RESEARCH HIGHLIGHTS

THE STRENGTHENING OF PIONEERING RESEARCH FOR PALAWIJA CROPS PRODUCTION PROJECT

ATA-378 PROJECT

(April 1986 - March 1991)

Bogor Research Institute for Food Crops (BORIF)

Japan International Cooperation Agency (JICA)

Bogor 1991

RESEARCH HIGHLIGHTS

THE STRENGTHENING
OF
PIONEERING RESEARCH
FOR
PALAWIJA CROPS PRODUCTION PROJECT

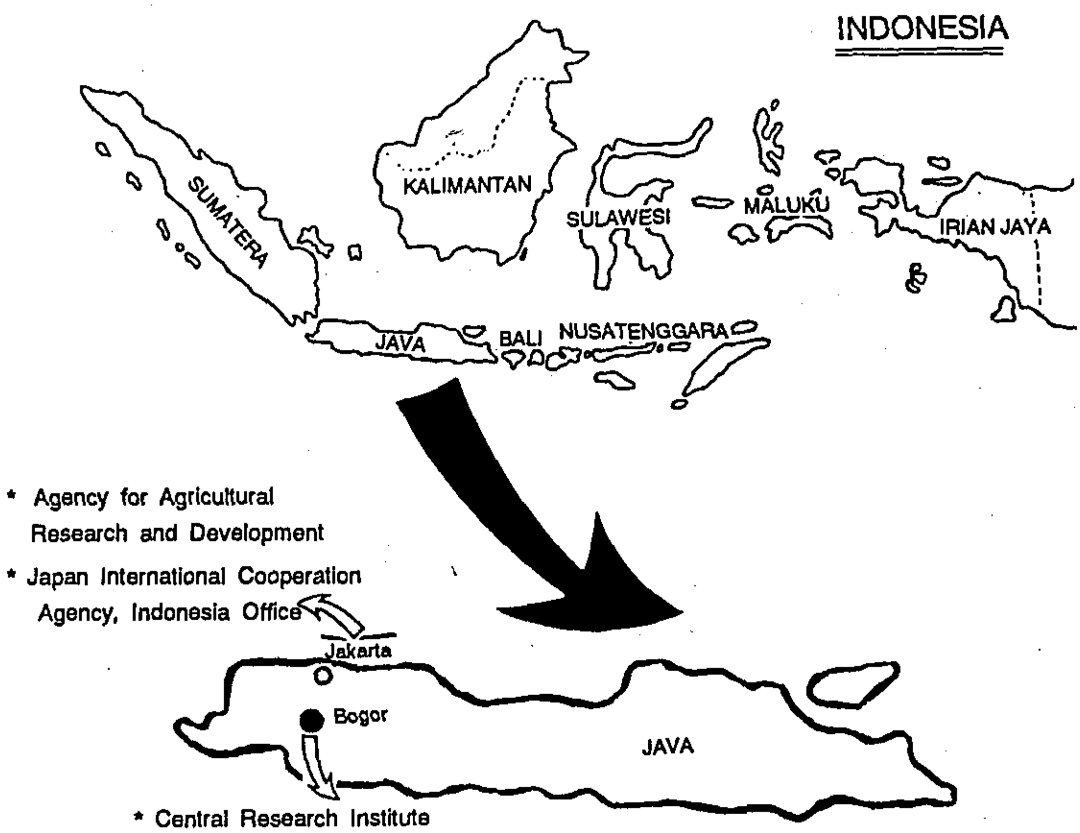
ATA-378 PROJECT

(April 1986 - March 1991)

Bogor Research Institute for Food Crops (BORIF)

Japan International Cooperation Agency (JICA)

Bogor 1991



* Central Research Institute for Food Crops
* Bogor Research Institute for Food Crops

JICA ATA-378 Project

PREFACE

Bogor Research Institute for Food Crops (BORIF) in cooperation with Japan International Cooperation Agency (JICA) carried out several research activities on soybean under the "Strengthening of Pioneering Research for Palawija Crops Production" ATA-378 Project.

