	-	39.1	16.0	18.2	73.3	91	1.63
12 mth. after planted.	-	-	49.7	23.2	72.9	91	2.28

Note: Planting time was March 1978, the field at Pakatto, fertilizer 200 kg. N/ha./year, applied 4 times a year.

As first harvest delays, diameter of a shoot that will be the future main trunk becomes bigger, and this accelerates the growth of shoots in diameter (table 8-2-4).

d) Conclusion.

Mulberry is a perennial crop; therefore in order to maintain ideal growth, the first pruning time should be when the trunk diameter is bigenough. The most appropriate time is 9 months after planting. At the place with un fertile soil, first harvesting should be delayed.

(S. Fujiwara, Zito S.).

3) Relation between the height of main trunk and leaf yield.

a) Objective.

Pruning performed on mulberry trees is usually medium cat. The height of pruning depends on the method of cultivation to be adopted, on the method of harvesting, and on the occurrence of pests. This experiment was performed to learn the relation between those matters.

b) Materials and Methods.

The experiment was performed twice, giving the same results.

The first experiment was from 1979 to 1980, at heights of respectively 10 cm., 30 cm., 60 cm. and 90 cm. from the ground. Pruning was per formed in the dry season (July) and in the rainy season (January). Observation of shoot growth and leaf yield is made 3 months after pruning. The second experiment was carried out between 1981 and 1982, at heights of respectively 10 and 50 cm. from the ground. Three months after each pruning, shoot growth and annual leaf yield were observed. The variety used was M. nigra with the application of 100 kg. N/ha./year. Planting space was 2.5 x 0.6 m. (6700 trees per ha.). Place was the field at Pakatto Center.

c) Results.

The first and second experiment may be said to have the same results, i.e. that in a tall pruning the shoot growth is low but the number of shoots is large so that leaf yield is high, while in low pruning the shoot growth is high but the number of shoots is small so that leaf yield is low. Thus leaf yield is influenced by the number of shoots and the condition of season.

d) Conclusion.

High pruned mulberry trees have many shoots, hence a high leaf yield. The appropriate height for pruning is 30 to 60 cm. from the ground. Besides the high leaf yield, it is also easy in harvesting leaves. However, in the regions where occurrence of longicorn beetle and mulberry scales is severe it is worried that the infestation of pests becomes high if

d) Conclusion.

In trees where the trunks were cut at 20 cm's height from the ground, leaf yield was reduced by 10 % as compared with trees no cut. "Kabusage caused 10 % yield decrease in one year. In order to avoid the adverse effect of "Kabusage" Kabusage pruning should be limited to the pruning of died back shoot and pest in tested portions, after observing die back of main trunks and the condition of pest infestation.

(Munassar S., Zito S., M. Yamamoto)

8) Relation between plant ng space and leaf yield.

a) Objective.

Leaf yield per unit of area is closely related with planting space i.e. plant density per ha. The planting intervals depend on mulberry variety, field condition and method of pruning. This experiment was performed on M. nigra with a control plot of 1 x 1 m. planting intervals. The aim was to decide the most appropriate planting intervals for M. nigra.

b) Materials and Methods.

The tree population per ha. is 10,000 to 40,000 with 6 kinds of planting intervals (See table 8-2-8). Variety used was M. nigra, three years old, 60 cm. tall, 3 leaf harvesting a year (once in 3 months), fertilizer applied was Urea at a dosage of 100 kg. N/ha./year. Experiment was started in June 1981, and is still continued as a today. Place of observation was the field at Pakatto 24 to trees were observed. Items observed were shoot growth and leaf yield.

c) Results.

First year's observation (Table 8-2-8) showed that shoot growth in densely planted plots e.g. 1.0 x 0.25 m., was uneven. It was presumed to have been caused by a strong competation on the absorption of nutritive element and growing shoots among trees. There was no difference in leaf yield between different planting intervals. Consequently it cannot be determined yet as to the effect of planting space on leaf yield. This experiment should be continued for a long term.

the height of main trunk is made high. Thus low trunk height is perferred in such a region. So the height of pruning should be decided in accordance with the benefit to be gained from it.

(Zito S., S. Fujiwara, M. Yamamoto, Munassar S.)

4) Relation between mulberry growing period after pruning and leaf yield.

a) Objective.

Relation between mulberry period after pruning and leaf yield was studied so as to know the right harvesting time.

b) *Materials and Methods.*

Variety used was M. nigra, 2 years old, trunk 60 cm. tall planting interval 1.8 x 0.7 m. (7900 trees/ha.). The pruning time of each plot was the same, i.e. April 1977. Leaf yield was observed respectively 2 months, 2.5 months, 3 months, 3.5 months and 4 months after pruning. Total fertilizer application at a dosage of 200 kg. N/ha./year was made in tour split application a year. The applied fertilizer was Urea. Place was the field at Bili-Bili Center. Number of trees observed was 20 per plot.

c) Results.

Table 8-2-5 shows that harvesting at 3 and 3-1/2 months after pruning gives lower yield. This is because detoliation occurs severely at 4 months stage. So the best age to be harvested is 3-1/2 and 3 months; the leaf yield will decline after that.

Table 8-2-5. Relation between shoot growing period and leaf yield.

Period from pruning to harvest	Maximum Shoot length	Number of shoot	Percentage of of difoli-ation	Leaf Yield/ are	Yield index
	cm.		%	kg	
2 month	141	8.5	4	38.3	100
2.5 month	185	21.1	21	56.7	148
3 month	219	26.8	30	73.9	193
3.5 month	237	27.1	50	76.4	199
4 month	256	27.4	65	64.0	167

Note: Pruning time was April 1977.

d) Concolusion.

Based on shoot growth and leaf yield, the appropriate age to be harvested for grown silkworms is 3 to 3.5 months after pruning. But since the observation was conducted in only one period, an exact conclusion cannot be drawn yet. An other experiment observing for the period of one years is required.

(S. Fujiwara, Zito S.)

5) Relation between harvesting frequency and leaf yield.

a) Objective.

To know the most appropriate frequency of leaf harvest in order to support grown silkworm rearing round the year, and to know further affect on plant life.

b) Materials and Methods.

Variety used was M. nigra, 2 years old, 60 cm. tall, plan planting interval 1.8 x 0.7 m. (7900 trees per ha.), frequency of leaf harvest respectively 6 times (every 2 months), 4 times (every 3 months) and 3 times every 4 months a year. Fertilizer applied was Urea at a dosage of 200 kg. N/ha./year, applied in tour split applications. Observation started in August 1977 and lasted in June 1978. Place of experiment was the field of Bili-Bili Center, the number of trees observed was 40 per plot, which was divided into 2 blocks.

c) Result.

A higher frequency of leaf harvest leads to a poor growth of the shoots, while a lower frequency leads to a longer shoot growth. The percentage of defoliation throngh out a year is respectively; 23 % in a 6 - harvest plot, 46 % in a 4 harvest plot, and 64 % in a 3 - harvest plot. In the plot where frequency of leaf harvest is low resulting in longer growth of shoots, percentage of defoliation is high. As a result of observation, shoot length with green leaves were; 90 cm. in six time harvesting plot, 99 cm. in tour time harvesting plot and 89 cm. in three time harvesting plot in annual average, showing no difference between plots. In short, severe defoliation accurs and yield decreases if shoot growing period is to too long.

d) Conclusion.

At a leaf harvest frequency of 6 times a year, defoliation percentage is low and leaf yield is high. But pruning do done every other month reduces the vitality of tree. Mulberry being a perennial crop, this experiment ought to be proceeded for a longer period.

(S. Fujiwara, Zito S.)

6) Comparison of various pruning tools.

a) Objective.

It is the sericultural farmers' habit to use a chopping knife for pruning. But this method brings about many problems, such as the presence of scars in prospective buds, which further distrub plant maintenance becoming the source of pests.

b) *Materials and Methods.*

Variety used was Morus australis, 2 years old, 60 cm. tall, pruned in March 1980, the place of observation was the field at Pakatto. Pruning method was classified into two one using a chopping knife and another one using pruning scissors (made in Japan). Observation was made on the number of grown buds two months after pruning.

c) Results.

Percentage of grown buds (shoots) in scissor pruned plants was 83 %, and in chopping knife-pruned plot was 54 %. Poor result in knife pruned plot was cansed by the damaged buds existing on the shoots, which were cut slantingly, resulting in many scars on shoots and many dried shoots. Such a stuation does not exist in pruning plot with pruning scissors.

d) Conclusion.

Pruning with the use of a chopping knife leads to scars on the shoots which may become nests for mulberry pests and thus disadvantageous. Therefore it is advised that pruning be performed with the use of pruning scissors in order to obtain better shoots.

(S. Fujiwara, Zito S.)

7) Revitalization of mulberry trees by downward pruning method "KABUSAGE".

a) Objective.

In old mulberry trees many shoots or trunks are damaged and dead. This may cause the trunks to become the sources of pests and diseases. Therefore old trunks were cut by lowering the height of pruning, termed "Kabusage" in Japanese, with the expectation of reritation of reritalizing old plants.

b) Materials and Methods.

Variety used was Morus nigra, 4 years old, 70 cm. tall, planting interval 2.5 x 0.6 m. (6700 trees/ha.), leaf harvesting 4 times a year, fertilizer applied was Urea at a dosage of 100 kg. N/ha./year in tour split applications. Experiment was started in December 1980 and lasted in February 1982. Place of experiment was the field at Bili-Bili Center.

In December 1980, the trunks of old trees were cut at heights of 20 cm. above ground. 120 trees were observed, divided into four plots, thus numbering 30 trees in each plot. After wards they were compared with old trees, of which the trunks not cut. The trees cut at 20 cm's height were allowed to develop shoots. A month later they were pruned at 50 cm's

height above ground, and the leaf yield was observed for one year. Then after one year, pests and diseases were also observed.

c) Results.

In the comparison of the shoot length, there was no difference between "Kabusage" and "non-Kabusage". But number of shoot was lower in "Kabusage" plot, and this trend continued even one year after "Kabusage". Yield was also regularly lower in Kabusage plot, and showed about 10 % lower production annually (table 8-2-6). Longicorn beetle were reduced with Kabusage, mulberry scale did not occur much with or with out Kabusage (See Table 8-2-7).

Table 8-2-6. Shoot growth and leaf yield after Kabusage, pruning.

Plot Name	Max. shoot length	% of defoliation	Number of shoots	Leaf %	Yield / ha.	Yield index
	cm.	%		%	t	
Control	172	17.4	22.1	50.7	29.9	100
Kabusage	177	16.7	16.2	51.2	26.0	87

Note: Leaf harvest was done 4 times a year, averagedly 4 blocks of leaf & shoot yield, a year.

Table 8-2-7. Condition of pests/damage one year after the performance of Kabusage.

Plot name	% damage of longicorn beetles			% damage of Mulberry scale		
	None	Little	Much	None	Little	Much
Control (not cut)	15	20	65	80	10	10
Kabusage (cut 20 cm.)	97	3	0	95	3	2

Note: The average % damage trees of 4 blocks.

d) Conclusion.

Results of the experiment showed that for a planting space of 1 x 1 m., which is commonly seen in farmer's there is no problem in leaf yield. Fertilizer application at a dosage of 100 kg. N/ha./year is optimam for 10,000 trees per ha. Observation of planting space lasting merely one year will not bring the right conclusion, and consequently it has to be continued for a long term.

(M. Yamamoto, Sucipto H., Endjang K., S. Fujiwara)

Table 8-2-8. Relation between planting space and leaf yield.

Planting Interval	Number of trees	Max shoot length	% of defoli-ation	Number of shoots	Leaf %	Mulberry shoots yield	yield index
m.		cm.	%		%	t	
1.0 x 1.0	10,000	151	36.3	15.9	60.2	20.9	100
2.0 x 0.5	10,000	169	37.8	13.8	58.2	18.6	89
1.5 x 0.5	13,000	145	41.1	15.2	60.7	16.8	80
1.0 x 0.5	20,000	142	39.6	13.6	61.9	20.7	99
0.5 x 0.5	40,000	146	40.5	7.7	57.9	24.9	119
1.0 x 0.25	40,000	137	37.9	8.9	58.8	20.3	97

Note: Those figures are average of three period, yield of total three period.

9) Relation between different pruning times and shoot growth condition.

a) Objective.

For establishing annual leaf harvesting system, by physiological and ecological effects of pruning on shoot growth and defoliation should be known.

b) Materials and Methods.

