Vapour-proof Seed Packages

Being hygroscopic, seeds gain moisture from high atmospheric RH. If seeds are hermetically sealed in vapour-proof packages, moisture vapour in the outside air cannot enter the packages. Thus, seed moisture content does not change regardless of ambient RH. Very dry seeds in vapour-proof packages can be stored for 2-4 years in good nonconditioned storages, at reduced storage construction and operation costs.

Packaging very dry seeds in vapour-tight containers appears to hold much promise as a low cost, simple means of protecting seed viability during both storage and transport, especially under humid tropical conditions and where adequate storages are not available. The packaged seeds are not affected by outside air RH; being very dry, the seeds can withstand reasonably higher temperatures; low seed moisture is maintained after leaving storage, providing protection during transport, in retail stores, and on the farm. Also, there are no moisture problems in taking seeds out of cold storages.

Moisture content of seed sealed in vapour-proof packages must be considerably lower than for nonvapour-proof packages. There is no exchange of moisture vapour between air outside and inside the package, so seed moisture content determines equilibrium RH of air sealed inside the package. For example, air inside a vapour-proof bag of corn (Zea mays L.) seeds at 13 percent moisture will equilibrate at about 65 percent RH. At this RH seed respiration is high, fungi are active, and insects can multiply. These create additional moisture and heat, seeds deteriorate rapidly.

Reported data indicate that in general, seeds can be safely sealed in vapour-proof packages if their moisture content is low enough to be in equilibrium with approximately 30-35 percent RH.

Vapour-tight bags for larger amounts of seeds may be made of solid thick films of polyethylene (10 guage or more), polyester, or plastics with similar vapour transmission characteristics; multiwall paper or other laminations which include suitable layers of plastic film, asphalt/plastic, asphalt/aluminum foil, aluminum foil/plastic, etc. The bags must either be heat-sealed or of valvepack design with the valve properly sealed.

Sewn bags are not vapour-proof, as moisture vapour will enter through holes left by the sewing machine needle (Harrington and Douglas, 1970).

Some bag materials are not vapour-proof, but are vapour-resistant to varying degrees; i.e., they do not prevent entry of vapour, but have a slow rate of vapour transmission. These include bags of woven plastic threads with only a thin film of solid plastic; sewn multiwall bags; multiwall bags of materials of higher vapour transmission rates, etc. These bags can keep seed moisture low longer than porous bags, but seeds slowly increase in moisture under high ambient RH. When seed moisture reaches higher levels inside such bags, vapour cannot escape readily and seeds deteriorate rapidly. Careful management should be employed when such bags are used.

Small amounts, as vegetable and flower seeds, may be packaged in heat-sealed vapour-proof bags, pouches, or packets of suitable polyethylene, polyester, laminated aluminum/plastic, cellophans/plastic, etc. Sealed tin cans, gasketed metal cans, gasket-sealed glass jars, and sealed rigid plastic containers may also be used. Paper packets and friction-sealed tin cans are not vapour-tight.

Due to increased susceptibility of low-moisture seeds to mechanical injury, vapour-proof seed bags must be handled gently.

Source: Practical Safe Seed Storage and Its Management, B. Gregg

APPENDIX G

POTATO

Seed Potato Requirement, Planted Area and Production Volume of
Seed Potato Growers(I) in Cases of 'with Project' and 'without Project'

Project Year	With Project					Without Project		
	Seed Requirement (ton)	Planted Area (ha)	Production Seed Requirement (ton)			Seed Requirement (ton)	Planted Area (ha)	Production (ton)
			Seed Potato	Food Consumption	Total			
1								
2								
3								
4	45	30	300	150	450	45	30	300
5	135	90	900	450	1,350	135	90	900
6	135	90	900	450	1,350	135	90	900
7	135	90	900	450	1,350	135	90	900
8	135	90	900	450	1,350	135	90	900
9	135	90	900	450	1,350	135	90	900
10	135	90	900	450	1,350	135	90	900
11	135	90	900	450	1,350	135	90	900
12	135	90	900	450	1,350	135	90	900
13	135	90	900	450	1,350	135	90	900
14	135	90	900	450	1,350	135	90	900
15	135	90	900	450	1,350	135	90	900
16	135	90	900	450	1,350	135	90	900
17	135	90	900	450	1,350	135	90	900
18	135	90	900	450	1,350	135	90	900
19	135	90	900	450	1,350	135	90	900
20	135	90	900	450	1,350	135	90	900
Total	2,205	1,470	14,700	7,350	22,050	2,205	1,470	14,700

Proceeds, Production Cost, Profit and Increase of Income of
Seed Potato Growers(I) in Cases of 'With Project' and 'Without Porject'

Unit: 1000 Rp

Project Year	With Project					Without Project			Income Increase
	Proceeds			Production Cost	Benefit	Proceeds	Production Cost	Benefit	
	Seed Potato	Seed Consumption	Total						
1									
2									
3									
4	300,000	36,000	336,000	109,500	226,500	72,000	48,000	24,000	202,500
5	900,000	108,000	1,008,000	328,500	679,500	216,000	144,000	72,000	607,500
6	900,000	108,000	1,008,000	328,500	679,500	216,000	144,000	72,000	607,500
7	900,000	108,000	1,008,000	328,500	679,500	216,000	144,000	72,000	607,500
8	900,000	108,000	1,008,000	328,500	679,500	216,000	144,000	72,000	607,500
9	900,000	108,000	1,008,000	328,500	679,500	216,000	144,000	72,000	607,500
10	900,000	108,000	1,008,000	328,500	679,500	216,000	144,000	72,000	607,500
11	900,000	108,000	1,008,000	328,500	679,500	216,000	144,000	72,000	607,500
12	900,000	108,000	1,008,000	328,500	679,500	216,000	144,000	72,000	607,500
13	900,000	108,000	1,008,000	328,500	679,500	216,000	144,000	72,000	607,500
14	900,000	108,000	1,008,000	328,500	679,500	216,000	144,000	72,000	607,500
15	900,000	108,000	1,008,000	328,500	679,500	216,000	144,000	72,000	607,500
16	900,000	108,000	1,008,000	328,500	679,500	216,000	144,000	72,000	607,500
17	900,000	108,000	1,008,000	328,500	679,500	216,000	144,000	72,000	607,500
18	900,000	108,000	1,008,000	328,500	679,500	216,000	144,000	72,000	607,500
19	900,000	108,000	1,008,000	328,500	679,500	216,000	144,000	72,000	607,500
20	900,000	108,000	1,008,000	328,500	679,500	216,000	144,000	72,000	607,500
Total	14,700,000	1,764,000	16,464,000	5,365,500	11,098,500	3,528,000	2,352,000	1,176,000	9,922,500

