POTATO RESEARCH

IN

INDONESIA

RESEARCH RESULTS
in a Series of Working Papers
1998

Collaborative Research between
The Research Institute for Vegetables (RIV)
and
The International Potato Center (CIP)

INTERNATIONAL POTATO CENTER (CIP)
P.O. Box 1586, Bandung 40001 - Indonesia

RESEARCH INSTITUTE FOR VEGETABLES (RIV)
Jl. Tangkuban Perahu 517 Lembang, Bandung 40391 - Indonesia

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Foreword

This document contains working papers related to the 1998 collaborative potato research between the Research Institute of Vegetables (RIV) and the International Potato Center (CIP). The papers were presented in a Seminar held in RIV in November of 1998. A similar seminar was held in May of 1997. The seminar aims at exchanging information on research progress and reviewing research plans for the following year. I trust this document will provide readers with an overview of the potato research conducted in this partnership.

Enrique Chujoy

International Potato Center (CIP)

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Opening remarks

Respected Bapak Prabowo, Bapak Gordon, Ibu Elske, Bapak Chujoy, colleagues, and invited guests welcome to the Research Institute for Vegetables and to this Seminar on the collaborative potato research of RIV and CIP

Potato together with wheat, rice and corn are the most important staple foods in the world. Compared to other food crops, potato has the highest vitamin C and lowest calorie content. That is one reason why potato is recommended as a healthy food in diets. A single medium size potato could fulfill the daily need of vitamin C, and greatly contribute with vitamin B and iron.

In indonesia potato is used as a vegetable and, especially, for tourist consumption. Production of potato has increased every year since 1992. Likewise the demand of potato for immediate consumption or industrial use has also increased, it is because potato can complement rice as a staple food. Potato has also become an export commodity, and supports the national income. As the population increases it is expected that the consumption of potato will increase as well and thus the potato production research and development program should get our primary attention.

Production of potato faces several constraints. Among technical problems, the lack of alternative varieties and crop loss due to pest and diseases are considered prime constraints to be solved. We are fortunate that these particular problems are considered in the regional research program of CIP. Support and facilities that CIP provides for our potato research includes: 1) potato germplasm evaluation, 2) late blight, 3) potato tuber moth, and 4) bacterial wilt research. Implementation of the research activities are conducted by both RIV and CIP scientists. Twelve RIV scientists from different fields of expertise-plant breeding, plant ecophysiology, social economics, pests and diseases-are involved in this program. I hope that in the future RIV-CIP research collaboration could be broadened to other important problems and involve more RIV scientists. By broadening the research topics and involving more scientists, the solution of national problems facing potato production could be accelerated.

Today, research results of all activities will be discussed. Welcome to everybody and wish you a productive Seminar. Thank you for your attention.

Ati Srie Duriat
Director
Research Institute for Vegetables (RIV)

RIV-CIP Collaborative Potato Research

Enrique Chujoy

International Potato Center (CIP)

Highlights

In the past year, the RIV-CIP collaborative research has continued to focus on research areas of mutual interest to RIV and CIP, and where CIP had a comparative advantage in undertaking the research. These areas of research are Potato Germplasm Evaluation, Bacterial Wilt management, Potato Tuber moth control, Late Blight resistance, and utilization of True potato seed. We have continue developing our teams of researchers in the various areas of research (Table 1). Weekly meetings were conducted aimed at research planning, follow up, analysis, presentation and discussion of results.

I will present highlights of the collaborative research between the Research Institute of Vegetables (RIV) and the International Potato Center (CIP). Details of each research activity will be presented by a member of the research teams today.

Research

Potato Germplasm multiplication and evaluation

Research focuses on evaluation for potato clones with potential for variety release. High total and marketable tuber yield and suitability for processing (fried chips) have been major criteria for selection. Many of the CIP introduced clones have also resistance to either late blight or viruses. It appears that a better resolution of local breeding objectives will be valuable in identifying how can the RIV-CIP collaborative research be more effective. A major result is the identification of several high yielding potato clones which will be included in a government multi-location variety testing.

Future plans: The research will continue evaluating newly introduced potato clones. Already several advanced potato clones have been identified with potential for variety release. These advanced clones will be entered in the National Multi-location Potato Variety Trials. A guideline for the trials was jointly prepared by RIV-CIP.

Bacterial Wilt

Bacterial wilt (BW) caused by *Ralstonia solanacearum* is the main bacterial disease of potato. BW is a major concern to farmers as it may lead to crop failure. It is prevalent in most potato areas of the country. Although disease incidence is usually below 15% during the rainy season. Frequent seed sorting and selection appears to be an important practice by which farmers control BW and will continue to be studied. Research results has allowed us to better understand the importance of BW and how farmers cope with the disease. BW control components were identified and are being validated with experimental research.

Future plans: Farmers' practices to control BW will be continued together with the long term crop rotation experiment and the research on the use of bleach to control BW. Plans to integrate control practices and on farm research will be emphasized

Potato Tuber Moth

Potato tuber moth (PTM) is a mostly a storage pest, although in some locations in the country, serious foliage damage has been observed. The main concern is health hazard due the misuse and over-use of pesticides on table potatoes for export. Our research has been successful in isolating an indigenous baculovirus (also known as granulosis virus) which we demonstrated to control PTM.

Future plans : Finalize testing of efficacy of the indigenous baculovirus virus in the field and storage. Improve the mass rearing of potato tuber moth for research and baculovirus production. Plans to promote the baculovirus upon completion of the field and storage trials.

Late Blight

Phytophthora infestans is the most destructive disease. Farmers do not necessarily consider late blight an important disease, as they control it by applying fungicides. As many as 15 to 18 fungicide applications are used during the rainy season in Indonesia. Besides the high pesticide cost, there are health and environment concerns with the excessive use of fungicides. The government has a policy of reducing pesticide use in agriculture.

Future plans : The Standard International Field Trial (SIFT) will be conducted here. Potato cultivars with durable resistance to late blight have been introduced for the SIFT.

True Potato Seed (TPS)

Improved TPS progenies from CIP have been introduced and evaluated. Farmers in selected areas in the country are using TPS. Results appear to indicate variable degree of adoption.

Conferences and Training

Our collaboration has also included the strengthening of research capability by providing information on research and opportunities to attend meetings and conferences. In the past 3 years, a total of 4 scientists have participated in training courses, conferences at our CIP headquarters in Peru or international meetings in the region. Eight students from various Universities in Bandung conducted their thesis research with RIV-CIP.

Six training courses have been conducted in support of a project on farmer field training in North Sumatra since 1995 (Table 2). The courses were held in coordination with World Education, Yayasan Cinta Desa, BBTP and BBI.

Publications

A document in Indonesian language was published on the utilization of Granulosis virus to control Potato tuber moth. Another publication, a guide on major potato pests, also in Indonesian, is planned to be completed and published in 1999.

Table 1. Members of potato research teams

Research area	Member
Potato Germplasm multiplication and Evaluation	Ir. Maman Kusmana Ir. Asih Kartasih Ir. Sudjoko Sahat Dr. Anggoro Hadi Ir. Lufthi E. Chujoy
Bacterial Wilt	Ir. Onie Dr. Rofik Basuki Dr. Nikardi Gunadi Ir. Zaenal Ir Dining Istanti E. Chujoy
Potato Tuber moth	Ir. Wiwin Setiawati Ir. Rustaman E. Chujoy
Late Blight	Ir. Euis Widjaja Ir. Rachmat Sutarya E. Chujoy
True potato seed :	Dr. Rofik Basuki Dr. Nikardi Gunadi

Table 2. Potato training courses conducted in North Sumatra from 1995 to 1998

Training Course Theme	Year	Resource persons
Survey of potato production constraints	1995	E. Chujoy, S.Sahat, and M.Kusmana
Identification and control of main virus diseases of potato	1995	M. Querci, E. Chujoy, R. Sutarya, and M.Kusmana
Informal survey	1996	Chujoy, M. Kusmana, and A. Asandhi
Seed potato production and rapid multiplication techniques	1996	E. Chujoy and M. Kusmana
Fertilizer requirements of potato	1998	N. Gunadi and E. Chujoy
Bacterial wilt control in potato	1998	O. Setiani Gunawan, N. Gunadi, R.Basuki, Zaenal, D. Istanti, E. Chujoy

Rapid Multiplication of CIP Potato Materials

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Abstract

A total 173 in-vitro potato clones or cultivars introduced from CIP Peru, were multiplied with rapid multiplication techniques. Rapid multiplication technique has been widely accepted as an alternative to producing traditional tuber seed which is costly and often unavailable. Apical stem cuttings have been effectively utilized for seed multiplication.

Introduction

Potato *(Solanum tuberosum l)* has been given the highest priority in vegetable production because of its potential as an alternative carbohydrate source in food diversification and export markets.

Rapid multiplication techniques are used to increase rapidly the amount of basic seed needed to initiate the multiplication program of new varieties. The use of rapid multiplication techniques can revitalize a seed multiplication program and can become an integral part of the basic seed program. An alternative end product of rapid multiplication of potatoes are the apical stem cutting or mini tuber or tuberlets.

All rapid multiplication techniques are labor intensive and need special equipment and facilities such as insect screen house. However techniques can be practical, simple, adapted to local condition and utilize local materials. Rapid multiplication may increase the cost of potato seed. However, this is offset by the increased amount of seed produced, a reduction in the number of multiplication as well as improved seed health.

Materials and Methods

The activity has been conducted in the Tissue culture and Screen house of RIV from August 1997 until now. Three activity are currently implemented for rapid multiplication and are as follows :

Micropropagation / Cutting in vitro

Plantlets or in vitro plants introduced from CIP Peru are cut to make in-vitro nodal cutting, which consist of a part of the stem bearing one leaf and one axillary bud. Afterwards, cuttings are inoculated in a Murashige and Skoog media (Murashige and Skoog, 1962) with coconut water 100 ml/l, sugar 30 - 40 g/l, GA_3 0.1 - 0.25 mg/l, myo-inositol 100 mg/l and agar 6 - 7 g/l (Karjadi, et al 1997).

Cultures are maintained in a culture room or incubator at the temperature of 15 °C (night), 21 - 23 °C (days), a photo-period of 16 hours, and humidity of 70 - 75%. In-vitro micro-propagation or cutting is done until a sufficient number of in-vitro plantlets (IVP) are available for planting in the screen house. The in-vitro plantlets are normally ready for planting in soil mix 3 - 4 weeks inoculation.

Apical stem cutting production in the screen house.

In vitro plantlets are planted in sterilized stable manure and sub soil (1:2) mix in a screen house as mother plants. The plantlets are taken out of culture vessels and washed to remove agar media from the roots. Plantlets are planted by making a hole in the soil mix, inserting the roots of the plantlets, and pressing the soil mix around stem base and into the mix. It is recommended to avoid planting a node too deeply below the soil level. Plantlets are watered to further ensure root mix contact.

An organic fertilizer N-P-K (15-15-15) is applied every 10 days (through the watering system, at a rate of 20 g per 5 liters of water), or a nitrogen fertilizer through foliar spraying at a concentration of 0.01% and applied before or after harvesting the cuttings. Watering after planting is carried out carefully. Insecticides and fungicides are sprayed at seven to ten days intervals.

Once the mother plants are established, 3 - 4 weeks after planting, apical stem cutting which consists of 3 - 4 leaflets can be harvested at 10 - 14 days intervals. The roots of these cuttings are dipped in rooting hormone, and planted in beds inside the screen house for tuberlet or mini-tuber production, or in banana leaf-pots containing the same soil mix as described previously. These cuttings are ready for transplanting to the field 10 - 14 days after they are planted in banana leaf-pots.

Mini-tuber and tuberlet production

In the screen house, rooted cutting are used for tuberlet production. Soil media is sterilized stable manure and sub soil (1:2) mix. Cuttings are planted either in wooden beds at a density of 100 per m2 or in plastic trays (30 x 25 x 15 cm) with 40 cuttings.

During the growing period an organic fertilizer N-P-K (15-15-15) is applied every month (through the watering system at a rate of 20 g per 5 liters of water) or depending on the plant condition. Watering is done as often as necessary. Disease and insect control is carried out with weekly sprays.

Results and Discussion

Micropropagation/cutting in vitro.

A total of 173 in-vitro potato clones or cultivars (in 5 sets and shown in Table 1 to 5) were multiplied. Three or four cuttings were obtained at each multiplication. The majority of the clones grew rapidly and could be further multiplied every 3 to 4 weeks. A few clones grew slowly and were difficult to propagate. Contamination resulting from the multiplication process was less than 10 % for most clones. In vitro propagation was done three times or until a sufficient number of plantlets was available for planting in the screen house.

Apical stem cutting production in the screen house.

Mother plants were grown successfully from in-vitro plantlets of the 173 clones or cultivars (Table 1 to 5). Apical stem cuttings could be harvested from 3 to 4 weeks after planting and repeated every 10 to 14 days for a period of 3 to 4 months.

Apical stem cuttings were harvested until obtaining a sufficient number for mini-tuber production or transplanting in field. Maintaining the mother plant physiologically young or juvenile state was essential for maximum apical stem cutting production. Physiologically young or juvenile plants had simple and round leaves.

We found that apical stem cuttings can be a useful tool for potato germplasm evaluation. It enables the timely increase of new clones intended for evaluation; its rate of multiplication is high; it is a clonal propagation and there is little risk for genetic variation; and plants can be maintained pathogen- free to assure production of high quality planting materials.

Mini tubers / tuberlet production.

In the screen-house, young apical stem cuttings rooted readily and grew into vigorous plants. There was a significant effect of clones or cultivar on mini tuber production. Harvest of tubers was done at 90 to 100 days after planting for early maturing clones and 120 to 150 days for late clones, or when leaves start turned yellow or senesced. Tuber number varied with the clone and ranged from 2 to 5 per plant. It was noted that the optimum production of mini tubers or tuberlets was a function of the potato genotype and plant maintenance.

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Evaluation of 38 Potato Clones and Cultivars, in Java, Indonesia 1995 - 1998

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Abstract

Very few superior potato varieties are available for potato production in Indonesia. Therefore, tuber yield trials of 38 clones and cultivars introduced from Australia were conducted in tree locations (RIV-Lembang, Cibodas, Lembang and at Ngablak-Magelang, Central Java). The objective of the research was to identify high tuber yielding potato variety (ies) that can meet farmers or consumers preference. The introduced clones and cultivars were provided by the International Potato Center (CIP) through a research contract in Australia. The experimental design was a Randomized Complete Block Design (RCBD) with four replications. The local Cv. Granola was included for comparison. Results of the trials showed that six clones were high yielding (VC 33-9; Serrana; FBA-4; Dalisay; VC-24.16 and FLS-3). Five clones were considered to have potential for potato fried chip processing (BP 87-16.4; VC 76.1; FBA-1; FBA-4 and FLS-4). Either table potato clones or processing ones should be compared in the national multilocation trial.

Introduction

Granola is the most common potato variety in Indonesia. It is estimated to be grown on 85 to 90 % of potato area. Granola is a well adapted variety to the intensive cropping system of the highland. It has an average 90 days growing period, a short tuber dormancy of 3 to 4 months. This variety is susceptible to late blight disease (LB), caused by *Phythophthora infestans*, but moderately resistant to PLRV and resistant to PVX. Granola is best used for fresh consumption as a vegetable, although due to the lack of suitable varieties, it is also used for fried chips processing. This variety is an ideal potato for the highlands because of its high and stable yield, tuber appearance and storability.

Other potato varieties grown in Indonesia include Atlantic, Hertha, (Java and Sumatera) and recently Vanda especially in West Java. These can be used for fried chips processing, however, farmers indicated that these varieties usually have lower yields than Granola. There is a need, therefore, to evaluate more potato clones to identify potential varieties with stable and high tuber yield and good processing quality for fried chips.

This report presents results of four yield trials conducted from 1995 to 1998 at Lembang, Cibodas and Ngablak.

Materials and Methods

The yield trials were conducted at three locations i.e. Experimental field of the Research Institute of Vegetable (RIV); farmer field at Cibodas (twice) and at Ngablak (Magelang). A total of 38 advanced clones and cultivars were compared for their tuber yields. The cultivars Achirana, Granola, Kennebec, Red Pontiac and Serrana were included for comparison. Seed tubers were received from the Institute of Horticultural Development (IHD) Victoria, Australia. Seed tuber of cultivar Granola was obtained from RIV.

The first yield trial was carried out at RIV (1250 m a.s.l) from September 25, to December 27, 1995. The experimental design was a Randomized Complete Block Design with 4 replications. An experiment unit consisted of a plot with 10 hills of each clone. Thirty six clones and varieties were compared. Horse manure was applied at a rate of 20 ton/ha, 3 days before planting. Chemical fertilizer consisted of Urea at 500 kg/ha; Triple Super Phosphate (TSP) at 300 kg/ha and Potassium Chloride (KCl) at 200 kg/ha. This is equivalent to 225 Nitrogen, 135 P_2O_5 and 120 K_2O in kg/ha. The Urea was split, half applied at planting and the other half at 3 weeks after planting (WAP). Other fertilizers were applied at planting. Plant spacing was 80 cm x 30 cm.

The second field trial was carried out of Cibodas, Lembang, Bandung, West Java (1400 m a.s.l) from November 1996 to February 1997. Thirty six varieties and clones compared. Fertilizer was 666 kg Urea, 1125 kg TSP and 375 kg K_2o / ha Half of the urea was applied at planting and the other half at 3WAP. This is equivalent to 300 Nitrogen, 225 P_2 O5 and 225 Potassium in kg / ha. Plant spacing was 75 cm x 25 cm.

The third yield trial was conducted at Ngablak, Magelang, Central Java (1400 m a.s.l), from August to November 1997. Fertilizer and plant spacing were similar to those of the second experiment.

The 4th yield trial was conducted at Cibodas, in 1998. Thirty eight clone and varieties were compared. Fertilizer and spacing were similar to those of the second experiment.

Dithane M 45 (mancozeb) was sprayed to control late blight at a rate of 3,6 kg/ha, together with Bayrusil (Kuinalpos 5%) to control insect pests at 2,4 l /ha. Other pesticides (Padan and Confidor) were applied at a rate of 2 l / ha to control leaf miner flies, aphids and thrips. Spray volume was on average 800 l/ ha.

Data gathered included, at plant growing stage: Late blight (LB) score from 1= no damage to 9 = dead plant. At harvest, data included tuber number per plant, tuber yield per plant, tuber size, percentage of marketable tuber and tuber specific gravity (S. G). Dry matter and starch were obtained from tables by Simmonds (1977) and Houglands (1966). Total sugar content was obtain through a digital refractometer PR-10 Atago and glucose content was obtained buy using the rapid test "Chips color tester for sugar (glucose). Determination in Potatoes Only " of Elango Product Ccompay, USA.

Potato fried chip were compared using a Color Reference Standard for Potato Chips (B.L. Thomas and Associates, Ohio, USA) .

Results and Discussion

Inspite the applications fungicide to control late blight, several varieties showed foliage damage by the disease. Score of late blight damage in the foliage at RIV and Cibodas (1998) are pressented in Table 1. An average 10 clones had LB scores ranging from 1.00 to 1.50. These were VC 75.11; 2.36-20; VC 33.9; VC 88.14; 2-5.5;2-66.3;2-120.3; FBA 4; FLS-4 and 2-43.3.

The mean number of tubers per plant in presented inTable 2. Eight clones had the highest tuber number per plant . These were FBA-4; VC 38.6; FBA-6; B.87.16.4; VC 76.1; VC 75.3 and VC 81.2. Compared with Granola, they had significantly higher number of tubers at each site. The ideal number of tubers per plant are 10 to 15 (Ivins and Milthorpe, 1963). If the number is less than 10, the tuber tends to be oversized, and if more than 15, they tends to be of non-marketable size.

Mean tuber yield per plant is presented in Table 3. The highest tuber yielding clones were: VC 24.16 (516 g); FBA-4 (515 g); VC-33.9 (512 g); VC 38.6 (508 g); VC 88.8 (475 g); FLS.2 (444 g) and Dalisay (441 g). The cultivar Granola yielded 363 g per plant.

The mean tuber size is presented in Table 4. The clones with largest size (45 to 66 g) were : Sequoia; 2-36.20; VC 33.9; Serrana; 2.120-9; FLS-2; Kennebec; Daekwar and FS-3. The percentage marketable tubers is presented in Table 5. Eleven clones had a percentage marketable tuber ranging from 60% to 79%. They were DTO-28 (79%); Kennebec (76%); Serrana (73%); Daekwar (71%); 2.36-20 (68%); Dalisay (63%); VC 33.9 (62%); Sequoia (62%); VC 24.16 (61%); VC- 75.3 (60%) and VC 88.8 (60%). According to farmers at Cibodas, their ideal percentage of marketable tubers was 70%.

The clones were ranked according to their late blight score, number of tubers per plant, tuber yield, tuber size and marketable tuber yield and are presented in Table 6. The lower rank value, the better the clones is represents the better clones. An overall average was obtained. Six clones that considered promising clones for table potato; i.e : VC 33.9; Serrana; FBA-4; Dalisay; VC 24.16 and FLS-3.

The specific gravity of tubers is an important measure of quality used extensively by processors to assess the suitability for the production of french fries, chips and dehydrated product. The yield of a product is higher per unit fresh weight from tubers with a high solids content. The value of specific gravity and other tuber quality components are presented in Table 7. Five clones are considered for processing potato because of their superior quality in all aspects (specific gravity, dry matter; starch content; total sugar content; reducing sugars; chips color; flesh color). These clones are BP 86-16.4; VC 76-1; FBA-1; FBA-4 and FLS-4.

A low content of reducing sugars (0.1% fresh weight) is ideal for the manufacture of fried chips, whereas higher than 0.33% is unacceptable (Dale and Mackay, 1994). Reducing sugars (glucose, fructose, sucrose) react with α amino acids during the frying process resulting in dark brown fries. The color can be controlled to a certain extent by applying, among others, variation in slice thickness, frying temperature and time, blanching, etc. Total sugar content is positively correlated with reducing sugars. Hence, a low total sugar content can be used to approximately identify potato clones with low reducing sugars.

The clones are being analyzed for their tuber yield stability.

Conclusions

Best clones for table use were VC 33.9, Serrana, FBA-4, Dalisay, VC 24.16 and FLS-3.

Best clones for processing quality (fried chips) use were BP 87.16.4, VC 76.1, FBA-1, FBA-4 and FLS-4.

Best clone for table and processing use was FBA-4.

Recommendations

The best clones will be included in the national program of multilocation trials.