Varieties used were Morus nigra and M. alba, 4 years old, 50 cm. tall, planting spaces 1.8 x 0.7 m (7900 trees/ha.). Fertilizer applied was Urea at a dosage of 100 kg. N/ha./year, applied in split application after each pruning.

Pruning times were respectively:

in plot A: September, December and March;

in plot B: October, January, April and July;

in plot C: November, may and August.

Ten days after pruning, time of bud growth in each plot was observed; then once in 10 days during three months, growth of shoots and length of their defoliation were observed. After 3 months, leaf yield was observed. Ten trees were oberved in each plot. The experiment lasted from September 1981 to October 1982, taking place at the field of Bili-Bili Center.

c) Results.

Shoot growth in M. nigra and M. alba tended to be similar. In M. nigra, the bud growing time and the first shoot growth was seen during 30 - 60 days after pruning, but the growth was slow after 60 days. About 50 - 60 days after pruning. Defoletion starts at 50 - 60 days after pruning and rapidly increases thereafter. From this, we can presume mulberry leaf age about 40 - 50 days. Maximum length of shoot with green leaves (effective shoot length) can be obtained at 60 - 90 days after pruning, and effective shoot length decreases after this peak period. There fore ideal harvesting is sometime between 60 days and 90 days (2-3 months) after pruning. But defoliation varies between dry season and rainy season, and severer during rainy season (Figure 8-2-4).

In addition, in all three groups of A. B. & C., shoot grows decreases as harvesting continued. This is probably caused by water deficit in the dry season, and decreasing growth vigor as the result of continuing harvesting & pruning.

d) Conclusion.

Based on the condition of shoot growth and defoliation the best period between pruning and leaf harvest is 60 - 90 days. In the future, the leaf harvesting system should be adjusted to the condition of plant growth. Continuous leaf harvesting leads to a decreasing plant vigor. Therefore in order to have a constnat leaf yield, there has to be resting time between leaf harvesting and pruning.

(M. Yamamoto, M. Silaen, Endjang K.)

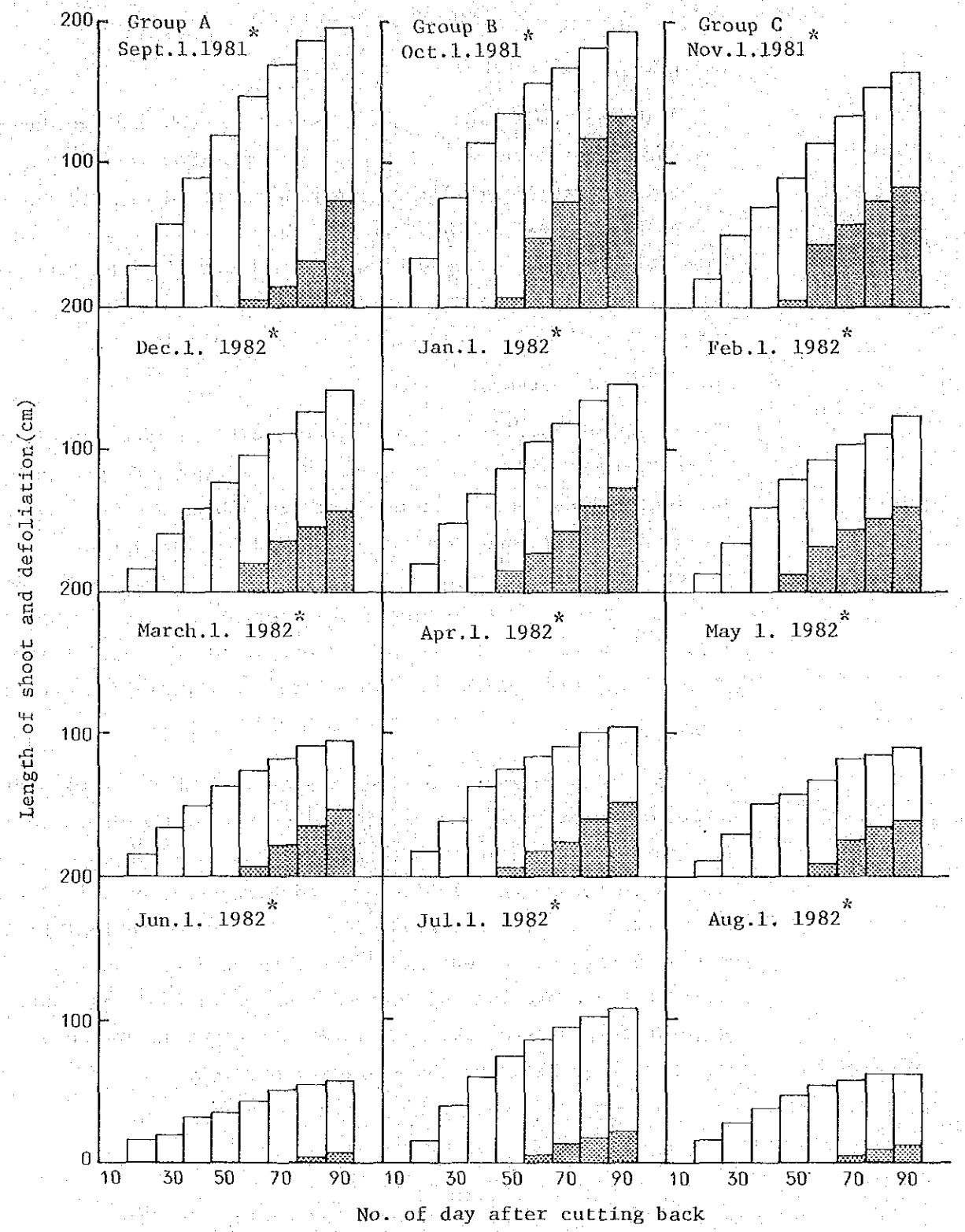


Fig. 8-2-4. Conditions of shoot growth and defoliation between different pruning times

shoot growth defoliation

*time of pruning.

10) Formulation of mulberry harvesting system for six rearing periods a year.

a) Objectives.

For the completion of the standard of technical guidance for sericultural farmers, harvesting method for six rearing periods a year is formulated. In this experiment, main target was placed on how growth vigor of mulberry trees can be maintained longer, and to develop stable mulberry leaf harvesting method, in which mulberry field was divided into two and respective half was harvested three times a year.

b) Metarials and Methods.

In this experiment, the field was divided into two blocks: A and B, each one harvested three times a year. So pruning and leaf harvest were performed once in 100 days. Control field was not divided, but was harvested 6 times a year. Variety used was M. nigra, 4 years old, 60 cm. tall, planting space 2.5 x 0.6 m. (6700 trees/ha.), fertilizer applied was Urea at a dosage of 100 kg. N/ha./year, applied in split application after each peruning. The place was the field at Pakatto.

c) Results.

In plants harvested 6 times a year, the shoots grew short, numbering more, fewer deforliation, because of the short period between pruning and leaf harvesting. In plants harvested three times a year, shoots grew longer, and percentage of defoliation was up to 50 %. There was not so big difference on leaf yield between 6 harvests a year and 3 harvests a year. When the period between pruning and leaf harvesting is too long, more leaves defoliate from the shoot, and efficient shoots become also few, thus bringing about a low leaf yield.

Table 8-2-9. Relation between frequency of leaf harvest, shoot growth and leaf yield.

Plot Name	Leaf harv. time	Period from 1-st pruning to harv.	Max shoot length	% of defoli-ation	Number of shoot	Leaf %	Leaf yield /ha.	Yield index
	1981	day	cm.				tons	
Six	6.30	50	144	6.9	26.2	47.3	5.6	
harvests	8.24	55	85	4.7	29.1	59.6	1.8	
a year	10.19	56	88	2.3	31.6	57.0	2.7	
	12.9	51	135	14.8	20.3	51.6	4.9	
	1982							
	1.29	51	98	2.0	23.8	54.2	3.3	
	3.9	40	56	0	25.7	63.1	1.5	
	Ave.	51	101	5.1	26.1	55.5	19.8	100
(A)	6.30	100	261	57.1	16.2	24.6	11.8	
Three harvests	10.19	111	137	54.0	16.5	64.6	2.6	
a year	1.29	102	221	47.5	20.6	63.5	6.4	
	Ave.	104	206	52.9	17.8	50.9	20.8	105
(B)	8.24	100	196	57.1	20.3	68.8	2.7	
Three harvests	12.9	107	208	31.2	21.0	55.6	9.5	
a year.	3.9	90	172	47.3	22.4	62.0	6.0	
	Ave.	99	192	45.3	21.2	62.1	18.2	92

Note: Average of two repetitions, total leaf yield in one year.

d) Conclusion.

In plants harvested 3 times a year, or with a 100 days harvesting interval, there are more defoliation; efficient branches are shorter, hence a lower leaf yield, but there is no bit difference in leaf yield between 6 harvests a year and 3 harvests a year grow weaker due to the continuous harvests Consequently, in order to gain a constant leaf yield, there should be an idle period between leaf harvesting and pruning. To acquire a good system for leaf harvesting, this experiment should be carried on, involving ecological and physiological factors of the plants.

(3) Developed techniques on pruning and harvesting for young and grown silkworms.

1) Methods of pruning and harvesting for young silkworms.

For the healthy grouth of young silkworms, mulberry leavesfed to young silkworms must be better quality leaves. Training is conducted as follows. Pruning is done about 30 - 40 days before "Hakitate" leaving about 10 cm of shoot base and wait for the growth of new shoots. 140 kg/ha of Urea is applied at the time of pruning. Harvesting for first to third stage silkworms is done by harvesting table age of leaves as required. Standard of leaf yield for first to third stages is 200 grams per tree in the rainy season, and 100 grams per tree in the dry season.

2) First pruning of the mulberry trees.

Mulberry being a perennial crop, first pruning and harvesting is carried out when the trunk diameter is bit enough. The right time for first pruning is 9 to 12 months after planting, at 50 cm. above the ground.

3) Tools for mulberry pruning.

The tool for leaf harvesting may be a chopping knife or an "ani-ani". After leaf harvesting, repruning ought to be done with the use of pruning scissors, at the height of 5 cm. above the trunk. Repruning serves to heal wonds made during leaf picking with the use of a chopping knife e.g. many scars on the branches, and many dried shoots. Without repruning, leaf yield will be low. Repruning also serves to prevent pests from utilizing scars their nests.

4) Revitalization of plant by "Kabusage" pruning.

Old plants have many dried branches which were damaged and containing pests leading to very low leaf yield. Revitalization is required to increase leaf yield, and done by low level pruning (Kabusage method), i.e. exactly below the damaged or pest-invaded trunk. If cutting is too low, it will also reduce leaf yield.

5) Planting space.

The number of trees suitable farmers' fields is 10,000 trees per ha. Farmers are recommended to use intervals of 1.0 x 1.0 m. and 2.0 x 0.5 m., but when the field is overgrown by weeds, plant interval ought to be narrowed.

6) Methods of pruning and leaf harvesting for grown Silkworms.

Leaf harvesting performed 6 times a year has an adverse effect on plants, as their vigor will decrease and leaf yield decreases, too. On the other hand, 3 leaf harvests a year by dividing the field into 2 blocks & harvesting alternately, with a period of 60 - 90 days between pruning and harvesting, proves to be most suitable. To obtain a good harvesting system, further experiments should be carried out.

(M. Yamamoto)

(4) Problems solutions.

1) Systems of pruning and leaf harvesting for young and grown silkworms.

Mulberry trees in the tropics grow throughout a year without dormancy period; when pruned, buds grow rapidly, but leaf age is only 40 - 50 days, shorter than there should be a guidance on pruning and leaf havesting systems. For grown silkworms in accordance with the mulberry species and the season. The basis of decision lies in the plant physicology and ecology. Leaf quality tests are highly necessary to be performed directly on silkworms.

2) Planting space for mulberry.

The number of 10,000 trees per ha. is a standard at farmers' fields. In the future, this standard should be changed according to the vigor of mulberry varieties. On the economical point of view, the amount of fertilizer needed for one hectare should be different for planting space different further investigation is needed on this aspect.

3) Yield estimation of mulberry leaves.

The yield estimation is very useful in deciding the amount of silkworm to be reared in each period. The table of estima-

tion should consider the difference in locations, growing time planting space and season. To compile a table of estimation that can be used as standard, data should, first of all, be collected on above-mentioned items and it will take long time study to minimize errors of estimation.

(M. Yamamoto).

VIII-2-5 Techniques of mulberry cultivation (Sub-center).

(1) The actual condition of the mulberry field at the main sericultural region.