Seed Potato Requirement, Planted Area and Production Volume of
Seed Potato Growers(II) in Cases of 'With Project' and 'Without Project'

Project Year	With Project					Without Project		
	Seed Requirement (ton)	Planted Area (ha)	Production (ton)			Seed Requirement (ton)	Planted Area (ha)	Production (ton)
			Seed Potato	Food Consumption	Total			
1								
2								
3								
4	300	200	2,000	1,000	3,000	300	200	2,000
5	900	600	6,000	3,000	9,000	900	600	6,000
6	900	600	6,000	3,000	9,000	900	600	6,000
7	900	600	6,000	3,000	9,000	900	600	6,000
8	900	600	6,000	3,000	9,000	900	600	6,000
9	900	600	6,000	3,000	9,000	900	600	6,000
10	900	600	6,000	3,000	9,000	900	600	6,000
11	900	600	6,000	3,000	9,000	900	600	6,000
12	900	600	6,000	3,000	9,000	900	600	6,000
13	900	600	6,000	3,000	9,000	900	600	6,000
14	900	600	6,000	3,000	9,000	900	600	6,000
15	900	600	6,000	3,000	9,000	900	600	6,000
16	900	600	6,000	3,000	9,000	900	600	6,000
17	900	600	6,000	3,000	9,000	900	600	6,000
18	900	600	6,000	3,000	9,000	900	600	6,000
19	900	600	6,000	3,000	9,000	900	600	6,000
20	900	600	6,000	3,000	9,000	900	600	6,000
Total	14,700	9,800	98,000	49,000	147,000	14,700	9,800	98,000

Proceeds, Production Cost, Profit and Increase of Income of
Seed Potato Grower(II) in Cases of 'With Project' and 'Without Project'

Unit: 1000 Rp

Project Year	With Project					Without Project			Income Increase
	Proceeds			Production Cost	Benefit	Proceeds	Production Cost	Benefit	
	Seed Potato	Seed Consumption	Total						
1									
2									
3									
4	1,500,000	240,000	1,740,000	580,000	1,160,000	480,000	320,000	160,000	1,000,000
5	4,500,000	720,000	5,220,000	1,740,000	3,480,000	1,440,000	960,000	480,000	3,000,000
6	4,500,000	720,000	5,220,000	1,740,000	3,480,000	1,440,000	960,000	480,000	3,000,000
7	4,500,000	720,000	5,220,000	1,740,000	3,480,000	1,440,000	960,000	480,000	3,000,000
8	4,500,000	720,000	5,220,000	1,740,000	3,480,000	1,440,000	960,000	480,000	3,000,000
9	4,500,000	720,000	5,220,000	1,740,000	3,480,000	1,440,000	960,000	480,000	3,000,000
10	4,500,000	720,000	5,220,000	1,740,000	3,480,000	1,440,000	960,000	480,000	3,000,000
11	4,500,000	720,000	5,220,000	1,740,000	3,480,000	1,440,000	960,000	480,000	3,000,000
12	4,500,000	720,000	5,220,000	1,740,000	3,480,000	1,440,000	960,000	480,000	3,000,000
13	4,500,000	720,000	5,220,000	1,740,000	3,480,000	1,440,000	960,000	480,000	3,000,000
14	4,500,000	720,000	5,220,000	1,740,000	3,480,000	1,440,000	960,000	480,000	3,000,000
15	4,500,000	720,000	5,220,000	1,740,000	3,480,000	1,440,000	960,000	480,000	3,000,000
16	4,500,000	720,000	5,220,000	1,740,000	3,480,000	1,440,000	960,000	480,000	3,000,000
17	4,500,000	720,000	5,220,000	1,740,000	3,480,000	1,440,000	960,000	480,000	3,000,000
18	4,500,000	720,000	5,220,000	1,740,000	3,480,000	1,440,000	960,000	480,000	3,000,000
19	4,500,000	720,000	5,220,000	1,740,000	3,480,000	1,440,000	960,000	480,000	3,000,000
20	4,500,000	720,000	5,220,000	1,740,000	3,480,000	1,440,000	960,000	480,000	3,000,000
Total	73,500,000	11,760,000	85,260,000	28,420,000	56,840,000	23,520,000	15,680,000	7,840,000	49,000,000