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Table 1. Late blight foliage damage score of 38 potato clones at two locations

NO	CLONE NO.	CIP CODE	NAME OF CULTIVAR	LATE BLIGHT (SCORE: 1-9) Lembang	Cibodas	Average
1	23	720087	Serrana	2.0	2.0	2.0
2	24	720088	Dalisay	2.5	2.0	2.2
3	102	380605.16	VC.24.16	1.5	4.0	2.8
4	103	380523.6	VC.38.6	3.0	2.0	2.5
5	108	BP86035.4	B87.16.4	5.5	2.0	3.8
6	112	384558.10	FBA-4	1.0	2.0	1.5
7	113	381064.3	BW-6	3.0	1.0	2.0
8	114	384068.17	FLS-1	4.0	2.0	3.0
9	115	384091.11	FLS-2	7.5	4.0	5.8
10	116	385080.9	FLS-3	2.0	1.0	1.5
11	117	385130.5	FLS-4	8.5	2.0	5.2
12	118	385130.11	FLS-5	8.0	4.0	6.0
13	120	380501.9	VC 33.9	1.5	1.0	1.2
14	121	382013.5	VC 46.5	4.5	4.0	4.8
15	122	384071.3	VC 75.3	4.0	1.0	2.5
16	123	384071.11	VC 75.11	-	1.0	1.0
17	124	384085.1	VC 76.1	4.0	1.0	2.5
18	125	384101.2	VC 81.2	2.5	2.0	2.8
19	127	384112.8	VC 88.8	2.5	2.0	2.8
20	128	384112.14	VC 88.14	1.5	1.0	1.2
21	129	384011.3	FBA-3	1.0	3.0	2.0
22	130	385313.4	FBA-6	4.5	4.0	4.2
23	133	BP86152.7	FBA-8	1.0	3.0	2.0
24	134	384002.1	FBA-1	5.0	2.0	3.5
25	135	BP86044.3	FBA-7	3.0	2.0	2.5
26	136	384008.5	FBA-2	1.5	2.0	1.8
27	141	801014	2.5-5	1.5	1.0	1.2
28	-	800169	DTO-28	-	5.0	5.0
29	143	801016	2-36.20	1.0	1.0	1.0
30	144	801017	2-43.3	2.0	1.0	1.5
31	145	801018	2-66.3	1.5	1.0	1.2
32	146	801019	2-120.9	1.5	2.0	1.2
33	147	801021	Jopung	9.0	3.0	6.0
34	148	801022	Daekwar 48	8.5	3.0	5.8
35	-	-	Sequoia	9.0	3.0	6.0
36	-	800098	Kennebec	2.0	2.0	2.0
37	-	-	Red Pontiac	9.0	2.0	5.5
38	-	800959	Granola	9.0	3.0	6.0
	Mean			3.8	2.0	
	CV (%)			27.3	47.0	
	LSD 5 %				1.0	

Table 2. Tuber number per plant of 38 potato clones at four locations

NO	CLONE NO.	CIP CODE	NAME OF CULTIVAR	TUBER NUMBER / PLANT Lembang 1995	Cibodas 1996	Ngablak 1997	Cibodas 1998	Average
1	23	720087	Serrana	5	13	7	11	9
2	24	720088	Dalisay	6	17	11	11	11
3	102	380605.16	VC.24.16	7	24	13	14	14
4	103	380523.6	VC.38.6	9	25	15	19	17
5	108	BP86035.4	B87.16.4	10	25	15	13	16
6	112	384558.10	FBA-4	13	20	22	19	18
7	113	381064.3	BW-6	12	16	14	11	13
8	114	384068.17	FLS-1	11	23	8	12	14
9	115	384091.11	FLS-2	6	15	7	8	9
10	116	385080.9	FLS-3	9	15	10	10	11
11	117	385130.5	FLS-4	5	17	7	8	9
12	118	385130.11	FLS-5	6	18	7	9	10
13	120	380501.9	VC 33.9	9	14	10	10	11
14	121	382013.5	VC 46.5	6	15	13	8	10
15	122	384071.3	VC 75.3	-	-	10	18	14
16	123	384071.11	VC 75.11	5	13	7	9	8
17	124	384085.1	VC 76.1	9	32	10	12	16
18	125	384101.2	VC 81.2	9	22	8	17	14
19	127	384112.8	VC 88.8	9	16	7	11	11
20	128	384112.14	VC 88.14	6	20	16	9	13
21	129	384011.3	FBA-3	8	21	11	10	12
22	130	385313.4	FBA-6	12	26	15	12	16
23	133	BP86152.7	FBA-8	12	20	15	7	14
24	134	384002.1	FBA-1	9	17	11	9	9
25	135	BP86044.3	FBA-7	10	14	15	8	12
26	136	384008.5	FBA-2	9	14	12	14	12
27	141	801014	2.5-5	5	13	7	7	8
28	-	800169	DTO-28	-	-	9	9	9
29	143	801016	2-36.20	4	8	7	6	6
30	144	801017	2-43.3	8	14	11	7	10
31	145	801018	2-66.3	6	18	12	12	12
32	146	801019	2-120.9	6	11	7	6	8
33	147	801021	Jopung	8	15	8	11	10
34	148	801022	Daekwar 48	5	12	8	20	11
35	-	-	Sequoia	5	14	-	6	8
36	-	800098	Kennebec	6	15	5	9	9
37	-	-	Red Pontiac	7	13	7	13	10
38	-	800959	Granola	6	12	9	14	13
	Mean			7.63	17.2	10.2	10.9	
	CV (%)			29.6	29.5	35.4	41.7	
	LSD 5 %			3.20	7.11	5.0	6.1	

Table 3. Tuber yield per plant of potato clones at four locations

NO	CLONE NO.	CIP CODE	NAME OF CULTIVAR	YIELD / PLANT (GRAM) Lembang 1995	Cibodas 1996	Ngablak 1997	Cibodas 1998	Average
1	23	720087	Serrana	204	656	413	544	404
2	24	720088	Dalisay	265	735	448	315	441
3	102	380605.16	VC.24.16	280	915	397	470	516
4	103	380523.6	VC.38.6	209	874	356	594	508
5	108	BP86035.4	B87.16.4	260	850	251	309	418
6	112	384558.10	FBA-4	402	765	371	522	515
7	113	381064.3	BW-6	277	490	327	309	351
8	114	384068.17	FLS-1	186	581	199	351	329
9	115	384091.11	FLS-2	148	884	345	400	444
10	116	385080.9	FLS-3	319	858	198	311	422
11	117	385130.5	FLS-4	145	573	285	148	288
12	118	385130.11	FLS-5	193	638	346	181	340
13	120	380501.9	VC 33.9	404	943	240	462	512
14	121	382013.5	VC 46.5	169	245	265	245	231
15	122	384071.3	VC 75.3	-	-	335	401	366
16	123	384071.11	VC 75.11	157	548	238	387	333
17	124	384085.1	VC 76.1	271	619	209	197	324
18	125	384101.2	VC 81.2	301	679	241	350	393
19	127	384112.8	VC 88.8	393	695	423	389	475
20	128	384112.14	VC 88.14	328	652	375	178	383
21	129	384011.3	FBA-3	225	574	217	299	329
22	130	385313.4	FBA-6	293	712	310	195	378
23	133	BP86152.7	FBA-8	262	568	165	174	292
24	134	384002.1	FBA-1	256	677	194	318	361
25	135	BP86044.3	FBA-7	252	575	224	157	302
26	136	384008.5	FBA-2	216	392	152	284	261
27	141	801014	2.5-5	212	695	189	251	337
28	-	800169	DTO-28	-	-	317	333	163
29	143	801016	2-36.20	206	609	220	261	324
30	144	801017	2-43.3	239	484	185	218	282
31	145	801018	2-66.3	220	780	281	260	385
32	146	801019	2-120.9	273	564	169	143	287
33	147	801021	Jopung	302	560	461	236	390
34	148	801022	Daekwar 48	224	617	467	357	416
35	-	-	Sequoia	223	683	363	268	384
36	-	800098	Kennebec	323	561	309	352	368
37	-	-	Red Pontiac	228	518	418	314	370
38	-	800959	Granola	176	532	363	382	363
	Mean			251	647	293	309	
	CV (%)			35.98	21.37	29.90	29.00	
	LSD 5 %			126.6	193.9	122.9	126.0	

Table 4. Average tuber size of 38 potato clones at three locations

NO	CLONE NO.	CIP CODE	NAME OF CULTIVAR	AVERAGE TUBER SIZE (GRAM) Lembang 1995	Cibodas 1996	Cibodas 1998	Average
1	23	720087	Serrana	44	58	50	51
2	24	720088	Dalisay	43	46	28	39
3	102	380605.16	VC.24.16	40	41.4	41	41
4	103	380523.6	VC.38.6	23	36	32	30
5	108	BP86035.4	B87.16.4	27	35	26	29
6	112	384558.10	FBA-4	32	45	31	36
7	113	381064.3	BW-6	25	31	27	28
8	114	384068.17	FLS-1	22	28	29	26
9	115	384091.11	FLS-2	26	62	53	47
10	116	385080.9	FLS-3	34	57	44	45
11	117	385130.5	FLS-4	29	46	20	32
12	118	385130.11	FLS-5	33	37	19	30
13	120	380501.9	VC 33.9	44	69.4	48	54
14	121	382013.5	VC 46.5	27	17	30	25
15	122	384071.3	VC 75.3	-	-	24	24
16	123	384071.11	VC 75.11	34	42	45	40
17	124	384085.1	VC 76.1	30	22	17	23
18	125	384101.2	VC 81.2	38	40	22	33
19	127	384112.8	VC 88.8	45	44	38	42
20	128	384112.14	VC 88.14	54	37	24	38
21	129	384011.3	FBA-3	27	31	23	27
22	130	385313.4	FBA-6	25	27	17	23
23	133	BP86152.7	FBA-8	23	28	17	23
24	134	384002.1	FBA-1	29	40	45	38
25	135	BP86044.3	FBA-7	27	42	19	29
26	136	384008.5	FBA-2	23	28	21	24
27	141	801014	2.5-5	41	54	36	44
28	-	800169	DTO-28	-	-	42	42
29	143	801016	2-36.20	48	75	46	56
30	144	801017	2-43.3	31	35	31	32
31	145	801018	2-66.3	41	43	21	35
32	146	801019	2-120.9	51	73	24	49
33	147	801021	Jopung	45	49	22	39
34	148	801022	Daekwar 48	47	55	36	46
35	-	-	Sequoia	50	54	95	66
36	-	800098	Kennebec	52	44	44	47
37	-	-	Red Pontiac	34	42	25	37
38	-	800959	Granola	26	49	29	35
	Mean			35	49	32	
	CV (%)			27.48	23.00	68.00	
	LSD 5 %			3.2	20.6	31.0	

Table 5. Percentage of marketable tubers of 38 clones at four locations

NO	CLONE NO.	CIP CODE	NAME OF CULTIVAR	MARKETABLE TUBER (%) Lembang 1995	Cibodas 1996	Ngablak 1997	Cibodas 1998	Average
1	23	720087	Serrana	56	68	83	84	73
2	24	720088	Dalisay	56	56	73	68	63
3	102	380605.16	VC.24.16	45	55	66	78	61
4	103	380523.6	VC.38.6	21	48	51	78	50
5	108	BP86035.4	B87.16.4	21	35	24	57	34
6	112	384558.10	FBA-4	35	41	38	84	50
7	113	381064.3	BW-6	11	41	54	42	37
8	114	384068.17	FLS-1	21	34	38	65	40
9	115	384091.11	FLS-2	11	66	69	85	58
10	116	385080.9	FLS-3	34	66	38	83	55
11	117	385130.5	FLS-4	24	28	55	41	37
12	118	385130.11	FLS-5	25	40	72	41	45
13	120	380501.9	VC 33.9	52	69	44	83	62
14	121	382013.5	VC 46.5	19	23	17	65	31
15	122	384071.3	VC 75.3	-	-	66	54	60
16	123	384071.11	VC 75.11	30	51	69	79	57
17	124	384085.1	VC 76.1	23	26	42	27	30
18	125	384101.2	VC 81.2	49	39	64	55	52
19	127	384112.8	VC 88.8	46	53	73	68	60
20	128	384112.14	VC 88.14	64	52	38	52	52
21	129	384011.3	FBA-3	27	32	40	47	37
22	130	385313.4	FBA-6	18	29	34	39	30
23	133	BP86152.7	FBA-8	12	32	7	30	20
24	134	384002.1	FBA-1	9	47	10	62	32
25	135	BP86044.3	FBA-7	26	49	3	23	25
26	136	384008.5	FBA-2	15	28	20	65	32
27	141	801014	2.5-5	49	55	60	67	58
28	-	800169	DTO-28	-	-	77	81	79
29	143	801016	2-36.20	46	79	76	78	69
30	144	801017	2-43.3	40	41	28	70	45
31	145	801018	2-66.3	33	53	41	44	43
32	146	801019	2-120.9	68	81	56	32	59
33	147	801021	Jopung	49	56	84	47	59
34	148	801022	Daekwar 48	61	60	82	82	71
35	-	-	Sequoia	47	60	-	78	62
36	-	800098	Kennebec	68	72	83	80	76
37	-	-	Red Pontiac	36	55	88	55	59
38	-	800959	Granola	18	62	66	66	53
	Mean			35	49	53	60.	
	CV (%)			39.59	23.00	30.10	23.00	
	LSD 5 %			19.41	15.95	22.20	20.00	

Table 6. Rank of clone on each category

NO	CLONE NO.	CIP CODE	NAME OF CULTIVAR	L.B	Tuber Number	Tuber Yield	Tuber Size	Market	Average
	23	720087	Serrana	5	20	11	4	3	8.60
2	24	720088	Dalisay	6	14	7	14	6	9.40
3	102	380605.16	VC.24.16	8	5	1	24	9	9.40
4	103	380523.6	VC.38.6	7	2	4	25	20	11.60
5	108	BP86035.4	B87.16.4	10	4	9	27	27	15.40
6	112	384558.10	FBA-4	3	1	2	18	20	8.80
7	113	381064.3	BW-6	5	8	23	28	25	17.80
8	114	384068.17	FLS-1	9	7	26	30	24	19.20
9	115	384091.11	FLS-2	16	20	6	6	14	12.40
10	116	385080.9	FLS-3	3	15	8	9	16	10.20
11	117	385130.5	FLS-4	14	20	32	23	25	22.80
12	118	385130.11	FLS-5	17	19	24	26	22	27.00
13	120	380501.9	VC 33.9	2	16	3	3	9	6.20
14	121	382013.5	VC 46.5	12	18	25	31	29	23.00
15	122	384071.3	VC 75.3	7	6	20	32	10	15.00
16	123	384071.11	VC 75.11	1	22	27	13	1	15.60
17	124	384085.1	VC 76.1	7	4	29	35	31	21.20
18	125	384101.2	VC 81.2	8	6	12	21	18	19.00
19	127	384112.8	VC 88.8	8	17	5	11	10	13.80
20	128	384112.14	VC 88.14	2	9	16	16	19	12.40
21	129	384011.3	FBA-3	5	10	28	29	26	24.50
22	130	385313.4	FBA-6	11	3	17	33	30	31.33
23	133	BP86152.7	FBA-8	5	7	31	34	33	36.66
24	134	384002.1	FBA-1	10	20	22	16	28	19.20
25	135	BP86044.3	FBA-7	7	13	30	27	32	21.80
26	136	384008.5	FBA-2	4	11	34	32	28	21.88
27	141	801014	2.5-5	2	24	25	10	14	15.00
28	-	800169	DTO-28	13	20	26	12	1	14.40
29	143	801016	2-36.20	1	26	27	2	5	12.20
30	144	801017	2-43.3	3	19	33	22	21	19.60
31	145	801018	2-66.3	2	12	14	19	23	14.00
32	146	801019	2-120.9	2	25	32	5	11	15.00
33	147	801021	Jopung	17	18	13	15	12	15.00
34	148	801022	Daekwar 48	16	14	10	8	4	10.40
35	-	-	Sequoia	17	23	15	1	8	12.80
36	-	800098	Kennebec	5	21	19	7	2	10.80
37	-	-	Red Pontiac	15	19	18	17	13	16.40
38	-	800959	Granola	17	8	21	20	17	16.60

Table 7. Tuber and processing quality of 38 potato clones

NO	CLONE NO.	CIP CODE	NAME OF CULTIVAR	S.G	D.M	Starch	Sugar Total	Cont. (%) Gluc.	D.W G/ 100g	Chips Color	Flesh Color
1	23	720087	Serrana	1.095	23.9	17.53	3.8	0.25	15.40	7	4
2	24	720088	Dalisay	1.067	18.7	12.64	3.9	0.10	18.50	4	4
3	102	380605.16	VC.24.16	1.059	17.2	11.22	4.0	0.05	18.55	4	3
4	103	380523.6	VC.38.6	1.067	18.7	12.64	2.8	0.10	18.19	3	2
5	108	BP86035.4	B87.16.4	1.104	25.6	19.18	3.3	0.01	20.40	4	2
6	112	384558.10	FBA-4	1.075	22.0	14.06	4.3	0.05	22.81	3	2
7	113	381064.3	BW-6	1.068	18.9	12.83	3.0	0.10	18.20	2	4
8	114	384068.17	FLS-1	1.059	17.2	11.22	4.8	0.10	21.30	5	3
9	115	384091.11	FLS-2	1.074	20.0	13.87	4.5	0.10	17.55	6	4
10	116	385080.9	FLS-3	0.064	18.1	12.07	3.4	0.25	18.23	6	2
11	117	385130.5	FLS-4	1.075	22.0	14.06	4.7	0.05	18.45	3	2
12	118	385130.11	FLS-5	1.069	19.1	12.97	5.0	0.175	20.76	4	2
13	120	380501.9	VC 33.9	1.078	20.8	14.63	3.4	0.05	19.85	3	4
14	121	382013.5	VC 46.5	1.52	15.8	9.89	2.6	0.25	20.32	5	4
15	122	384071.3	VC 75.3	1.067	18.7	12.64	3.9	0.10	21.77	3	4
16	123	384071.11	VC 75.11	1.066	18.5	12.45	3.4	0.05	20.00	3	4
17	124	384085.1	VC 76.1	1.078	20.8	14.63	5.2	0.05	21.77	2	2
18	125	384101.2	VC 81.2	1.064	18.1	12.07	2.5	0.10	15.89	2	4
19	127	384112.8	VC 88.8	1.075	22.0	14.06	3.9	0.10	21.00	4	4
20	128	384112.14	VC 88.14	1.069	19.1	12.97	3.7	0.175	20.11	4	4
21	129	384011.3	FBA-3	1.060	17.4	11.41	3.9	0.10	17.00	5	4
22	130	385313.4	FBA-6	1.066	18.5	12.45	4.5	0.10	22.44	3	2
23	133	BP86152.7	FBA-8	1.070	19.2	13.11	3.3	0.05	18.09	1	4
24	134	384002.1	FBA-1	1.080	21.2	15.00	3.5	0.10	22.31	4	1
25	135	BP86044.3	FBA-7	10.60	17.4	11.41	3.2	0.50	17.55	7	2
26	136	384008.5	FBA-2	1.046	13.6	8.75	2.2	0.05	14.38	5	4
27	141	801014	2.5-5	1.058	17.0	11.03	4.0	0.375	16.23	5	2
28	-	800169	DTO-28	1.059	17.2	11.22	3.4	0.25	15.61	2	1
29	143	801016	2-36.20	1.070	19.2	13.11	3.3	0.50	16.32	6	4
30	144	801017	2-43.3	1.048	14.0	9.13	3.5	0.25	18.71	5	2
31	145	801018	2-66.3	1.058	17.0	11.03	2.7	0.25	16.50	4	2
32	146	801019	2-120.9	1.052	15.8	9.89	3.0	0.10	14.90	4	4
33	147	801021	Jopung	1.058	17.0	11.03	3.3	0.05	14.07	2	4
34	148	801022	Daekwar 48	1.058	17.0	11.03	3.1	0.50	13.00	7	1
35	-	-	Sequoia	1.066	18.5	12.45	2.9	0.25	15.00	2	1
36	-	800098	Kennebec	1.065	18.3	12.26	4.0	0.10	17.44	5	1
37	-	-	Red Pontiac	1.046	13.6	8.75	4.0	0.175	16.17	5	2
38	-	800959	Granola	1.064	18.1	12.07	2.9	0.10	15.68	5	4

Fried chips color: 1=light to 9=dark
Flesh color: 1=white; 2=cream; 3=pale yellow; 4=yellow

Potato germplasm evaluation for tuber yield in Indonesia in 1997 / 98

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Abstract

The development of improved potato varieties is a priority in the government potato program in Indonesia. A total of 97 advanced potato clones and cultivars have been introduced from the International Potato Center (CIP) and evaluated in for tuber yield in 1997 and 1998. The trials have the objective to identify best clones with high tuber yield in the highlands of West Java. Sets of 20, 30 and 45 advanced clones and cultivars were compared using experimental design at Cibodas and Lembang in West Java. Among the highest yielding clones and cultivars were MF II, AGB 69.1, I-1062, Cruza 27, Gikungu, 379420.1, ASN 69.1, Maria tambena, CFJ-69.1 and XY-17. Further tuber yield trials will be conducted to verify their superiority.

Introduction

Potato production in Indonesia has increased from 230,400 in the year 1978 to 877,146 tons in 1995. The main potato variety is Granola which was introduced in the country in the early 1980s.

Research on the development of potato varieties derived from the CIP world potato collection and breeding program was conducted in the mid- and late-1980s in Indonesia by the Research Institute of Vegetables (RIV) in a collaboration with the Southeast Asian Potato Program for Research and Development network (SAPPRAD). Potato clones introduced from CIP were evaluated for tuber yield in the warm mid-elevations. Although a few potato clones were identified as potentially suitable for this agro-ecology, the main potato production areas remained in the cool highlands of the country.

The demand for potato varieties suitable for processing, i.e. for fry chips, has increased in recent years (Witono et. al., 1996). Processing potato varieties have been introduced and grown by farmers under contract with processing companies. However these varieties, such as Atlantic, Hertha and Kennebec, have not been grown as widely as Granola.

Research on the evaluation of advanced potato clones and cultivars introduced from CIP for the highlands of Indonesia started in 1995 under a RIV-CIP research project collaboration. The ultimate goal of this research is to identify potato clones with potential to be further evaluated in the government multi-location variety testing scheme and released as varieties. This report presents the results of evaluating CIP's advanced potato clones and varieties for tuber yield in 1997 and 1998. Results of evaluating CIP advanced potato clones and cultivars, initially selected in other Southeast Asian countries, using seed tubers multiplied in Australia are presented by Sahat et. Al. in this proceedings.

Materials and methods

Experiments were conducted at Cibodas (1350 m asl) and in the experimental fields of the Research Institute of Vegetables (1,250 masl) in West Java.

A total of 97 different advanced potato clones and cultivars were introduced in the form of pathogen tested in-vitro plantlets from CIP-Lima and evaluated for tuber yield in 3 trials in 1997 and 1998. The first set of 20 advanced clones and cultivars were rapidly multiplied from in vitro plantlets in a glasshouse to produce minitubers. These minitubers were used as planting material in the yield trial. The second and third set consisted of 30 and 45 advanced clones and cultivars. Apical stem cuttings of these clones were used as planting material in the yield trial. The reason for using minitubers and apical stem cuttings as planting material was to accelerate the tuber yield evaluation process. In all 3 yield trials, the potato cultivars Granola, Desiree and / or Atlantic were included for comparison. The kind assistant of Ir. Asih Kartasih in the rapid multiplication of the clones is acknowledged.

Unless indicated otherwise, the following experimental design and agronomic practices were common to the 3 yield trials. The experimental design was a Randomized Complete Block Design with 4 replications. The experimental unit was a 10-hill plot. Plant spacing was 0.3m x 0.7 m. Mixed cow and chicken manure was applied at the rate of 30 t/ha, two days before planting. Chemical fertilizer was 200-160-150 kg/ha of N-P-K. The nitrogen fertilizer was split into equal amounts and applied at planting and 30 days after planting (DAP). Other fertilizers were applied at planting. The nematicide Curater was applied at a rate of 20 kg/ha at planting time. Dithane M-45 was used to control late blight at a rate 4 kg / ha. Decis and Curacron were sprayed to control cutworm and aphids at a rate of 2.4 l / ha and spray volume of 800 l /ha. The potato were irrigated during the dry season trials.

Data gathered included:

1. Plant stand: number per plot at 3 weeks after planting
2. Plant vigor: score scale of 1= very poor, 3= poor, 5= average, 7= good, 9= very vigorous, and recorded at 6 and 9 weeks after planting
3. Plant appearance: score scale of 1=poor; 3= medium; 5= good, and recorded at 7 weeks after planting
4. Late blight foliage damage: score scale of 1= no damage, 3= 10 % , 5= 50 % , 7= 90 %, 9= 100 % foliage damage, and recorded at 9 weeks after planting.
5. Plant height: measured in cm. and recorded at 8 weeks after planting
6. Canopy cover: measured with a canopy grid and recorded at 9 weeks after planting
7. Tuber yield, number of tubers per plant and average tuber size
8. Fried chip color: score ranging from 1= very light to 9= dark colored chips

Results and Discussion

Meteorological data

The monthly maximum, minimum and mean temperature, rainfall, relative humidity, and evaporation from August 1997 to July 1998 are presented in Table 1. Data from September to June indicate that monthly maximum and minimum temperature ranged, respectively, from 24.7 to 28.0, and from 11.6 to 17.6. The warmest month was January and the coolest was August. The months of September and October 1998 were dry with little rainfall (1.4 and 0.0 mm., respectively) followed by a distinct rainy season from November 1997 to June 1998 with an accumulative rainfall of 1949.2 mm.

Tuber yield trial 1

Plant growth parameters, tuber yield and yield components of 20 advanced clones and cultivars using minitubers as planting material are presented in Table 2. Plant stand and vigor of the potato clones were comparable to those of the local cultivar Granola; with the exception of the clones 382197.7, 380583.8 and 379673.150 which had poor plant vigor. Granola was the shortest among treatments.

At harvest, the overall mean percentage of hill harvested was only 72 % which may be partially attributed to the combination of drought and limited irrigation during the first 9 weeks after planting, and the small seed tuber size. Mean tuber yield ranged from 109 to 384 g with an overall mean of 193 g.

Tuber yield trial 2

Plant growth parameters, tuber yield and yield components of 30 advanced clones and cultivars using apical stem cuttings as planting material are presented in Table 3. Initial plant growth in the first 9 weeks after planting was unsatisfactory as reflected by the overall mean canopy cover of only 40%. Drought and limited irrigation during the first 9 weeks after planting appears to have negatively affected plant growth of the apical stem cuttings.