This report presents several selected highlights from research activities of the project.

On behalf of BORIF, I would like to express my sincere thank to JICA for providing technical and financial support in addition to Indonesian funds. My sincere thanks also to Dr. T. Igarashi, Project leader, Mr. S. Nishiyama, Project coordinator, all Japanese experts and Indonesian research scientists, for their collaborative efforts in implementing the research program of the project and contributed to this report.

Dr. A. Syarifuddin Karama,
Director of Bogor Research
Institute for Food Crops

Expereriments to find effective natural products for control soybean storage pests were conducted in 1989 and 1990.

Husk ash, wood ash and lime which are easily obtainable by Indonesian farmers were used for the experiments. The results showed that the husk ash was the most effective one among the three materials tested.

Fig. 1. *Callosobruchus analis* attacking soybean seeds.

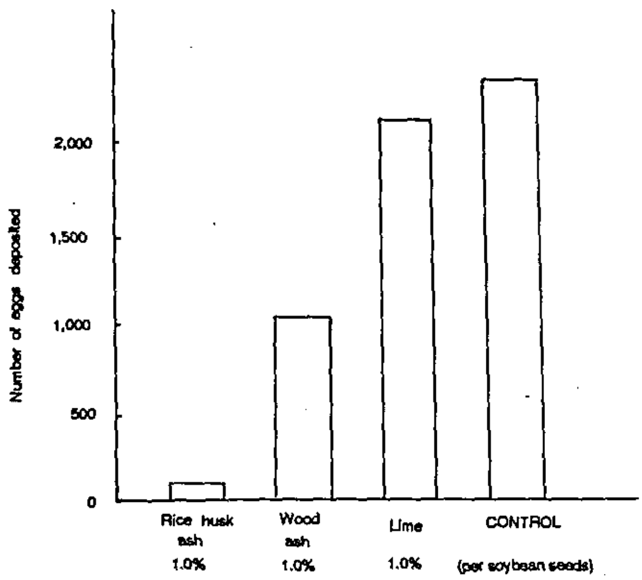


Fig. 2. Effectiveness of some natural products on the number of eggs of *Callosobruchus analis*.

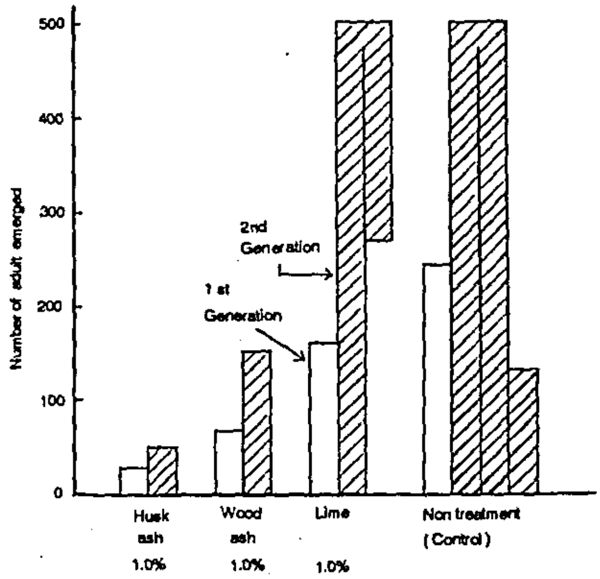


Fig. 3. Effectiveness of some natural products to prevent population built up of *Callosobruchus analis*.

How to use husk ash : 1% (w/w) of fresh ash is mixed with seeds before storage. Less than 1% is rather inferior effect.

In Indonesia, husk ash has been used by Java farmers traditionally, when they store the soybean seeds in a container such as a tin. Usually, the ash is applied on the top layer of seeds in a tin. However, most farmers do not recognize that the ash is good for control the storage pests.

How does the husk ash affect to the insects ? :

The mechanism of death of storage insects by the ash has not made clear yet. However, it is assumed that the water loss from insect epidermis and partly by the direct mechanical irritation would be the main causes.