Seed Requirement and Planted Area of General Potato Growers

Project Year	With Project								Without Project	
	Seed Requirement				Planted Area				Seed Supply (ton)	Planted Area (ha)
	ES	ES_1	ES_2	Total	ES	ES_1	ES_2	Total		
1										
2										
3										
4										
5	2,000			2,000	1,333			1,333	2,000	1,333
6	6,000	2,000		8,000	4,000	1,333		5,333	8,000	5,333
7	6,000	6,000	2,000	14,000	4,000	4,000	1,333	9,333	14,000	9,333
8	6,000	6,000	6,000	18,000	4,000	4,000	4,000	12,000	18,000	12,000
9	6,000	6,000	6,000	18,000	4,000	4,000	4,000	12,000	18,000	12,000
10	6,000	6,000	6,000	18,000	4,000	4,000	4,000	12,000	18,000	12,000
11	6,000	6,000	6,000	18,000	4,000	4,000	4,000	12,000	18,000	12,000
12	6,000	6,000	6,000	18,000	4,000	4,000	4,000	12,000	18,000	12,000
13	6,000	6,000	6,000	18,000	4,000	4,000	4,000	12,000	18,000	12,000
14	6,000	6,000	6,000	18,000	4,000	4,000	4,000	12,000	18,000	12,000
15	6,000	6,000	6,000	18,000	4,000	4,000	4,000	12,000	18,000	12,000
16	6,000	6,000	6,000	18,000	4,000	4,000	4,000	12,000	18,000	12,000
17	6,000	6,000	6,000	18,000	4,000	4,000	4,000	12,000	18,000	12,000
18	6,000	6,000	6,000	18,000	4,000	4,000	4,000	12,000	18,000	12,000
19	6,000	6,000	6,000	18,000	4,000	4,000	4,000	12,000	18,000	12,000
20	6,000	6,000	6,000	18,000	4,000	4,000	4,000	12,000	18,000	12,000
Total	92,000	86,000	80,000	258,000	61,333	57,333	53,333	172,000	258,000	172,000

Increase of Potato Production of General Potato Growers

Unit: ton

Project Year	With Project				Without Project	Production Increase
	Production				Production	
	ES	ES_1	ES_2	Total		
1						
2						
3						
4						
5	20,000			20,000	13,333	6,667
6	60,000	18,000		78,000	53,333	24,667
7	60,000	54,000	16,000	130,000	93,333	36,667
8	60,000	54,000	48,000	162,000	120,000	42,000
9	60,000	54,000	48,000	162,000	120,000	42,000
10	60,000	54,000	48,000	162,000	120,000	42,000
11	60,000	54,000	48,000	162,000	120,000	42,000
12	60,000	54,000	48,000	162,000	120,000	42,000
13	60,000	54,000	48,000	162,000	120,000	42,000
14	60,000	54,000	48,000	162,000	120,000	42,000
15	60,000	54,000	48,000	162,000	120,000	42,000
16	60,000	54,000	48,000	162,000	120,000	42,000
17	60,000	54,000	48,000	162,000	120,000	42,000
18	60,000	54,000	48,000	162,000	120,000	42,000
19	60,000	54,000	48,000	162,000	120,000	42,000
20	60,000	54,000	48,000	162,000	120,000	42,000
Total	920,000	774,000	640,000	2,334,000	1,719,999	614,001

Note: Yield per Unit (With Project): 15.0 ton/ha (ES), 13.5 ton/ha (ES_1), 12.0 ton/ha (ES_2)

Yield per Unit (Without Project): 10.0 ton/ha

Increase of Income of General Potato Growers

Unit: 1000 Rp

Project Year	Production (ton)	Income Effect		
		Gross Income	Additional Cost	Net Income
1				
2				
3				
4				
5	6,667	1,600,080	700,000	900,080
6	24,667	5,920,080	2,100,000	3,820,080
7	42,000	10,080,000	2,100,000	7,980,000
8	42,000	10,080,000	2,100,000	7,980,000
9	42,000	10,080,000	2,100,000	7,980,000
10	42,000	10,080,000	2,100,000	7,980,000
11	42,000	10,080,000	2,100,000	7,980,000
12	42,000	10,080,000	2,100,000	7,980,000
13	42,000	10,080,000	2,100,000	7,980,000
14	42,000	10,080,000	2,100,000	7,980,000
15	42,000	10,080,000	2,100,000	7,980,000
16	42,000	10,080,000	2,100,000	7,980,000
17	42,000	10,080,000	2,100,000	7,980,000
18	42,000	10,080,000	2,100,000	7,980,000
19	42,000	10,080,000	2,100,000	7,980,000
20	42,000	10,080,000	2,100,000	7,980,000
Total	619,334	148,640,160	32,200,000	116,440,160

The Collaboration between
CIP, SAPPRAD and AARD, Indonesia

Present situation

1. TPS Evaluation of CIP Materials by Mr. Sudjoko Sahat of Lembang.

2. Bacterial wilt and late blight screening of CIP germplasm also by Mr. Sahat.

3. Marketing study with director Okabe and Mr. Bottema of coprt-ESCAP at Bogor.

4. SAPPRAD project on tropical agronomy at mid-elevation areas of West Java, Central Java, East Java and Bali. Work being done by IR. Surachmat Kusumo at Food Crops Res. Center at Bobor.

5. SAPPRAD project on pilot potato farmer production trials in West, East, Central Java and Bali conducted by Dr. Azis Asandhi of Lembang.

6. SAPPRAD project on pilot testing of rapid multiplication technique for seed production at Lembang West Java, Sumberbrantas East Java and Wonosobo Central Java conducted also by Dr. Azis.

Future Projects

1. Potato and sweet potato improvement - to select parental materials for breeding - Mr. Sahat.

2. Research contract on bacterial wilt - Mr. Sahat

3. TPS progeny evaluation and seed production - Mr. Sahat

4. Potato adaptation to warmer climates - with Dr. Potts

5. Socio-economic study - by Dr. Greta Watson of Rockefeller Foundation

6. Postharvest studies with assistance of Dr. Siert Wiersema.

7. SAPPRAD current studies to continue plus additional projects on screening for potato processing varietied and piloting of seed production systems in government farms and farmers fields.

Source: CIP

Case Study from Potato Programs in Developing Countries

Lessons from the cases

Several lessons for designing and implementing potato programs can be derived from these cases.

1. Strong national commitment is essential. In every case, national policymakers, researchers, or extension workers provided leadership and financial support for the potato program, rather than depend entirely on a foreign agency. In India, Vietnam, and Sri Lanka, the programs were staffed and funded locally from the outset. They occasionally sought training, technical assistance, and financial support from abroad, but at no time did a foreign agency provide leadership or resident personnel for the program. In the cases of Rwanda, Tunisia, and PRECODEPA, foreign agencies played important roles initially in catalyzing and supporting local efforts. Foreign agencies provided a coleader for PNAP in Rwanda, a resident scienitist in Tunisia, and a coordinator for PRECODEPA in Central America. But in each program, local leadership quickly emerged, and within a few years the budgets were financed principally from national resources.