Mean hills harvested was only 63%. Mean tuber yield ranged from 19 to 462 g/hill. Overall mean tuber yield was comparable to the previous trial using minitubers. The best clones for tuber yield were Gikungu, Maria Tambena, and XY-17 which significantly outyielded the local cultivar Granola.

Tuber yield trial 3

Plant growth parameters, tuber yield and yield components of 45 advanced clones and cultivars using apical stem cuttings as planting material are presented in Table 4. Plant growth of the clones was better than those in the previous two yield trials as reflected by the better plant vigor and canopy cover. This yield trial was conducted during the rainy season. Overall mean plant vigor at 9 weeks after transplanting (WAT) was 7 from a scale ranging from 1 to a maximum of 9. Mean canopy cover was satisfactory ranging from 17 to a high 100% with an overall mean for the 45 clones of 79%. Most clones exceeded 90% canopy cover. Late blight (LB) occurred despite fungicide applications. The most susceptible clones were 379706.34 (LT-9), 378015.16 (TS-2), Atlantic, 377957.5 (LT-5), 377850.1 (BW-10), Granola, 380605.16 (VC24-16), and Desiree which had scores exceeding 4. In contrast the overall mean LB score for all 45 clones was 2. The high susceptibility to LB of these 8 clones explains the reduction of their plant vigor at 6 and 9 WAT.

Mean tuber yield ranged from 78 to 569 g/hill. The highest tuber yielding clones were IP82010.2 (MF II), 676025 (AGB 69.1), 575010 (I-1062), 575031 (Cruza 27), 379420.1 (27/15), 573275 (ASN 69.1), and 67600 (CFJ-69.1) and significantly outyielded the control cultivar Granola

Further tuber yield trials will be conducted with the clones.

Conclusions

A total of 97 advanced potato clones and cultivars have been introduced from the International Potato Center (CIP) and evaluated in for tuber yield in 1997 and 1998.

The trials have the objective to identify best clones with high tuber yield in the highlands of West Java.

Among the highest yielding clones and cultivars were MF II, AGB 69.1, I-1062, Cruza 27, Gikungu, 379420.1, ASN 69.1, Maria tambena, CFJ-69.1 and XY-17.

Table 1. Monthly maximum, minimum and mean temperature, total rainfall, relative humidity (HR), and total evaporation at Lembang, West Java, Indonesia from August 1997 to July 1998

Month	Temperature (Celcius)			Rainfall	RH	Evaporation
	Maximum	Minimum	Mean	(mm)	(%)	(mm)
August	25.2	12.7	18.9	0.0	86.2	4.3
September	25.5	11.6	19.1	1.4	83.2	4.4
October	26.3	13.0	20.7	0.0	83.0	4.2
November	25.1	14.6	20.8	136.0	82.1	3.8
December	24.7	15.7	19.6	246.9	87.1	3.9
January	28.0	17.6	22.6	142.3	95.9	4.1
February	25.0	16.5	20.3	302.9	86.6	3.3
March	24.9	16.3	20.2	463.0	80.8	2.9
April	24.5	16.7	19.8	486.6	87.8	3.2
May	24.8	17.0	21.0	171.5	85.5	3.6
June	25.0	15.5	20.1	209.2	86.0	4.0
July	24.7	10.9	20.4	96.0	86.5	3.9

Table 2. Mean plant stand, plant vigor, plant appearance, canopy cover, plant height, stem number, and tuber yield component of 20 potato clones from tuberlets in RIV, Lembang Oct. 1997 to Feb. 1998.

CIP No.	Cultivar name	Plant stand (#)	Plant vigor 1-9	Plant appear. 1-9	Canopy cover (%)	Plant height (cm)	No. stem (#)	Hill harv. (%)	Tuber number (#)	Tuber weight (g)	Tuber yield (g)
380610.14	VC 29-14	10	5	3	85	69	3	63	16	24	384
800959	Granolla	10	6	5	72	57	4	90	10	27	282
387504.2	XY-2	10	6	5	99	63	4	93	13	20	255
379421.1	28/75	10	8	5	92	68	3	73	12	22	235
720054	Tollocan	10	7	3	96	77	4	80	7	34	222
BP87112.3	LBr 1-3	10	7	4	96	75	3	77	6	36	213
801013	I-1058	10	6	4	88	59	4	70	7	30	200
382197.7	88146	10	3	2	74	65	3	80	10	19	198
676025	AGB-69-1	10	6	3	95	60	3	53	7	30	185
575015	I-1124	10	6	3	90	74	3	77	7	27	184
385058.17	XY-17	10	9	4	100	67	4	67	6	33	183
382317.11	Y84.011	9	5	3	91	68	3	67	4	39	183
384559.6	FBA-5	10	7	4	99	61	4	93	9	18	168
386209.1	LBr-29	9	5	3	90	62	3	77	8	20	159
BP87116.17	LBR 1-17	10	5	3	84	64	3	73	8	19	151
387233.24	Gikungu	9	6	2	88	66	3	60	7	18	149
BP 87112.1	LBR 1-1	9	6	4	91	63	3	67	6	25	137
380583.8		9	2	1	86	69	3	60	6	22	132
378501.16	Sissay	10	6	4	96	68	3	67	5	26	123
379673.150	P 150	10	4	2	79	56	4	47	8	13	109
Means		10	6	3	89	66	3	72	8	25	193
LSD		1	3	2	19	12	1	29	7.	16	180
CV		6	26	36	13	11	26	24	50	38	56

Table 3. Mean percent of plant stand, canopy cover at 9 weeks, plant vigor, plant height and plant appearance of 30 potato advanced clones from apical stem cutting in Cibodas. 30 Sep. to 5 Feb. 1998.

CIP. No	Clone name	Plant stand (%)	Canopy cover (%)	Plant vigor 1-7	Plant height (cm)	Plant appear 1-5	Hill har. (%)	Tuber size (g)	Tuber number (#)	Tub. yield per. plant (g)
387233.24	Gikungu	96	94	7	46	5	83	36	15	462
386768.1	Maria Tambena	99	81	7	35	5	80	58	13	422
385058.17	XY. 17	43	57	6	34	5	48	31	24	416
387504.2	XY.2	98	81	5	29	3	88	33	20	314
384515.1	88052	98	49	3	22	1	90	44	7	304
380583.8		50	32	4	18	2	33	35	10	276
379420.1	27/15	100	81	5	31	2	80	40	11	276
382197.7	88/46	99	48	4	26	1	100	28	12	274
BP87122.3		99	60	4	25	1	80	50	5	262
379420.2	27/40	100	85	6	30	3	80	30	8	238
800959	Granola	93	6	2	9	2	60	58	6	225
380610.8	VC 29.8	43	45	6	32	3	78	49	8	224
384505.10	X 86010	108	49	5	21	2	55	29	13	222
378501.16	Sissay	81	63	5	22	4	78	18	15	196
720054	Tollocan	81	47	5	26	2	30	13	9	186
BP87122.1		86	30	3	24	1	55	28	9	178
384559.6	FBA -5	99	37	2	21	1	83	29	6	152
801013	I-1085	74	13	2	18	2	20	14	13	150
386209.10	LBr-2	91	54	4	26	3	85	17	9	149
382317.11	Y 84.011	100	12	2	14	1	70	18	13	139
575015	I-1124	96	33	3	20	2	65	23	4	91
380584.3		98	20	2	18	1	68	16	9	77
379673.150	P-150	96	14	1	14	1	58	18	4	68
676025	AGB 69-1	99	8	2	10	1	68	14	5	67
381138.63		83	20	1	15	1	70	12	4	60
379667.421	P421	98	10	2	15	1	58	11	4	49
	Granola*	98	5	1	12	1	68	9	6	43
3806010.14	VC 29.14	89	34	3	18	1	23	1	11	29
BP87121.17		73	21	2	17	1	10	2	14	20
	Atlantic	94	9	1	9	1	23	3	8	19
Means		89	40	3	22	2	63	26	9	186
LSD		16	22	2	7	1	26	7	10	144
CV		13	39	34	23	41	28	75	76	55

*minituber

Table 4. Mean plant growth parameters,tuber yield and yield components of 45 potato advanced clones from stem cutting. Cibodas 1400 m asl. March 10 to June 8, 1998

CIP No	Name	Plant. app. 1-5	Flower ing 1-7	Late Blight 1-9	Plant vigor 6 WAP 1-9	Plant vigor 9 WAP	Canopy cover (%)	Plant height (cm)	Hill harvested (%)	Tuber number (#)	Percent market. (%)	Tuber size (g)	Tuber yield / (g)
IP82010.2	MF II	5	1	1	9	9	95	80	93	6	92	102	569
676025	AGB- 69-1	5	5	2	8	8	94	57	80	12	81	46	561
575010	I-1062	4	2	1	7	8	99	74	100	7	61	70	481
575031	Cruza 27	4	2	1	8	9	100	98	98	15	68	31	477
379420.1	27 / 15	2	4	1	8	8	97	73	98	13	63	33	430
573275	ASN - 69 - 1	5	1	2	9	9	100	63	95	9	74	50	423
67600-2	CFJ - 69-1	4	1	2	8	9	86	99	88	13	57	37	422
283233.11		4	1	2	8	9	100	89	90	8	57	48	386
378711.7		5	1	1	9	8	86	52	93	9	80	49	384
573079	I - 1035	4	1	3	7	5	70	49	95	6	74	59	378
575020	I - 1150	5	1	1	8	8	100	79	98	9	75	43	376
575003	I - 931	4	2	1	8	8	98	66	90	9	75	44	375
676070	Cruza 155	5	2	2	8	8	92	77	98	11	77	37	364
378501.3		5	2	2	8	9	99	74	100	11	61	33	361
IP. 81001.1	MF - I	6	2	1	9	9	96	76	85	12	68	30	360
386629.32	TS -13	5	3	1	9	9	86	74	88	6	71	55	350
380584.3		4	1	2	8	9	93	62	98	7	72	49	342
575049	CEW - 69 -1	4	5	1	8	7	87	73	93	7	63	51	340
575001	I - 853	4	2	1	7	8	92	59	100	11	50	29	331
720049	Montsama	3	2	2	7	8	98	78	100	7	67	45	331
575051	CFQ- 69-1	4	2	1	8	9	96	64	98	11	68	29	325
378711.5	Muziranzara	2	1	2	6	8	92	70	85	10	50	32	324
3806010.14		5	7	2	9	8	91	72	95	16	29	23	316
382171.10	Precodepa	4	1	1	8	9	93	78	95	8	66	40	311
676079	I - 850	4	1	1	7	8	83	64	95	5	81	61	308
285411.22		2	1	2	5	7	94	98	100	12	31	22	300
800955	Graso - 28	3	2	1	5	8	88	55	90	10	63	29	300
378015.16	TS-2	4	3	5	8	6	66	42	83	4	82	85	291
	Granola*	5	1	4	9	5	29	51	93	12	58	24	281
377369.7	P - 4	4	3	1	7	8	99	55	73	6	65	48	279
676004	CFR - 69 -1	4	2	2	9	8	88	72	93	6	67	51	278
720118	Cruza 148	3	2	2	7	9	99	101	95	13	42	22	273
380605.16	VC24.16	4	1	4	6	5	74	47	90	8	63	34	274
720130	Chiquita	4	1	2	7	8	75	46	93	5	70	39	213
575036	ABZ - 69 -1	4	1	1	6	8	69	56	90	7	46	27	191
379673.150		5	2	3	9	7	55	53	95	9	18	20	178
800048	Dessire	3	1	4	6	6	60	47	95	6	60	29	176
573272	Michoacan	3	1	1	7	7	80	60	98	7	46	25	173
379706.34	LT-9	3	2	6	6	6	72	70	98	5	66	31	170
676003	CFM - 69-1	3	1	1	6	7	80	60	98	7	50	23	168
575048	CCN - 69 -1	3	1	1	6	6	43	63	88	7	28	20	134
	Granola	1	1	3	4	5	23	39	93	5	52	23	120
	Atlantic	4	1	5	6	4	53	41	90	4	57	37	115
377957.5	LT -5	1	3	5	3	4	17	55	90	4	56	30	107
377850.1	BW-10	3	1	5	6	5	37	42	95	3	39	27	95
575047	I-1654	1	1	1	3	4	23	34	71	4	23	18	78
Means		4	2	2	7	7	79	65	92	8	60	38	301
LSD		2	1	1	2	2	21	19	20	3	25	19	139
CV		35	64	48	16	17	19	15	10	27	30	35	33

* tuber seed

Potato Multilocation Trials

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Introduction

The multilocation variety trials are a requisite for food as well as horticultural crops for variety release. The variety to be included in the trial is the one that has been tested for more than two times of reasons and has shown promising/better than the existing cultivar.

According to the Agric. Minister Decree No. 737/Kpts/TP.240/9/98 the number of locations will be determined by the Director General of Food Crops, in the case of food crops including horticultural crops. For vegetables the number of location is proposed 10 locations instead of 20 as mentioned in the former decree, i.e. decree No. 902/Kpts/TP.240/12/96. The data of the trials must be submitted to the Variety Release Committee of the National Seed Board of the Department of Agriculture for the consideration of releasing of any new variety. The trials must be conducted following a proper field experiment design, and in both rainy and dry seasons in any single location.

For vegetables, including potato, the trials are implemented by the Institute of Seed Certification and Control of the Directorate of Seed Production of the Department of Agriculture, or the Institute for Agricultural Technology Assessment of the Agency for Agriculture Research and Development, Department of Agriculture in close collaboration with the Research Institute for Vegetables (RIV). The latter provides the implementation guideline with regard to scientific method and seed. The trials are funded by the Directorate of Seed Production (DSP) and the Institute for Agricultural Technology Assessment (IATA). However, since 1998/1999 fiscal year the trials are funded by DSP and RIV.

The research on developing new potato clones in RIV is carried out by the Department of Germplasm and Plant Breeding and in collaborations with other international agencies such as CIP, UNDP Project, ABSP/MSU Project, etc. From these collaborations some promising clones have been developed and these clones should be included in multilocation trials before being released.

This paper will inform how the potato multilocation trials from 1998/1999 and further trials will be implemented.

Implementation of potato multilocation trials

Potato is commonly propagated by means of tuber. Several components determined the potential yield of potato such as the size, cleanliness from pathogen, generation of tuber, etc. To obtain fair comparison among different clones, therefore, the seed tuber of each clones in the trials should be of similar quality. For this reason the preparation of seed tuber for multilocation trial, idelly, should come from the same quality mother tuber.

Inventory of clones

Breeders or selectionists who intend to include their clones in multilocation trials should register their clone(s) and provide their clone(s) in the form of pathogen free plantlet or tuber as mother material(s) for further multiplication in the same environment.

Multiplication of seed tuber

Mother materials will be carried out in similar environment. The target number of tubers to be produced depends on the number of plant/plot, number of replication and number of location.

Seed tuber quality

The recommendation of seed quality is as follows:

a. Use undamaged seed
b. Use seed of size : 30 to 40 g. Cut seed may be used if there is not enough number of whole seed.

c. Use free bacterial wilt and low virus content seed
d. Physiological age: use multiple sprouting stage of seed

Experimental design

The recommended experimental design is:

a. Randomized Complete Block Design
b. Number of replication : 3 to 4
c. Plot size : 30 hills/plot
d. Plant spacing : 0.8 x 30 m

Status of 1998/1999 multilocation trials

The advanced clones planned for 1998/1999 multilocation trial are as follows:

1. R.S. Basuki : 1 clone (from TPS selection)
2. Sudjoko Sahat : 4 clones (from local crosses)
3. Anggoro H. P : 3 clones (from CIP-LB clones)
4. CIP : 4 clones (from CIP-RIV research)
5. Control : Granola and Atlantic

Advanced potato clones available in the beginning of 98/99 multilocation trials are as follows:

a. CIP : 4 clones (from CIP/RIV research)
b. Anggoro H.P : 2 clones (derived from CIP-LB clones)
c. Control : Granola and Atlantic

Locations at the beginning of 98/99 trials

a. East Java : Sumberbrantas/Batu
b. Central Java : Batur/Banjarnegara and Kledung/Magelang
c. West Java : Lembang and Ciwidey

Experimental Design

a. Randomized Complete Block Design
b. Replication : 4
c. Plot size : 30 hills/plot
d. Plant distance : 80 x 30 cm

Cultivation

a. Choice of land: Avoid land previously planted to solanancae crops.
b. Planting method: Depth of planting, plant density
c. Fertilizer:
   c.1. Ammonium sulphate available
   - Stable manure: 30 t/ha at planting time
   - Amm. Sulphate: 800 kg/ha at planting time
   - SP-36: 891 kg/ha at planting time
   - KCl: 522 kg/ha at planting time
   - Urea: 350 kg/ha at 25 d.a.p

   c.2. Ammonium sulphate not available
   Amm. Sulphate is sibstituted by urea 350 kg/ha
d. Irrigation: 7 dap, 2x/week, 5 cm depth
   30-45 dap, 2x/week, 7 cm depth
   45-70 dap, 3x/week, 7 cm depth

Data taken

a. Plant growth (0=just appear; 1=multiple sprout; 3= branch sprout)
b. Seed weight per plot at time of planting
c. Leafminer fly infestation
d. Late Blight infection
e. At time of harvest:
    - Number of harvested plants
    - Number of tuber/plot
    - Tuber weight/plot
    - Tuber size (marketable, seed, "kriel")
f. Tuber quality for chip
g. At 55 and 100 d.a.p. farmers are invited to evaluate
h. Additional data
    - Elevation
    - Rainfall
    - Max./min. temperature
    - RH
    - Pesticide applied: kind, dose, interval of application

True Potato Seed Research

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Abstract

A research to promote the diffusion of True Potato Seed (TPS) as alternative seed system in Indonesia has been initiated since 1997. Two major activities have been conducted i.e. promoting the diffusion of TPS and conducting research on creating or improving TPS technology component in order to support the promotion of TPS diffusion. Promoting the TPS diffusion was conducted through farmer-led technology transfer. The TPS technology component research was conducted through field experiment either on station or in farmer field. In the formal survey which was conducted in July 1998 in order to have a view of sowing TPS in the first season at all locations, 186 farmers out of 660 farmers involved in the research, have been surveyed. Preliminary results of the formal survey indicated that the percentage of farmers that transplanted their seedling transplants to the fields and harvested their potatoes from TPS was low, about 45 and 27%, respectively. In the nursery, the germination and the percentage of seedling transplanted to the field were 46 and 17%, respectively. The results of demonstration plots and the evaluation of TPS progenies indicated that the control clone, cv. Granola had higher tuber yield than the TPS progenies. Five TPS progenies were selected as the best progenies i.e. HPS 7/67, TPS-7 x TPS-13, MF-I x TPS-67, Serrana x TPS-67dan MF-II x TPS-67 in the progeny evaluation as seedling transplants. In the seedling tuber selection experiment, although the differences were not significant, hill selection treatment tend to give higher tuber yields compared to bulk selection. Observation and collecting data of the progress of farmer experimentation with TPS will be continued. Other field experiments such as the evaluation of 19 TPS progenies as seedling tuber, fertilizer requirement, seedling tuber selection, degeneration, seed size and seed rate will also be conducted.

Introduction

Research on the use of True Potato Seed (TPS) in Indonesia has been conducted either on-station since 1984 (Satjadipura, 1987; Asandhi and Satjadipura, 1988; Asandhi and Chilver, 1993) or on-farm since 1988 (Sinung-Basuki and Gunadi, 1991; Potts *et al.*, 1990; 1992; Gunadi *et al.*, 1992; Asandhi and Chilver, 1993; Chilver *et al.*, 1993; 1994; Gunadi and Sinung-Basuki, 1993). Despite the concept of TPS as an alternative seed source which is widely recognized in Indonesia, there are indications that the TPS progenies introduced to farmers until recently, have several weaknesses, i.e. variability, size of the plant, late tuberization, relatively low tuber yield and long growing period especially when compared to cv. Granola, the common cultivar grown by farmers at present (Sinung-Basuki, 1994; Gunadi, 1994; Sinung-Basuki and Gunadi, 1995). The right TPS progenies with the range of adaptation needed in Indonesia did not exist until very recently for this technology to have a lasting impact.

In most of the locations selected for TPS diffusion in Indonesia previously farmers had easily access to good quality of seed and therefore the TPS has to compete with the good quality seed tuber. In fact, in Indonesia there are many other potato production areas which do not have access to good quality seed tuber. By disseminating TPS technology into these areas, there is reasonable expectation that the TPS technology will have a lasting impact.

Earlier experiences with TPS have indicated that most of the farmers in Indonesia used TPS only in the first planting season as a source of initial planting material. Once the seedling tubers were obtained, the farmers would use them in the following planting season. Therefore attention should also be given to research on the seedling tuber derived from TPS. This TPS technology component research is needed in order to support the sustainability of TPS technology dissemination. The major focus will be on the use, selection and management of the seedling tuber derived from TPS. Selection of tubers may be one way of improving uniformity and yield capacity of potatoes grown from TPS as indicated by Rowell *et al.* (1986). They reported that yields were increased 14 to 16% by hill selection. Also, observations by either farmers or researchers indicated that from a TPS plant population there were some superior plants which yielded almost doubled or tripled the average yield (Sinung-Basuki, 1994). This aspect may also become a potential of TPS as a source of obtaining a new superior potato cultivar. At one side, the variability of TPS is considered as a weakness by farmers, however, at the other side, the genetic diversity of TPS is considered to have been a potential source in obtaining new superior potato cultivar.

Considering that the potato areas in Indonesia are spread within the country, therefore it is necessary to involve local researchers, extensionists and key farmers to maintain the sustainability of TPS technology dissemination. These local researchers, extensionists and key farmers (so called field workers) will be trained on the TPS technology through either formal or informal training methods.

The present research aims at promoting the diffusion of TPS (True Potato Seed) as an alternative seed system through farmer-led technology transfer, continuing conducting research on creating or improving TPS technology component in order to support the promotion of TPS diffusion and disseminating knowledge of TPS technology to field-researchers, extensionists and farmers through either formal or informal training methods.

Methods and Procedures

Promoting the diffusion of the TPS (True Potato Seed) as an altemative seed system through farmer-led technology transfer

a. Selection of location for TPS technology diffusion was conducted on the basis of the following criteria:

- low productivity
- difficult to access to good quality of tuber seed
- seed only used as many as two generations
- high interest of credit
- potato produced in the area will market locally
- small land ownership/small farmer

The location criteria were obtained from the secondary data (publication) and primary data (survey).

b. Promoting the TPS diffusion was conducted through farmer-led technology transfer. In this research only TPS was given free of charge to the farmers. Farmers provided other inputs. The amounts of TPS offered to be tried were from 1,000 up to 6,000 seed. Researchers suggested that farmers should consider the financial risk when asking the amount of TPS to try, since technical failure commonly happened with any new technology try out. Most farmers asked a total of 2,000 seed of two different TPS progenies, i.e. HPS II/67 and HPS 7/67; and only some farmers requested 10,000 seed to try. To help farmers easily memorize the name of TPS progenies used in this research, "a new name" of Lembang 1 was given for HPS 7/67 and Lembang 2 for HPS II/67. The technology package transferred through field training included 1) seedling tuber production in nursery to be used as seed in the following season to produce ware potatoes and 2) seedling transplanted to the field to produced ware and seed potatoes. The farmers were free to modify the TPS technology package introduced. This initial stage is a critical period for the success of TPS diffusion. The success of the first planting season in general will become a trigger for the success of the farmer-led TPS technology transfer in the following season.

Conducting research on creating or improving TPS technology component in order to support the promotion of TPS diffusion

The TPS technology component research was conducted either on station or in farmer field selected covering the research area as follows:

- Identification of promising adapted/appropriate TPS progenies
- Seedling tuber selection technique
- Degeneration of seedling tuber
- Fertilizer requirement
- Seed size and seed rate

The result of the technology component research will be transferred to the TPS diffusion location to support the promotion of TPS diffusion and to maintain the sustainability of TPS technology dissemination.

Study the economic feasibility of the mass production of TPS progenies identified in the first phase in order to anticipate future demand

The best technique for mass production of TPS found in the first phase of the TPS Project will be applied in a commercial scale and analyzed. The scale of research which assumed amenable to economic assessment is 0.2 ha. The result of the economic assessment will be conversed into a larger scale in a linear basis.

Results and Discussion

In TPS diffusion activity, six districts out of 35 districts considered as the potato areas in Indonesia, were identified and selected as the potential areas for promoting the diffusion of TPS technology. The six districts are Kuningan (West Java), Brebes and Magelang (Central Java), Magetan and Pasuruan (East Java) and Bangli (Bali). From these six districts, seven sub-districts and 11 villages were selected as the research sites (Table 1). By the end of October 1997, a total of 660 farmers from different sites (villages) including 12 other new villages in the provinces were selected as farmer participants. In December 1997, 42 other farmers from two other villages in two sub-districts asked to be involved in the research activity.