Fig. 4. A farmer shows a tin for storing soybean seeds. You can see a vinyl bag packed with the husk ash on the tin.

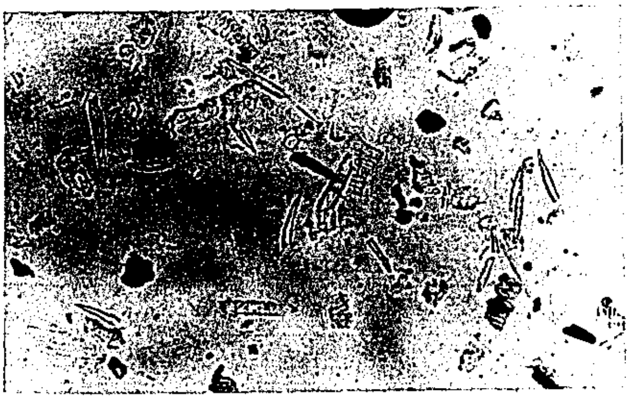


Fig. 5. Microscopic magnification of the rice husk ash A lot of pointed perticles are observed.

Table 1. Chemical analysis data of the materials tested

Chemical Compounds	Rice husk ash	Wood ash	Lime
	%	%	%
SiO_2	96.01	60.00	35.57
CaO	0.30	23.50	60.51
MgO	0.28	3.32	3.67
Na_2O	0.06	0.16	0.04
Fe_2O_3	0.08	0.19	0.01
Al_2O_3	0.96	1.04	0.07
K_2O	0.96	9.60	0.01
P_2O_5	0.86	2.34	0.01

- Entomology Division -

2. SELECTION OF ACID SOIL TOLERANT SOYBEAN RHIZOBIUM

Soybean nodules were collected from main cropping areas; 198 isolates from Java, 86 from Lampung, 13 from Padang, 17 from North Sumatra and 12 from Bali. Furthermore, 16 were obtained from Japan (A 10 code) and 9 from the U.S.A. (USDA code). They were characterized according to their growth (shape, colony, size, growth rate, carbohydrate metabolism and capability of altering pH). The majority were slow growers (Table 1). They were then identified as nodule bacteria inoculating on siratro *(Macroptilium artropurpureum)*.

The activity of a part of them, 133 from Indonesia and all isolates from Japan and U.S.A., were tested. Generally, the Indonesian strains produced larger nodule weight and nitrogen uptake than Japanese and American ones (Fig. 1). To consider the tolerance to acid soil, 58 isolates were examined by a simple agar method with the following four treatments: control (pH 6.8, 1000μM P and 0μM Al), low pH (pH 4.5, 1000μM P, and 0μM Al), low P (pH 4.5, 5μM P, 0μM Al) and high Al (pH 4.5, 5μM P, 100μM Al). Grouping was done based on the growth rate, metabolism reaction and gummy substances (Table 1). Forty four strains were intolerant to the factors of acid soil, but twelve were tolerant. Growth rate in medium (yeast-extract mannitol agar) was not directly related to the tolerance.