The condition of farmers' mulberry fields and the techniques possessed by South Sulawesian farmers have been described in previous chapters. In 1976 when the Indonesian - Japanese co-operational project was started, farmers' mulberry fields seemed like unkempt forests. This had been the sericultural farmers' habit which led to a low productivity. As farmers received technical guidance to mulberry cultivation, there has been a slight development, for example mulberry fields that used to be kept around the house are now established on special spot away from the house; where there used to be no fertilizer application, it is now applied. Careless field maintenance has changed into good maintenance. It can thus be expected that techniques of mulberry cultivation have improved, but there has been no adequate guidance yet concerning mulberry varieties, establishment of mulberry field, pruning and harvesting method. In other words, farmers have hitherto acquired merely little techniques of mulberry cultivation.

(2) Verifying experiments of moriculture techniques.

1) Survey of sunhine intensity at mixed cropping field of mulberr mulberry and coconut.

a) Objective.

Mulberry fields at the main sericultural region are mostly mixed fields of mulberry and coconut. Mulberry requires sufficient sunshine for growth. This experiment aims to effect of shelter on sunshine intensity falling on mulberry plants.

b) Materials and Methods.

To determine the fields to be used in this survey, a preliminary observation has been made in sericultural farmers' fields. The suitable field turned to be farmer's field at Pissing Lalabata Soppeng, which extends about 19 are. Plenty of coconut trees are found, and they are observed as to the tree height, the crown diameter and the direction in which

they were planted.

Points of observation are than determined at distance of 3 m x 3 m. There are thus 81 points (9 points north - southwards and 9 points east - westwards). Observation is performed once an hour, started from 8 a.m. to last until 4 p.m. Light intensity is measured by a Lux-meter (Tokyo Koden ANA 300); measurement is performed by putting the instrument in a horizontal position, parallel to the water surface. Observation was made twice, first in the dry season (Septermber 17, 1981 - a fine day), and the second time in the rainy season (March 19, 1982 - a cloudy day). The coconut trees were about 20 years old, averagedly 14 m tall, having a crown diameter of averagedly 8.1 m. Fourteen trees were observed (density was 74 trees per hectare); mulberry variety was Morus nigra, one year old, planting space 1.5 x 0.6 m (11,000 trees/ha), stalks about 70 cm tall, in good growth condition.

c) Result.

Average sunshine intensity in a day for 81 points of observation under fine weather was maximally 75 k lux, minimally 19 k lux, the medium being 54 k lux (at a relative intensity of 64 %). On a cloudy day, the intensity was 20 k lux at most, 11 k lux at least, and the mean intensity was 16 k lux (relative intensity of 76 %). The highest intensity was attained at noon, amounting to 120 k lux in a fine weather and 44 k lux in a coloudy weather. TAZAKI (1977) stated that on a directly sunlit leaf the optimum intensity of light received would be 30 k lux, and this would be enough for the process of photosynthesis. Mulberry would not survive if sunshine intensity reaching the leaves was only 0.5 to 0.7 k lux.

During this observation, highest sunshine intensity in fine weather may be attained from 10 a.m. to 14 p.m., i.e. more than 30 k lux. Whereas in a cloudy weather the minimum limit of sunshine intensity could be above the minimum limit stated by TAZAKI which was 0.5 - 0.7 k lux; therefore the plant was not depriwed of its sunshine requirement for photosynthesis. Observation at the site showed that the rainy months of December to February it did not rain all day, thus never lacking sunshine.

The number of coconut trees in this observation was 74 per ha, thus one tree requiring an area of 11.6 x 11.6 m or 135 m^2, while leaf diameter was 8 m, so the sheltering percentage was 20 - 30 % and thereby not hindering sunshine for the proces of plant growth (see fig. 8-2-5).

process of plant growth (see Fig.8-2-5).

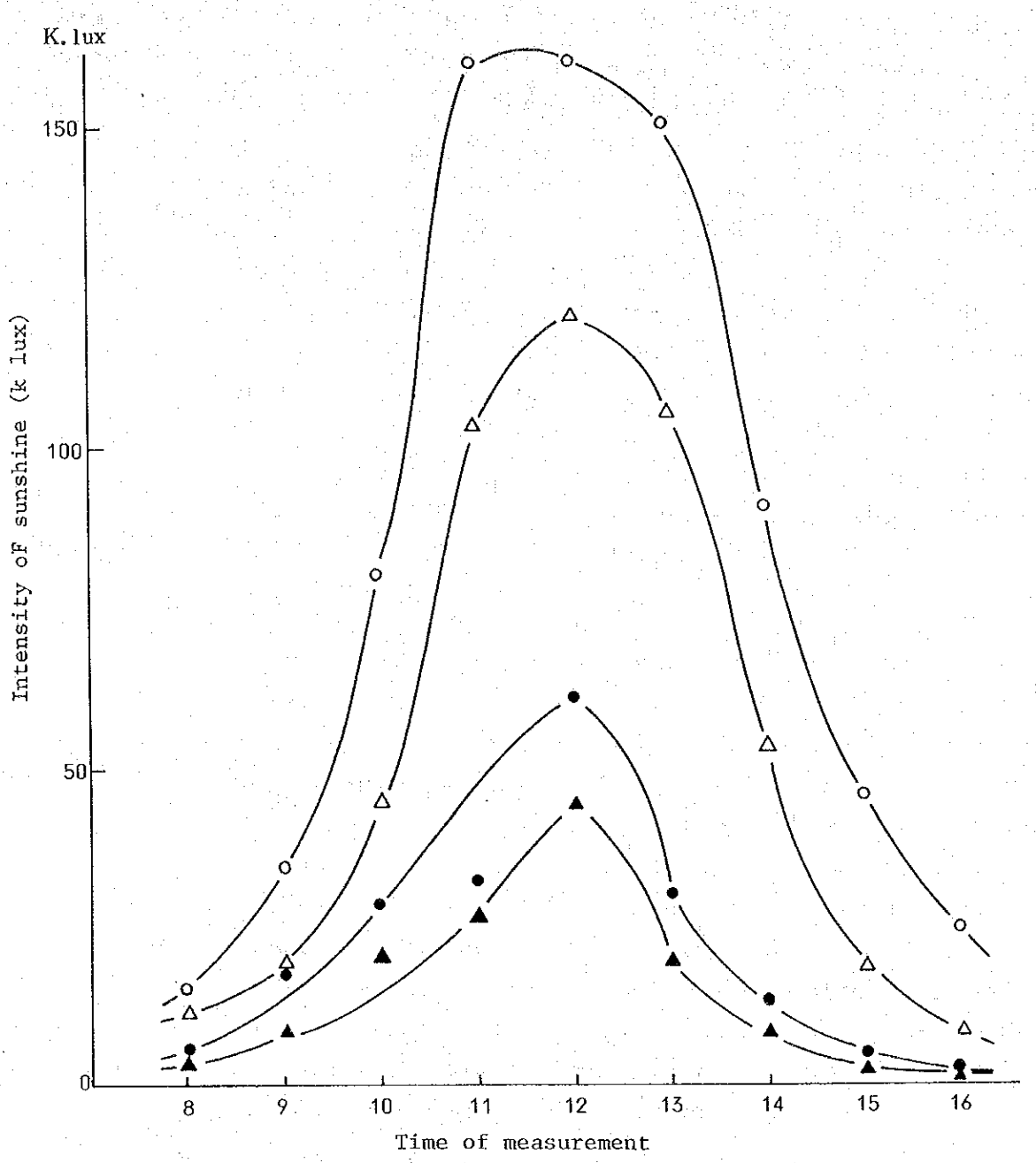


Fig. 8-2-5. Diurnal variation of intensity of sunshine at the mixed cropping field.

○ : Direct sunshine on fine weather

△ : Intensity sunshine under the crown coconut trees on fine woather.

● :Direct sunshine on cloudy weather.

▲ :Intensity sunshine under the crown coconut trees on cloudy weather.

d) Conclusion.

Interval between coconut trees was 12 m, while that between the tree crown was 8 m, there was thus an open space of 4 m to admit sunshine reaching the mulberry trees. Such a condition did not hinder mulberry tree growth. Therefore, in case of a distance less than 12 m between coconut trees, those trees are be reduced in density. Similarly when there thick banana trees around the mulberry field, there will be a competition for nutrient and sunshine. The field should therefore be rearranged.

(M. Yamamoto, Endjang K., N. Rasyid and Sucipto H.)

2) Survey of shoot growth and yield estimation of mulberry.

a) Objective.

The planned silkworm rearing, first of all the "hakitate" time should be determined, and also the quantity of silkworms (in boxes) to be reared. In order to decide the quantity of silkworms to be reared, the extent of the rearing place and the quantity of leaves should first of all be identified. To estimate leaf yield, data on shoot growth and number of shoots should be taken during a long period. In the context of data collection, experiments are performed at the main sericultural region.

b) Materials and Methods.

"Suetsugi" grafting of M. nigra with five other variety has been performed at the place of experiment. After planting 2 years old, 50 cm tall, at a planting space of 1.7 x 0.5 m (11,000 trees/ha). Shoot growth and defoliation were observed once in 10 days. Leaf yield was observed 90 days after pruning. Urea was applied at a dosage of 100 kg N/ha/year, given 3 times a year. The place of experiment was the field at Luppange Soppeng (the Pilot Unit location of mulberry field for young silkworms). The field was divided into 2 blocks, one pruned on September 1, 1981 and the other on December 1, 1981.

c) Result.

Precipitation in 1981 was hight enough to provide a good shoot growth. Nevertheless, there was difference of shoot growth between the block pruned on September 1 (dry season) and the one pruned on December 1, 1981 (rainy season). Mulberry defoliation started to 50 days after pruning, and more defoliation after the 80 th day. After leaf harvesting (90 days after pruning), defoliate at the block pruned on September 1 reached a percentage of 50 - 60 % while at the one pruned on December 1 up to 30 - 50 %. The above-mentioned turned out to differ from the data obtained from the Center (see Fig. 8-2-6). So the development of defoliating in mulberry fields differ by region. Consequently it would be less good to make leaf yield estimates with the use of a variable shoot length, and it would be best to estimate it using the variable shoot length, and it would be best to estimate it using the variable length of shoot reinove defoliation and the number of shoots.

d) Conclusion.

Shoot growth and leaf fall in 6 mulberry varieties growing at the Center as well as at the Sub-center tend to be equal. In making a table of leaf yield estimation, variables of the length of mulberry shoots should be observed in several mulberry variety and in different seasonal condition, so as to obtain an estimation with the slightest error.

(M. Yamamoto, N. Rasyid)

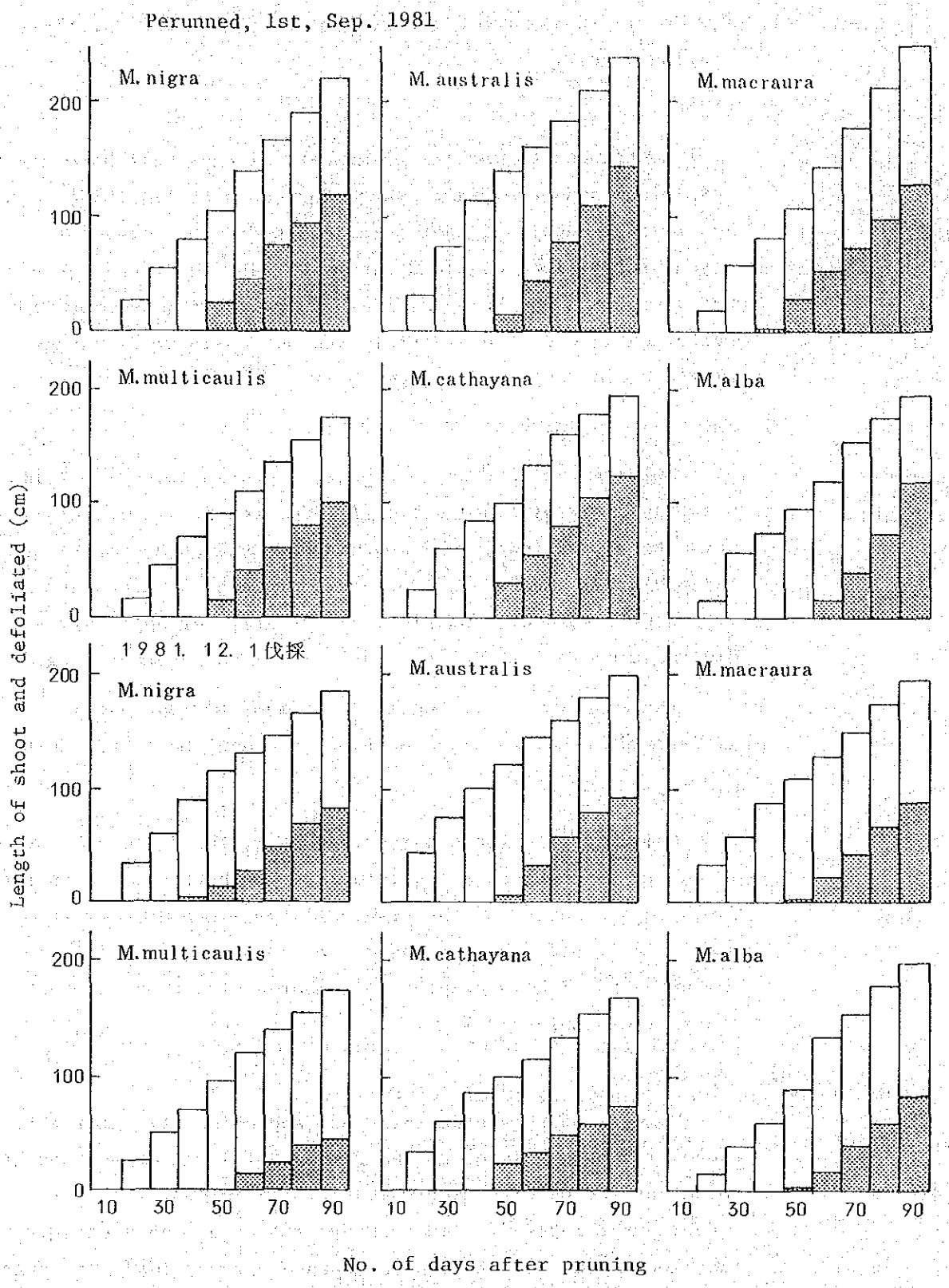


Fig. 8-2-6. Growth of shoot and defoliate difference of mulberry varieties at Soppeng

length of shoot. length of defoliated.