Farmer group discussion or informal survey conducted in May 1998 indicated that the introduction and training to provide farmers with knowledge of appropriate techniques for growing potato derived from TPS conducted in October 1997 could be understood by farmers at all locations. It was thought that the limited number of farmers sowing TPS in the first season was due to the difficulties in sowing TPS. The delay in sowing TPS in the first season was more in general due to waiting their colleagues to sow their TPS so that they could see first their colleagues' 'trial'.

In the formal survey which was conducted in July 1998 in order to have a view of sowing TPS in the first season at all locations, 186 farmers out of 660 farmers involved in the research, have been surveyed. Preliminary results indicated that the percentage of farmers sowing TPS in the first season was 91.9 and 91.1% for Lembang 1 and Lembang 2, respectively (Table 2). The percentage of farmers that transplanted their seedling transplants to the fields was 45.5 and 45.1% for Lembang 1 and Lembang 2, respectively and the percentage of farmers that harvested their potatoes from TPS was 27.2 and 28.5% for Lembang 1 and Lembang 2, respectively. In the nursery, the germination of Lembang 1 and Lembang 2 were 46.2 and 46.4%, respectively and the percentage of seedling transplanted to the field was 17.5% for both Lembang 1 and Lembang 2.

The results of demonstration plots conducted in two villages involved in the research i.e. Kebonlegi, Kaliangrik sub-district, Magelang-Central Java and Tosari, Tosari sub-district, Pasuruan-East Java and in the research station i.e. Lembang- West Java, indicated that the highest tuber yield was obtained in Magelang (Table 3). Potato grown from clone i.e. cv. Granola had a higher tuber yield per plant than those of TPS progenies.

The evaluation of several TPS progenies recommended by CIP-Lima as seedling transplant conducted in the rainy season from December 1997 to March 1998, indicated that the control clone, cv. Granola grown from tubers had the highest tuber yield i.e. 14.1 t ha^{-1} and was significantly different with those of any TPS progenies (Table 4). Tuber yields of TPS progenies ranged from 4.9 to 12.9 t ha^{-1}. The best TPS progenies were HPS 7/67, TPS-7 x TPS-13, MF-I x TPS-67, Serrana x TPS-67and MF-II x TPS-67 which had tuber yields of 12.9, 12.2, 10.3, 10.2 and 10.1 t ha^{-1}, respectively.

The results of the effect seedling tuber selection on the growth and yield of potatoes derived from true seed on the following season indicated that hill selection treatment tend to give higher tuber yield at harvest either per plant or per ha compared to bulk selection treatment, but the differences were not significant.

Conclusions

In the TPS diffusion activities, six districts i.e. Kuningan (West Java), Brebes and Magelang (Central Java), Magetan and Pasuruan (East Java) and Bangli (Bali) which included seven sub-districts and 11 villages, have been selected as the research locations. A total of 660 farmers from different villages in the provinces were selected as farmer participants. Preliminary results of the formal survey indicated that the percentage of farmers that transplanted their seedling transplants to the fields and harvested their potatoes from TPS was low, about 45 and 27%, respectively. In the nursery, the germination and the percentage of seedling transplanted to the field were 46 and 17%, respectively. The results of demonstration plots and the evaluation of TPS progenies indicated that the control clone, cv. Granola had higher tuber yield than those of TPS progenies. Five TPS progenies were selected as the best progenies i.e. HPS 7/67, TPS-7 x TPS-13, MF-I x TPS-67, Serrana x TPS-67and MF-II x TPS-67.

Work plan

- Continue observe and collect data of the progress of farmer experimentation with TPS
- Conducting demplot in the diffusion research locations
- Conducting the evaluation of 19 TPS progenies as seedling tuber
- Conducting other field experiments i.e. fertilizer requirement, seedling tuber selection, degeneration, seed size and seed rate
- Conducting the economic feasibility for mass TPS production

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Table 1. Number of farmer participants of TPS diffusion research in Indonesia, November 1997

Province/ Districts	**Sub-districts**	**Villages**	**Number of Participants**
West Java:			
Kuningan	Cigugur	Cisantana	18
	Darma	Karangsari	21
		Sagarahiang *)	7
		Gunungsirah *)	24
Central Java:			
Magelang	Kalingkrik	Kebonlegi	105
		Temanggung	36
Brebes	Sirampog	Igirklanceng	6
		Dawuhan	32
East Java:			
Pasuruan	Tosari	Tosari	33
		Ngadiwono	40
		Sedaeng *)	11
		Kandangan *)	10
		Wonokitri *)	10
		Podokoyo *)	10
		Balidono *)	12
Magetan	Plaosan	Dadi	50
		Buluharjo	19
		Ngancar *)	12
Bali:			
Bangli	Kintamani	Abangsongan	33
		Br. Yehmampeh	33
		Klp. Mekarsari	30
		Klp. Mertasari	35
		Klp. Abangdukuh	73
	TOTAL		660

*) Additional new villages selected later after they interested and asked to try the TPS

Table 2. Results of formal survey to evaluate the first season TPS sowing in each village, July 1998

Province		West Java		Central Java			East Java				Bali	Total
District		Kuningan		Brebes	Magelang		Magetan			Pasuruan	Bangli	
Sub-district		Cigugur	Darma	Sirampog	Kaliangrik		Plaosan			Tosari	Kintamani	
Village		Cisantana	Karangsari	Dawuhan & Igirklanceng	Kebonlegi	Temang-gung	Dadi	Buluharjo	Ngancar	Tosari	Abang-songan	
No. farmers surveyed		13	14	25	29	19	27	8	3	26	22	186
No. farmers received TPS	L1	11	13	25	28	15	23	8	2	25	22	172
	L2	10	11	23	28	12	21	5	3	23	22	158
No. farmers sowing TPS	L1	8	12	21	27	15	23	6	1	24	21	158
	L2	7	10	19	27	12	21	3	2	22	21	144
No. farmers transplanted TPS to fields	L1	2	1	6	17	9	11	2	1	11	12	72
	L2	2	1	5	16	8	10	0	2	10	11	65
No. farmers harvested TPS	L1	1	1	1	11	7	8	0	1	6	7	43
	L2	1	1	1	10	5	7	0	1	7	8	41
% TPS germination	L1	36.5	27.3	29.0	49.6	55.7	32.5	28.5	80.0	62.9	60.3	
	L2	30.4	30.5	27.3	55.3	65.4	31.3	10.0	77.5	65.4	70.5	
% seedling transplanted	L1	3.3	5.5	11.1	27.1	22.3	17.1	16.8	80.0	35.5	13.4	
	L2	6.3	5.6	6.9	27.3	29.5	11.6	0	67.5	33.6	18.3	

Note: L1 = Lembang 1; L2 = Lembang 2

% of farmers sowing TPS: L1 = 91.9%
L2 = 91.1%

% of farmers transplanted to the field: L1 = 45.5%
L2 = 45.1%

% of farmers harvested: L1 = 27.2%
L2 = 28.5%

TPS germination: L1 = 46.2%
L2 = 46.4%

% of seedlings could be transplanted to the field: L1 = 17.5%
L2 = 17.5%

Table 3. Tuber yields and yield components of two TPS progenies (HPS 7/67, Lembang 1 and HPS II/67, Lembang 2) grown as seedling transplant and one potato clone (cv. Granola) grown at three site from December 1997 to March 1998

Site	Progeny	Tuber yield per plant (g)	Tuber yield per plot (56.25 m2) (kg)	% tuber > 60 g by weight	% tuber 30-60 g by weight	% tuber < 30 g by weight	% marketable tuber by weight
Magelang (950 m asl.)	HPS 7/67	180.9	41.3	18.8	14.5	66.6	33.3
	HPS II/67	221.7	49.6	19.5	14.6	65.9	34.1
	cv. Granola	330.3	66.7	31.0	16.7	52.2	47.7
Pasuruan (1700 m asl.)	HPS 7/67	137.5	24.6	20.2	13.6	66.3	33.8
	HPS II/67	129.7	22.2	14.9	14.5	70.6	29.4
	cv. Granola	133.9	16.7	29.2	18.9	51.9	48.1
Lembang (1250 m asl.)	HPS 7/67	169.6	28.9	23.1	35.7	41.2	58.7
	HPS II/67	218.7	43.5	36.5	36.1	27.3	72.7
	cv. Granola	145.4	22.5	60.8	26.3	12.8	87.1
Mean		185.3	35.1	28.2	21.2	50.5	49.4
LSD 5%		39.5	8.1	6.3	6.2	6.3	6.3
CV (%)		17.9	19.4	18.8	24.4	10.5	10.7

Note: LSD = Least Significant Difference; CV = Coefficient of Variation

Table 4. Mean tuber yields and yield components of 19 TPS progenies grown as seedling transplant in the highland, Cibodas (1400 m asl.) from December 1997 to March 1998

Progeny	% hill harvested	Tuber yield per plant (g)	Tuber yield per ha (ton)	% marketable tuber by weight
HPS 7/67	75	291	12.9	45
TPS-7 x TPS-13	77	274	12.2	56
MF-I x TPS-67	80	231	10.3	44
Serrana x TPS-67	80	230	10.2	53
MF-II x TPS-67	75	226	10.1	57
TS-5 x TPS-67	85	217	9.6	37
MF-II x TPS-13	80	210	9.3	65
Atzimba x TPS-67	85	193	8.6	37
LT-9 x TPS-67	87	181	8.0	46
MF-I x TPS-13	85	179	7.9	56
I-1931 x TPS-13	90	176	7.8	54
I-1035 x TPS-67	82	175	7.8	50
TS-5 x TPS-13	80	169	7.5	47
Atzimba x TPS-13	85	160	7.1	52
LT-9 x TS-3	82	158	7.0	65
LT-8 x TPS-13	85	135	6.0	58
Serrana x TPS-13	87	129	5.7	63
TPS-25 x TPS-67	87	120	5.3	48
I-1035 x TPS-13	70	111	4.9	53
cv. Granola	94	318	14.1	83
Mean	83	194	8.6	53
LSD 0.5%	15	28	1.2	11
CV (%)	12	10	10.2	14

Note: LSD = Least Significant Difference; CV = Coefficient of Variation

Identification of Potato cultivars resistant to Late Blight through a Standard International Field Trial (SIFT) in Indonesia in 1998

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Abstract

Late blight caused by _Phythopthora infestans_ Mt de Barry is the most important fungal disease of potato. The 1998 research plans aimed at identifying high tuber yielding, late blight resistant potato cultivars in a Standard International Field Trial (SIFT) are presented here.

Introduction

Late blight of potato is the most important disease of potato. The causative agent was first recognized in 1845 and a description published as _Phythopthora infestans_ Mt de Barry a year after. The out break of late blight in Ireland dramatically emphasized the limited diet of the poor (Cook,1978) The disease caused serious losses. Yield reduction caused by late blight was recorded to range from 10 -100 % . Late blight can be prevented by using fungicides, however this method of control is not always effective. The development of resistant cultivars is considered the preferred alternative. We report here plans for the testing of potato clones with durable resistance to late blight in a Standard International Field Trial (SIFT) in Indonesia in 1998.

Materials and Methods

The first trial will be conducted at the Research Institute for Vegetables (RIV) experimental field, Lembang (1250 m asl) from October 1998 until March 1999. Twenty one potato cultivars with resistance to late blight from CIP and the susceptible cultivar Granola (Table 1) will be compared in a Randomized Complete Block Design with 3 replications. The experimental unit is a plot of 3 rows and 15 hills per row. Hill spacing is 0.75 x 0.25 m. Planting material is apical stem cuttings.

Agronomic Management

Ammonium Sulfate will be applied at the rate of 100kg N per ha as basal fertilizer and 100 kgN per ha^{-1} side dressed 4 weeks later. Super Phosphate 36 and KCl will be applied at the rate of 509 Pkg per ha^{-1} and 148 kg K per ha^{-1} respectively as basal fertilizer. Stable manure will be applied at the rate 20 ton per ha^{-1}, 1 week before planting. Irrigation and hand weeding will be done whenever necessary. Insecticide carbofuran at the rate 20 kg per ha^{-1} will be used to control soil insect pests. Abamektin (1 cc /l) will be used for controlling leat miner fly (_Liriomyza sp_).

1. Resistance trial: In this trial the cultivars will be protected with fungicide application the first 40-45 days after transplanting in order to ensure a high plant stand. Afterward, late blight will be allowed to infect the plants. Late blight susceptible Granola will be planted around the experiment as source of inoculum. The objective of this test is to compare the cultivars for their resistance to late blight.

2. Tuber yield trial: Fungicide will be applied for controlling late blight by using an Oomycetes systemic fungicide and a contact broad spectrum fungicide respectively. The objective is to compare the cultivars for their tuber yield.

Data collection and analysis

Late blight resistance:

Percentage of foliage damage by late blight in 5% increments
Weekly recording of late blight damage (minimum 4 weeks)

Statistical analysis will include Area Under Disease Progress Curve (AUDPC)

Tuber yield:
Total, marketable and non-marketable tuber yield

Discussion

Best cultivars with higest tuber yields and resistance to late blight will be identified. A second set of potato cultivars with late blight resistance is expected to be tested in 1999.

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Table 1. Twenty two potato cultivars included in the SIFT experiment in Indonesia, 1998

No.	CIP Number	Name
1	379055.1	Ica Zipa
2	380389.1	Chanchan Inia
3	380496.6	Chagllina Inia
4	575031	Cruza 27
5	381381.20	Victoria /Asante
6	381390.30	Idiafrit
7	382119.20 B	Iniap Rosita
8	382178.14	LBr-1
9	384866.5	Amarilis-Inia
10	385240.2	LB Group VII
11	386040.9	Birris
12	386056.7	Floresta
13	386209.10	LBr-2
14	387205.5	LBr-20
15	387348.20	LBr-8
16	388790.24	Iniap Fripapa.99
17	389746.2	Lb Group X
18	720071	Monserrate
19	720118	Cruza 148
20	720150	Pampeana-Inta
21	800953	Bzura
22	800959	Granola

Potential Yield of Potato with resistance to Late Blight in 3 Locations

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A "Biotechnology-assisted Breeding to Reduce Pesticide Use in Potato" project was sponsored by the International Potato Center (CIP) and coordinated in SE Asia by the Southeast Asian Program for Research and Development (SAPPRAD). The project was funded by UNDP. Indonesia was one of the participant countries. The aim of the project was to reduce pesticide use in potato cultivation by means of development of resistant potato clone(s) against late blight (*Phytophthora infestans*). Twenty clones from CIP were tested for four generations in three locations: Lembang, Wonosobo and Dieng. Eight clones showed resistant reaction in those locations, i.e. IP.8100-1/MF-1, I.1085, 387172.4, 387096.18, 389746.2, 390310.33, 387315.15, and 387091.10. Further testing of those clones in the same locations showed that clones 387315.15, 390310.33, I.1085, and 387091.10 yielded more than 16t/ha. Among these, clone No. 387901.10 and IP.8100-1/MF-1 were selected by farmers and included in multilocation trials in 6 locations in 1998.

Analysis of variance of potato yield

Source of variation	d.f	Sum of squares	Mean squares	F Table
Location (L)	2	15.71	7.85	122.47**
Rep. / Loc	8	0.51	0.06	
Variety (V)	9	16.27	1.81	25.21**
V x L	18	11.47	0.63	8.89**
Error	72	5.16	0.07	
Total	100	48.72		

Yield (gr/plot)

No.	Variety	Location			Average	Potential Yield (t/ha)
		Wonosobo	Dieng	Lembang		
1	IP.1200-1/MF1	2.625de	10.067bcd	3.162,5bc	5.285	11.0
2	I.1085	6.500c	13.200abc	4.125,0b	7.942	16.5
3	387172.4	3.250de	15.333abc	3.000,0bc	7.194	15.0
4	387096.18	2.188de	6.500de	3.955,0b	4.214	8.8
5	389746.2	9.500ab	8.833cd	1.375,0c	6.569	15.5
6	390310.33	7.125bc	13.300abc	9.162,5a	9.862	20.5
7	387315.15	10.500a	16.767a	7.612,5a	11.626	24.2
8	387091.10	4.875cd	14.600abc	5.587,5b	7.687	16.0
9	Granola	1.750e	1.383e	2.287,5bc	1.807	3.8
10	Cipanas	6.625c	11.533abcd	1.300,0c	6.486	13.8

Reaction of potato clones against late blight at Lembang (63 dapl) and Ciwidey (35 dapl)

	Lembang	Ciwidey
VC 81.2	R	HR
VC 33.9	MR	HR
FLS 3	HS	HS
FLS 8	HS	HS
Cl. 8 (I 181091.1 = MF-1)	R	HR
Cl. 17 (387091.10)	R	HR
Atlantic	HS	S
Granola	HS	HS

Participatory Needs Assessment on Potato IPM in Indonesia

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Introduction

In response to reports from the field of increasing pest and disease problems in potato production in Indonesia, the International Potato Center's regional office for East, Southeast Asia and the Pacific (CIP ESEAP) initiated a participatory needs assessment in four major potato growing areas. In particular, the increased occurrence of the leafminer fly (LMF), *Liriomyza huidobrensis*, which appeared in Indonesia in damaging proportions only since the last 3-4 years, needs special attention. In collaboration with farmers, local NGOs and researchers, CIP seeks to describe the various potato enterprise systems in the four areas, the associated cultivation constraints, and farmers' attitude and practices to manage these cultivation constraints, as a base for designing a targeted Potato IPM development program.

Methodology

The needs assessment involves a season-long study applying participatory approaches with the following objectives:

- To understand the importance of potato cultivation for farm households in major potato growing areas in Indonesia.
- To inventory potato cultivation practices and output relating to crop management, in general, and pest management, in particular.
- To monitor the development of the crop, pests and diseases, and natural enemy populations throughout the 1998 dry (C. Java) and 1998/98 wet seasons (all sites).
- To understand farmers' problems and constraints in potato cultivation.
- To understand farmers' solutions to their problems and their information sources.
- To identify opportunities for sustainable improvement of the potato enterprise in the study areas, both from an ecological and an economic perspective.
- To identify research needs and set the agenda for a collaborative Potato IPM R&D program in Indonesia.

Study sites selected and collaborators at each site include:

Province	District	Collaborator	Kind of organization
Central Java	Banjarnegara	YPPSE	Local NGO
West Java	Bandung	TP4	IPM Farmer Trainer network
North Sumatra	Berastagi	JTTK*	Farmer network
	Simalungun	YCD*	Local NGO

* IPM activities of these two organizations are coordinated by World Education (WE).

Both quantitative and qualitative data are collected in the study areas during the 1998 dry season and the 1998/99 wet season, using the following methods:

Method	When
1. Village profiling and problem ranking using PRA methods (transects, group discussions, ranking exercises, seasonal calendar, informal individual interviews with men and women farmers, traders, consumers)	Sep.-Nov. '99
2. Season-long record keeping of the potato enterprise by farmers, including technological and economic cultivation data.	'98 (C. Java) wet season '98/'99 (all sites)
3. Regular monitoring of the fields of the record keeping farmers by the field technician (direct observations and sticky traps).	dry season '98 (C. Java) wet season '98/'99 (all sites)
4. Assessment of the rate of parasitism of LMF.	wet season '98/'99
5. Individual interviews with potato farmers on production and marketing aspects.	dry season '98 (C. Java) wet season '98/'99 (all sites)
6. End-of-season group discussions with all stakeholders per site for participatory data evaluation and interpretation.	Jan.-Feb '99
7. National workshop	March '99

Data collection during the 1998 dry season in C. Java (July-October) served as a pretesting of the methodology, as well as a comparison of field conditions and practices of the dry versus the wet season. Farmers are actively involved in data collection and analysis, and at the end of the study in research agenda setting. From there, farmer participation is also anticipated in technology and training development.

Tentative results

Profile of the study areas

Potato was identified as a crop of major relative importance in the study areas, ranking first in the area in West Java, and third in the areas in Central Java and North Sumatra (see Table 1). The advantage of the potato crop over other commonly cultivated crops, as perceived by farmers, includes its potential for high productivity, and easy and profitable marketing. Its disadvantages include the high investment needed to cover production cost, the intensive crop care required, and its susceptibility to a range of potentially damaging pests and diseases, partly causing the high investment needed and implying great risk. Potato cultivation in the study areas is, therefore, limited to a select group of farmers who can afford the investment and risk. On average, these farmers obtain a relatively high profit from the potato enterprise.

A tentative, overall need is identified to develop more ecologically and economically sustainable cultivation practices, in general, and pest management measures, in particular, in order to (1) provide better opportunities to poorer farmers to benefit from the potentials of potato cultivation, and (2) make potato cultivation in Indonesia less polluting.

Table 1: Profile of the study areas and their potato cultivation systems.

Area	Banjarnegara (C. Java)	Bandung (W. Java)	Tanah Karo (N. Sumatra)	Simalungun (N. Sumatra)
Typification of farm enterprise	mixed subsistence and cash crops, relatively far from big city	cash crop (vegetable) system, relatively near to big city	cash crop (vegetable) system, relatively near to big city	mixed subsistence and cash crops, relatively far from big city
Typification of potato enterprise	input-intensive, for local market	input-intensive, for local market	input-intensive, mainly for export to Singapore and Malaysia	input-intensive, mainly for export to Singapore and Malaysia
Ranking of potato (relative importance of crop to farmers)	3	1	3	*)
After	maize, sweetpotato	-	chili pepper, maize (ranking almost equal to potato)	*)
Followed by	peas, cabbage	chili pepper, cabbage, Chinese cabbage, tomato	cabbage, tomato	*)
Ranking of constraints in potato cultivation	1. Leafminer fly 2. Late blight 3. Bacterial wilt 4. Mole cricket 5. Thrips	1. Leafminer fly 2. Late blight 3. Viruses 4. Thrips 5. Bacterial wilt	1. Bacterial wilt 2. Late blight 3. Leafminer fly 4. Potato tuber moth 5. Unpredictable weather conditions	*)

*) PRA activities currently implemented.

Follow-up plan

At the end of the season, after data analysis and reporting (March '99) , a national workshop is planned with representatives from all study sites and appropriate research and development institutions in the country (RIV, provincial Agricultural Technology Assessment Centers (BPTP), National IPM Program, etc.) to present the results of the needs assessment, share research done in other places, and set a research and action agenda for a collaborative Potato IPM Development Program. Based on the outcome of the national workshop research activities will be conducted, both on-station (CIP, RIV) and on-farm in the needs assessment study sites.

Granulosis virus and control of Potato Tuber Moth (PTM), *Phthorimaea operculella* Zell. (Lepidoptera ; Gelechiidae) on Potato

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Abstract

The development of insect resistance and concern the safety of the environment have led to a search for alternative pesticides that are effective and safe to the environment. The Phthorimaea Baculovirus or Granulosis Virus (GV) offer an alternative for a benigh insect control material. The ability of GV in controlling PTM has been known in various countries. This virus is very likely to be occurring naturally in moth infested potato fields in Indonesia. The objective of this study were 1) to determine the interaction, if any, of GV and plant derived compounds (azadiractin, limonin, and eucalyptol) and 2) to evaluate the efficacy of GV to control PTM in the storage. The efficacy of GV were compared with the *Bacillus thuringiensis* formulation and chemicals insecticide. The experiment were conducted in the screen house and storage of the Research Institute for Vegetables (RIV), Lembang, West Java from March to October 1998. A randomized complete block design with 12 treatments and three replications (screen house) and eight treatments and four replications (storage) were used in this experiment. Result of this study indicated that the use of GV effectively suppress the population of PTM, in the screen house and storage. Larva mortality following infection with the virus was observed as early as one day after treatment and its reached 83.3 % for GV (40 LE/l) and 63.3 % for GV (20 LE/l) at 10 days. GV (40 LE/l) was recorded to have the fastest LT_{50} with 5.0 DAT. The Efficacy of plant derived compounds were lower than that of GV. How ever, additional of GV can increase efficacy of plant derived compound. In the storage experiment, GV (40 LE/l) was extramelly effective in reducing of PTM infestation and less damage (90 %) at 4 month of storage and PTM population was reduced 90 % when compared to the control. The utilization of indigenous strains GV will help in developing a low cost (90 %) and effective control of PTM as well as in reducing pesticide use in potato. The development of GV-based insecticide would also help reduce the nation dependency on imported synthetic insecticides.
(*Keyswords*: *Phthorimaea operculella*, *Granulosis virus* (GV), *Solanum tuberosum*, Potato.)