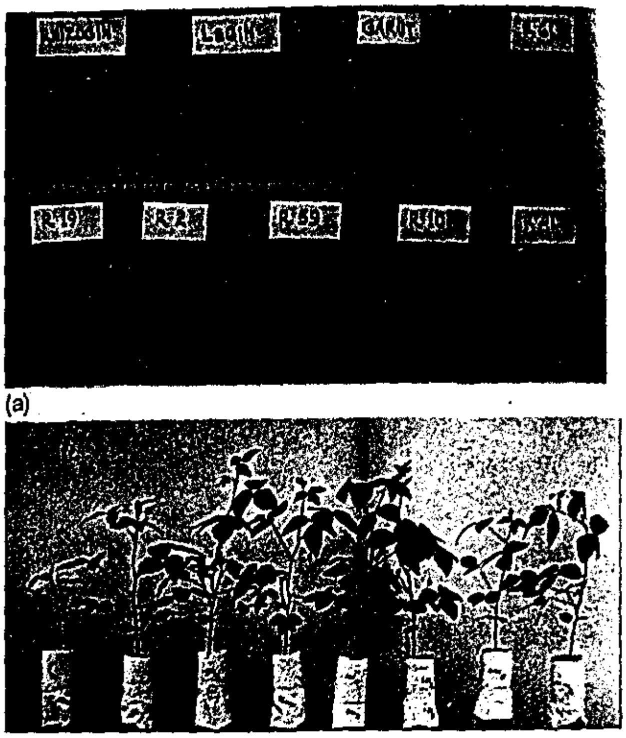


Fig. 1. (a) Various nodules produced by different inoculants, (b) Indonesian strains resulted in better soybean growth than Japanese and USA ones.

Nitrogen fixing capacity of the tolerant strains was examined in limed Red-Yellow Podsolic soil. Lime rates were equivalent to 0, 0.5, 1.0 and 1.5 times of exchangeable Al in the soil (10.9 me/100 g soil). Soybean plants inoculated with GRT, L9A2, L10 and L22Al had the largest dry weight and nitrogen uptake in a treatment equivalent to 1.0 time exchangeable Al (pH 5.3), and those with R61, L24Al, PCJ6, KG4 and TKG 4B did in that equivalent to 1.5 times (pH 6.2). According to the relative symbiotic activity, R61, L24Al, PCJ6, TKG 4B, KG4, GRT, L10 and L22 AL can be used for inoculation in acid soil being limed equivalent to 0.5 time exchangeable Al. Although, 100 kg/ha of nitrogen application without liming resulted in better growth and larger nitrogen uptake of soybean than inoculation at any level of liming. A yield target should be consideted for practical use of rhizobium in the field from an economic point of view.

Table 1. Growth rate, acid-Al tolerance and antibiotic resistance

No. strain	Growth rate	Colony shape	Acid Al tolerance	Streptomycin antibiotic resistence (1000 ppm)
Jtg 1A1	slow	A	+ (slightly tolerant)	-
Jtg 1B	slow	B	- (intolerant)	+
Jtm 2A	slow	A	-	+
Jtm 3A	slow	B	+	-
Jtm 5	slow	A	++ (moderately tolerant)	-
Jtm 7A	slow	A	-	-
Jtm 8a1	slow	A	++	-
Jtm 9GB	slow	A	-	-
Jtm 11A	slow	A	-	-
Jtm 12A	slow	A	-	+
Jtm 14A	slow	A	-	-
Jtm 15B	slow	A	+	+
Jtm N16B	slow	A	-	+
Jtm 17B	slow	A	-	+
Jtm 18B	slow	A	-	-
Jtm 19A1	slow	A	-	-
Jtm 20A	slow	A	+	-
Jtm N22B	slow	A		
Jtm 24	slow	A		-
Jtm R2	slow	A	++	-
Jbr R10	fast	C	-	-
Jbr R19	fast	C	-	-
Jbr R41	fast	C	-	-
Jbr R61	slow	A	+	+
Jbr GRT	slow	A	-	-
Jbr PCJ6	fast	C	+++ (tolerant)	-
L TKG4A	fast	C	-	-
L TKG4B	slow	A	++++ (highly tolerant)	-
L KG4	fast	C	++++	-
L 3A	slow	A	-	+
L 4A1	slow	A	-	-