3) System of pruning and harvesting to adaptable for six times rearing a year.

a) Objective.

Continuous harvesting of mulberry leaves will harm plant physiology and make plant growth worsen. It also leads to a low leaf production. Therefore, the system of three harvests a year for a block of field should be developed, and one block and another should be used alternately. This experiment was performed in order to ascertain the advantage or disadvantage of the above mentioned system.

b) Materials and Methods.

Mulberry variety was M. nigra, 3 years old, 60 cm tall, planting interval 1.5 x 0.5 m (13,000 trees/ha). Six times harvests a year (once in 2 months) was used as a comparison, the field was divided in two, each harvested 3 times a year alternately (Block A and block B). Fertilizer applied was Urea at a dosage of 100 kg N/ha/year, given after pruning.

The experiment started in March 1982 to last until January 1982, taking place at Tanah Bellange mulberry field.

c) Result.

Compared with the 6 harvests a year, the 3 times harvest of the two blocks had a lower leaf yield, particularly in the dry season, because of the clay soil that made root growth poor. Leaf fall was more and no. of shoots were smaller in number at the 3 harvest plot as compared with those at the Center (see table 8-2-10).

d) Conclusion.

Results of this experiment are approximately similar to those of the experiment at the Center. This experiment ought to be carried on with improvement of the method, i.e. by reducing the lapse of time between pruning and harvesting at the block, and there should be a pause between leaf harvesting and pruning.

(M. Yamamoto, N. Rasyid)

Table 8-2-10. Relation between frequency of harvest and shoot growth, leaf yield (at Tanah Bellange).

Plot name	Leaf harvest time	Lapse prun. harv.	Max shoot length	% of defoli-ation	Number of shoot	Leaf %	Leaf yield/ ha.	Yield index
	1981.	(day)	cm				t	
	3.15	50	118	5.9	18.7	52.9	7.5	
	4.30	46	103	4.9	20.5	52.7	6.3	
Six times harvest a year	6.20	51	60	0.0	15.4	64.6	2.1	
	8.70	48	37	0.0	9.5	61.9	0.8	
	11.12	97	117	23.1	14.7	53.3	6.7	
	1982.							
	1.20	69	119	15.1	15.6	61.9	5.3	
	Average		92	8.2	15.7	57.9	28.7	100
	1981.							
Three harvest a year	3.15	100	206	50.5	12.7	49.8	12.6	
	6.20	97	140	52.5	17.9	61.4	5.2	
(A)	11.12	145	159	59.1	16.6	61.4	7.8	
	Average		168	54.0	15.7	57.9	25.6	89
Three harvests a year	4.30	100	149	27.2	14.9	51.3	8.3	
	8.70	99	97	23.2	15.2	50.6	4.3	
	1982.							
(B)	1.20	166	200	63.3	17.9	61.2	4.0	
	Average		149	37.9	16.0	54.4	16.6	58

Note: Average of two repetition; total leaf yield per year.

(3) Developed technique of mulberry cultivation.

1) Sunshine observation in mixed mulberry and coconut fields.

An observation was made in a mulberry field where coconut trees were also planted at a planting space 12 x 12 m (70 trees per hectare). In such a condition mulberry plants still received sufficient sunshine to under go the process of photosynthesis. Thefore, where coconut trees are planted at an interval of less than 12 x 12 m, thining should be attempted, thus attaining the interval above, because the planting space less than 12 x 12 m would lessen the intensity of sunshine to

be received by plant for photosynthesis, hence a low leaf yield. It is suggested that thick trees and densely growing banana trees around the mulberry field by rearranged so as not hinder sunshine to fall on mulberry plants.

2) Relation between shoot growth and leaf yield for the estimation of mulberry field.

Shoot growth and the height of defoliate in mulberry plants at the Center and at the Sub-center are slightly different. Consequently, to arrange a table on leaf yield estimation, the basis applied would be the height of leafy shoots an and the number of shoots in a tree.

3) System of pruning and harvesting to adaptable for six times rearing a year.

Shoot growth during the period of one harvest in three months shows a lengthening where defoliated off. Where harvesting occurs at an interval of over three months, the length of leafless shoots is longer. Estimation shows that the appropriate period of leaf harvesting in order to obtain sufficient length of defoliation is once in 60 - 90 days. To ascertain a definite result, this experiment should be proceeded.

(M. Yamamoto)

(4) Problems and Solution.

1) Relation between shoot growth and leaf yield for mulberry yield estimation.

The bases for leaf yield estimation are: the weight of shoots and leaves, the weight of leafy shoots and the number of shoots, where as the bases for calculation is the computation of a constant (K).

$$K = \frac{\text{weight of shoot and leaves}}{\text{length of leafy shoot}}$$

Much data from various locations are required to know the value of K. This value will vary with the mulberry variety and the seasonal condition. To attain a definite result, a cooperation with Bili-Bili Center is expected in data collection.

2) System of training and harvesting adaptable six times silkworm rearing a year.

This method should divide the field in three blocks, and a pause is required between leaf harvesting and pruning. To obtain a more definite result, this experiment is still to be continued persistently for at least three year, there by to understand leaf production and its influence on shoot growth.

3) Promotion of soil fertility by mulching with the use of paddy husk or green manure.

The basis to maintain soil fertility is application of organic matter. Sericultural farmers in general have not applied organic matter and fertilizers to their mulberry fields.

By planting green manure in the mulberry fields, soil fertility is expected to be maintened; therefore green manure planting ought to be tried in the mulberry fields, in cooperation with the Sericultural Center.

4) Planting the recommended varieties.

Selection of mulberry variety results in the discovery of recommended varieties, i.e. Morus alba and Morus cathayana.

These varieties have to be planted immediately at Tanah Bellange, which will be used to experiment and for production of silkworm eggs.

(M. Yamamoto)

VIII-2-6 Production of mulberry scions and their distribution to sericultural farmers (Center and Sub-center).

(1) Production and distribution of mulberry scions.

Selection of recommended varieties and the condition of farmers' mulberry variety have been described in the previous re report. The recommended variety has been tested and proved to have a high leaf yield.

To distribute the recommended variety to farmers, the mulberry field at Pakatto in November 1980 a propagation farm planted Morus alba 17.6 are and one planted Morus cathayana 7.3 are have been established; at the field in Bili-Bili, "suetsugi" grafting has been performed with the variety Morus alba at an area planted 10 are, and at Sub-center planted 15 are. So the sericultural development project has now posessed a propagation farms for Morus alba planted 42.6 are (27.6 are at the Center and 15 are at the Sub-center), and one for Morus cathayana planted 25 are has been established in Malino mulberry field.

After the discovery of the recommended variety and the establishment of the propagation farm, scion of Morus alba were distributed as follows:

First: in December 1981 the variety Morus alba was distributed from the Center to district office in Bulukumba, Pangkep, Bone and Polmas, amounting totally 40,000 scions.

second: From March to April 1982, 22,000 scions were distributed from the Sub-center to the Pilot Unit members and 32,000 scions to district office in Soppeng, Sidrap and Wajo.

Hence a total of 94,000 scions have been distributed during the period of 1981 - 1982, and this amount can cover a field of about 5 hectare. As mulberry field will be established in Malino, *The mulberry field at the Center and Sub-center will not be able* to distribute scions to farmers during the period of 1982 - 1983.

(2) *The rules of mulberry scions distribution.*

To solve problems and to speed up the distribution of recommended varieties to farmers, extension should be conducted. In accordance to the Project Managers' expection, i.e. to speed

up the distribution of mulberry scions to farmers, a rule of mulberry scion distribution has been established in November 1981, containing the following subjects:

a. The object of scions distribution;
b. Determination of mulberry variety to be distributed to farmers;
c. The recommended variety;
d. The procedure for the request;
e. The amount of scions to be distributed;
f. The time for distribution;
g. Characteristics of good scions;
h. Regulation for the distribution of scions;
i. The cost for a request.

To speed up further the distribution of scions to farmers, each district is expected to establish its own propagation farm, with guidance and counselling on the method of field establishment.

(3) Problems and Solution.

1) Increase of recommended variety.

It is common that plants have different properties with respect to their resistance to natural disaster and their adaptation to the environment. Those matters are thus to be considered in the context of distributing plant variety, in order to ovoid unfavorable occurrences in future. It is thus not allowed to cultivate one variety alone. Selection of economically valuable ulberry variety is expected to find an economic variety which will be distributed gradually to the farmers, and to speed up the distribution of the variety, a rule for the distribution of scions is to be established. A recommended variety (Morus alba) has now been found, for which propagation farm has been established at the Center and the Sub-center; another recommended variety is Morus chathayana, for which a 25 are has been established in Malino mulberry field, and the first production of scions is anticipated to be in 1983, when Morus cathayana will be the second recommended variety.

2) The distribution system of scions.

Unlike paddy and vegetables, which are annual crops, mulberry is a perennial, which will encounter difficulty to replant in case of any error in the first planting. For a mulberry field which is to be planted for the first time, the recommended variety is to be used, and the following matters are to be performed for the distribution of the scions:

a) Establishment of propagation farm at the Center and the Sub-center.

The original propagation farm is located at the Center, and further on, mulberry field scions production will be established at the Sub-center (Tanah Bellange), respectively 20 are for Morus cathayana and Morus alba.

b) Establishment of propagation farm in every district.

To satisfy farmers' requirement for scions, each village is recommended to establish its own mulberry field production of scions. Its expected to multiply in 30 to 50 folds, or 1 ha of propagation farm is expected to increase to 30 - 50 hecteres.

c) Distribution of scions to their farmers.

Before distributing to the farmers, extension workers should inspect the field to be planted upon, both concerning its extent and the technique of planting, so as to be able to estimate the requirement for scions, and there after will the scions be given.

d) Counselling on the recommended variety.

Before propagating the recommended variety, farmers should understand the characteristics of the variety and the region where it can adapt itself. These matters can be inquired to Indonesia expert and the extension worker. And the practice at the planting time should be in accordance with the manual on the cultivation of the recommended variety.

(M. Yamamoto)

VIII-6-1 Training of Indonesian technical staffs (Center and Sub-center).

(1) Training of counterparts.

1) Mulberry cultivation.

A. Practical training.

Mulberry fields were established in Bili-Bili, Pakatto and Tanah Bellange in 1976, under guidance by Japanese experts. Technical guidance includes the method of land levelling, basic fertilizer application, planting method and post-planting field maintenance. Methods of pruning and leaf harvesting in a year, weed control, fertilizer application and pest control are also given. The counterparts can practice these matters by themselves. Job distribution has been performed among the counterparts, both in field maintenance since 1981. In this case counterparts are supposed to draw up their own operational plan, seeking expert' advise in case of any trouble.