2. Potato programs must blend into local institutions. The organizational structures of successful potato programs vary greatly. For example, India has one of the world's largest and most complete potato programs; PNAP in Rwanda is much smaller and less comprehensive; Tunisia's seed program involves five public institutions coordinated by a technical committee; the Dalat seed program in Vietnam involves a single institution working with farmers. Although none of these organizational arrangements are necessarily ideal, each has proven to be highly effective. Building the potato program within existing local institutions is essential to ensure its acceptability and continuity. Many programs

have failed because they attempted to bypass local institutions rather than work within them.

3. Successful programs have clear priorities. Few countries can afford a comprehensive potato research and extension program. The cases show that a potato program can make a significant impact by addressing just a few key constraints to potato production and use, setting aside other problems for a time. For example, the careful research on aphid populations in India, which led to development of the seed-plot production method, opened the way for immense expansion of potato production and consumption on the Indian plains. Dissemination of improved storage methods has allowed Sri Lankan farmers to intensify their market-gardening systems by planting potatoes when imported seed tubers are not available. In Central America, each of the PRECODEPA countries is now focusing on a few key production problems and sharing information with the other member countries.

4. Most successful potato programs have paid close attention to seed production and distribution. Whereas improvement programs for other crops generally start with the introduction of new varieties, the most common theme of successful potato programs is seed improvement. In every case reviewed, potato programs placed high priority on improving the seed supply. Due to their bulkiness, perishability, high cost, and variable quality, seed tubers are a critical element in potato production systems, and better seed can benefit producers and consumers in many ways. In India, development of the seed-plot system allowed plains farmers to break their dependency on the limited supply of seed from the hills. Similarly, improved seed storage in Sri Lanka is allowing farmers to spend less on imported seed. In Rwanda and Vietnam, new seed systems have allowed the rapid evaluation and dissemination of better potato varieties. These and other experiences

suggest that in most developing areas, the first priority for a potato program should be to identify and solve the major constraints in local seed systems.

5. Small programs can generate high returns. Many seed programs in developing countries attempt to supply a large proportion of all the seed potatoes required by farmers, but few succeed. Most produce no more than 5 percent of the seed required, and few produce as much as 20 percent of the total requirement. The inability of a program to meet its seed production goal often results from an overly optimistic forecast rather than from poor performance. Farmers in many areas can multiply their own seed two or three times, and sometimes more, before virus infection substantially reduces yields. Hence, a reasonable target for many seed potato programs is no more than a third or a fourth of farmers' total seed requirements.

As the cases have shown, a small, well-managed seed program can generate high returns to expenditures. Making available a small quantity of high-quality seed on a timely basis can have a large multiplier effect. Rather than being concerned with the volume of a seed potato program, managers should focus on the quality of the seed produced and the rate of return generated by the program.

6. Technology cannot be directly transferred; it must be adapted to local conditions. In none of the cases examined was foreign technology applied directly by researchers or farmers. Local adaptations were needed. The commercial application of tissue culture methods to seed potato production in Vietnam, establishment of an economically viable seed multiplication system for Tunisia's fall crop, and the rich variation of practical applications of the diffused-light seed storage principle in several developing countries provide striking illustrations of this point.

Bibliographic notes

Ruttan (1982) and Pinstrup-Andersen (1982) provide summary statements of the extensive literature on assessment of the impact of agricultural research. Scobie (1979) makes a more extensive review of evidence from developing countries. CGIAR (1985) summarizes results of a comprehensive study of the achievements and potential of the international agricultural research centers.

The sections of this chapter on types of impact and methods for assessing impact are based on Horton (1986). The illustrative cases are drawn from Pushkarnath (1976) for India; Monares (1984) for Rwanda; Horton et al. (in press) for Tunisia; Uyen and van der Zaag (1983, 1985) for Vietnam; Rhoades (1985) and Somaratne (1985) for Sri Lanka; and an unpublished text prepared by Kenneth Brown for Central America. Detailed versions of several of the cases appear in International Potato Center (1984).

Source: Potatoes "Production, Marketing and Programes for Developing Countries", Douglas Horton, 1987

STRENGTHENING POTATO SEED PRODUCTION IN CENTRAL JAVA 1)

Anggoro Hadi Permadi, Witono Adiyoga, Sudjoko Sahat and Ati Sri Duriat 2)

ABSTRACT

A pilot project on potato seed production in Wonosobo was established by a cooperation among the Bank of Indonesia Yogyakarta, LEHRI, and the Extension Service at Wonosobo. The aims of this project were to improve the technical skill of four farmers and two extension workers in their know how to produce good potato seed along with to improve farmer's income and finally to strengthen their potato seed production in Central Java. In this connection LEHRI was supposed to participate in technical supervision which was emphasized on method of growing potato for seed, plant protection, plant selection, clonal selection and storage of seed. The results, of field technical supervision so far were: (1) the quality of potato seed was improved by plant selection against virus and bacterial wilt infected plants while diffuse light storage of seed improved the vigor of the sprout; (2) clonal selection which was aimed to maintain qualified basic seed was felt to be complicated for the farmers and therefore, other alternatives to obtain virus free seed was introduced i.e. growing potato from virus-free stem or sprout cutting; (3) potato seed production business proved to be beneficial; (4) since the capacity of potato seed production of these four farmers were still far from enough to supply Wonosobo area alone, other farmers should be encouraged to participate on potato seed production in Central Java.

Potato is one of the main vegetable crops in Indonesia. It has been cultivated since long time ago. It's area of production is ever increasing. The main production area is in Java. In this case, more advance potato cultivation is

found in West Java. The farmers in this area growing potato for consumption as well as for seed. The latter is produced for farmers in and out of West Java and one of the consumers of this seed is Central Java farmers.