No. strain	Growth rate	Colony shape	Acid Al tolerance	Streptomycin antibiotic resistance (1000 ppm)
L 7B	slow	A	-	-
L9A2	slow	A	-	+
L 10A	slow	A	-	+
L 13A1	slow	A	-	-
L 15D1	slow	A	-	-
L 21A1	slow	A	-	+
L 22A1	slow	A	-	+
L 23B1	slow	A	-	-
L 24A1	slow	A	++	-
L 6 1	slow	A	-	-
A 1017 kas	slow	A	-	nd
A 1017 kas spec	slow	A	-	nd
A 1014	slow	A	-	nd
TSH-1	slow	A	-	nd
TSH-1 kas	slow	A	-	nd
J 10 kas	slow	A	-	nd
J 20	slow	A	-	nd
AHU 1130	slow	A	-	nd
IRJ 2101 spec	slow	A	-	nd
TS 5033	slow	A	-	nd
IRJ 2114 str	slow	A	-	+
USDA 6	slow	A	-	nd
USDA 110	slow	A	-	nd
USDA 122	slow	A	-	nd
USDA 136	slow	A	-	nd
USDA 138	slow	A	-	nd
USDA 142	slow	A	-	nd

* nd = not determination

A = Circular, convex, regular, little gum and size = 0.5 - 2 mm
B = Amorf, thin, little gum
C = Circular, convex, regular and gummy

Table 2. Gum production of some Rhizobium and Bradyrhyzobium strains

Strain	Characteristics of Rhizobium strain
L TKG4B	Acid-Al tolerant, alkaline producing, gummy on acid medium
L KG4	Acid-Al tolerant, alkaline producing, gummy on acid medium
Jbr PCj6	Acid-Al tolerant, alkaline producing, gummy
L 24A1	Acid-Al moderately tolerant, gummy on control media
Jbr R61	Acid-Al slightly tolerant, acid producing, not gummy
Jbr GRT	Acid-Al intolerant, acid producing, not gummy
L 22AI	Acid-Al intolerant, acid producing,not gummy
L 9A2	Acid-Al intolerant, gummy
L 10A	Acid-Al intolerant, gummy

3. VIRUS DISEASE

Many kinds of virus diseases on soybean have occurred in Indonesia. Some of these diseases are seed-borne which are tranmitted by insects and they can be the limiting factors for soybean seed production. Diseased plants show various symptoms such as stunting, mottling, dwarfing, distortion, rugose, slimy leaf, yellowing, mosaic etc. usually depending on the nature of each virus.

Occurrence of virus diseases in Java and Sumatra during the past five years:

SSV (Soybean stunt virus)
SMV (Soybean mosaic virus)
ISDV (Indonesian soybean dwarf virus)
CMMV (Cowpea mild mottle virus)
SYMV (Soybean yellow mosaic virus)
PSV (Peanut stripe virus)
Unknown virus of severe blister symptom

Fig. 1. Soybean stunt virus

Establishment of virus detection method is very important to improve soybean seed quality. Enzyme-linked immuno-sorbent assay (ELISA) is rapid and highly sensitive method for the detection of seed-borne viruses, especially SSV in soybean.

Table 1. Detection of seed-borne virus by enzyme-linked immuno- sorbent assay (ELISA) and electron microscope (EM)

Soybean seed examined	Virus detected by			
	ELISA		EM	
	SSV[a)]	SMV[b)]	SSV	SMV
Seedlings from healthy like seeds	2/60[c)]	0/60	0/11	0/11
Seedlings from brown mottle seeds	10/60	0/60	3/9	0/9

a) SSV = soybean stunt virus
b) SMV = soybean mosaic virus
c) No. of infected seedlings/total plants