B. Experimental design, execution and arrange of data.

In the context of experiment and testing at the Center, experts have attempted to give instructions on the performance of experiments to counterparts. For the first time, expert do the planning and they together with counterparts perform the experiment. Twenty three titles of experiment have been performed either at the Center or at the Sub-center from November 1976 to November 1980 under experts' guidance. It was during this period that counterparts found the basic techniques of experiments. From November 1980 to February 1982 the remaining experimental titles were selected, those passing the selection were re-tested. Each time counterparts make the plan, perform the experiment and process the experimental data themselves; experts just act as advisors in this case. Titles of experiment are distributed to each counterpart corresponding to their respective expertise, and each counterpart does not change titles. Techniques found in these experiments are further extended to extension workers or farmers during the training course. Among the titles of experiment performed, eight have been reported. In the middle of the cooperational period counterparts were recruited, they are hitherto not sufficiently

able to plan and perform experiments and to process experimental data, but they are expected to develop their ability to perform experiments, and experts will go on guiding.

C. Ability for development techniques and technical guidance.

In the effort to improve the skill for the technical development of mulberry cultivation, counterparts are given the knowledge of mulberry cultivation and of the performan of experiments on mulberry plants. Experiments are planned before performance; data obtained from the experiments are analized and reported. The reports are then taken to seminars among experts and counterparts; to improve the skill to give guidance, conclusions of the performed experiments are compiled into a textbook. This textbook provides the items of study for the training courses for guidance technician and farmers.

For the future in South Sulawesi a more developed technique for mulberry cultivation will be required, and on the other hand farmers want one technique that is most suitable for them. Experiments are thus to be performed in both cases. Counterparts are deemed unable to perform experiments of higher level; so guidance from Japanese experts is still required in order to improve the skill of developing techniques and technical guidance.

(M. Yamamoto)

(2) Training of technical staffs at the Sericulture Center.

1) Mulberry cultivation.

At the start of project there were four assistant counterparts (1976). One more was recruited to add the number to five. Assistant counterparts' period of service ranges from one to six year; the assistant counterpart who has had the longest period of service is now able to work independently. Assistant counterparts accomplish jobs planned by counterparts, i.e. co ordinating and activating gardeners. All assistant counterparts assist counterparts in the performance of experiments. The former is expected to understand the objective of the experiment concerned. When assistant counterparts have grasped and understood techniques of plant maintenance or techniques

derived from experimental results, they are expected to be able to extent guidance and counselling throughout regions where sericultural activities take place, in order to enhance the technique of mulberry cultivation throughout South Sulawesi.

(M. Yamamoto)

VIII-7-1 Plan for the demonstration of moliculture techniques.

(1) Plan for the demonstration of mulberry cultivation

1) Mulberry fields for young silkworms.

Special mulberry fields for young silkworms are intended to provide a healthy and vigorous life for young silkworm. Consequently, the leaf quality should be maintained. The field for young silkworms should be located near the young silkworm rearing place; there must be no obstruction for air cirulation and sunshine, and the soil should not be dried up during the dry season.

a) Mulberry variety: Morus alba is the best one. Having a high leaf yield and good quality. Therefore it is recommended to subtitute for Morus nigra.

b) Planting space: The standard number of trees per hectare is 10,000, or at a planting space of 2.0 x 0.5 m. Such a planting space facilitates field maintenance.

c) Pruning method: Medium cut training, i.e. as high as 50 - 60 cm from the ground, is performed. For frequently flooded areas, pruning should be performed at a higher level.

d) Method of leaf harvesting: Pruning height is 10 cm from the trunk, pruning is 30 - 40 days before "hakitate"; pruning is performed with the use of plant scissors. The top part is picked for first and second stage, while the remainder of the harvest is provided for the third stage. The bottom part is harvested, leaving 3 to 5 blades.

e) Weeding and fertilizer application: As soon as pruning is completed, weeding should be done immediately, and afterwards, fertilizer application using Urea at a dosage of 140 kg/ha each time (about 14 grams per tree) fertilizer is bestrown between rows, and then mixing with soil. In the dry season mulching is conducted with the use of paddy husk, grass or hay in order to maintain soil moisture.

f) Pest control: At pruning time, removal small shoots too, for the pest control to Mealy bug and Mulberry pyralid, as they provide a nest for pests. In case of pest invasion, Basudin

2,000 x (10 litre water mixed with 5 cc Basudin) should be sprayed. Ten litre mixture should be applied to one are. Spraying should be carried out at the lastest 15 days before "hakitate".

(M. Yamamoto, Y. Kubomura)

2) Mulberry fields for grown silkworms.

To gain a steady leaf yield, an appropriate planning is required for the mulberry maintenance; pruning and leaf harvesting should not be performed continuously or repeatedly in one block of the field. Techniques dealing with mulberry cultivation to be applied to farmers should be simple, easy and suitable for farmers.

a) Mulberry variety: Morus nigra is used at present; it should be replaced by Morus alba in the future.

b) Planting space: The standard number of trees in 1 ha is 10,000. Usually 1 m x 1 m, but it would rather be 2 m x 0.5 m or 1.5 m x 0.6 m for easier maintenance.

c) Pruning method: Pruning should be performed 60 - 80 days before leaf harvest for grown silkworms; leaf picking is started from the top and carried on until 5 cm distance from the main trunk ("kabunaosi"); pruning used plant scissors; at the same time, small, unproductive stems are removed. Leaf harvest method is performed by dividing the field into 2 blocks A and B, using them alternately, each one harvested 3 times a year. When Block A and Block B are used alternately, there will be 6 rearings a year. Leaves should not be harvested in the dry season, as plants are to be left idle.

d) Weeding and fertilizer application: as soon as pruning is completed, the field should be weeded, and then fertilizer is applied at a dosage of 70 kg Urea/ha, each time (about 7 trees). Fertilizer is bestrown between rows, and mixing with soil.

e) Pest control: Usually control is cleaning the field and mulberry trunk. But plenty of mulberry pyralid and Mealy but at the regions. They have to be eradicted through the spraying of Basudin. 2,000 x (10 litre water with 5 cc Basudin), at a

volume of 10 litre per are. Spraying should be carried out at the latest 15 days before leaf harvest.

(M. Yamamoto, Y. Kubomura)

3) The plan for a model of six times harvesting system a year.

a) Basic plan for the model: Mulberry growing in the tropics has no dormancy. It buds immediately after pruning, and shoot grow on without ceasing. Consequently, if mulberry is pruned repeatedly, vegetative growth will be retarded and tree vigor decreases, leading to a low cocoon production. To improve the above-mentioned condition, plants require a period of pause harvest.

b) The period of pause harvest in mulberry plants: The average precipitation during a decade in Bili-Bili is shown in Fig. 8-7-1. Precipitation differs slightly between regions. The lowest precipitation occurs between August and October when it is so dry that mulberry leaf yield is low and it is hardly possible to rear silkworms. Therefore, it is the best time for plants to take a rest.

c) Shoot growth and defoliation in mulberry: Items 8-2-4 shows shoot growth and defoliation in mulberry plants, while Fig. 8-7-2 describes the above-mentioned. The figure show that the best shoot growth and slightly defoliation occur at after pruning 60 - 90 days. After the 90 th day, defoliation increase on. So the best time harvest is at after pruning 60 - 90 days. This time is useful in the planning annual leaf harvesting system. To support the performance of six times silkwarm rearing a year, the mulberry field should be divided into two blocks such as described proviously.

d) Model system of six times harvesting and management of mulberry field: The duration of field use is 40 days, plus the pause harvest and fertilizer application, weeding and other jobs. Table 8-7-1 shows all these items but not too perfectly; data on performed experiments should be added to make it better.

(M. Yamamoto)

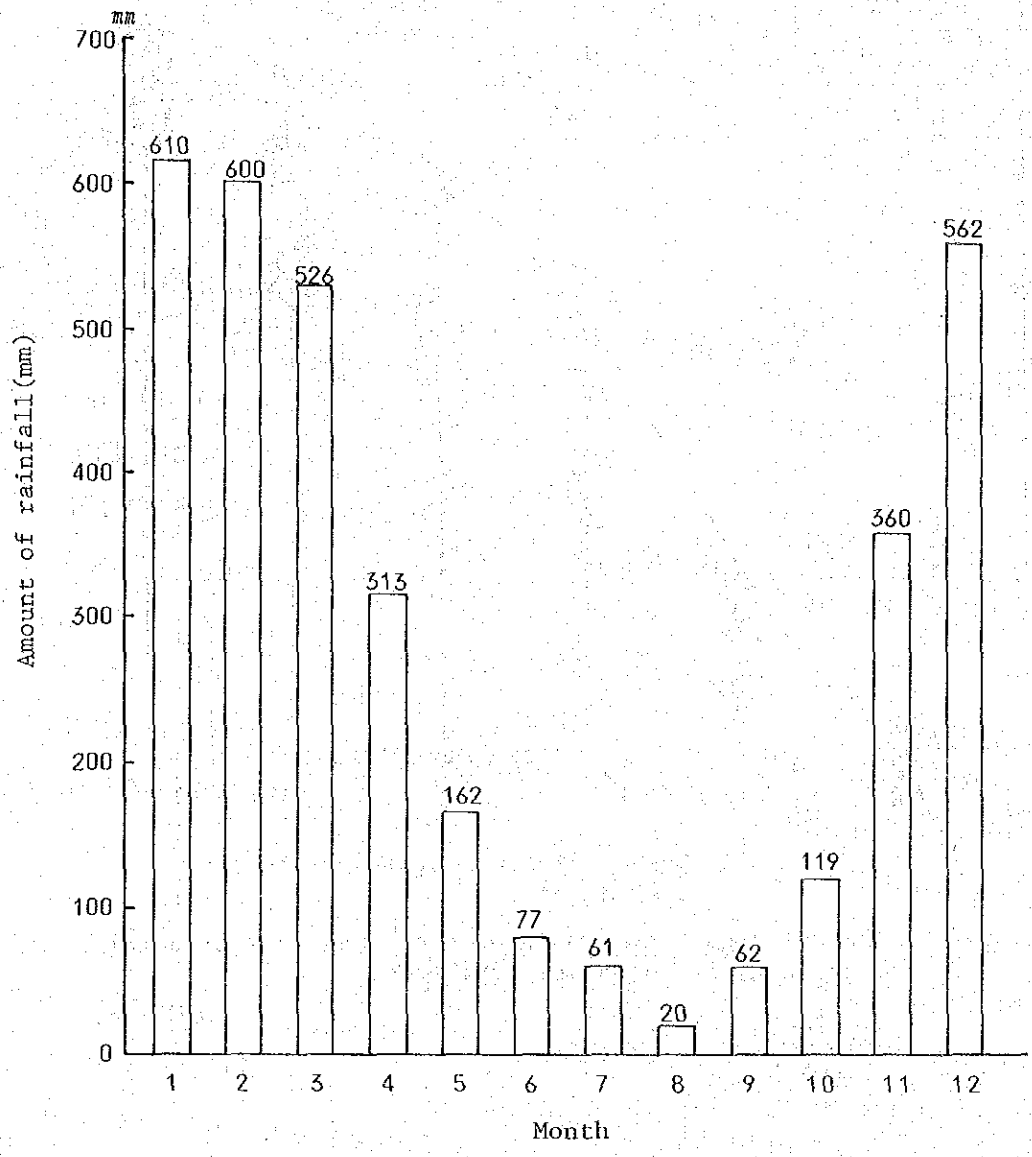


Fig. 8-7-1. Amount of rainfall in normal value 10 years at Bili-Bili, Gowa(1970 - 1979).
(data by L.P.P.M. Sub-station, Bonto Bili).

Average annual rainfall : 3.472mm.