Introduction

Potato tuber moth (*Phthorimaea operculella* Zell.) or PTM (Lepidoptera : Gelechiidae) is an important pest of potato in Indonesia. The larvae of PTM damages the plant shoot, bores into the stem, and mines the leaf and tuber. It is a pest both in the field and in the storehouse. Under heavy PTM infestation, potato haulms and stems occasionally dessieate and break. This pest originated in South America and has spread over many potato areas throughout the world (CIP, 1992). The pest also attacks tomato, tabbaco, egg, plant and other species of Solanaceae family. In field experiments yield loss due to PTM damage was 36% (Setiawati and Tobing, 1997). In an unprotected storage, tuber loss due to PTM damage reached as high as 60-70% in Thailand (Chouvalitwongporn, 1993).

Chemical control of PTM is costy and not completely successful. The use of pesticides in potato production is estimated to represent about 40% of the total variable production cost (Rauf, *et al*, 1993). In order to control PTM, potato growers must spray the crop as often as 16 to 25 times, particularly in the dry season crop. The development of resistance to insecticides and the harmful effects of insecticides are concerns to vegetables growers in highland vegetable areas of Java, Nort Sumatera and South Sulawesi Laboratory studies revealed that PTM collected in West Java has developed resistance to acephate, triazophos, deltamethrin and carbaryl insecticides (Sastrosiswojo, *et al.*, 1981).

Increasing concern for the quality of the environment and the increasing costs of developing new compounds as older ones become less effective has encouraged research and investment in saver alternatives than can reduce pesticides usage to safe levels. The use of biological control is an increasingly accepted way to reduce pesticide use in potato production. Biological control comprises the use of parasitoids, predators and pathogens. Among them the Phthorimaea Baculovirus or also known as Granulosis Virus (GV) has been successfully utilized in the control of PTM in various countries (Alcazar *et al*, 1992, Ben Salah *et al*, 1992 and Lagnaoui, *et al*, 1996). GV has been found to be highly effective in controlling PTM in the field and storage. GV is highly specific to PTM and is of safe use. Liquid and powder formulations of the virus have been published (CIP, 1992). This virus has been found naturally infecting PTM in several countries, and it is likely that it also occurs in PTM infested potato fields in Indonesia.

Setiawati *et al.*, (1998) reported that indigenous GV effectively suppress the population of PTM, in laboratory, screen house and storage when fed of tuber at a dose of 10^{5}. Larva mortality following infection with the virus was observed as early as 2 – 10 days after ingesting the virus. Lagnaoui (1997) reported that three factors seem to influence the use and performance of the potato tuber moth, *P. operculella*, granulosis virus are production, biological activity (virulence) and persistence. In other insect species, efforts have been devoted to the enhancement of baculovirus efficacy by increasing host susceptibility with selected chemicals. Historically, plant derived chemicals have been an important source of insecticides with monoterpenoids figuring among the most successful pesticides. These compounds can be biologically active against insects and may represent an additional strees on the insect's system, which would allow enhanced virus performance.

The objective of this study were 1) to determine the interaction, if any, of GV and plant derived compound (azadiractin, limonin, and eucalyptol) and 2) to evaluate the efficacy of indigenous GV to control PTM in storage. The utilization of indigenous GV will help in developing a low cost and effective control of PTM as well as in reducing pesticide use in potato.

Materials and Methods

The research was conducted at the Research Institute for Vegetables (RIV), Lembang, West Java from March to October 1998.

Larva of PTM were collected from potato fields free of pesticide use and farmers potato storages in Pangalengan, West Java. Larvae of creamy white color, slightly swollen and of slow movement were crushed and used to prepare on inoculum. The inoculum consisted of 20 larvae perliter of water. Potato slices were dipped in the inoculum and 10 healthy larvae of 2^{rd}-3^{rd} instar were placed on each slice. Larvae mortality was recorded daily for 10 days. Water was use to dipp potato slices as control treatmnets. The experiment was a copletely randomyzed block design with 6 replications. The experiment was conducted twice. Become highly siginificant in larva mortality in formed among treatments, samples of dry larva were sent to Dr. Gerry Cainer form Clemson University, USA who confirmed the occurrence of Granulosis Virus in the samples.

1). Mass rearing of PTM

PTM larvae were taken from laboratory culture. 50 males and 50 females adult of PTM were placed in a plastic container with a place of cotton indilute 5% sucrosa solution. The top of the container was closed using a mesh cloth to which a filter paper was attached eggs of PTM were recorded on the filter paper. The filter paper was changed every 2 days. Eggs were placed on potato tuber for mass rearing of PTM.

2). Mass production for GV

GV was multiplied using mass-reared potato moth larvae as host. A water suspension was prepared by crushing 10 infected larvae and added to one liter of water. 1-2 kg of tubers in a mesh bag was soaked in the water suspension for one minute. The tubers were take out of the mesh bag, dried in the shade, and placed in paper bags. Then 300 to 500 mass reared potato tuber moth larvae were placed on the tubers. After 2 to 3 weeks, infected larvae were collected from inside and outside the tubers, and used to prepare powder or liquid formulations.

3). Efficacy of GV to control *P. operculella*.

3.1. Sreen house experiment using the GV and plant derived compounds and its combination to control PTM.

A preliminary experiment was conducted in a randomized complete block design with 12 treatments and three replications. The treatments were:

A. GV (20 LE/l).
B. GV (40 LE/l)
C. Azadirachtin
D. Limonin
E. Eucalyptol.
F. GV (20 LE/l) + azadirachtin
G. GV (20 LE/l) + limonin
H. GV (20 LE/l) + eucalyptol.
I. GV (40 LE/l) + azadirachtin
J. GV (40 LE/l) + limonin
K. GV (40 LE/l) + eucalyptol
L. Control.

Note: All treatments were diluted with water containing Agristic (0.5 cc/l) as a wetting agent. Concentration of plant derived compounds was 3.0 %, respectively.

Six weeks old potato plants in the pot were infested with 10 healthy and GV and another treatments (a volume 20 cc/plant) was applied with a hand sprayer for each treatment. Larva mortality was recorded daily until 10 days after treatment (DAT), plant damage was recorded at 10 days after treatment. Data were analyzed satistically using probit method to determine the Lethal-Time$_{50}$ (LT_{50}) and analysisof variance to determine the percentage of mortality and their significance using Duncan's Multiple Range Test. Then percentage of larvae mortality was corrected using Abbott's formula.

3.3. Efficacy of GV to Control PTM in the Storage.

The experiment was conducted in a randomized complete block design with eight treatments and four replications. The treatments were: : A). GV (10 LE/l) ; B). GV (20 LE/l); C). GV (30 LE/l); D). GV (40 LE/l); E). Talc F). *B. thuringiensis;* G). Methomyl; and H). Control (Without GV).

This study was replicated two times. The first was exposed with larva infestation or artificial infestation calculated from (1 larvae/5 gram) and second was exposed to natural PTM infestation. For the artificial infestation treatment, 10 potato tuber (500 gr) and 2.5 g of GV, *B. thuringiensis* and carbaryl per treatments placed in the bag, shake until the tubers appear completely white. Each treatment kept in the storage until 4 months. For the natural PTM infestation, 10 kg of potato tuber and 50 g of GV, *B. thuringiensis* and Carbaryl per treatment placed in the bag, shake until the tubers appear completely white, and placed in the wooden box.

Potato tuber were monitored at 14 day intervals for a 4-month storage period. Observation were made on 10 tuber/treatment selected at random from each tuber. The percentages of infested tuber, damage tubers (number of holes), PTM population and number of sprout were recorded.

Results and Discussion

1). Screen house experiment using the GV and plant derived compounds and its combination to control PTM.

The effect of GV and plant derived compounds and its combination on PTM larvae mortality are presented in Table 1 and Figure 1. The mortality of all treatment occur as early as one day after treatment in mean percentage of 3. 3 % to 13.3 %. At the first observation GV (40 LE/l) + limonin more effective and significantly if compare with another treatments. These data indicated that the addition of limonin to GV (40 LE/l) will result in faster virus-induced PTM mortality. The use of azadirachtin caused mortality of PTM larvae was much higher than that limonin or eucalyptol. The use of azadirachtin caused 56.7 % mortality of PTM larvae, and both limonin and eucaluptol only 43.3 %. The highest mean percentage larva mortality was observed at GV (40 LE/l) 83.3 % followed by GV (40 LE/l) + azadirachtin (73.3 %). GV (40 LE/l) alone and combination with plant derived compound more effective than

GV (20 LE/l). Shapiro and Bell (1981) reported that the slightly lower activity of GV at the lower concentration could be related with lower numbers of virions in the relatively small polyhedra that are present at this stage of the virus infection. Reed (1971) reported that the incubation period of the virus disease in PTM larvae varies with dose, temperature, and the age of larvae.

Treatments with plant derived compounds used alone showed an effect on PTM larva mortality. When exposed to the combination and the GV ecpesially GV (20 LE/l), larvae died signiticantly faster than fed of compounds used solely (Figure 1).

Table 1. Mean Percentage of Potato Tuber Moth Larval Mortality after 10 Days Observation, Lembang 1998

Treatments	Mortality of PTM larvae (%) .... DAT									
	1	2	3	4	5	6	7	8	9	10
A. GV (20 LE/l)	0.0 b	10.0 ab	16.7 bcd	30.0 abc	33.3 bc	43.3 abc	56.7 abc	60.0 bc	63.3 cd	63.3 cd
B. GV (40 LE/l)	3.3 b	13.3 ab	26.7 a	33.3 ab	50.0 a	53.3 a	66.7 a	73.3 a	83.3 a	83.3 a
C. Azadirachtin	3.3 b	13.3 ab	13.3 cd	30.0 abc	40.0 ab	43.3 abc	50.0 cde	53.3 cd	56.7 de	56.7 de
D. Limonin	6.7 ab	10.0 ab	23.3 ab	26.7 abc	30.0 bc	33.3 c	40.0 c	43.3 ef	43.3 f	43.3 f
E. Eucalyptol	6.7 ab	10.0 ab	16.7 a-d	20.0 bc	30.0 bc	36.7 bc	40.0 e	40.0 f	43.3 f	43.3 f
F. A + C	3.3 b	10.0 ab	26.67 a	36.7 a	40.0 ab	50.0 a	53.3 bcd	63.3 b	66.7 bc	66.7 bc
G. A + D	0.0 b	6.7 b	10.0 d	20.0 c	23.3 c	36.7 bc	43.3 de	53.3 cd	56.7 de	56.7 de
H. A + E	3.3 b	6. 7 b	13.3 cd	23.3 abc	36.7 abc	43.3 abc	50.0 cde	50.0 de	50.0 ef	50.0 ef
I. B + C	3.3 b	13.3 ab	23.3 ab	36.7 a	50.0 a	50.0 a	63.3 ab	73.3 a	73.3 b	73.3 b
J. B + D	6.7 ab	10.0 ab	20.0 abc	30.0 abc	36.7 abc	43.3 abc	46.7 cde	53.3 cd	60.0 cde	60.0 cde
K. B + E	13.3 a	16.7 a	23.3 ab	30.0 abc	36.7 abc	46.7 ab	50.0 cde	56.7 bcd	56.7 de	56.7 de
L. Control	0.0 b	0.0 c	0.0 e	0.0 d	0.0 d	0.0 d	0.0 f	0.0 g	0.0 g	0.0 g

Note : DAT = Days after treatment

Average of three replications. In column, means followed by a common leteer are not significantly different at the 5 % level by Duncan's multiple range test

The LT_{50} of GV and plant derived compound and its combination are presented in Table 2. GV (40 LE/l) alone and combination with azadirachtin were more virulent and LT_{50} were faster than another treatments with 5.0 DAT. There were differences in the effectiveness of plant derived compounds alone in combination with GV. The use of GV can increase LT_{50} of PTM mortality. The LT_{50} of GV (40 LE/l) combination with azadirachtin, limonin and eucalyptol were 5.0, 7.2 and 6.5 DAT, respectively. This LT_{50} were faster than GV (20 LE/l) with 5.8, 7.3 and 6.6 DAT, respectively.

Plant damage in different treatments are presented in Figure 2. The amount of damage followed the same pattern as the mortality data. This data indicated with GV (40 LE/l) application causing the largest reduction of damage (30 %) if compare with control followed by GV (40 LE/l) + azadirachtin 34.53 %.

Table 2. The LT_{50} value at different treatment against the second-instar larvae of PTM, Lembang 1998

Treatments	LT_{50} value (DAT) *
A. GV (20 LE/l)	6.9
B. GV (40 LE/l)	5.0
C. Azadirachtin	6.7
D. Limonin	11.0
E. Eucalyptol	11.0
F. GV (20 LE/l) + Azadirachtin	5.8
G. GV (20 LE/l) + Limonin	7.3
H. GV (20 LE/l) + Eucalyptol	6.6
I. GV (40 LE/l) + Azadirachtin	5.0
J. GV (40 LE/l) + Limonin	7.2
K. GV (40 LE/l) + Eucalyptol	6.5

Note : DAT = Days after treatment

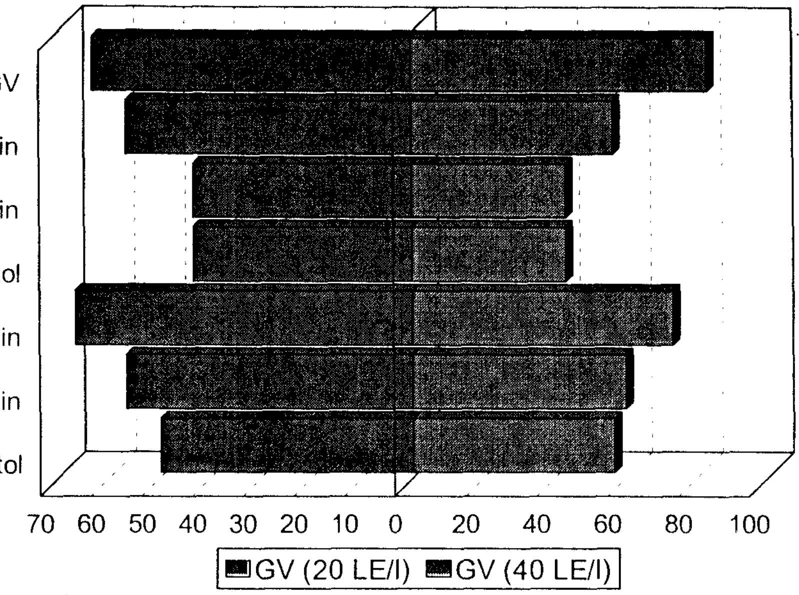

Fig 1. The effect of GV and plant derived compounds and its combination on PTM larvae mortality, Lembang 1998

At the highest concentration most larvae were killed before causing any significant damage due chiefly to the overdose effect (Reed, 1971). Shapiro and Bell (1981) reported that virus should be applied as early as possible during development, but in any case before larvae reach the third instar, in order to prevent most of feeding damage to the crop.

The result also indicated that efficacy of plant derived compounds were lower than that of GV. How ever, addition of GV can increase efficacy of plant derived compounds such as azadirachtin, limonin and eucalyptol.

Azadiractin, extracted from the leaves of the neem tree, *Azadirachta indica*A. Juss., has been demonstrated as potent feeding inhibitor and growth regulator against many lepidopteran pests. it is not toxic, but it both repels and disrupts insect development and reproductive (Sastrodihardjo and Adytia, 1994). Limonin, extracted from peels of *Citrus aurantifolia* has been shown as an anti-feedant for many insects in several orders including Lepidoptera and Coleoptera . Eucalyptol, obtained from the eucalyptus tree is an effective repellent against a number of dipterans and Lepidopterans (Lagnaoui, 1997).

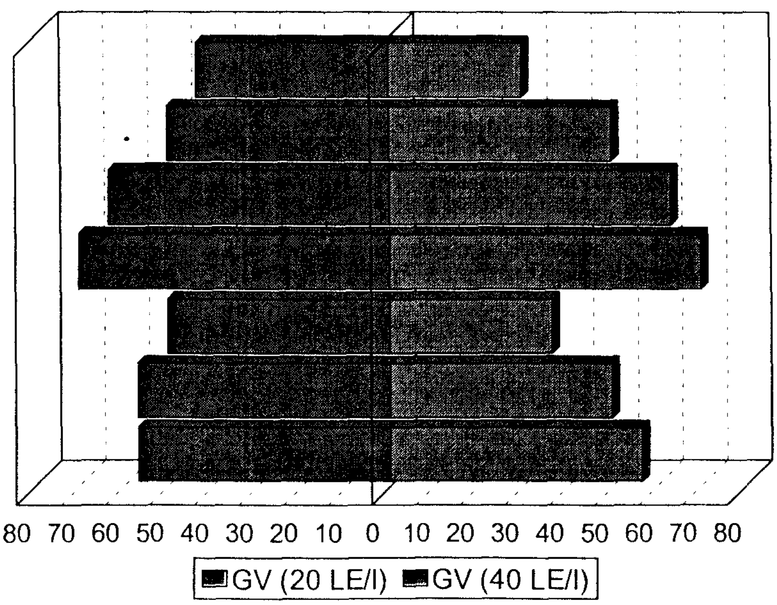

Fig 2. The effect of GV and plant derived compounds and its combination on plant damage, Lembang 1998

2). Efficacy of GV to control PTM in Storage

The result of this experiment are presented in Table 3 and Table 4 and Figure 3, 4, and 5. The result showed that all tested compound (artificial infestation and natural infestation) successfully reduced PTM damage when compared with the control. The treatments showed varying toxicity depending on concentrations. GV (40 LE/l) successfully reduced PTM damage when compare with the control and another treatments. The use of GV, *B. thuringiensis* and carbaryl were effective against PTM for up to 4 month of storage. The use of GV (40 LE/l) can reduce number of hole was 90 % after 4 month, followed by *B. thuringiensis* (78.8 %) and carbaryl (75.6 %) if compare with control .

The effect of GV in number of sprout are presented in Figure 3. The use of GV (40 LE/l) gave better number of sprout if compare with another treatments. Number of sprout in artificial infestation (3.0 sprout/plant) and in natural infestation (2.5 sprout /plant). Even though the data were not analyzed statistically, it was apparent that succssful population was affected by the treatment. At 4 month after treatment PTM population was dropped to less than 38 % - 90 % as compared to the control. In general there was a tendency that the population decreased as the concentration of GV increased (Fig.4). High concentration of GV had the lowest damage (8.33 %), followed by middle concentration (25.33 %) and both of them significantly higher than lower concentration (45.58 %) (Fig 5).

Many researcers have used *B. thuringiensis* and GV to control PTM successfully under field conditions (Haydar and El Sherif, 1987; Ali, 1991; Das *et al.*, 1992). Under field condition in Tunisia, Ben Salah and Albu (1992) tested the effectiveness of GV, both in spray and as dust, in an attemps to reduce PTM damage to potatoes at harvest. They found that tuber infestation at harvest was reduced significantly by the spray (73 %) and the powder (35 %). Field application of the spray can also reduce the development of PTM in storage potatoes (Ben Salah and Abu, 1992).

Table 3 Number of holes per tuber at storage period (artificial infestation), Lembang 1998

Treatments	No. of holes/tuber at ....DAT							
	14	28	42	56	70	84	98	112
A. GV (10 LE/l)	4.28 a	4.55 a	5.20 a	6.50 b	8.10 ab	7.80 ab	8.75 a	11.55 a
B. GV (20 LE/l)	3.78 a	4.10 a	4.15 a	6.40 b	7.35 ab	7.63 ab	7.22 ab	9.75 ab
C. GV (30 LE/l)	2.65 ab	4.00 a	4.40 a	5.90 b	6.85 b	6.97 ab	7.38 ab	7.07 bc
D. GV (40 LE/l)	0.52 c	0.75 b	0.85 b	0.95 d	1.05 d	1.33 d	1.73 d	1.27 e
E..Talc	2.60 ab	3.22 a	3.22a	3.50 c	4.03 c	5.30 bc	4.35 bc	4.88 cd
F. B. thuringiensis	0.45 c	1.20 b	1.38 b	1.90 cd	2.65 cd	3.53 c	3.47 cd	2.72 de
G. Carbaryl	1.30 bc	1.40 b	1.35 b	1.95 cd	2.58 cd	2.90 cd	2.70 cd	3.13 de
H. Control	3.68 a	4.30 a	4.30 a	9.77 a	10.63 a	10.63 a	10.73 a	12.82 a

Average of three replications. In column, means followed by a common leteer are not significantly different at the 5 % level by Duncan's multiple range test

Table 4 .Number of holes per tuber at storage period (natural infestation), Lembang 1998

Treatments	No. of holes/tuber at ....DAT							
	14	28	42	56	70	84	98	112
H. GV (10 LE/l)	0.0 b	0.90 b	1.30 b	0.60 b	0.60 b	1.65 b	1.30 b	2.28 b
I. GV (20 LE/l)	0.05 b	0.65 bc	0.65 c	0.40 bc	0.35 bc	1.05 bc	0.77 bc	1.33 bc
J. GV (30 LE/l)	0.00 b	0.38 bcd	0.52 cd	0.20 bc	0.38 bc	0.65 cd	0.55 bcd	0.98 bcd
K. GV (40 LE/l)	0.03 b	0.13 cd	0.17 de	0.08 c	0.08 cd	0.20 de	0.03 d	0.20 d
L. Talc	0.05 b	0.15 cd	0.28 cde	0.30 bc	0.08 cd	0.15 de	0.15 cd	0.28 cd
M. B. Thuringiensis	0.00 b	0.0 d	0.03b e	0.15 bc	0.0 d	0.03 e	0.17 cd	0.35 cd
N. Carbaryl	0.00 b	0.13 d	0.32 cde	0.15 bc	0.0 d	0.20 de	0.60 bcd	1.02 bcd
O. H. Control	0.60 a	3.10 a	3.95 a	3.90 a	3.50 a	3.72 a	3.50 a	4.85 a

Average of three replications. In column, means followed by a common leteer are not significantly different at the 5 % level by Duncan's multiple range test