The centers of potato production in Central Java are located in three places, i.e. Banjarnegara, Wonosobo, and Magelang. These places are located in the center of Central Java, and in 1982-1984 they covered 82.4% of the total potato area of production which was 4418 ha annually. It means that during those periods Central Java needed at least 4000 tons of potato seeds annually. A small part of this quantity was supplied by imported seed and the rest was fulfilled with locally produced seed and most of the latter seed came from West Java.

In general, the way the farmers "produce" potato seed is by selecting seed size tubers at the time of harvesting and keep them as seed for the next season. Usually there was no selection done during the growing period, since they grew potato for consumption. In West Java some farmers are more or less specialized in potato seed production and they used imported seed as the initial seed. However, not many of them were familiar with roguing diseased plants, particularly those plant infected with virus which can reduce the productivity potential of the next generation crop.

Table 1. Harvested area of potato crop in Indonesia; Java and Central Java in 1982 - 1984

Area	Harvested area (ha)		
	1982	1983	1984
Java:	11,752	21,048	22,780
1. West Java	6,786	9,898	11,432
2. East Java	2,951	6,211	4,824
3. Yogyakarta	33	77	133
4. Central Java:	2,000	4,862	6,391
a. Banjarnegara	537	2,121	3,288
b. Wonosobo	784	1,271	1,031
c. Magelang	-	381	880
d. Others	679	1,089	1,192

Source: Biro Pusat Statistik, 1982, 1983, 1984, Jakarta.

P. Elenbaas (in Hendro Sunarjono & Anggoro Hadi Permadi, 1969) observed a drastic increase of virus infected potato plants in generation after generation if roguing were not done during the growing season. He observed 1% infected plants in GO generation (imported seed) but it was already 60-100% in the fourth generation.

In order to initiate the improvement of potato seed production in Central Java, the Bank of Indonesia at Yogyakarta was interested to help farmers in this area to be able to produce good potato seed and trained them to become potato seed producer so that in the future, Central Java can self sufficiency in potato seed. For this purpose the Bank of Indonesia Yogyakarta in cooperation with the Lembang Horticultural Research Institute and the Extension Service at Wonosobo started a pilot Project on Potato Seed Production in Wonosobo. In this project four selected farmers and two extension workers were trained and supervised technically in potato seed production by LEHRI and Extension Service for three years and supported financially, in the form of credit for the farmers, by the bank.

PILOT PROJECT ON POTATO SEED PRODUCTION IN WONOSOBO

The aims of the project are to improve technical skill of the farmers and extension workers in their know-how to produce good potato seed along with to improve farmers income, and finally to strengthen potato seed production in Central Java.

This project consisted of four steps, i.e. (1) feasibility study; (2) training for the farmers and extension workers before initiating production in the field; (3) technical supervisions during the growing seasons; and (4) evaluation of the project.

In the first step, information were collected from 10 candidates about their knowledge and experience on growing vegetables, especially potato, and potato seed production.

Also their motivation to participate in the project. Visits to their fields to observe their land situation, irrigation system and facilities, and the surrounding fields. These informations were used as important criteria to select four out of 10 candidates who were recommended by the extension service. Afterwards more technical detail informations were collected from these four selected farmers, such as field condition, soil pH and fertility, plant rotation, soil pathogenety and storage facility.

The second step was to train those four farmers plus two extension workers in Lembang. They were trained in growing potato for seed, methods of plant protection, cultivar identification, familiarizing with virus disease symptoms in plant, plant roguing, potato storage and clonal selection.

The third step was field activities in farmers fields under LEHRI supervision and daily/on the spot supervision by extension workers. The farmers grew potatoes in the field and during the growing period they have to do plant selection by roguing out wilting plants, plant showing virus symptoms and off-types at least three times, i.e. at 30, 45 and 60 days after planting. For this purpose, in the first three growing seasons the farmers and extension workers were intensively supervised by LEHRI team and in the next three growing seasons the farmers and extension workers did themselves and afterwards LEHRI team inspected their works if some plants that supposed to be rogued out were still left. During these growing seasons the farmers also practiced clonal selection to maintain their healthy stock seed for future production of potato seed.

Between third and fourth growing seasons a new technology was introduced i.e. production of potato from stem cutting. The participants were again trained in Lembang for general vegetable growing including growing potato from stem and sprout cuttings.

The last step is a final evaluation of the project including evaluation to the four participating farmers that will be recommended as potato seed grower.

The role of Bank of Indonesia in this pilot project is providing funds for the first and second steps and all funding for technical supervision during growing seasons while the four farmers were provided with credit for operational cost which covered field operation and store house building.

RESULTS OF POTATO SEED PRODUCTION PILOT PROJECT

Feasibility

This study has recommended four farmers to be the participants of this pilot project. Detail study on their field showed that each field has different soil fertility, therefore the farmers were supposed to follow the guide line from agronomy section on liming, manure and fertilizer recommendations, that was based on soil analysis; the recommendations, are in Table 2.

Besides the soil fertility bacterial wilt and nematode infections were also analyzed from the soil. Based on bioassay method on bacterial wilt soil samples showed 10-17.4% infection. Therefore, care should be taken to lessen bacterial wilt infection, e.g. use bacterial wilt free seed, do recommended plant rotation in the same field, if possible use bactericide, etc. While nematode examination showed that nematode population in the soil was still low.

Potato Seed Production Training

The training was held at LEHRI from 20th-26th February 1984. The participants consisted of four farmers and two extension workers.

The training lessons composed of 23.0% theory, 23.0% discussions, and 54.0% practical works. It covered: variety identification, potato growing in general and for seed production, pest and disease management, familiarizing virus disease symptoms, clonal selection, and potato storage. For seed storage, a diffuse light storage was introduced.