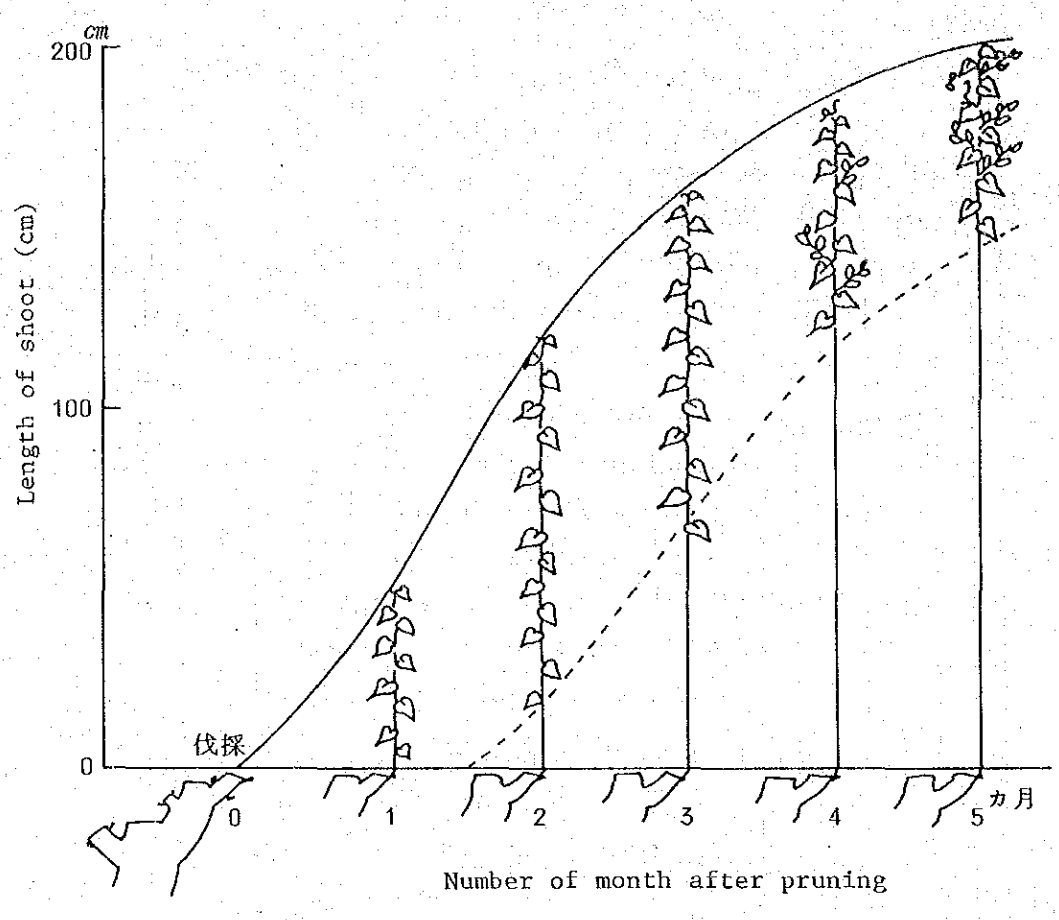


Fig. 8-7-2. A model figure to growth of shoot and time of defoliation in a period on mulberry tree.

Table 8-7-1. System of harvesting and maintenance of mulberry field hor grown silkworms.

Works / Period	Pruning and mulberry harvesting		Fertilizing and weeding		Spraying for pest and cleaning of mulberry stumps	
	A	B	A	B	A	B
Jan.	• 1st					
Feb.						
Mar.		• 2nd				
Apr.	• 3rd					
Mar.						
Jun.		• 4th				
Jul.	• 5th					
Aug.			• Not fertilizer			
Sep.	(Rest time)	• 6th		Not fertilizer		
Oct.					Stumps cleaning	
Nov.	Cuting only	(Rest time)				Stumps cleaning
Dec.		Cuting only				

• "Hakitate" (begining of silkworm rearing).

4) Method of leaf yield estimation in mulberry plants.

Before silkworm rearing is commended, leaf yield is to be estimated to determine the amount of silkworms to be reared. A table of yield estimation is required herefore. The present table of leaf yield estimation per tree is derived from data on performed experiment (Table 8-7-2 and 8-7-3).

Table 8-7-2. The estimate of leaf yield in rainy season (Dec. to May). (kg/tree)

Average* shoot length	Number of shoot per tree								
cm	4	6	8	10	1	14	16	18	20
40	0.04	0.07	0.09	0.11	0.13	0.15	0.18	0.20	0.22
60	0.07	0.11	0.14	0.18	0.22	0.25	0.29	0.32	0.36
80	0.10	0.15	0.20	0.26	0.31	0.36	0.41	0.46	0.51
100	0.14	0.20	0.27	0.34	0.41	0.48	0.54	0.61	0.68
120	0.17	0.26	0.35	0.43	0.52	0.60	0.69	0.78	0.86
140	0.21	0.32	0.43	0.53	0.64	0.74	0.85	0.96	1.06
160	0.25	0.38	0.51	0.63	0.76	0.88	1.01	1.14	1.26
180	0.30	0.44	0.59	0.74	0.89	1.03	1.18	1.33	1.48

Table 8-7-3. The estimate of leaf yield in dry season (June to November). (kg/tree)

Average* shoot length	Number of shoot per tree								
cm	4	6	8	10	12	14	16	18	20
20	0.01	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.05
40	0.02	0.04	0.05	0.06	0.07	0.08	0.10	0.11	0.12
60	0.04	0.06	0.08	0.11	0.13	0.15	0.17	0.19	0.21
80	0.06	0.10	0.13	0.16	0.19	0.22	0.26	0.29	0.32
100	0.09	0.13	0.18	0.22	0.26	0.31	0.35	0.40	0.44
120	0.12	0.17	0.23	0.29	0.35	0.40	0.46	0.52	0.58

* Shoot length to posses leaf only.

This table is used to estimate leaves at harvest; 10 trees are taken as sample; the sample is observed concerning the length and the number of shoots. Results of the observation are checked with table of leaf yield estimation; yield per tree will be obtained; this result, multiplied by the number of trees, will produce the amount of leaf yield per a certain extent. This table of estimation is not perfect yet, and to improve it a continuous experiment is needed, thus resulting in a close estimation.

(M. Yamamoto)

VIII-7-2 Guidance for the demonstration of sericultural technique at the farmers group.

(1) Guidance activity at the Pilot Unit (Sub-center).

1) Guidance on the demonstration of mulberry cultivation.

a) Mulberry fields for young silkworms.

The mulberry field and the young silkworm rearing place are under immediate management of the project, i.e. those situated at Luppange (Kabupaten Soppeng) and at Baraka (Kabupaten Enrekang). The mulberry field for young silkworms owned and managed by Pilot Unit members themselves is situated at Pising (Kabupaten Soppeng). At the Pilot Unit situated at Ugi (Kabupaten Wajo) part of the mulberry field for young silkworms is adjacent to the rearing place while an other part is far from it; the letter is not a special field for young silkworms but sometimes also for grown ones. The pilot Unit at Wanio (Kabupaten Sidrap) has hitherto not had a special field for young silkworm; leaves for young silkworm are taken from fields owned by members, so leaves are taken from different sources every period. This fact obstructs the Pilot Unit activity, and it is also adverse to the techniques mentioned in the Pilot Unit operational guide. With recommendations that a special field for grown silkworms be established immediately, it is possible that in 1983/1984 a mulberry field extending 0.4 - 1 ha will be established, for the appropriate application of techniques. Table 8-7-1 and table 8-7-2 describe the technical guidance activities at the Pilot Unit during 1981 - 1982; technical guidance that has been performed is pruning and fertilizer application on fields for young silkworms (performed 30 - 40 days before "hakitate"). Technical guidance to the farmers is given by expert and counterparts; it includes pruning, advice on major items and other matters. Extension workers are also guided on this occasion, both those engaged in and those outside the Pilot Unit. During the first period of Pilot Unit activity, mealy bug invaded the mulberry field for young silkworms; it was beyond our expections; so it is recommended further to stand by for such an invasion. Insecticides are desirably available

Table 8-7-1. Demonstration of guidance techniques at mulberry field for young silkworm in Pilot Unit (1).

Location	Time of hakitate	Time to inform	Contents of techniques	Preface
	1982	1982		
Pising	March, 16	Feb. 9	Pruning; pruning method and leaf harvesting; spraying; weeding.	Expert and Counterpart
Luppange	March, 16	Feb. 9	- do -	- do -
Ugi	March, 17	Feb. 11	- do -	- do -
Wanio	March, 17	Feb. 11	- do -	- do -
Baraka	-	-	-	-
	1982	1982		
Pising	June, 1	May, 1	Pruning; pruning methcd; leaf harvesting; to spraying of pest; weeding.	Guidance technician
Luppange	June, 1	May, 1	- do -	- do -
Ugi	June, 2	May, 1	- do -	- do -
Manio	June, 2	May, 1	- do -	- do -
Baraka	-	-	-	-
	1982	1982		
Pising	Aug. 30	July, 15	Pruning; pruning method and leaf harvesting; fertilization; utilization plan of mulberry field	Counterpart and Assistant counterpart
Luppange	Aug. 30	July, 15	- do -	- do -
Ugi	Aug. 31	July, 16	- do -	- do -
Wanio	Aug. 31	July, 16	- do -	- do -
Baraka	Sep. 2	July, 18	- do -	- do -

Table 8-7-2. Demonstration of guidance techniques at mulberry field for young silkworm in Pilot Unit. (2)

Location of pilot unit	Time of hakitate	Time of guidance techniques	Contents of techniques	Preface
	1982	1982		
Pising	Oct. 13	Sep. 1	Pruning; fertilization; pest control and utilization plan mulberry field	Guidance technician
Luppange	To stop because withered	-	-	-
Ugi	- do -	-	-	-
Wanio	- do -	Sep. 14	Pruning; fertilization; pest control; utilization plan mulberry field	Counterpart and Assistant counterpart
Baraka	- do -	Sep. 15	- do -	- do -
	1982	1982		
Pising	Dec. 20*	Nov. 15*	Pruning; fertilization; pest control; utilization plan of mulberry field	
Luppange	Dec. 20*	Nov. 15*	- do -	
Ugi	Dec. 21*	Nov. 16*	- do -	
Wanio	Dec. 21*	Nov. 16*	- do -	
Baraka	Dec. 23*	Nov. 18*	- do -	
	1983	1983		
Pising	Feb. 20*	Jan. 15*	Pruning; fertilization; pest control and utilization plan of mulberry field	
Luppange	Feb. 20*	Jan. 15*	- do -	
Ugi	Feb. 21*	Jan. 16*	- do -	
Wanio	Feb. 21*	Jan. 16*	- do -	
Baraka	Feb. 23*	Jan. 18*	- do -	

* Plan of activities guidance techniques.

all the time at the Pilot Unit in order to facilitate pest control.

The greatest problem in the Pilot Unit activity is subtitution of mulberry variety, because not even the field for young silkworms has been established, let alone the subtitution of the variety. Most important now is the establishment of a special field for young silkworms for which the variety used is the recommended one. It turned out that one of the farmers at Pising has grasped the techniques dealing with Morus alba; the particular farmer has even cultivated Morus alba before the Pilot Unit was established. At first period "hakitate" in the mulberry field for young silkworms, comparison was made of shoot growth and leaf yield between Morus nigra and Morus alba (Table 8-7-3).

Table 8-7-3. Shoot growth and leaf yield in fields for young silkworms at the Pilot Unit of Pising (Kabupaten Soppeng)

Mulberry varieties	Maximum shoot length	Number of leaves/ shoot	Number of shoots	Shoot & leaf weight/ tree	In 1.0 hectare	
					Shoot and leaf yield	Number of Silkworms
	cm			kg	kg	box
M. nigra	77	20.6	12.6	0.22	2,380	40
M. alba	71	13.9	14.3	0.29	3,150	53

Notes: Pruning time was February 10, 1982, or 30 days before "hakitate". Planting interval was 1.5 x 0.6 m (11,000 trees per ha); fertilizer applied was Urea (140 kg/ha), for I - III stage, 10 trees were taken as sample; observation time was March 18, 1982, plant age was 2 years, the field owner was Mr. Tahir M.

Morus alba leaf yield turned out to be 30 % more than Morus nigra. And Morus alba leaf quality was better, hence the field owner decided to replace the entire field with Morus alba. It was ensured that the substitution of mulberry variety did not hinder silkworm rearing as result of the lack of mulberry leaves. Therefore, the substitution should be conducted bit by bit. The economic consideration above will be made by farmers. The techniques fertilizer application and

pest control to be applied to farmers should be easily feasible and adjustable to farmers. Nevertheless, it would take along time to implement the technique, particularly for Pilot Unit members at Baraka and Wanio.

(M. Yamamoto, Endjang K., N. Rasyid)

b) Selection of demonstration farmers.

To decide the farmer to perform a demonstration, a selection was held among members. The result of selection decided 1 - 3 farmers of each Pilot Unit as model farmers. They will be guided by counterparts and extension workers conserning techniques of sericulture.

Qualifications to be met by farmers in order to be chosen as model farmers are: possessing a field extending about 0.5 ha and situated at a spot visible to the surrounding members.

Results of the mulberry field selection in Pilot Unit members are shown in Table 8-7-4, while the maps of the estimation of Pilot Unit situation are shown in Figures 8-7-3 to 8-7-7.