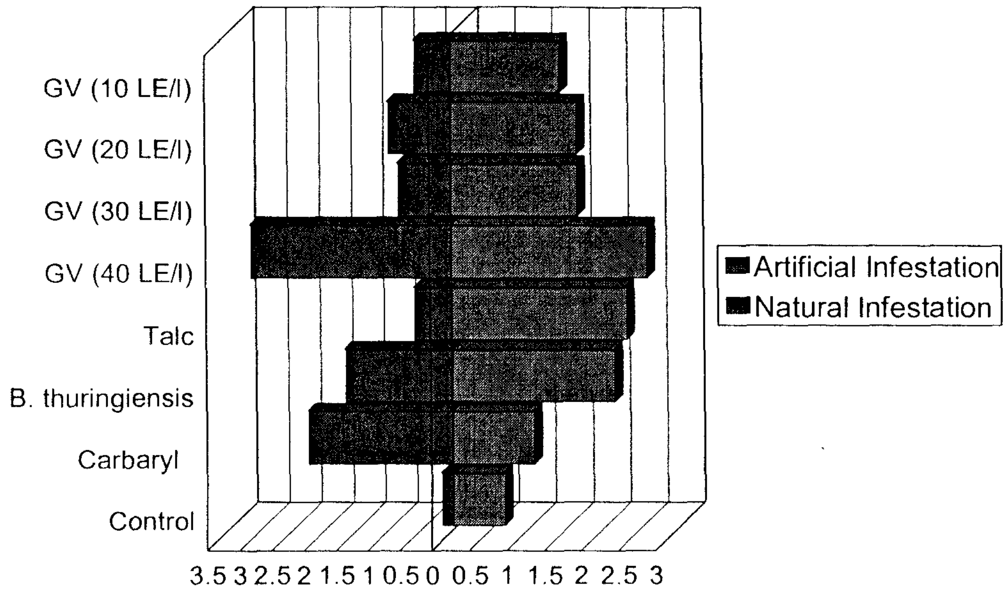

Fig 3. Number of sprout after 4 months infestation, Lembang 1998

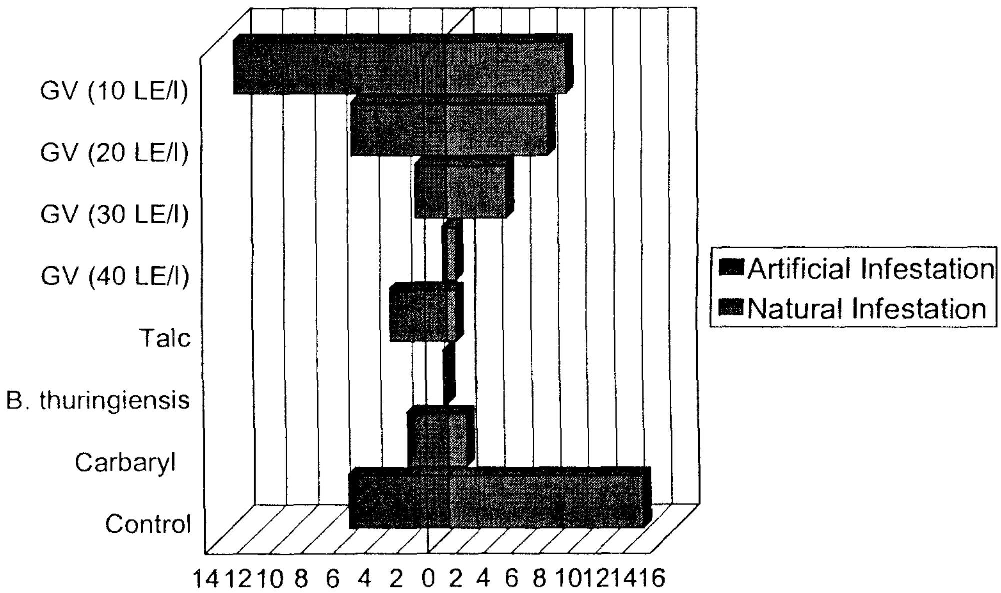

Fig 4. Number of PTM populations after 4 months infestation, Lembang 1998

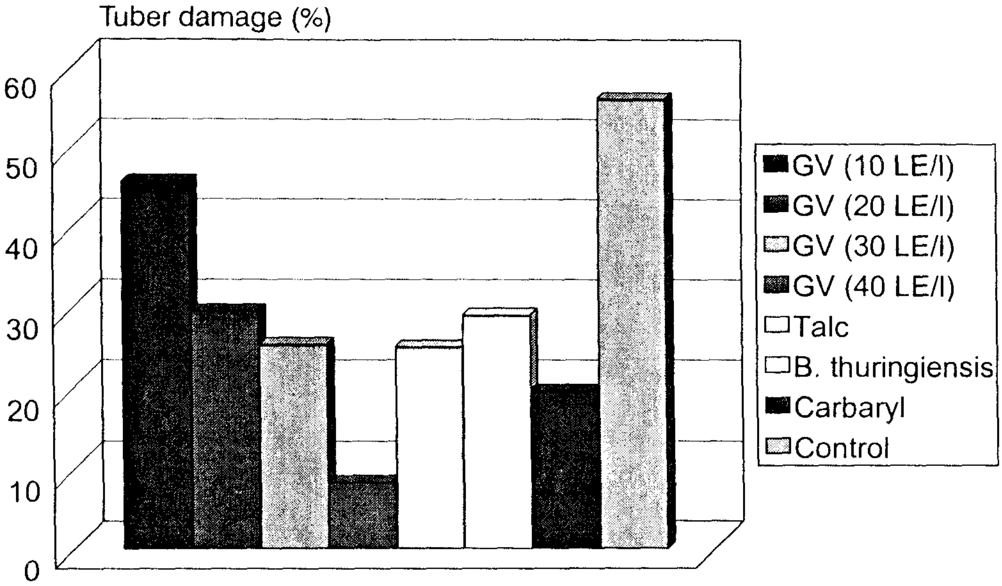

Fig 5. Percentage of tuber damage after 4 months infestation, Lembang 1998

Dass *et al.,* (1992) and Doss *et al.,* (1994) investigated the effectiveness of different control treatments against PTM infesting stored potatoes over periods 2 and 4 month. They found that GV was effective against PTM for up to 2 moths of storage. Very low infestations were achived with different treatment combinations (GV + *B.t* + delthamethrin + *Lantana camara,* and delthamethrin + *B.t* + GV) even 4 months of storage.

The analysis cost of GV production has been done. As a result, the GV production /kg was Rp. 4728,- on average with specification :

- Cost of mass rearing room/moth : Rp. 100.000,-
- Cost of GV production/month Rp. 1.673.000,-
- Average of GV production/month 375 kg
- Average cost of GV/kg : Rp. 4728,-.

If a price of synthetic insecticide Rp. 50.000,-/kg, the use of GV can reduce cost of insecticide more than 90 %. It is expected that the utilization of indigenous strains of GV will help in producing a low cost and effective control of PTM and in reducing pesticide use in potato.

Conclusions

Based on the result of the experiment and discussion above, it can be concluded as follows :

1). The use of GV effectively suppress the population of *P. operculella* in the sceen house and storage.

2). Larva mortality following infection with the virus was observed as early as one day after treatment and its reached 83.3 % for GV (40 LE/l) and 63.3 % for GV (20 LE/l) at 10 days.

3). GV (40 LE/l) was recorded to have the fastest LT_{50} with 5.0 DAT.

4). The Efficacy of plant derived compounds were lower than that of GV. How ever, aditional of GV can increase efficacy of plant derived compound.

5). In the storage experiment, GV (40 LE/l) was extramelly effective in reducing of PTM infestation and less damage (90 %) at 4 month of storage and PTM population was reduced 95 %when compared to the control.

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Farmers practices in seed sortation to control Bacterial Wilt of Potato in Pangalengan

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Abstract

This on-going interdiciplinary research has been conducted by a research team of the Research Institute for Vegetable (RIV) and the International Potato Center (CIP) since June 1998. Research was conducted based on the main assumption that the problem of bacterial wilt of potato in Pangalengan is caused mainly by latent infected tuber seed as the result of inappropriate seed sortation practiced by farmers. Data were collected from 51 farmers through individual interviews and direct observations on samples of plants and tubers taken from the farmers fields and storages. Preliminary results showed that in the dry season bacterial wilt was not the main disease problem for the majority of farmers because the incidence of the disease was low. The non-host crops to *Ralstonia solanacearum* planted by the majority of farmers before potato could reduce the incidence of bacterial wilt. Inappropriate seed sortation practiced by farmers at the harvest time resulted in the infection of *Ralstonia solanacearum* in the farmers fields. This finding indicates that farmers may lack the knowledge of the importance of sanitation as a control practice to reduce bacterial wilt. Inappropriate seed sortation practiced by farmers in the storage was rooted in the farmers constraints of limited space of storage facilities. Therefore, to improve farmers practices in seed sortation, an efficient spaced seed storage technology is needed.

Introduction

Seed sortation and crop rotation were the most common farmers practices in Pangalengan to control bacterial wilt of potato (Chujoy, et al. unpublished). However, it seemed that the control practices were not effective enough because farmers still claimed that bacterial was the main disease problem of potato in their location.

Bacterial wilt caused by *Ralstonia solanacearum* may originate from infected tuber seed or infested soil. According to French (1994) bacterial wilt (BW) of potato is primarily a tuber borne disease. The BW disease in Pangalengan also seems mainly originated from infected tuber seed rather than from infested soil. Farmers commonly keep and sort their own seed until the 4th or 5th generation before they buy a new and clean seed. Due to inappropriate practices in seed sorting, some infected tuber seed may escape and be planted by farmers to the field.

This research aimed to understand farmer practices in seed sortation. It is expected that technical and socio-economic factors which directly or indirectly affects the inappropriateness of seed sortation done by farmers can be identified. Based on this research findings, an on-farm experiment or technological components could be designed or recommended to improve farmer practices in seed sortation.

Materials and Methods

This on-going research has been conducted since June 1998 in Pangalengan by an interdiciplinary research team from Research Institute for Vegetable (RIV) and International Potato Center (CIP), in cooperation with local extensionists and farmers. The research team consisted of a social scientist, two bacteriologists, a weed specialist and a CIP' s potato specialist. Five field assistants, four from social department and one from plant protection department of RIV were involved in data collection.

Data were collected from 51 farmer respondents in four different villages chosen purposively through individual interviews and observations of farmers' fields and storages. Data from interviews included socio-economic characterisitics of farmers; crop rotation; seed generation and farmers' description and reason of seed sortation practiced. Data from observations included the percentages of plant wilt and tuber losses in the farmers' fields and storages; the percentage latent infection of farmers tuber seed, slope of farmers field, materials used and procedures of seed sortation practiced by farmers.

The percentage of plant wilt and tuber loss in farmers field were estimated from 3 sample plots (250 plants per plot), disregarding the land size actually planted to potato . The percentage of tuber loss in the storage was estimated from a sample of two baskets of potato seed, disregarding the total amount of seed actually stored by the farmer. The percentage of latent infection of a farmer tuber seed was estimated from a 2 kg sample of sprouted tuber seed bought from farmers and incubated in RIV' storage for 2 months.

To identify technical and socio-economic factors which directly or indirectly affects on the inappropriateness of seed sortation done by farmers (indicated by the percentage of latent infection of farmers' tuber seed), a path analysis will be used.

Results and Discussion

General findings : a preliminary result

This on-going research is expected to be finished the end of January 1999. Analysis to identify direct and indirect factors that effect on the percentage of latent infection of farmers' tuber seed could not be made yet. However, some general findings are presented here.

Potato production

There are three main potato planting seasons in Pangalengan, i.e. beginning of the rainy season (September - November), end of the rainy season (March - April) and the dry season (June-July). In the dry season 1998, most respondents (88%) planted the potato cultivar Granola after crops which are known as a non-host crop of *Ralstonia solanacearum*, i.e. chinese cabbage, cabbage, corn and beans (Table 3). Most farmers (86%) used seed of generation three or higher (Table 4), and 97% farmers used seed with the size of more than 20 gram per tuber (Table 5). Sahat and Azirin (1996) found that potato crops grown from seed smaller than 20 grams per tuber were easier to attack by *Ralstonia solanacearum* than that those grown from bigger seed.

Bacterial wilt incidence

The percentage of plant wilt in most farmers fields was low, i.e. less than 10%. However, in 6 locations (12%) the plant wilt was quite high, ie. 15 - 25 % (Table 7). The low percentages of plant wilt may be due to the dry season effect. In the rainy season, when soil moisture is high, the incidence of BW in farmers fields was expected to be high. According to Martin and French (1996) high soil moisture promotes survival, infectivity, disease development and spread of the bacterium.

On the average, tuber loss at harvest was 3.9% by weight or 4.7% by tuber number; whereas in the storage tuber loss at the time of first seed sortation was about 1% by weight or 2% by tuber number (Table 8).

Considering that in general the incidence of bacterial wilt in the field, at harvest and in the storage were low, our interpretation is that bacterial wilt is not the main disease problem in the dry season.

Seed sortation

During the plant growth stage when many plants wilt, farmers commonly harvest the wilting plants earlier (from 70 to 75 days) and sell the potato in the local market at a low price. If the percentage of wilting plants is high (more than 20%), farmers usually sell all the potato and do not keep any tuber for seed. These practices appear to reduce the farmers' risks of keeping infected tuber seed at the harvest time.

Farmers sorted the tuber seed from the time of harvesting until the seed was to be planted. At least farmers sorted seed twice, i.e. at harvest and 2-3 days before planting or at planting time. Most farmers (63%) sorted seed from 2 to 3 times, and 37 % sorted seed from 4 to 6 times (Table 9). Farmers who stored the seed in bamboo baskets sorted the seed less frequent than those farmers who stored the seed by spreading it on the storage floor.

At harvest, farmers sorted tuber seed by collecting healthy looking small size tubers (20 - 40) into separate bamboo baskets. Among rotten and very small tubers, 88% of them were infected by

Ralstonia solanacearum (Table 10), and were left by farmers in the field. This practice indicated that farmers did not realize or neglected that they infected they own land with the pathogen.

Farmers brought their seed from the field to their storage facilities using bamboo baskets. Some farmers sorted their seed again as soon as they arrived and before storing it, but most of them waited for 2-7 days to do it. Pests and diseased infected tubers were dicarded, while the healthy looking tubers were stored.

Most farmers (77%) used bamboo baskets to store their seed because they did not have seed storage facility or their storages were too small. The use of bamboo baskets as seed container allowed farmers to store a lot of potato seed in a small space. The baskets were piled up 2 to 4 baskets and some times up to 5 or 6 baskets. Each basket contained about 25 kg of seed and it was as deep as 40 cm.

Farmers mentioned that in the bamboo baskets disease infected tubers were not easy to observe. They realized that if seed sortation was conducted late, the disease would spread quickly resulting in many rotten tubers. However, since seed sortation was laborious and difficult, i.e. tuber seed had to be unloaded from bamboo baskets, spreaded, sorted, and loaded back into the bamboo baskets; and during the seed sortation some seed sprouts might be damaged (Table 11). Hence, farmers were still less prone to sort their seed .

This findings suggest that inappropriate seed sortation practiced by farmers was rooted in the farmers constraints of limited space of storage facilities. Therefore, to improve farmers practices in seed sortation, an efficient spaced seed storage technology is needed.

Conclussions

In the dry season, it seemed that bacterial wilt was not the main disease problem for the majority of farmers, because the incidence of the disease was low. The non-host crops of *Ralstonia solanacearum* planted by the majority of farmers, i.e . chinese cabbage, cabbage, corn and beans before potato could reduce the incidence of bacterial wilt.

Inappropriate seed sortation practiced by farmers at the harvest time resulted in the infection of *Ralstonia solanacearum* in the farmers fields. This finding indicates that farmers may lack knowledge of the importance of sanitation as a control practice to reduce bacterial wilt.

Inappropriate seed sortation practiced by farmers in the storage was rooted in the farmers constraints of limited space of storage facilities. Therefore, to improve farmers practices in seed sortation, an efficient spaced seed storage technology is needed.

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Appendix 1

Table 1. Frequency (F) distribution of the farming scale

Farming scale	**f**	**%**
< 0.5 ha	15	33
>0.5 - < 1.0 ha	7	15
> 1.0 - < 2.5 ha	11	24
> 2.5 - < 5 ha	6	13
> 5 - < 10 ha	5	11
>10 ha	2	4
Total	**46**	**100**

Table 2. Frequency (F) distribution of farmers' experience in potato farming

Years of experience	**f**	**%**
< 5 years	8	18
> 5 - < 10 years	5	11
> 10 - < 15 years	4	9
> 15 - < 20 years	5	11
> 20 years	23	51
Total	**45**	**100**

Table 3. Crops planted before potato , dry season 1998

Crops	**n**	**%**
Chinese cabbage	3	7
Cabbage	31	74
Corn	2	5
New land	1	2
Potato	2	5
Chilli	1	2
Tomato	1	2
Beans	1	2
Total	**41**	**100**

Appendix 2

Table 4. Generation of seed used by farmers

Generation of seed	n	%
G2	2	4
G3	27	50
G4	8	18
G5	3	7
G7	2	4
>G7	3	7
Total	**45**	**100**

Table 5. Frequency (F) distribution of tuber size used by farmers

Tuber size (gram)	**f**	%
< 20	1	3
20 – 30	22	56
31 – 40	14	36
> 40	2	5
Total	**39**	**100**

Table 6. Frequency (F) distribution of potato yield obtained by farmers

Yield (t/ha)	**f**	%
< 5	3	3
5 – 9.9	10	31
10 – 14.9	8	25
15 – 19.9	9	28
20 – 24.9	4	13
Total	**32**	**100**

Appendix 3

Table 7. Frequency (F) distribution of the percentage of plant wilt caused by bacterial wilt in farmers field

Plant wilt (%)	f	%
0.6 - < 5	19	37
> 5 - < 10	15	29
> 10 - <15	11	22
> 15 - < 20	3	6
> 20 – 25.9	3	6
Total	**51**	**100**

Table 8. Mean tuber loss caused by bacterial wilt in the field and in the storage

Unit	In the field (per 250 plants)				(n=30)		In the storage (per 2 baskets of tuber)				(n=34)	
	Brown rot		Soft rot		Total sample		Brown rot		Soft rot		Total sample	
	Unit	%	Unit	%	Unit	%	Unit	%	Unit	%	Unit	%
Weight of tuber (kg)	3.45	3.91	0.21	0.24	88.09	100	0.70	1.33	0.03	0.06	52.74	100
Number of tuber	83	4.72	5	0.28	1759	100	28	1.54	1	0.06	1815	100

Table 9. Frequency of seed sortation done by farmers (n=35)

Frequency	n	%
2 x	7	20
3 x	15	43
4 x	9	26
5 x	3	8
6 x	1	3
Total	**35**	**100**

Appendix 4

Table 10. Identification of pests and diseases on potato tubers left in the field by farmers at harverst (per 65.6 m2) (n=30).

Unit	Brown rot		Soft rot		Others		Total samples	
	Unit	%	Unit	%	Unit	%	Unit	%
Tubers weight (gr)	723	88	37	4	64	8	824	100
Tubers number	28	88	1	3	3	9	32	100

Table 11. Seed storage facilities used by farmers (n=45)

Facilities	n =45	%
Seed Storage used		
• Seed storage	30	67
• Houses	15	33
Seed container used		
• Bamboo baskets	22	49
• Bamboo basket+wooden boxes	2	4
• Spreaded on the storage floor	10	22
• Spreaded on the storage floor + bamboo basket	11	24

Appendix 5

Table 12. Farmers' perception of the advantages and drawbacks of storing potato tuber seed in the bamboo basket

Perception	n = 45	%
Advantages:		
• Practical: easy to handle and to store	11	24
• Efficient in space	26	58
• PTM attacked is isolated	4	9
• Sprouts grow quickly	5	11
• No anwers	10	22
Drawbacks:		
• Poor sprouts: thin, long, weak, white, heterogen	14	31
• More rotten tubers	15	33
• Sortation is difficult: un-observed rotten tuber more labour, sprout damaged	2	4
• Cost for baskets	4	9
• No answer	9	20
No drawbacks nor advantages	6	13

Effect of crop rotation patterns on *Ralstonia solanacearum* population in the soil

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Abstract

An experiment was conducted to determine the effect of crop rotation patterns on *Ralstonia solanacearum* population in the soil and on the potato crop in the subsequent season. The experiment was conducted at the experimental station of Research Institute for Vegetables (RIV) in Lembang-West Java (1250 m asl.). The experiment is planned to be conducted in six successive seasons. Three season crops have been harvested. Tomato, maize, cabbage, beans, carrot were rotated with potato in six different crop rotation patterns. *R. solanacearum* population was estimated before planting and after harvest in each season. Occurrence of wilt in subsequent potato crops was also recorded. In addition, the growth and yield of potato crops were recorded. Results after harvest in season 2 indicated that all rotation treatments reduced the *R. solanacearum* population, and the pathogen population in Potato-Maize treatment was significantly lower than those of the other rotation treatments. Thus, results suggest that rotation with maize is the best to reduce the pathogen population in the soil. The Potato-Tomato-Potato and Potato-Potato-Potato treatments in season 3 had more wilting plants than other treatments although significant difference only occurred at 11 week after planting (WAP). Tuber yields of potatoes in Potato-Tomato-Potato and Potato-Potato-Potato treatments were significantly lower than those of other treatments. Rotation with maize, cabbage, beans and carrot had a significantly lower percentage of wilting plants and a significantly higher tuber yields of potato in the subsequent season compared with those of rotation with tomato and potato, the solanaceae crops. These results also suggest that rotation with maize, cabbage, beans and carrot are effective in reducing the bacterial wilt incidence in the potato crop. The basis for the reduction of the pathogen population in the soil in crop rotation experiments, e.g. antagonistic bacteria, needs research.

Introduction

Bacterial wilt caused by *Ralstonia solanacearum*, also known as brown rot is an important disease of potato in Indonesia. Hutagalung in 1984 estimated that the incidence of bacterial wilt on potato in production centers in Java ranged from 4 to 32% (Machmud, 1986). Another survey, conducted in April 1996 at Pangalengan, the largest potato production area in West Java indicated that bacterial wilt ranked first according to their importance as perceived by farmers in most villages that had been surveyed. Farmers estimated that plant wilt incidence reached 25% in the field, whereas tuber loss in the form of rotten tubers was estimated to range from 3 to 25% and 5 to 20% at harvest and during storage, respectively (Chujoy *et al.*, 1996).

Bacterial wilt, as pointed out by Kelman (1981), is also an important limitation to growing potatoes and other susceptible crops in parts of Asia, Africa and South and Central America. In addition, the disease becomes a major constraint to expanding potato production at elevations of 500 to 1000 m where the climate is favourable for both potatoes and the disease (Van Der Zaag, 1985).

Several research indicated that crop rotation is effective in reducing bacterial wilt incidence in the subsequent potato crop (Devaux *et al.*, 1987; Kloos *et al.*, 1991; Bang and Wiles, 1994). French (1994a; 1994b) reviewed a strategy for integrated control at bacterial wilt and pointed out that crop rotation ranks four after soil free from *R. solanacearum*, fumigation and suppressive soils in term of factors that judged to contribute to good control of the disease.

The present research aims at determining the effect of crop rotation patterns on *Ralstonia solanacearum* population in the soil and on potato crop in the subsequent season.

Materials and Methods

The experiment was conducted at the experimental station of the Research Institute for Vegetables (RIV) in Lembang-West Java (1250 m asl.). The field of the experiment was selected due to the incidence of bacterial wilt in the potato crop the previous season. Tomato, maize, cabbage, beans, carrot and potato were used in the rotation experiment. These crops were selected because they are commonly planted by the farmers in the area.

The experiment is planned to be conducted in six successive seasons. The following treatments are used in the experiment:

Treatment	Season 1	Season 2	Season 3	Season 4	Season 5	Season 6
1	Potato	Tomato	Potato	Tomato	Tomato	Potato
2	Potato	Maize	Potato	Maize	Maize	Potato
3	Potato	Cabbage	Potato	Cabbage	Cabbage	Potato
4	Potato	Beans	Potato	Beans	Beans	Potato
5	Potato	Carrot	Potato	Carrot	Carrot	Potato
6	Potato	Potato	Potato	Weed fallow	Weed fallow	Potato

The experiment was conducted in a randomized complete block design with five replications. Each plot was 4.5 x 6 m. Plant spacing was 0.75 x 0.30 m for potato, 0.75 x 0.50 m for tomato, maize and cabbage, and 0.75 x 0.25 m for beans. Carrot was planted by broadcasting the seed in beds. Each crop received adequate fertilizer either organic or inorganic. Pests and diseases were also controlled. The first season (potato in all treatments) was planted on 14 April 1997 and harvested in the first week of August 1997. In the second season, all crops were transplanted /planted on 20 December 1997. Beans was harvested on 27 February 1998. Tomato was harvested six times and final harvest was conducted on 27 March 1998, the same day as the other crops i.e. carrot, potato, cabbage and maize. The third season crops i.e. potato in all treatments were planted on 5 May 1998 and harvested on 22 July 1998. The fourth season crops were transplanted/planted in August 1998.

Bacterial wilt infected potato plants were counted at weekly intervals in season 1 and 3. Soil samples were also collected at the start of the experiment and after each harvest in order to estimate the population of *R. solanacearum* in the soil using Kiraly (1970) method. In addition, the growth and yield of potato crops were recorded.

Results and Discussion

The experiment will be conducted in six successive seasons, but this paper only reports the research result until season 3. In order to have uniformity in the *R. solanacearum* population distribution in the experimental field, potatoes were planted in all treatments in season 1. In this season, the overall mean percent of wilting plants increased from 1.3% at week 4 to 27.3% at week 7. The percentage of hills harvested and percentage of rotten hill at harvest were also determined and averaged 87% and 30%, respectively.

Development of *R. solanacearum* population in the soil under the different crop rotation treatments in season 2 is presented in Table 1. Before planting, the population of *R. solanacearum* was lowest in Potato-Carrot (treatment 5) and highest in Potato-Tomato (treatment 1), but the difference was not significant. The mean *R. solanacearum* population in the soil in this season was 1499 x 10^7 cfu/ml. In season 2, all rotation treatments reduced the *R. solanacearum* population. The pathogen population in Potato-Maize (treatment 2) was significantly lower than those of the other rotation treatments (Table 1). A comparison of *R. solanacearum* population before planting and after harvest in season 2 is presented in Table 2. The *R. solanacearum* population after harvest was always significantly lower than those before planting in all rotation treatments.

The occurrence of remarkably reduction of bacterial wilt population after maize in this experiment as indicated in Table 1 is consistent with other reports (CIP, 1990; Elphinstone and Aley, 1992; Bang and Wiles, 1994). Elphinstone and Aley (1992) reported that a decline in *R. solanacearum* level in the maize rhizosphere may be related to an increased population of *Pseudomonas cepacia* which was an antagonistic bacteria to *R. solanacearum*.