Table 2. Recommendation for liming and fertilization of the participant's lands

Location and altitude	Amount of lime (t/ha)	Stable manure (t/ha)	Fertilizers (kg/ha)		
			N	P_2O_5	K_2O
Kejajar (1400 m)	-	20-30	100	150-150	100
Serang (1600 m)	-	20-30	100	150-200	100
Jojogan (1800 m)	1	20-30	100	100-200	100
Dieng (2100 m)	1 - 1.5	20-30	100-150	150-200	100-150

Potato Seed Production

Field Growing

The participant's choice for cultivar to be produced relied on its market which was mostly in West Java. Since Granola was the commonly grown cultivar in West Java, so the participants chose the same cultivar.

In the beginning, it was planned that each farmer planted 0.35 ha per season. It was true in the first season but in the next seasons the farmers planted 0.35-0.80 ha per season depend on the amount of seed they had.

In the first growing season imported seed produced high yield and visually showed low virus infected plants. The high yield in this growing season was due to good seed and supported by favourable climate that there was little rainfall. The land has also not been cultivated for one season. However, there was still bacterial wilt infection which was assumed

originated from the soil since imported seed was free from BW, and soil analysis also support this assumption.

For the second growing season it was originally planned to be started in September 1984 with imported seed. Since there was no imported seed, so the farmers used their own seed originated from the first growing season. For this purpose the dormant tubers were treated with CS_2 in September 1984 and then November 1984. According to Sahat, et.al. (1978) the application of CS_2 20 ml/m^3 could maintain yield. This can also be seen from Table 3 that the average tuber yield in the second and fourth growing season were about the same. G_1 seed for second and fourth plantings were exactly the same generation except that G_1 in the second growing season, the sprouts were forced to grow by CS_2. While in the fourth growing season they grew naturally.

The third growing season, again, it was planned to use imported seed, but the originality of the seed was suspected due to the fact that in the field a lot of off-types were found, also with high BW and virus infection. It was quite different from the seed used in the first growing season.

Table 3. Source of seed, ratio of seed to yield, % seed produced, and % infected plants during the period of potato seed production in Wonosobo 1)

Growing season	Source of seed	Ratio seed vs yield	Yield (t/ha)	% seed		Infected Plants(%)		Growing period
				Normal	Small	BW	Virus	
1	Import	1:16.9	21.8	28.9	34.0	6.0	1	4-9/34
2	G_1+CS_2	1: 9.6	13.5	13.8	14.4	8.1	1	11/84-3/85
3	"Import" 2)	1: 4.2	5.6	14.8	13.2	11.2	3	2-6/85
4	G_1	1: 9.4	13.7	31.9	2.3	2.3	1	9/85-2/86

1) Averaged from 4 farmers; 2) Suspected as imported seed.

Virus Infection

The fields where the participants grew their potato seed were surrounded by other potato fields. Although field inspections showed visually less than 1% virus infected plants in the field, laboratorium test showed different result. Samples of G_2 tubers were taken and then tested in LEHRI lab by means of: (1) growing these tubers in greenhouse and examined visually for virus & bacterial wilt symptoms; and (2) Elisa test for more precise identification for virus. The results of these test are presented in Table 4.

Table 4 showed that PLRV is more important than mosaic. On average seed produced by pilot project showed far less virus infection than locally produced seed without selection, the later seed was almost equal to the data observed by P. Elenbaas (20-40%). So it means that visual field selection proved to be effective in reducing potato seed from PLRV infection. This is important, since, according to Duriat (1982) PLRV alone can reduce 25-90% yield of potato, therefore, roguing diseased plants during growing season is recommended very much in order to get better potato seed quality.

The expression of certain virus symptom is more clear in cooler than hotter place. Therefore, selection againsts virus infected plants is more efficient when done in higher altitude. Thus if potato seed produced in higher altitude will be better than that produced in lower altitude. This was one indication that selection in higher altitude can be done better than that in lower altitude.

Table 4. Laboratorium examination of potato tubers originated from seed production program in Wonosobo

Location and altitude	Tuber tested		Visual ident.(%)			Elisa test		
	Source	Number	PLRV	Mozaic	Total	No. Tuber	PLRV (%)	BW (%)
Kejajar (1400 m)	1. G_2 1)	95	2.1	0	2.1	93	8.6	8.5
	2. G_2^2 1)	10	0	0	0	0	0	0
	3. G_2^2 2)	167	0.6	0	0.6	-	-	4.9
Average		-	0.9	0	0.9	-	4.3	6.7
Serang (1500 m)	G_2 2)	10	0	0	0	10	0	0
Jojogan (1800 m)	1. G_2 1)	40	-	-	-	37	10	-
	2. G_2^2 2)	-	1.1	0	1.1	-	-	33
	3. Local 2*)	44	6.8	4.5	11.3	36	16	15.9
Average		-	0.5	0	0.55	-	5.0	16.5
Dieng (2100 m)	G_2 1)	41	5	0	5	10	0	12.0
Total average		-	-	-	1.6%	-	2.3%	8.8%

1) Tubers were taken from storage house
2) Tubers were taken from the field at time of harvesting.
2*) Tubers were taken from store house as a result produced in the field without field selection.

Haulm Killing

Haulm killing was done in every growing season to prevent tuber from patogen infection that came from the stem. When the crop populations grew normally, haulm killing was done 70 days after planting but sometimes it was also done later if the weather favours growth and no disease. It can also be done earlier, 56-60 days after planting if the plant population were heavily infected with pest and/or disease in the earlier stage. Haulm killing can also increase the % of potato seed tuber size.

Clonal Selection

Clonal selection was aimed to produce potato seed tubers with virus infection as low as possible and use this relatively clean materials as basic seed for the next seed production.

This selection method started with single plant selection followed by clonal selection in the next 3 generations and then bulk seed for another 3 generations. This method has been introduced during the training period. However, in practice the farmers felt that it was too complicated and after 4 growing period they did not continue with this method. They felt that rapid multiplication technique that was introduced to them during the second training would be easier to practise.