Table 8-7-4. Condition of mulberry field in Demonstration farmers (1982).

Location of pilot unit	Name of member	Area of mulberry field	Planting space	Mulberry variety	Number of silkworm rearing
		ha			boxes
Pising, Soppeng	M. Tahir	4.0	1 m x 1 m	M. nigra	3
	Beddu B.	1.5	1 m x 1 m	M. nigra	2
	Ibrahim	1.0	1 m x 1 m	M. nigra	2
Luppange, Soppeng	Ballu	0.4	1 m x 1 m	M. nigra	1
Wanio, Sidrap	Aras	0.7	1 m x 1 m	M. nigra	2
	Ruslan	0.6	1 m x 1 m	M. nigra	1
Ugi, Wajo	Usman P.	3.0	1 m x 1 m	M. nigra	2
	Balla	1.3	1 m x 1 m	M. nigra	2
Baraka, Enrekang	Ambe Mina	0.5	1 m x 1 m	M. nigra	1

(M. Yamamoto, Endjang K., Munassar S., N. Rasyid, Sucipto H. and Baharudin A.)

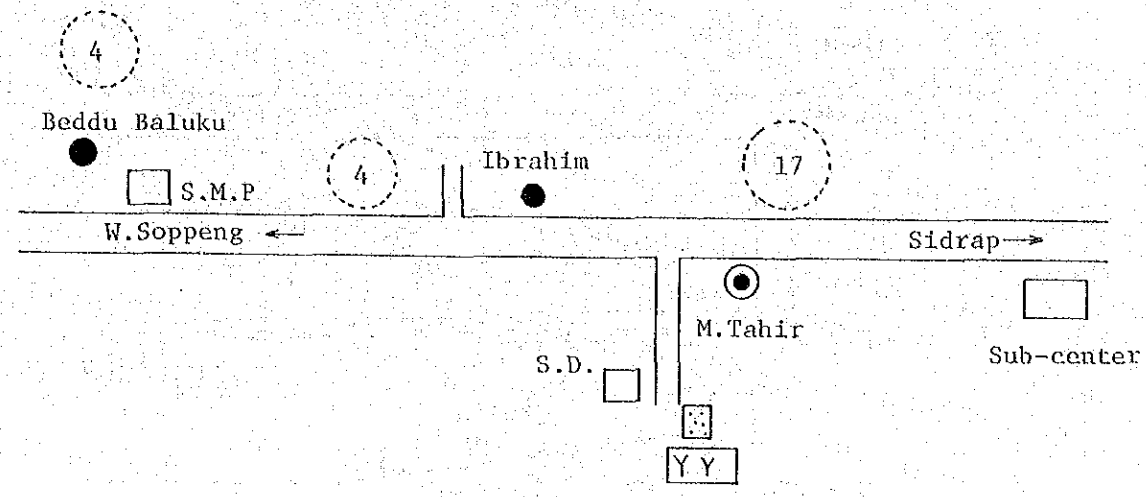


Fig. 8-7-3. Pising Kabupaten Soppeng

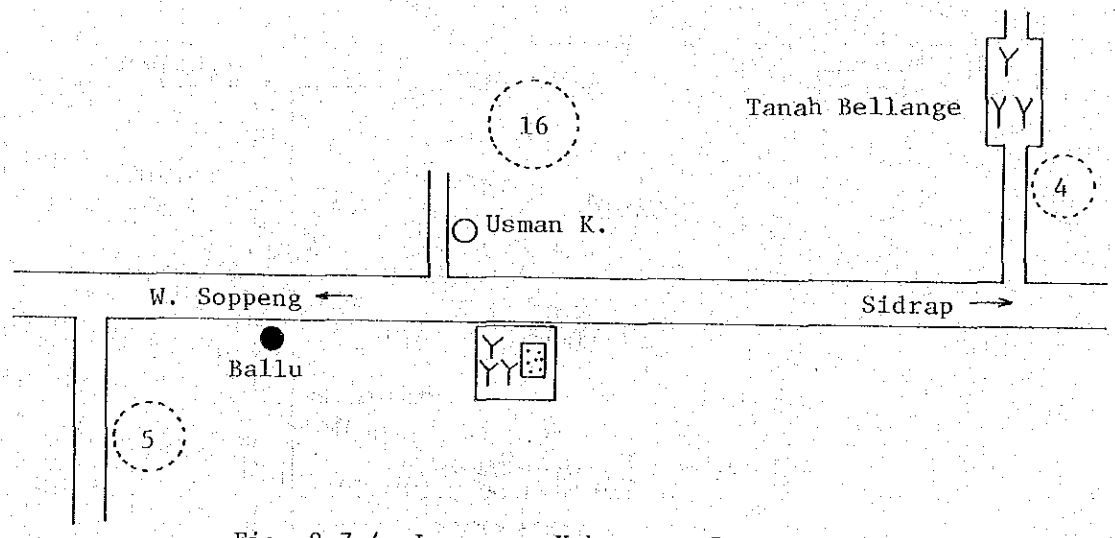


Fig. 8-7-4. Luppange Kabupaten Soppeng.

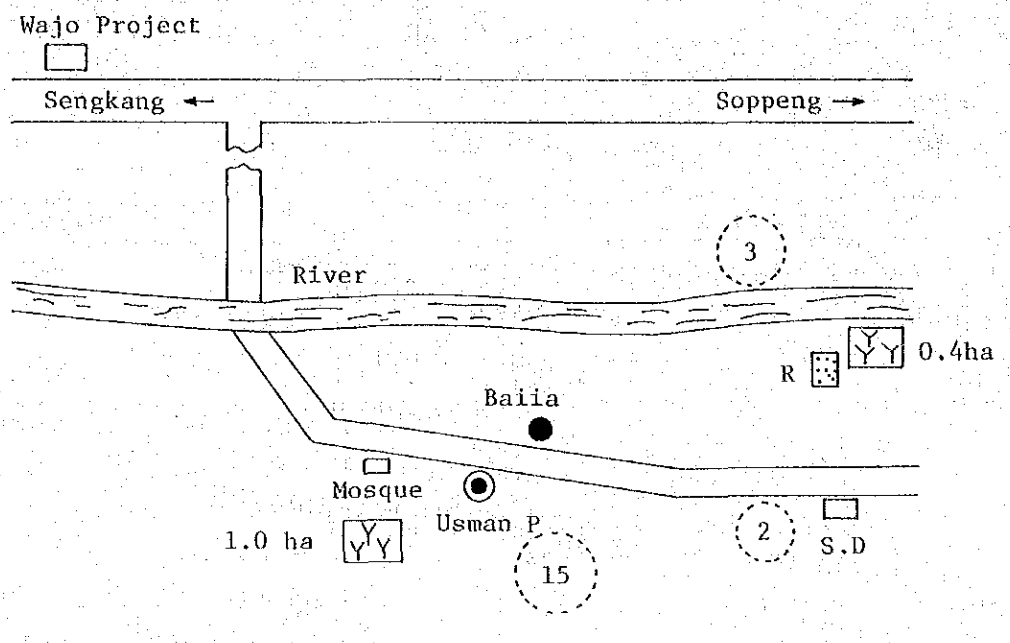


Fig. 8-7-5 Ugi Kabupaten Wajo.

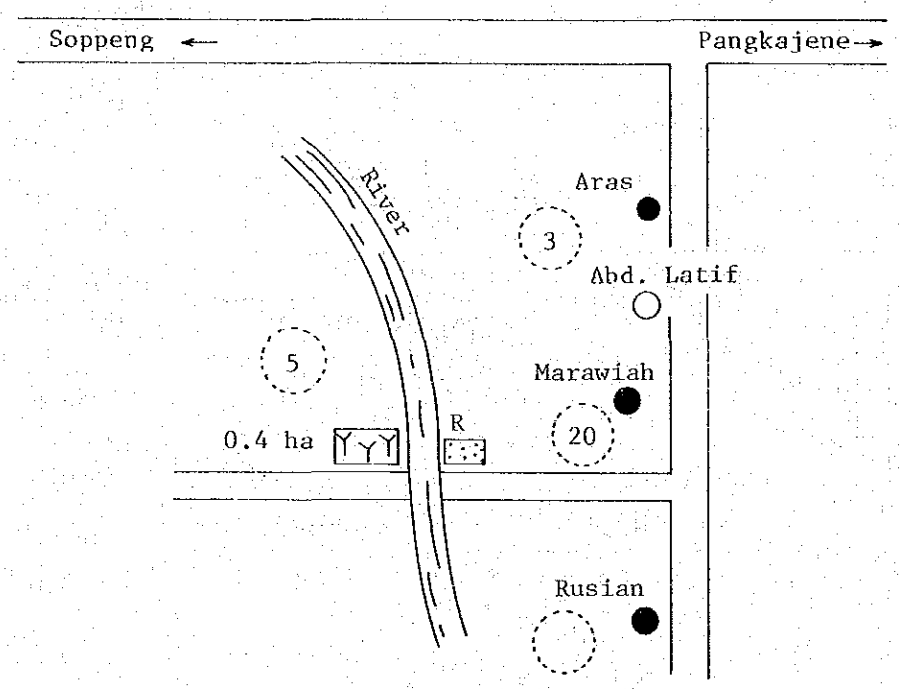


Fig. 8-7-6 Wanio Kabupaten Sidrap.

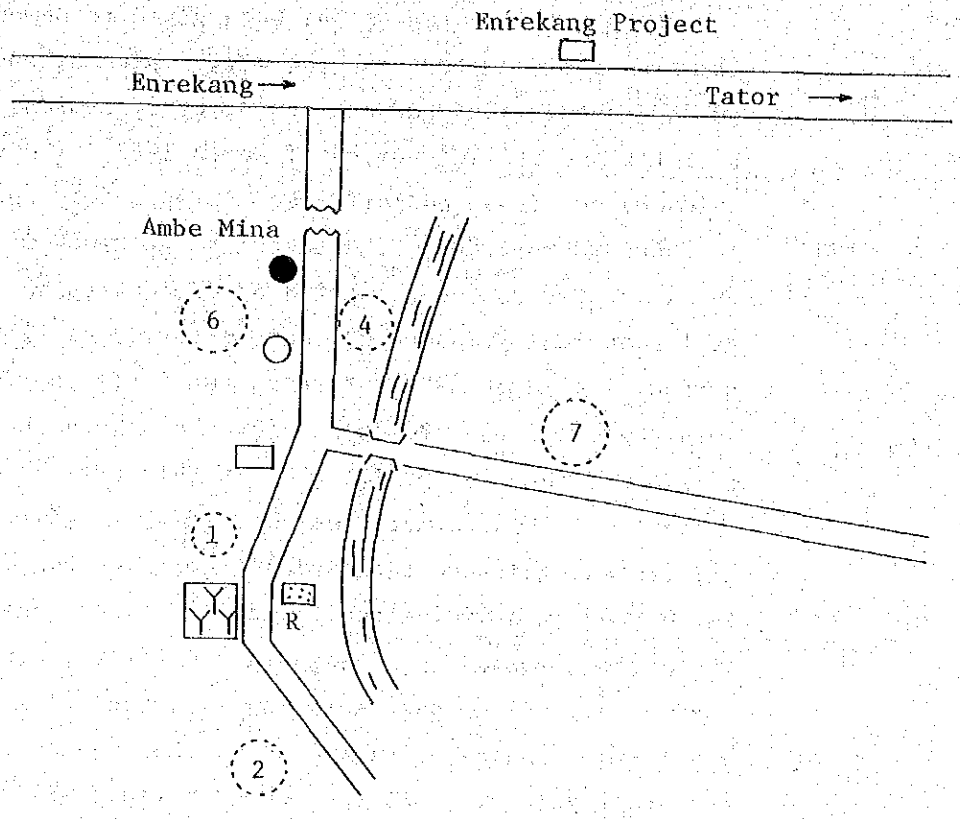


Fig. 8-7-8 Baraka Kabupaten Enrekang.

Notice ;

○ Chief of Pilot Unit.

● Demonstration farmet.

[Y] Mulberry field for young silkworms.

[∴] Place of silkworms rearing.

(◌) Number to show amount of farmers.

c) Technical guidance for demonstration farmers.