The effect of rotation on plant emergence, canopy cover, percent of wilting plant and tuber yield components of potatoes in season 3 is presented in Table 3. The Potato-Tomato-Potato and Potato-Potato-Potato treatments had a higher percentage of wilting plants than other treatments although significant differences only occurred at 11week after planting (WAP). At harvest, tuber yields of potatoes were also affected by the crop rotation patterns. Tuber yields of potatoes in Potato-Tomato-Potato and Potato-Potato-Potato treatments were significantly lower than those of other rotation treatments (Table 3). The data of percent of wilting plant and tuber yield components of potatoes in season 3 (Table 3) is not consistent with the data of *R. solanacearum* population after harvest in season 2 (Table 1). Although the *R. solanacearum* population in all treatments, except Potato-Maize-Potato treatment, were not significantly different, the treatments affected the percent of wilting plant and tuber yield components of potatoes in season 3. Rotation with maize, cabbage, beans and carrot had a significantly lower percentage of wilting plants and a significantly higher tuber yields of potato in the subsequent season compared with those of rotation with tomato and potato, the solanaceae crops. Thus, the results suggest that rotation with maize, cabbage, beans and carrot are effective in reducing the bacterial wilt incidence in the potato crop.

The population of *R. solanacearum* in all treatments increased after planting potato in season 3 (Table 4). Potato-Beans-Potato had a higher *R. solanacearum* population but the difference was not significant compared to other treatments. The mean pathogen population before planting and after harvest in season 3 is presented in Table 5. The pathogen population after harvest was always significantly higher than those before planting in all rotation treatments.

Conclusions

The research results until season 3 indicated that rotation with maize reduced the population of *R. solanacearum* in the soil. The result also suggests that rotation with maize, cabbage, beans and carrot are effective in reducing the bacterial wilt incidence in the potato crop. It is expected that the conclusion of this experiment would be clearer when the two season rotations in season 4 and 5 have been conducted and affected the potato crops in season 6. The basis for the reduction of the pathogen population in the soil in crop rotation experiments, e.g. antagonistic bacteria, needs research.

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Table 1. Comparison of population of *R. solanacearun* in the soil among crop rotation patterns before planting and after harvest in season 2, Lembang-West Java, December 1997 – March 1988 (Values were analysed using data transformation of log x+1)

Treatment	*R. solanacearum* population in the soil (x 10^7 cfu/ml)	
	Before planting	After harvest
Potato-Tomato	2152 a	463 a
Potato-Maize	1120 a	263 b
Potato-Cabbage	1680 a	415 a
Potato-Beans	1525 a	399 a
Potato-Carrot	1045 a	478 a
Potato-Potato	1475 a	404 a
Mean	1499	404
Significance	ns	*
CV (%)	2.26	1.41

Table 2. Comparison of population of *R. solanacearum* in the soil before planting and after harvest in each rotation treatment in season 2, Lembang-West Java, December 1997 – March 1998 (Values were analysed using data transformation of log x+1)

Observation	*R. solanacearum* population in the soil (x 10^7 cfu/ml) in					
	Pot-Tom	Pot-Mai	Pot-Cab	Pot-Bea	Pot-Car	Pot-Pot
Before planting	2152 a	1120 a	1680 a	1525 a	1045 a	1475 a
After harvest	463 b	263 b	415 b	399 b	478 b	404 b
Mean	1307	691	1047	962	761	939
Significance	**	*	**	*	*	**
CV (%)	1.96	2.51	0.86	2.49	1.73	1.62

Table 3. Effect of crop rotation treatments on plant emergence, canopy cover, percent of wilting plant and tuber yield components of potato cv. Granola in season 3, Lembang-West Java, May 1998 to July 1998

Treatment	Emergence 4 WAP (#)	Canopy cover (%)	Percent of wilting plant 9 WAP (%)	10 WAP (%)	11 WAP (%)	Hill harvested (%)	Tuber yield per ha (ton)	per plant (g)	Marketable Tuber (%)
Pot-Tom-Pot	72 a	97 a	17 b	30 b	74 ab	56 a	11.0 bc	264 bc	69 b
Pot-Mai-Pot	72 a	98 a	17 b	26 b	69 b	62 a	12.9 ab	309 ab	75 a
Pot-Cab-Pot	72 a	99 a	10 b	16 b	54 b	65 a	13.9 a	334 a	78 a
Pot-Bea-Pot	72 a	99 a	17 b	24 b	66 b	59 a	14.4 a	345 a	79 a
Pot-Car-Pot	73 a	97 a	14 b	26 b	51 b	60 a	14.1 a	338 a	73 ab
Pot-Pot-Pot	73 a	96 a	38 a	57 a	89 a	45 a	9.4 c	227 c	76 a
Mean	72	97	19	30	67	58	12.7	303	75
LSD (5%)	3	4				10	2.5	61	6
CV (%)	3	3	29	24	20	14	15.2	15	6

Table 4. Comparison of population of *R. solanacearun* in the soil among crop rotation patterns before planting and after harvest in season 3, Lembang-West Java, May 1998 – July 1988 (Values were analysed using data transformation of log *x*+1)

Treatment	*R. solanacearum* population in the soil (x 10^7 cfu/ml)	
	Before planting	After harvest
Pot-Tom-Pot	463 a	1702 a
Pot-Mai-Pot	263 b	1393 a
Pot-Cab-Pot	415 a	1820 a
Pot-Bea-Pot	399 a	2151 a
Pot-Car-Pot	478 a	1755 a
Pot-Pot-Pot	404 a	1311 a
Mean	404	1688
Significance	*	Ns
CV (%)	1.41	2.07

Table 5. Comparison of population of *R. solanacearum* in the soil before planting and after harvest in each rotation treatment in season 3, Lembang-West Java, May 1998 – July 1998 (Values were analysed using data transformation of log *x*+1)

Observation	*R. solanacearum* population in the soil (x 10^7 cfu/ml) in					
	Pot-Tom-Pot	Pot-Mai-Pot	Pot-Cab-Pot	Pot-Bea-Pot	Pot-Car-Pot	Pot-Pot-Pot
Before planting	463 b	263 b	415 b	399 b	478 b	404 b
After harvest	1702 a	1393 a	1820 a	2151 a	1755 a	1311 a
Mean	1082	828	1117	1275	1116	858
Significance	**	**	*	**	**	*
CV (%)	1.65	1.85	2.61	1.99	1.70	2.51

Effect of bleach on the control of *Ralstonia solanacearum* population in the soil

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Abstract

Bacterial wilt disease caused by *Ralstonia solanacerum* is difficult to control. Soil disinfectants have been tried to control the disease with little success. However, the use of stable bleaching powder together with clean seed and cold weather cultivation have been reported to control bacterial wilt in subtropical areas elsewhere. The objective of our research is to determine bleach application rates suitable to control bacterial wilt in the soil under the tropical areas of Indonesia. Two experiments were conducted at the experimental fields of the Research Institute of Vegetable, Lembang, West Java, in the dry season and in the rainy season. Four rates of bleach application were compared at the rates of 0, 15, 30, and 60 kg/ha. A randomized complete block design with four replications was used. In the dry season, the use of bleach at the rate of 30 kg/ha was the best treatment for mean percentage plant stand and canopy cover and mean plant height at 2, 5, and 9 weeks after planting, respectively. And in the rainy season, the rate of 30 kg bleach/ha was the best treatment for tuber per plant. The use of bleach appeared to reduce the population of *R. solanacearum* in the soil. However, no significant differences were found among treatments.

Introduction

Ralstonia solanacearum which causes bacterial wilt (BW) of potato, is native in many tropical soils. Survival of the bacterium is influenced by temperature, humidity, and other physical and chemical soil factors. In certain soils, *R. solanacearum* may survive for many years, in others the bacterium may disappear from one growing season to the next (Martin and French, 1985). Many attempts have been made to control *R. solanacearum* by soil disinfecting chemicals. Several disinfecting chemicals such as potassium permanganate, ammonical copper carbonate, bordeaux mixture, potassium sulfide, copper acetate, copper sulfate, and formalin have been tried with little success (Kelman, 1953). In the North-western mid hills (up to 2200 m asl) of India, the use of disease free seed, cold weather cultivation and use of stable bleaching powder - at a rate of 12 kg/ha mixed with fertilizer in furrows at the time of planting - have been reported adequate to control bacterial wilt incidence (Shekhawat *et. al.*, 1988b, 1990b). In order to reduce *R. solanacearum* population in the soil, experiments were conducted to determine bleach application rates suitable to control bacterial wilt under the tropical highlands condition of Indonesia and results are reported here.

Materials and Methods

The experiments were conducted at the experimental fields of the Research Institute for Vegetables (RIV), Lembang, West Java at elevation of 1250 m asl. Two experiments were conducted : the first one in the dry season from March to June 1997 and the second in the rainy season from December 1997 to March 1998, in the same field. The experiment field had been previously planted to chili. Four rates of application of bleach powder (calcium hypochlorite, 60% chlorine content) were compared at the rates of 0, 15, 30, and 60 kg/ha. A randomized complete block design with four replications was used. The experimental unit consisted of a plot of four rows with 5 hills per row of the potato cultivar Granola. The seed tubers were free of BW disease. Plant spacing was 0.75 m X 0.30 m. Bleach was applied in the furrows three weeks before planting time, mixed with the soil, and the field was irrigated. Cow manure was applied at a rate of 20 ton/ha one week before planting. Chemical fertilizer consisted of 300 kg N/ha, 98 kg P/ha and 187 kg K/ha. Furadan to control nematodes was applied together with the fertilizer at planting time. A soil sample was taken from each plot to determine the *R. solanacearum* population. In each row, 3 sub-samples of 100 g soil were collected from 20 - 30 cm depth for a total of

12 sub samples per plot. These latter were mixed to produce the soil sample. Soil samples were collected before treatment application, 1, 2 months after planting, and at harvest. Ten g of the soil sample was suspended in 90 ml sterile distilled water to produce a 10^{-1} dilution. Similarly serial dilutions were obtained until 10^{-7}. 0.1 ml of this 10^{-7} dilution was plated on a petri dish containing TZC Kelman medium and incubated at 30ºC for 2 days. The population of *R. solanacearum* was counted using Kiraly methods (1970) where, number of bacteria in 1 ml = number of colonies x sample diluted x 10.

Results and Discussion

Dry season

Mean percentage plant stand and canopy cover, and the mean plant height following the four bleach application treatments are presented in Table 1. Significant differences among treatments were found for mean percentage plant stand and canopy cover and mean plant height at 2, 5, and 9 weeks after planting (WAP), respectively. The use of bleach at the rate of 30 kg/ha was the best treatment with 65% plant stand, 28% canopy cover, and 54 cm plant height.

Mean percentage plant wilt and *R. solanacearum* population in the soil following the four bleach application treatments are presented in Table 2. At 6 WAP, no plant wilt was found for the 0 and 30 kg bleach treatments. At 8 and 10 WAP, plant wilt was highest for the 15 and 60 kg treatment, respectively. At 12 weeks after planting, the highest plant wilt was found in the 15 kg treatment, but lowest in the control treatment (without bleaching). At 12 WAP, the mean plant wilt was 41%. However no significant differences were found among treatments for mean percentage plant.

Before treatment, the plots assigned to the 15 kg treatment had the highest population of *R. solanacearum* followed by those assigned to the 30, 0, and 60 kg treatments. After 1 and 2 months after planting (MAP), all treatments reduced the *R. solanacearum* population. But at harvest, the *R. solanacearum* population had increased where the 15 kg treatment was the less effective to reduce the pathogen in the soil ; the best treatment was 60 kg/ha and had the lowest population of *R. solanacearum*. At harvest, the mean population of *R. solanacearum* was 378 x 10^7 cfu/ml. However, no significant differences were found among treatments in all time of observations.

The effect of bleach treatment on tuber yield is presented in Table 3. The use of 30 kg bleach/ha had the highest tuber yield per plant although no significant differences among treatments were found.

Rainy season

Mean percentage plant stand and canopy cover, and the mean plant height following the four bleach application treatments are presented in Table 1. No significant differences among treatments were found for mean percentage plant stand and canopy cover, and mean plant height.

Mean percentage plant wilt and *R. solanacearum* population following the four bleach application treatments are presented in Table 2. At six WAP, no plant wilt was found for the 15 and 30 kg treatment. After six weeks, the percentage plant wilt had increased. At 12 WAP, plant wilt ranged from 12.5% to 22.5%.

At 1 MAP, the population of *R. solanacearum* decreased. However, no significant differences were found among treatments. At 2 MAP, the population of *R. solanacearum* was significantly different among treatments. However, the reduction in the control treatment was unexpected.

The effect of bleach treatment on tuber yield is presented in Table 3. Tuber yield was also affected by the treatment. The number of tuber per plant was significantly different. The use of 30 kg bleach/ha had the highest number tuber per plant and lowest for the 60 kg bleach/ha.

Conclusions

The use of bleach appeared to reduce the population of *R. solanacearum* in the soil. However, due to the likely effect of treatment plots on control plots, no significant differences were found among treatments. The use of separation trenches may avoid the effect of treatments in adjacent plots.

Work Plans for 1998/1999

In order to confirm results of the effect application on the reduction of *R. solanacearum* population, we plan to conduct further experiments. For security reasons, the experiments will be moved to a different field. To obtain a uniform distribution of *R. solanacearum* in the field, potato tubers will be inoculated with *R. solanacearum* at the concentration of 10^9 , 1 ml per tuber. The crop will be incorporated into the soil. Bleach will be applied on the surface of the soil, mixed, and irrigated, and applied two weeks before planting. Separation trenches will be use to avoid the effect of neighboring treatment on control plots. The trenches will be 1 m width and 50 cm deep.

Further experiment under controlled condition in the screen house will be conducted in 20 cm diameter pots. Soil media will be inoculated by pouring a *R. solanacearum* inoculum at the concentration of 10^9, 10 ml per pot. One tuber will be planted per pot. Data to be collected will include plant vigor, plant height, number of wilted plant, the *R. solanacearum* population, number of tuber per plant, average tuber size, number of rotten tuber, and marketable tuber.

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DRY SEASON

Table 1. Mean percentages plant stand and canopy cover, and mean plant height of potato cv. Granola after four bleach application treatments from March to July 1997 in RIV- Lembang (1,250 m sl).

Treatments	Plant stand (%)		Canopy cover (%)		Plant height (cm)	
	2 WAP	4 WAP	5 WAP	9 WAP	5 WAP	9 WAP
0 kg/ha	56 AB	100	20 B	82	26	50 AB
15 kg/ha	53 AB	98	24 AB	81	25	50 AB
30 kg/ha	65 A	100	28 A	84	29	54 A
60 kg/ha	41 B	95	23 AB	80	27	48 B
LSD	20	5	6	10	4	5
CV(%)	23	3	17	8	9	6
Mean	54	98	24	82	27	50

asl : above sea level
LSD : Least signifficant different at the 5% level
CV : Coefficient variance
WAP : Week after planting
NS : Non significant different at the 5% level

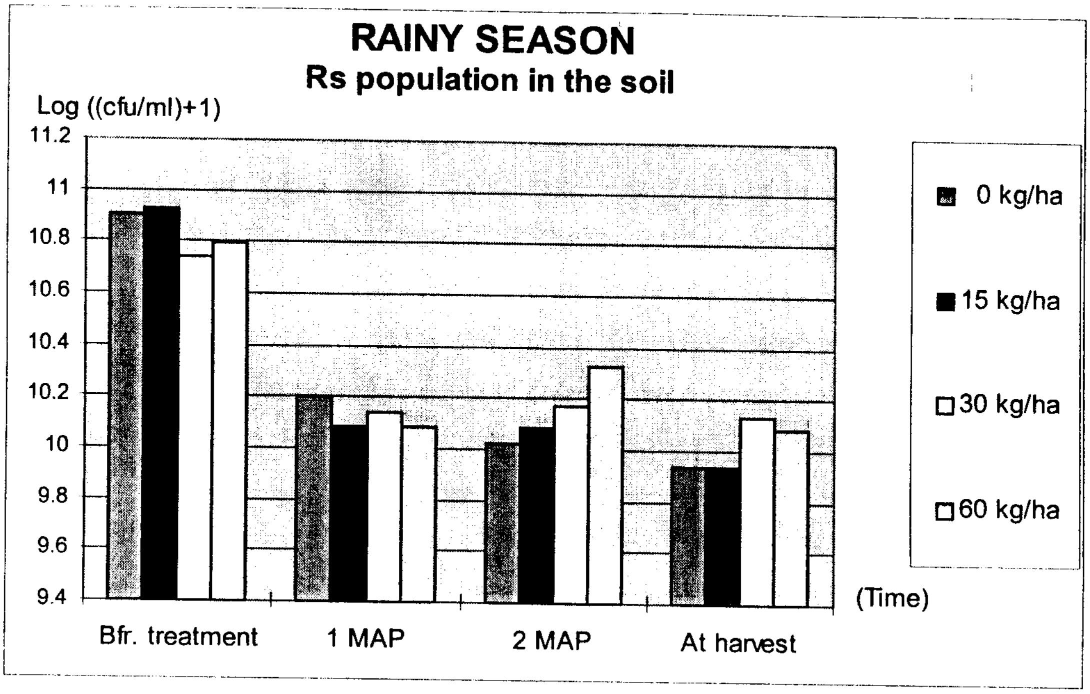
Table 2. Mean percentage plant wilt in the potato cv Granola Ralstonia solanacearum colony number in the soil after four bleach application treatments from March to July 1997 in RIV-Lembang (1,250 m asl).

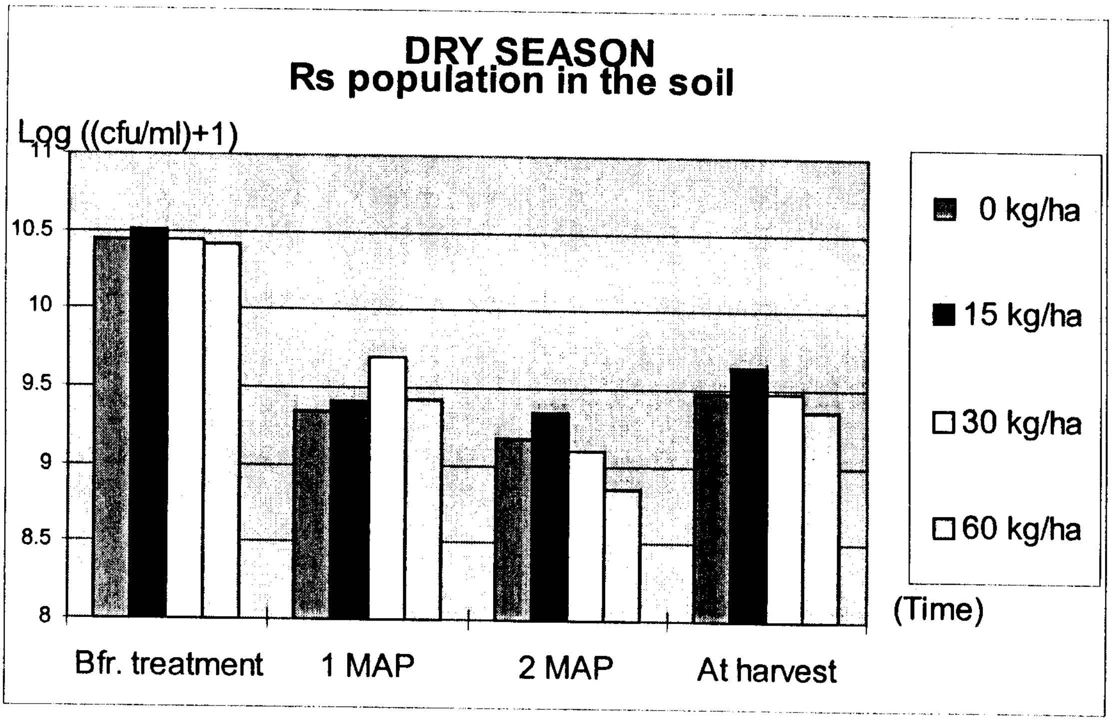
Treatments	Plant wilt (%)				Rs colony number (CFU/ml x 10^7)			
	6 WAP	8 WAP	10 WAP	12 WAP	Bfr. treat.	1 MAP	2 MAP	At harvest
0 kg/ha	0	5	20	33.75	3138	446	248	412
15 kg/ha	2.5	12.5	16.25	47.5	3643	358	280	485
30 kg/ha	0	2.5	17.5	42.5	3355	513	167	368
60 kg/ha	2.5	10	22.5	38.75	2643	301	121	247
Mean	1.024	2.377	4.201	6.275	10.454	9.46	9.117	9.5
Significant	NS	NS	NS	NS	NS	NS	NS	NS

MAP = month after planting ; CFU/ml = colony forming unit/ml
Significance test based on sqrt (X + 0.5) for % plant wilt, and log (X + 1) for colony number

Table 3. Tuber yield and yield components of potato cv. Granola after four bleach application treatments from March to July 1997 in RIV-Lembang (1,250 m asl)

Treatments	Plant harvested (%)	Tub./plant (#)	Average tub. size (g)	Rotten tuber (%)	Yield/plant (g)	Marketable tuber (%)
0 kg/ha	90	6	35	19	208	52
15 kg/ha	88	6	35	19	209	50
30 kg/ha	91	5	44	20	221	55
60 kg/ha	83	6	32	14	191	54
LSD	14	2	8	13	60	15
CV(%)	10	21	13	44	18	17
Mean	90	6	37	18	207	53
Significant	NS	NS	NS	NS	NS	NS


RAINY SEASON
Rs population in the soil
Log ((cfu/ml)+1)
11.2
11
10.8
10.6
10.4
10.2
10
9.8
9.6
9.4
Bfr. treatment
1 MAP
2 MAP
At harvest
(Time)
0 kg/ha
15 kg/ha
30 kg/ha
60 kg/ha


DRY SEASON
Rs population in the soil
Log ((cfu/ml)+1)
11
10.5
10
9.5
9
8.5
8
Bfr. treatment
1 MAP
2 MAP
At harvest
(Time)
0 kg/ha
15 kg/ha
30 kg/ha
60 kg/ha

Common weeds of potato as host of *Ralstonia solanacearum* in West Java Indonesia

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Abstract

Bacterial wilt caused by *Ralstonia solanacearum* is the most important bacterial disease of potato in tropical countries. To develop a strategy for an integrated disease management (IDM) of bacterial wilt, information is needed on the sources of pathogen inoculum. Weeds have been reported to harbor the pathogen and their control is consider a component of IDM. This research aims at identifying common weeds of potato that may host *R. solanacearum*.

Common weeds of potato were collected in Pangalengan and Lembang in West Java. A total of 35 weed species was collected and 19 of them were found to harbor the pathogen in their rhizosphere, root, and stem. Samples of bacterial colonies isolated from the 19 weeds had a positive reaction to an NCM-ELISA test. Experiment will be conducted to verify the results. Our preliminary findings indicate that weed control should be considered in an IDM strategy to control bacterial wilt of potato in West Java.

Introduction

Plant species infected by *Ralstonia solanacearum*, that causes bacterial wilt (BW) of potato, include not only important economical plants, but also a number of ornamentals and a very diverse group of weeds (Kelman, 1953). The role of the indigenous vegetation in the dissemination and maintenance of the pathogen has been clearly established when potatoes have wilted in the fields never previously planted with solanaceous host or planted in virgin soil. The high level of bacterial wilt in potato fields never before planted with solanaceous host is an example of the importance indigenous vegetation in the host-pathogen interaction (Martin, 1979).

Several weeds, i.e., *Melampodium perfoliatum and Biden pilosa* were reported as important hosts of the pathogen (Jackson and Gonzalez, 1979). *Solanum nigrum* (black nightshade) can be also a source of inoculum for the planting (Harrison, 1960). *Portulaca oleracea* and *Eulisine indica* weeds were found to harbor the pathogen in their rhizosphere (Quimio and Chan, 1979); the bacterial population reached 17.11 x 10^6 cfu and 5.46 x 10^6 /gram at 9 weeks after planting. They also found that the *R. solanacearum* population in the rhizosphere of suppression of the pathogen population was greater after planting rice and corn. Gunawan (1987) reported that two weeds (*P.oleracea and E.indica)* was 7 - 7.5x107 cfu/gram soil 7 weeks after planting and was lower in the rhizosphere of carrot (*Daucus carota)* and cauliflower (*Brassica spp*).

Our research aimed at identifying common weeds of potato host of *R. solanacearum*.

Materials and Methods

Common weeds of potato were collected in 8 locations (Marga mekar, Marga mulya I; Marga mulya II,Pangalengan, Pulosari, Sukamanah, Tribakti mulya and,Marga mukti) of Pangalengan and 1 location in Lembang.