Diffuse Light Storage (DLS)

This system was introduced to the farmers and they found that the seed was in better conditions at the time of the following planting. The seed tubers were still hard with stronger and shorter sprout growth. To get rid of tuber moth pest sex-pheromone was used in the DLS house. Three practices were acceptable.

Cost of Production

Table 5 showed that the use of imported seed increase the input/ha since the cost of imported seed was Rp 1500/kg while if they used locally produced seed the cost of seed was Ro 800 - Rp 1000/ha. Although the cost of seed was high they still got benefit from their business in potato seed production. Therefore, the potato seed production is beneficial.

Table 5. Cost of production in relation with source of seed and the benefit of potato seed production

Source of seed	Input per ha	Benefit (%)
Import	3.5 millions	+98.3
Gl + CS_2	2.9 "	+94.0
"Import"	3.0 "	-42.0
G_1	2.0 "	+77.1

PRELIMINARY OBSERVATION ON GROWING POTATO FROM STEM CUTTING

Method of rapid multiplication technique was introduced to the participant farmers during the second training, i.e. by the time they were growing potato for the third growing season. One of the farmers was so interested and he did an observation of growing potato from stem cutting in his field. For this purpose he took stem cuttings from volunteer plants growing in his field. Rooting of cutting was done outside under white nylon aphid-free screen for about two weeks. Two kinds of cutting were taken: 1) stem cutting; and 2) shoot cutting.

Two thousands rooted cuttings were then planted in the field in two rows bed with plant distance of 70 x (25 x 25) cm with 200 grams stable manure and 10 grams guano per rooted cutting. One week after planting 6.7 grams urea/plant was side-dressed. Planting data was May 27, 1986 and harvested early August, 1986. Total area for this observation was 189 m^2.

At the age of 35 days three plants were pulled to see tuber development and this was repeated at 45 days with two plants. Haulm killing was done at the age of 60 days and harvested at 90 days. Twenty shoot cuttings and twenty stem cuttings were chosen at random to be harvested separately as

samples and the tubers were then classified according their size (Table 6). The total cost of this experiment was Rp 28,002/189 m^2.

The cost of this observation was Rp 28,020 equivalent to Rp 1,500,000/ha and produced 233 kg tubers equivalent to 12.3 ton/ha. With this result the farmer was quite happy.

Table 6. Tuber development of 35 and 45 days-old cuttings, yield of stem & shoot cuttings, and total yield of potato tuber planted from cuttings.

No. plants	Plant age	Tuber/plant		Tuber weight (kg)			
		No.	Weight	60 gr	Seed	Small	Total
3	35 days	2	50	-	-	-	-
2	45 days	4	150	-	-	-	-
20	60 days	-	-	-	-	-	-
	a. shoot	-	-	3.5	1.25	0.25	5.0
	b. stem	-	-	3.5	2.75	0.25	6.5
1800	60 days	-	-	191.5	36.0	5.5	233.0

Mid-elevation Potato Production Trials Expanded

Indonesia has adopted the strategy of moving potatoes down to the mid-elevation areas in order to shorten the chain of input and product flow. This way, production and marketing costs are lowered and potatoes can be sold at a reasonable price to consumers.

Traditionally, potatoes are grown only in the highlands (above 1,000 meters) of Indonesia. Under highland conditions, however, production costs are high because of high labor and transport costs of inputs. Likewise, marketing costs are high because most of the potato consumers live in the lowlands.

In line with the strategy, Dr. A.A. Asandhi, technology transfer project coordinator for Indonesia, has identified appropriate mid-elevation production sites near large population centers. Together with Ir. Surachmat Kusumo, SAPPRAD project leader for tropical agronomy, Dr. Asandhi has tested varieties and cultural management practices in these selected production sites to make the technoguides location-specific and viable.

In 1986, 45 farmers were supervised to grow potatoes in mid-elevation areas. These consisted of 5 farmers each in four locations in East Java, 5 farmers in 4 locations in Central Java, and 5 farmers in Bali.

In general, yields in this trial were relatively low because of late availability of seed potato for all areas, lack of water (in East Java) and excessive water (in Central Java). Despite these constraints, the average yields ranged from 4.2 tons per hectare in Lawang, East Java to 31.1 t/ha in Bali.

The value of growing potatoes in a rice-based cropping system was also studied in Magelang, Central Java. Results showed that growing potatoes in between two crops of rice was more profitable than growing rice in three seasons or growing corn or sweet potatoes between two crops of rice (Table 1).

Owing to this encouraging result, Indonesia will expand its farmer production trials in mid-elevation areas in 1987, as shown in Table 2.

The trials consist of 102 farmer cooperators in 7 mid-elevation potato communities. The trials were done in June - July 1987. An Indonesian mid-elevation potato field day is scheduled in late August during the SAPPRAD annual meeting to show the progress of this technology transfer effort.

Table 1. Profitability of growing potatoes in between rice.

Cropping Pattern	Total Production Cost (in US$)	Gross Income (in US$)	Net Income (in US$)
Rice-Rice-Rice	814	1552	738
Rice-S. Potato-Rice	760	1352	592
Rice-Corn-Rice	771	1278	507
Rice-Potato-Rice	1297	4124	2827

Table 2. Expanded production trials in mid-elevation areas in 1987.