A technical guidance has been given to demonstration farmers according to the plan, i.e.: pruning conducted 60 - 80 days before leaf harvest for grown silkworms at each Pilot Unit for the rearing period of March 1982. The technical guidance could not be performed appropriately because the performance was overdue. The technical guidance was performed at the same time as the selection of demonstration farmers. The real technical guidance was not performed until the second period, i.e. June 1982. Pruning and fertilizer application were performed 60 - 80 days before leaf harvest for grown silkworms, thus in April 1982. At this time expect and counterparts visited farmers' mulberry fields, giving guidance to farmers and guidance technician concerning the method of leaf harvesting by dividing the field into blocks used alternately, the pruning method employing plant scissors, method of fertilizer application, pest spraying etc. according to the local condition. Tables 8-7-5 and 8-7-6 show the accomplished technical guidance. At the second period, which coincided with the period, of V stage silkworms, shoot growth and leaf yield in fields for grown silkworms were observed, to demonstration farmers at each Pilot Unit. Results of the observation on shoot growth and leaf yield in fields for grown silkworms are shown in Table 8-7-7. Twenty trees were observed at demonstration farmers. Table 8-7-7 shows that Mr. Tahir's field has the lowest yield, with defoliation percentage of 56 %, because of a too long time after pruning 110 days and of mulberry pyralid damage, shoots and leaf yield in another demonstration ranged between 4,500 and 12,800 kg per hectare. The above data implied a high productivity of farmers' mulberry fields where no continous pruning and leaf harvesting were conducted; plant vitality will be higher and it was stimated to be able offrearing 20 boxes of silkworms per hectare, because amount of cocoon crop 400 kg per a year. Under such circumstances, farmers' mulberry fields will have high productivity.

(M. Yamamoto, Endjang K., N. Rasyid)

Table 8-7-5. Demonstration of guidance techniques at mulberry field for grown silkworms in Pilot unit (1)

Location	Time of hakitate	Time to inform	Contents of techniques	Preface
	1982	1982		
Pising	March, 16	Feb. 10	Selection of demonstration farmers	Expert and counterpart
Luppange	March, 16	Feb. 11	- do -	- do -
Ugi	March, 17	Feb. 12	- do -	- do -
Wanio	March, 17	Feb. 12	- do -	Counterpart
Baraka	-	-	-	-
Pising	June, 1	Apr. 7	Pruning method, leaf harvesting, fertilization; pest prevention etc.	Expert and counterpart
Luppange	June, 1	Apr. 7	- do -	- do -
Ugi	June, 2	Apr. 8	- do -	- do -
Wanio	June, 2	Apr. 9	- do -	- do -
Baraka	-	-	-	-
Pising	Aug. 30	June, 16	Pruning method; leaf harvesting; fertilization; pest prevention etc.	Counterpart and Assistant counte counterpart
Luppange	Aug. 30	June, 16	- do -	- do -
Ugi	Aug. 31	June, 17	- do -	- do -
Wanio	Aug. 31	June, 18	- do -	- do -
Baraka	Sep. 2	June, 19	- do -	- do -
Pising	Oct. 13	Aug. 9	Pruning method; leaf yield; fertilization pest prevention; leaf yield estimation etc.	Counterpart and Assistant counterpart
Luppange	To stop because withered	Aug. 9	- do -	- do -
Ugi	- do -	Aug. 10	- do -	- do -
Wanio	- do -	Aug. 10	- do -	- do -
Baraka	- do -	Aug. 11	- do -	- do -

Table 8-7-6. Demonstration of guidance techniques at mulberry field for grown silkworm in Pilot unit (2).

Location	Time of hakitate	Time to inform	Contents of techniques	Preface
	1982	1982		
Pising	Dec. 20*	Oct. 88	Pruning method and leaf yield; fertilization; pest prevention	Counterpart and assistent counterpart
Luppange	Dec. 20*	Oct. 10		- do -
U g i	Dec. 21*	Oct. 7		- do -
Wanio	Dec. 21*	Oct. 9		- do -
Baraka	Dec. 23*	Oct. 7		- do -
	1983	1983		
Pising	Feb. 20*	Dec. 10*		
Luppange	Feb. 20*	Dec. 10*		
U g i	Feb. 21*	Dec. 11*		
Wanio	Feb. 21*	Dec. 11*		
Baraka	Feb. 23*	Dec. 12*		

* Activities plan.

Table 8-7-7. Shoots and leaf yield at mulberry field demonstration farmers (Pilot Unit).

Location	Name of Member	Planting space	shoot age (day)	Maximum shoot length
		m	days	cm
Pising	Tahir M.	1.0 x 1.0	110	171
	Beddu B.	1.5 x 0.5	80	106
	Ibrahim	1.0 x 1.0	80	114
Luppange	Ballu	1.0 x 0.6	80	127
U g i	Usman	1.0 x 1.0	80	121
	Balla	1.0 x 1.0	80	109
Wanio	Marawiyah	0.6 x 0.6	80	160
	Ruslan	1.0 x 1.0	80	165

Defoliation percentage	Number of shoots	Shoot + leaf yield/ tree	Shoot + leaf yield/ha	boxes/ha	Remark
%		kg	kg	boxes	
56	6.6	0.22	2,200	2	To be attack mulberry pyralid
11	7.5	0.51	6,630	6	
3	12.2	0.54	5,400	5	
17	10.0	0.77	12,800	12	
13	14.2	0.58	5,800	5	Many attacked of mulberry pyralid
9	19.6	0.74	7,400	7	
14	10.0	0.45	12,500	12	
7	6.6	0.45	4,500	4	

Note:

- twenty tress were taken as sample each farmer; box/ha (Number silkworm rearing per hectare);
- Pruning time: June 1982

(2) Survey on the actual condition of sericultural farmers.

1) Survey of mulberry cultivation at the Pilot Unit members.

The condition of sericultural farmers was observed in 120 farmers; they are all members of the Pilot Unit. The condition of mulberry cultivation will be explained as follows.

a) Conditions of location: In two regions, i.e. Soppeng and Enrekang, the land is mostly und lated and mountainous; particularly in Enrekang flat lands are rarely found. In Wajo and Sidrap, the soil is alluvial, being located near the rivers.

b) Area and type of mulberry fields: Area of mulberry field by each household in Soppeng and Enrekang are averagedly 1 ha, in Wajo 0.6 ha and in Sidrap 0.3 ha, thus the slightest in Sidrap. At farmers owning agricultural land of over 2.0 ha, paddy field percentage is the highest as compared with that of other fields. Farmers' mulberry cultivation is mostly mixed with coconut trees, particularly in Enrekang and Wajo. Pure mulberry fields occur most at Pising kabupaten Soppeng.

c) Mulberry varieties: Usually Morus nigra is used, mixed with Morus australis. At present no recommended variety Morus alba has been grown in pure cultivation.

d) Planting space: Most planting by cutting, at planting space of 1 m x 1 m is square system.

e) Methods of pruning and harvesting: The height of the main trunk varies, but it is usually 50 cm more than high from the ground. The pruning tool used is the chopping knife, and some farmers use "ani-ani" and sickle. Frequency of leaf harvesting is 3 - 4 times a year. Farmers generally use one field pruned and harvested continuously; besides, there are farmers who have divided their fields to be used alternately.

f) Mulberry field maintenance: Farmers in general do not apply fertilizer to their fields; only 20 % of the 120 farmers observed have applied fertilizers; the kind of fertilizer used is Urea. Farmers accustomed to weeding in Soppeng and Wajo occur in larger percentage than those in Sidrap and Enrekang.

g) Mulberry tree vitality: Shoot growth of mulberry plants growing in Soppeng and Wajo is better than those growing in

Sidrap and Enrekang have slightly lower productivity. Mulberry field productivity is related to the frequency of pruning and leaf harvesting in a year.

h) Mulberry pest and disease: Pest that invade mulberry plants to a large extent are: mulberry pyralid (Glyphodes pulverentalis), mealy bugs (Maconellicoccus hirsutus), mulberry scale (Pseudaulacapis pentagona) and logicorn beetles (Epepeotes plarator). Based on the area of distribution, logicorn beetles invade to a large extent in kabupaten Sidrap, smallest in Enrekang, mulberry pyralid and mealy bugs invade nearly the entire South Sulawesi. Powdery mildew (Phyllactinis moricola) and bacterial blight (Pseudomonas mori) are pest invading mulberry to a small extent.

i) Mulberry leaf yield: Farmers use mulberry leaves merely as silkworm feed, without the desire to know the weight of leaves produced; consequently there is as yet no correct data of leaf yield in farmers' fields.

(M. Fujii, S. Tomonari, Baharuddin A.)

(3) Technical assessment of sericultural farmers.

1) Mulberry cultivation.

Technical guidance is only given to demonstration farmers, while pilot unit members receive the technique from demonstration farmers by seeing or inquiry; demonstration farmers even visit the members in the neighborhood. The impact of technical transmission to all the Pilot Unit members can be known from the questionnaire made for farmers; filling up of the questionnaire was done after the completion of 2nd period silkworm rearing (June 1982).

The questionnaire was not distributed in Enrekang because the pilot unit in Enrekang has not commenced its activity before June. Data on the filling up of the questionnaire may be seen in Table 8-7-13.

a) Mulberry varieties: Until the time for questionnaire filling up, no pilot unit members has cultivated the recommended variety, because the counselling on the recommended variety could not be performed in a short time.

b) Appropriate time pruning: There was a large percentage of pilot unit members who conducted pruning at the right time; it means that farmers have learned, that overdue pruning will lead to a lower leaf yield.

Table 8-7-13. Carried out technique of mulberry cultivation in June 1982 (1).

Main techniques	Location	Number of members		Perform %	
		Perform	Not perform	Each Location	All Location
Planting of recommended variety (M. alba)	Pising	0	24	0	1
	Luppange	1	24	4	
	Wanio	0	27	0	
	U g i	0	20	0	
Right pruning time (60 - 80) days harvest)	Pising	19	5	79	93
	Luppange	23	0	100	
	Wanio	25	2	93	
	U g i	20	0	100	

Table 8-7-13. Carried out technique of mulberry cultivation in June 1982 (2).

Main techniques	Location	Number of members		Perform %	
		Perform	Not perform	Each Location	All Location
Alternate harvest by division of field	Pising	2	22	8	17
	Luppange	8	15	35	
	Wanio	1	26	4	
	U g i	4	16	20	
Cutting back (Kabunaoshi)	Pising	8	16	33	53
	Luppange	19	4	83	
	Wanio	18	8	69	
	U g i	5	15	25	
Pruning with the use of plant-scissors	Pising	3	21	13	43
	Luppange	18	5	78	
	Wanio	15	12	56	
	U g i	5	15	25	
Urea application after pruned (70 kg/ha)	Pising	19	6	76	60
	Luppange	12	12	50	
	Wanio	17	12	59	
	U g i	11	9	55	
Weeding after pruning	Pising	20	4	83	88
	Luppange	20	3	87	
	Wanio	22	5	81	
	U g i	20	0	100	
Pest control with Basudin or Dibrom	Pising	16	8	67	59
	Luppange	16	7	70	
	Wanio	23	4	85	
	U g i	3	17	15	
Average % of technique items	Pising	-	-	45	52
	Luppange	-	-	63	
	Wanio	-	-	56	
	U g i	-	-	43	

c) The alternate harvest of the mulberry field is very important for the vitality of mulberry trees: There is a small percentage of pilot unit members who have performed block division, so the technical guidance on block division should be prioriz ed.

d) Cutting back (Kabunaoshi): It was never performed by seri cultural farmers in the past, but at the present time a large percentage of pilot unit members have performed it. It may be attributable to the fact that technical guidance on the use of plant scissors has been given.

e) Fertilization and weeding: The year before only about 20 % of 120 farmers were accustomed to applying Urea to their mulberry field. There is now a large percentage 60 % of farmers who have accustomed themselves to fertilizer application, and also a large percentage of them who have weeded their fields. It implies that a change has occurred; that farmers who used to neglect their fields have now taken good care thereof.

f) Pest control: In April 1982 when it was dry season, nearly all mulberry fields were invaded by mulberry pyralid and mealy bugs; that was the best time to perform technical guidance concerning pest control in the mulberry fields. Percentage of pest-invaded farmers' mulberry fields was 60 %; the drug used for pest control was basudin or Dibrom. Most paddy field-owners/farmers perform pest control on their paddy fields with the use of sprayers. Because the pest control in mulberry fields is thus easier to perform.

g) Others: Nearly all farmers want an improvement in the condition of mulberry sields, where pruning and harvesting use plant scissors, whereas farmers have hitherto had no conscience to grow recommended mulberry variety or the conduct block division. To make farmers understand and those above-mentioned matters, technical advice and guidance are to be priorized. Qestionnaire filling up has only been performed in one period, and it will be carried on. Result of the assessment on technical guidance will show the existing problems for which solutions will be found; further on improvements are made on the vase of the guidebook and the technical guidance.

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