R. solanacearum was isolated from the rhizosphere soil, root and stem of the weeds following a procedure by Quimio and Chan (1979). One gram of the sample was placed in a test tube containing 9 ml sterile distilled water (SDW) and shaken for 4 minutes with an electric shaker. This suspension was used as stock to produce a 7-fold serial dilution. A 0,1ml of each serial dilution was plated on a petri dish plate containing TZC Kelman agar selective medium and incubated at 30° C for 3 days. This was replicated three times.

The colony forming units (cfu) were counted using a colony counter. The number of bacteria per ml was calculated following Kiraly (1970) as follows: Number of bacteria in 1 ml = number of colonies x sample diluted x 10. Typical virulent *R.solanacearum* colonies had irregular shape, pink color in the center and white cream slimy surrounding. Colonies with regular round shape and red color were considered of the avirulent type. Samples of the colonies were tested with a NCM-ELISA to detect *R.solanacearum.*

Results and Discussion

Weed samples were collected in 8 villages in Pangalengan and in Lembang total of 18 species of weeds was collected in 1997 (Table 1 and 2) and 35 species in 1998 (Table 3 to 6). All weed species were found to harbor *R.solanacearum* in their rhizosphere soil, root, and stem. Samples of bacterial colonies isolated from 19 weeds had a positive reaction to the NCM-ELISA. Bacterial colonies from the other 16 weed species will be detected with NCM-ELISA. All colonies found from all weeds have been purified. Pure culture of bacteria were placed in microtubes containing sterile distilled water and store in the room temperature. To verify the results all 35 weed species will be artificially inoculated under screen-house conditions (Appendix 1).

In conclusion, preliminary results indicate that weed species may host *R.solanacearum.* The implication of this finding is that weed control may need to be considered in strategies of integrated control management of bacterial wilt of potato.

Appendix 1

Verification of weeds as host of *Ralstonia solanacearum*

Common weeds of potato will be artificially inoculated with *R.solanacearum* using two methods of inoculation. Rhizosphere, root and stem will be tested for presence of the pathogen using morphological characterization of the bacterial colonies and a NCM-ELISA test.

Methods of inoculation

The weed will be grown in the screen house in pots containing sterilize soil. A bacteria suspension with a concentration of 10^7 and 10^{12} cfu/ ml) will be used as inoculum.

1. Pricking technique: the inoculum will be applied to the axil of the first true leaf of a young seedling using a pricking technique. The axil will be pricked with a needle dipped in the bacterial suspension. The needle will be kept in the axil for 30 minutes and later removed.
2. Root cutting: the inoculum will be applied to the based of the stem and a knife will be run into the soil to injure the roots and facilitate inoculation (Kelmans and Winstead methods 1954).

A control (potato or tomato) will be used for comparison with the weeds.

Sample preparation

To determine the occurrence of systemic infection, the 1 - 3 cm portion of the stem below and above the inoculated axil will be collected. The stem sample will be surface sterilized (immerse in 70% ethanol), washed with sterile distilled water (SDW) for 2 minutes, and dried on sterile tissue paper.

- A half portion of stem will be dipped in 9 ml SDW and incubated for 10 minutes. Three or four loops-ful of each suspension will be streaked on plate of TZC selective medium.
- A half portion will be grinded and used to prepare a 5-fold serial dilution. 0,1ml of each suspension will be plated on a petri dish containing TZC selective medium. This will be replicated three times. And incubated at 30° C for 2 to 3 days.
- Bacterial colonies will be counted using colony counter.

Data collection

Record data of plant wilt symptoms when the control (tomato or potato) starts wilting. Bacteria population in the rhizosphere of weeds, two weeks intervals. (3 times).

Disease score will be used as follows:

State of plant	Score
1.Plant healthy	1
2.One leaf wilting	2
3.One-third of plant wilting	3
4.Two- third of plant wilting	4
5.Whole plant wilting or dead	5

Screen-house experiment
Design: Split-split plot CRD design and 10 replications
Main plots: Weeds
Sub-plots: Inoculation method (pricking technique versus root cuting)
Sub-sub plots: Inoculum concentration (10^7 versus 10^{12} cfu/ml)

Schedule

Activities	Month	Year
Laboratory activities:		1998-1999
Purification of bacteria	September 1998	
Multiplication of bacteria	February 1999	
Screen House activities	January 1999	
Weeds sowing and planting	January 1999	
Inoculation of bacteria	February 1999	
Data gathering	February 1999	
Wilted plant		
Detection of B.W. after inoculation on stem	March 1999	
NCM ELISA	March 1999	
Data analysis	April 1999	
Writing report	May 1999	
Report	June 1999	

Table 1. Mean population (10^7 cfu) of *Ralstonia solanacearum* in the rhizosphere soil of weeds collected in 8 locations (1-8) in Pangalengan, 1997.

Name of weed	1	2	3	4	5	6	7	8
Ageratum houstorianum	36.00 abcd	21.00 a	19.00 a	27.00 a	33.33 ab	9.67 d	32.33 abcd	30.00 a
Althernanthera phitoxeroides	43.00 abcd	21.00 a	27.00 a	35.00 a	14.00 cd	26.33 abc	34.33 abcd	21.33 ab
Amaranthus lividus	29.00 d	16.00 a	13.00 a	8.00 a	9.33 a	12.00 cd	9.33 f	11.67 c
Bidens pilosa	51.33 abcd	31.33 a	12.00 a	36.67 a	45.00 a	42.33 a	39.33 ab	30.33 a
Capsella bursapastoria	29.68 bcd	13.00 a	22.67 a	22.67 a	34.33 ab	46.33 a	43.33 ab	27.33 a
Ciperus rotundus	69.00 ab	31.67 a	12.00 a	25.00 a	26.33 ab	27.33 abc	32.33 abcd	36.33 a
Commelina diffusa	28.33 bcd	12.33 a	17.33 a	51.33 a	31.33 ab	21.33 abc	45.33 a	35.33 a
Cynodon dactilon	26.67 d	22.33 a	37.33 a	39.33 a	38.33 ab	29.33 abc	36.33 abc	40.33 a
Datura stramonium	63.33 abc	22.33 a	24.33 a	23.00 a	25.33 ab	45.33 a	24.33 abcd	37.33 a
Digitaria cilicris	24.00 d	7.33 a	12.00 a	10.00 a	10.67 d	16.67 bc	35.33 abcd	19.67 abc
Drymaria cordata	78.00 a	21.00 a	28.67 a	24.67 a	32.67 ab	45.33 a	19.33 de	37.00 a
Eleusine indica	60.00 abcd	34.33 a	10.33 a	10.00 a	43.33 a	22.67 abc	22.33 bcd	34.33 a
Galinsoga parviflora	48.00 abcd	32.00 a	18.67 a	38.00 a	36.33 ab	27.33 abc	18.67 cde	31.00 a
Oxalis corniculata	32.33 bcd	11.67 a	21.33 a	25.33 a	33.33 ab	32.33 ab	27.33 abcd	19.33 abc
Panicum repens	31.00 abcd	12.00 a	34.00 a	23.00 a	21.00 bc	30.33 ab	32.33 abcd	13.33 bc
Paspalum paspaloides	26.33 d	31.33 a	45.33 a	44.67 a	12.33 d	37.33 abc	31.33 abcd	26.33 a
Portulaca oleracea	38.00 abcd	24.00 a	23.00 a	12.00 a	36.67 ab	28.67 abc	31.67 abcd	20.67 abc
Stellaria media	27.00 cd	23.00 a	12.00 a	16.00 a	25.33 ab	16.67 bc	11.33 ef	22.67 ab

Notes : population of B.W is average of three petri disks

Location : 1= Marga Mekar; 2= Marga Mulya I; 3= Marga Mulya II; 4= Pangalengan; 5= Pulosari; 6= Sukamanah; 7= Tribakti Mulya; and 8= Marga Mukti.

Table 2. Mean population (10^7 cfu) of *Ralstonia solanacearum* (log 10) in the rhizospheresoil of weeds collected in 8 location in Pangalengan, 1997.

Name of weed	1	2	3	4	5	6	7	8
Ageratum houstorianum	8.533 abcd	8.314 a	8.205 a	8.426 a	8.520 ab	7.852 d	8.497 abcd	8.445 a
Althernanthera phitoxeroides	8.625 abcd	8.285 a	8.404 a	8.532 a	8.129 cd	8.399 abc	8.502 abcd	8.324 ab
Amaranthus lividus	8.342 d	8.166 a	7.851 a	8.385 a	7.952 a	8.078 cd	7.926 f	8.019 c
Bidens pilosa	8.674 abcd	8.463 a	8.071 a	8.535 a	8.640 a	8.591 a	8.593 ab	8.452 a
Capsella bursapastoria	8.469 bcd	8.108 a	8.330 a	8.335 a	8.513 ab	8.657 a	8.604 ab	8.400 a
Ciperus rotundus	8.831 ab	8.372 a	7.764 a	8.141 a	8.414 ab	8.430 abc	8.505 abcd	8.540 a
Commelina diffusa	8.441 bcd	8.998 a	8.157 a	8.670 a	8.486 ab	8.298 abc	8.647 a	8.541 a
Cynodon dactilon	8.327 d	8.312 a	8.566 a	8.560 a	8.571 ab	8.433 abc	8.552 abc	8.570 a
Datura stramonium	8.790 abc	8.336 a	8.373 a	8.357 a	8.402 ab	8.650 a	8.378 abcd	8.570 a
Digitaria cilicris	8.339 d	8.356 a	7.948 a	8.359 a	7.976 d	8.211 bc	8.535 abcd	8.293 abc
Drymaria cordata	8.883 a	8.081 a	8.421 a	8.359 a	8.508 ab	8.653 a	8.241 de	8.567 a
Eleusine indica	8.715 abcd	8.473 a	7.952 a	8.952 a	8.621 a	8.348 abc	8.322 bcd	8.508 a
Galinsoga parviflora	8.643 abcd	8.473 a	8.631 a	8.562 a	8.557 ab	8.430 abc	8.269 cde	8.489 a
Oxalis corniculata	8.474 bcd	8.059 a	8.313 a	8.539 a	8.511 ab	8.507 ab	8.376 abcd	8.278 abc
Panicum repens	8.489 abcd	8.062 a	8.528 a	8.350 a	8.318 bc	8.481 ab	8.502 abcd	8.082 bc
Paspalum paspaloides	8.358 d	8.448 a	8.566 a	8.630 a	8.075 d	8.452 abc	8.488 abcd	8.394 a
Portulaca oleracea	8.565 abcd	8.233 a	8.348 a	8.038 a	8.560 ab	8.429 abc	8.488 abcd	8.295 abc
Stellaria media	8.412 cd	8.319 a	8.038 a	8.038 a	8.396 ab	8.205 bc	8,043 ef	8.354 ab

Notes : population of B.W is average of three petri disks

Location : 1= Marga Mekar; 2= Marga Mulya I; 3= Marga Mulya II; 4= Pangalengan; 5= Pulosari; 6= Sukamanah; 7= Tribakti Mulya; and 8= Marga Mukti.

Table 3. Mean population (10^7 cfu) of *Ralstonia solanacearum* in the rhizosphere soil, root and stem collected in Pangalengan and Lembang in 1998

Name of weed	Rhizosphere	Root	Stem
Ageratum conyzoides L	11.00	282.00	188.00
Althernanthera cecillis R.Br.	17.00	5.00	2.00
Bidens pilosa L	4.00	28.00	7.00
Boreria latifolia Schum	24.00	38.00	5.00
Centella asiatica Urb	150.00	52.33	219.00
Commelina benghalensis	141.33	240.00	132.67
Digitaria ciliaris Retz/Koel	59.00	177.00	94.67
Drymaria cordata Willd	260.33	174.00	49.00
Eleusina indica Gaerth	278.33	132.00	148.00
Emilia sonchifolius Moench	133.00	46.00	17.00
Eregron sumatraensis Retz	112.00	98.33	94.00
Galinsoga parviflora Cav	16.00	3.00	5.00
Gynura densiflora Mig	74.50	44.00	130.67
Kyllinga monocyhola Rottb	9.00	10.00	64.00
Nicandra physiloides Goerth	72.00	201.00	166.00
Oxalis corniculata L	106.00	39.00	134.00
Polygonum alotum Ham	107.33	229.33	163.33
Portulaca oleracea L	112.50	152.33	166.33
Sonchus arvensis L	43.67	253.50	187.50
Spiranthes sinensis Ame	31.00	46.00	9.00

Table 4. Mean population (10^7 cfu) of *Ralstonia solanacearum* (log 10) in the rhizosphere soil, root and stem collected in Pangalengan and Lembang in 1998 and reaction to NCM ELISA

Name of weed	Rhizosphere	Root	Stem	NCM ELISA
Ageratum conyzoides L	8.041	9.450	9.274	+
Althernanthera cecillis R.Br.	8.230	7.698	7.301	+
Bidens pilosa L	7.602	8.447	7.845	+
Boreria latifolia Schum	8.380	8.579	7.698	+
Centella asiatica Urb	9.176	8.719	9.340	not clear
Commelina benghalensis	9.150	9.303	9.193	+
Digitaria ciliaris Retz/Koel	8.771	9.248	8.976	+
Drymaria cordata Willd	9.415	9.240	8.690	+
Eleusina indica Gaerth	9.444	9.121	9.171	+
Emilia sonchifolius Moench	9.123	8.662	8.230	+
Eregron sumatraensis Retz	9.051	8.993	8.973	+
Galinsoga parviflora Cav	8.204	7.477	7.698	+
Gynura densiflora Mig	8.872	8.643	9.116	+
Kyllinga monocyhola Rottb	7.954	8.000	8.806	+
Nicandra physiloides Goerth	8.857	9.303	9.193	+
Oxalis corniculata L	9.025	8.591	9.127	+
Polygonum alotum Ham	9.031	9.360	9.213	+
Portulaca oleracea L	9.052	9.183	9.221	+
Sonchus arvensis L	8.972	9.372	9.273	+
Spiranthes sinensis Ame	8.491	8.662	7.954	+

Table 5. Mean population (10^7 cfu)of *Ralstonia solanacearum* in the rhizosphere soil, root and stem collected in Pangalengan and Lembang in 1998

Name of weed	Rhizosphere	Root	Stem
Amaranthus spinosus L	212.33	77.00	50.00
Artemisia vulgaris	46.67	64.00	121.00
Cerastium glumeratum Thnill	16.50	97.33	145.00
Cyperus iria L	99.33	41.35	91.67
Digitaria longiflora Terb	59.00	177.00	94.67
Euphoubia hirta L	228.33	274.00	145.00
Fimbristylis annura R *et* Sch *8.956*	90.33	570.50	90.67
Hydrocotyle subthorpiodes Lamrk	107.50	77.00	50.00
Mimosa invisa Mart	126.00	64.00	121.00
Panicum spp	93.00	692.33	96.00
Paspalum paspaloides L	50.00	238.00	118.33
Paspalum scorbiculatum L	83.58	107.00	102.00
Plantago major L	297.67	88.00	138.00
Rorripa indica (DC) Hoehr	355.33	45.33	155.33
Sida acuta Burn	358.50	2.33	56.00

Notes : population of B.W is average of three petri disks

Table 6. Mean population (10^7 cfu) of *Ralstonia solanacearum* (log 10) in the rhizosphere soil, root and stem collected in Pangalengan and Lembang in 1998

Name of weed	Rhizosphere	Root	Stem
Amaranthus spinosus L	9.327	8.886	8.699
Artemisia vulgaris	8.669	7.865	7.903
Cerastium glumeratum Thnill	8.217	8.988	9.161
Cyperus iria L	8.997	8.616	8.962
Digitaria longiflora Terb	9.615	9.348	8.729
Euphoubia hirta L	9.359	9.438	9.161
Fimbristylis annura R *et* Sch *8.956*	8.956	9.756	8.957
Hydrocotyle subthorpiodes Lamrk	9.031	8.881	9.132
Mimosa invisa Mart	9.100	8.806	9.083
Panicum spp	8.968	9.840	8.982
Paspalum paspaloides L	8.699	9.377	9.073
Paspalum scorbiculatum L	8.922	9.029	9.009
Plantago major L	9.474	8.944	9.139
Rorripa indica (DC) Hoehr	9.551	8.656	9.191
Sida acuta Burn	9.554	7.367	8.748

Notes : The population of B.W in table 6, was found from the average of three petri disk

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Weeds as host of Ralstonia Solanacearum

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There are two distinct sources of inoculum, i.e. infected soil and infected seed tuber. In the field, several species of weeds were found to be alternative hosts. These hosts may have an important role in the survival of the bacterium. Recent studies suggest that the pathogen can also survive symtomlessly in the roots of weed hosts or in presume non-host plants.

Ralstonia solanacearum does not survive in the soil itself but on or in plant roots. The bacterium appears to survive by continually infecting the roots of susceptible or carrier plants or by colonizing the rhizospheres of non - host plant (Sequeira, 1992)

The wide host range of *R. solanacearum* is known and many weeds could be infected by the bacterium with or without symptoms of wilt.

Weeds promote the survival of bacterium in the weed - fallowed soil during the summer season when rainfall is frequent. According to Jackson and Gonzales (1981); Melton and Powel (1991); Quimio and Chan (1979) weeds promote the survival of the bacterium in the soil, the carry over of inoculum to tobacco crops and at certain weed hosts reduce the effectiveness of rotation crops.

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Discussion

1st Session: Opening

Q: AS: How is the plan for the second phase of RIV-CIP collaboration under the new Memorandum of Understanding. I suggest to have a description of the CIP research program.
A: ECh: The collaborative research program in Lembang is jointly prepared by RIV and CIP. The research program for next year will include the continuation of research activities as necessary. The tentative program for future activities is to be discussed today.

Q: AS: I suggest to include research topics in the areas of regional trade, TPS impact studies, and seed production and distribution system.
A: GP: Your suggestion are well-taken. Socio-economic research in CIP-ESEAP will be coordinated by Dr. Keith Fuglie (new agro-economist in Bogor).

3rd Session: Late Blight Research research

Q: PT: Does the SIFT procedure applies to various diseases?
A: ES: No, it's only for late blight.
A: ECh: The SIFT research aims at evaluating selected potato clones specifically for their resistance to late blight.

Q: PT: What is different between Anggoro's research and Euis's research?
A: ES: The SIFT potato clones have horizontal or durable resistant to late blight. Dr. Anggoro's research considers potato clones that may have major R-genes conferring resistance to late blight.

Q: GP: Are the potato clones used in Dr. Anggoro's research from the Philippines?. And how do these clones are related to those evaluated in the SIFT research?
A: AS: The late blight resistant clones evaluated in the research funded by UNDP were received from CIP-Peru through SAPPRAD in the Philippines.
A: ECh: The clones evaluated by Dr. Anggoro originated from CIP – Peru from population A which has late blight resistance controlled by R-genes and may have horizontal resistance as well. The first set of clones evaluated in the SIFT research also originates from CIP-Peru, however they have horizontal resistance to late blight and no R-genes. CIP's strategy is to deploy clones with horizontal resistance to late blight. Potato clones with horizontal resistance obtained from other potato programs world wide will be also tested in the SIFT research. The question that arises is: what should be done with the selected clones having R-gene resistance considering that Dr. Angoro or NARS has spent much time and effort in evaluating and selecting them although the current emphasis is to use horizontal resistance ?. These clones with R-genes are still usable although durability of the resistance may be short-lived.

Q: MM: What are the races of late blight and their relation to the genetic resistance of the clones ?. What is their background; the control cultivars you used.
A: ES: We have identified several races in the past. The genetic background of SIFT clones is diverse. A few clones have both R-gene and horizontal resistance and are used for comparison. Other clones derive from population B that is they contain no R-genes but horizontal resistance. The cultivar Granola is used as late blight susceptible control.
A: ECh: With the use of horizontal resistance to late blight, there will be no need to identify the races of Phytophthora. This genetic resistance is independent of the race of the pathogen.

Q: Su: In the research with Dr. Anggoro, I planted late blight susceptible plants in disease spreader rows, surrounding the test clones. You have not mentioned the use of spreader rows. Also I did not apply any fungicide to control late blight. Are you doing the same in the SIFT trials ?

A: ES: We planted the susceptible variety Granola in the disease spreader rows in between test clones. We will protect the test clones the first 6 weeks after transplanting with applications of a contact fungicide to control late blight. This is to ensure a high plant stand.

4th Session: Potato Tuber month

Q: RSB: What is the role of non government organizations (NGOs) in the Tomok area? How to approach them and farmers.
A: EVF: The role of the NGOs is in organizing the farmers, as NGOs have staff working with farmers.

Q: ECh: Is there any plan to involve RIV Staff in the needs assessment research ?
A: EVF: RIV staff are not directly involved in this research. The data gathering is been done by farmers. In the future staff from RIV and other institutions will be invited to discuss the results.

Q: RSB: Which is the best method to control the potato tuber month (PTM), biorational or chemical pesticides according to your results ? Is it possible to commercialize the granulosis virus (GV) ?
A: EVF: The biorational and chemical pesticides could be used for PTM control. Decision on what control method to be used will depend on local conditions. Our results indicate that it is best to use both together.
Yes, the GV could be commercialized. Our results indicate that our GV controls PTM

Q: ES: In the experiment, the potato tubers treated with GV is intended for seed or consumption use ? Where was GV obtained from , is it indigenous or imported ? Have you collected different GV strains in different locations in Indonesia; which is the best?
A: EVF: The GV is for seed treatment. The GV was collected in Pangalengan (West Java), it is an indigenous strain. We have collected GV only from Pangalengan.

5th Session: Bacterial Wilt Research

Q: EVF: Is bleach application be able to kill other beneficial organism in the soil ?
A: IS: I am not sure whether bleach can kill other beneficial organism in the soil. But if necessary, we can conduct simple experiment in the laboratory to prove it.
A: EC: Under India condition, the use of bleach powder can reduce BW incidence. What she have done here is to verify whether bleach application is working under Indonesia condition.

List of Participant

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Eti Rochati	Student
Effie	Private Consultant
Sulaeman N	Guest
Yuli Sulistyowati	Research Assistant, TPS project
Rinda Kirana	Research Assistant, TPS project

Seminar Program

Research Institute for Vegetables (RIV) and International Potato Center (CIP)
Collaboration on Potato Scientific Research
RIV Conference Room
Wednesday, 11 November 1998

Objective: To present and discuss research results and future collaborative RIV-CIP research activities

Time	Title/Activity		Presenter
		Moderator	Dr. Witono
9:00 – 9:10	Opening		Dr. Ati Srie Duriat
9:10 – 9:20	Overview of the RIV-CIP collaboration		Dr. E. Chujoy
9:20 – 9:30	Socio-economic research in CIP-ESEAP (Indonesia)		Dr. G. Prain
9:30 – 9:40	Discussion		
	Potato Germplasm evaluation	Moderator :	Dr. R.S. Basuki
9:40 – 9:50	Rapid multiplication of CIP potato materials		Ir. Asih
9:50 – 10:00	Evaluation of CIP Advanced potato clones (From Australia)		Ir. Sudjoko
10:00 – 10:10	Evaluation of CIP Advanced potato clones (From Lima)		Ir. Kusmana
10:10 – 10:30	Discussion		
10:30 – 10:40	Multilocation Potato Variety Trial		Dr. Anggoro
10:40 – 10:50	True Potato Seed Research		Dr. N. Gunadi
10:50 – 11:05	Discussion		
11:05 – 11:25	Coffee break		
	Late Blight Research	Moderator :	Dr. E. Chujoy
11:25 – 11:35	Standardized International Field Trials (SIFT)		Ir. Euis
11:35 – 11:45	Potato clones with Late Blight resistance (UNDP-RIV-CIP-SAPPRAD)		Dr. Anggoro
11:45 – 12:00	Discussion		
	Potato Tuber Moth	Moderator :	Ir. Asih
12:00 – 12:10	Exploring Potato IPM research in ESEAP		Dr. Elske van de Fliert
12:10 – 12:20	Granulosis virus and control of PTM		Ir. Wiwin/Ir. Rustaman
12:20 – 12:35	Discussion		
12:35 –13:10	LUNCH		
	Bacterial Wilt Research	Moderator :	Dr. Anggoro
13:10 – 13:20	Survey of Bacterial Wilt control practices		Dr. Rofik
13:20 – 13:30	Crop Rotation to control Bacterial Wilt		Dr. N. Gunadi
13:30 – 13:45	Discussion		
13:45 – 13:55	Bleach to control Bacterial Wilt		Ir. Dining
13:55 – 14:05	Weeds as host of Ralstonia Solanacearum		Ir. Oni/ Ir. Zaenal
14:05 – 14:20	Discussion		
14:20 – 14:30	General discussion and comments		Dr. Azis A. Asandhi Dr. Ati Srie Duriat