Province/Community	No. of Farmers	Range of Area (sq.m.) planted per farmer
A. East Java		
Malang	10	250
B. Central Java		
Tegal	17	250 - 1,000
Yogyakarta	17	250 - 1,000
Magelang	17	250 - 1,000
Karanganyar	10	250
C. West Java		
Cianjur	10	250
D. Bali	21	250 - 500
Total	102	

APPENDIX H

MINUTES OF MEETING

MINUTES OF MEETING
ON
INCEPTION REPORT FOR
THE MASTER PLAN STUDY ON
THE MULTIPLICATION AND DISTRIBUTION OF
IMPROVED SOYBEAN SEED AND SEED POTATO
IN THE REPUBLIC OF INDONESIA

1. Date : July 8,1987.

2. Place : Board Room of Directorate General of Food Crop Agriculture, Ministry of Agriculture (MOA).

3. Attendants : See attached list.

4. Summary of Discussion :

The Team Leader, Mr. M.YAMADA explained to the attendants the Inception Report which the JICA Study Team submitted to MOA on July 8,1987. The chairman, Ir. Soelbiyati Soebroto, expressed her general acceptance of the Report and asked the attendants from MOA to make comments on the Report. Various discussions were then made on almost every aspects of the Project between MOA and JICA Study Team, and both sides confirmed the following through discussions :

(1) The general concept and plan of operation for the master plan study described in the Inception Report was accepted by MOA.

(2) MOA would assigned the counterpart personnel for execution of the master plan study.

(3) MOA strongly requested the JICA Study Team that :

a. Training of 2 (two) officials in Japan.

b. Sooner start of implementation of projects which are identified by the study.

JICA Team will convey the above requests to the Japanese authorities concerned.

July 8,1987

Makoto Yamada
Team Leader,
JICA Study Team for
The Master Plan Study on
The Multiplication and Distribution of
Improved Soybean Seed and Seed Potato

Ir.Soelbiyati Soebroto
Director of Programme
Development,
Directorate General of
Food Crops Agriculture,
Ministry of Agriculture

Kanezo Takeuchi
Head of Technical Affairs Div.,
Agriculture, Forestry and Fisheries
Planning and Survey Dept, JICA

MINUTES OF MEETING
ON
THE DISCUSSION FOR
THE MASTER PLAN STUDY ON
THE MULTIPLICATION AND DISTRIBUTION
OF IMPROVED SOYBEAN SEED AND SEED POTATO
IN THE REPUBLIC OF INDONESIA

1. Date : September 11, 1987
2. Place : Directorate General of Food Crop Agriculture, Ministry of Agriculture

3. Attendants: See attached list

4. Summary of Discussion :

The Team Leader, Mr. M. YAMADA explained to the attendants the outline of the results of field study conducted in Jambi, South Sumatera, North Sulawesi, Bali and East Java Province for Soybean, and Jambi, South Sulawesi, East Java, Central Java and West Java Province for Potato on the Study from July 14 to August 25, 1987. Various discussions were made on almost every aspects of the study between MOA and JICA Study Team, and both sides confirmed the followings through the discussions:

(1) MOA expressed the general acceptance of the results of the field study.
(2) MOA requested the JICA Study Team that 2 officials of MOA would have a technical training in Japan.
(3) MOA and JICA Study Team agreed that the core province for a pilot project for the successful implementation of the improvement plan would be East Java for Soybean; and West Java for potato.
(4) MOA and JICA Study Team agreed that a Seminar on multiplication and distribution of improved soybeen seed and seed potato would be held at the time of submission of Draft Final Report in the

middle of November , 1987. Also they agreed that MOA would discuss the following with JICA Indonesia Office by the middle of October, 1987:

- Themes of the Seminar
- Place(s) and date
- Number of participants
- Qualification and field of lecture(s)

September 11, 1987

Makoto Yamada
Team Leader,
JICA Study Team for
The Master Plan Study on
The Multiplication and
Distribution of Improved
Soybean Seed and Seed Potato

Soelbijati Soebroto
Director, Directorate of
Planning and Programming,
Ministry of Agriculture

Setsuro Toda
Team Leader,
Advisory Team,
Japan International Cooperation
Agency

Minutes of Meeting
on
The Draft Final Report for the Master Plan Study on Multiplication and Distribution of Improved Soybean Seed and Seed Potato

Japan International Cooperation Agency (JICA) sent an explanatory team on the Draft Final Report for the captioned study from 16 to 26 November, 1987.

During the stay in Indonesia, the team had meetings in Surabaya and Bandung, and held a seminar on Soybean and Potato on November 23 and 24 in Jakarta.

The team and Indonesian authorities concerned discussed the Draft Final Report on November 25, taking into concideration the results of the seminar.

A list of the participants in the meeting on D.F.R is attached to Annex I.

The salient results of the meeting are as follows;

1. Indonesian side principally accepted the D.F.R. submitted by the team. The comments by the Indonesian side are summarized in the Annex II.
2. Both sides agreed that Indonesian side would submit additional comments in two weeks after the signing of M/M through JICA Office in Indonesia, and that Japanese side would formulate the Final Report, taking into concideration the Indonesian comments and submit the F.R. by the end of December, 1987.
3. JICA donated the Overhead Projector and its attachments used in the seminar, in response to the request of the Indonesian side.

November 26, 1987, Jakarta

MAKOTO YAMADA
Leader of JICA Study Team

Dr.Ir. A. Muin Pabinru
Director General of Food Crops Agriculture

K. Sago
Katsuya Sago
Vice Chairman of Advisory Committee of the Study, JICA

Comments by Indonesian Side

General

For the implementation of pilot project, the result of the seminar should be taken into consideration.

Potatoes

1. The role and function of BBI/BBU Unit shall be more clearly described, as partners of " Private Enterprise " or " Semi Government Autonomous Enterprise/BUMN " serving quality seed and the plan to strengthen them shall also be proposed.

2. The strengthening of BBIs and BPSBs activities shall be planned not only for West Java Province but also for other 4 (four) Provinces where the study has been conducted.
   The equipments (available and additional) should be efficiently utilized.

Soybean

1. The promotion of roles of high quality seeds should take into consideration the establishing a marketing system through both utilizing the existing farmers' organization, such as Kelompok Tani (Farmers' Group) and KUD (Village Unit Cooperative), etc, as well as other private enterprise.

2. The Equipments and facilities needed for BBI and BPSB activities should be considered not only for these institutions in East Java Province, but also for those institutions in other provinces studied. The equipments (available and additional) should be efficiently utilized.