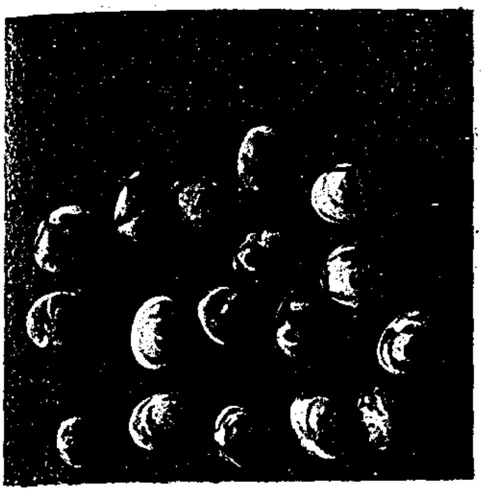


Fig. 2. Brown mottle symptom of soybean stunt virus

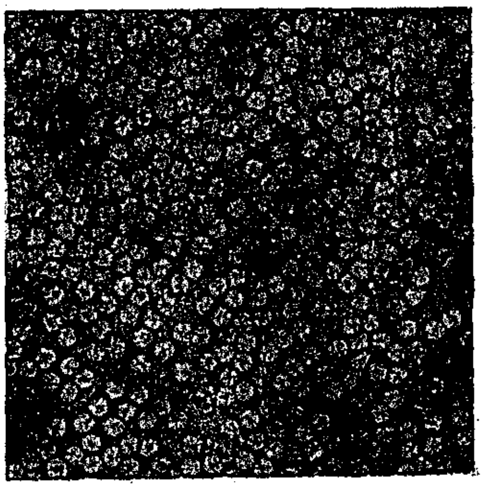


Fig.3. Isometric particles of soybean stunt virus with 27 nm in diameter

Indonesian soybean stunt virus is different from any Japanese SSV strains. There are some resistant soybean varieties to SSV in Indonesia.

Table 2. Reactions of differential soybean varieties to Japanese strains and Indonesian isolates of soybean stunt virus

Differential variety	Reaction to strains and isolates of SSV[a]						
	A	AE	B	C	D	13C	4-2A
Tokachinagaha	R	R	R	R	R	R	R
Ou No. 3	R	R	R	S	R	R	R
Harosoy	R	R	R	R	S	R	R
Nemashirazu	R	S	R	S	S	S	S
Kariutakiya No. 28	S	S	R	S	R	R	R
Norin No. 2	S	S	S	S	S(N)	S(N)	S(N)

a) Japanese isolates: A-D, Indonesian isolate: 13C and 4-2A
R = resistant; S = susceptible; (N) = necrosis symtom

Table 3. Appearance of brown mottled seeds and rate of virus seeds transmission from SSV- infected soybean plants

Variety	% of brown mottled		% of virus transmission	
	SSV 42A	SSV 13C	SSV 42A	SSV 13C
Davros	14	24	100	100
Lokon	82	67	50	86
Shakti	3	0	10	60
TK 5	100	0	50	11

- Plant Pathology Division -

Each variety of soybean has a proper harvesting time for optimum germination ability of seeds and maximum yield. When harvesting was carried out early (R_6 stage), the yield decreases approximately half.

Many Indonesian farmers do early harvest at R_6 or R_7 stage because they are afraid of yield loss due to rats, insects or other diseases. Analytical studies on bean filling process and germination ability of soybean seeds were conducted in division of agronomy at Seed Technology Laboratory which was donated by the Government of Japan, and at Cikeumeuh experimental farm of BORIF.

The soybeans were planted in February, 1990 at Cikeumeuh field. Three varieties planted for testing were Tambora, Kerinci and Tidar which have 100-seed weight and growth duration of 13-14 g and 85-87 days, 9.3 g and 87 days, 7.0 g and 75 days, respectively. The seeds were harvested with 5 days intervals started from 13-20 days after flowering until maturity as indicated in Fig. 1 - 3.

The stem growth was observed from 15 days after planting (DAP) and the maximum stem weight reached at 75 DAP in the case of Tidar. On the other hand, pod formation was started just after flowering and the beginning of bean formation could be observed at 10 days after flowering (52 days after planting). The seed weight became the maximum at 85 DAP (Tidar).

The mutual growth of vegetative and reproductives were from flowering time to 75 days after planting (42-47 days, Tidar). It is an important period for plant activity to high production.

The figures show the growth process of 100-bean weight of 20 plants, the germination ability and percentage of Tambora, Kerinci, and Tidar.

There were varietal differences in growth speed of 100-bean weight and period of rapid increase of bean weight. Tambora (big bean size) showed rapid growth and longer filling period (30 days), Tidar (small bean size) showed slow growth and shorter filling period (22 days) and Kerinci (medium bean size) showed medium growth speed and medium filling period (25 days).

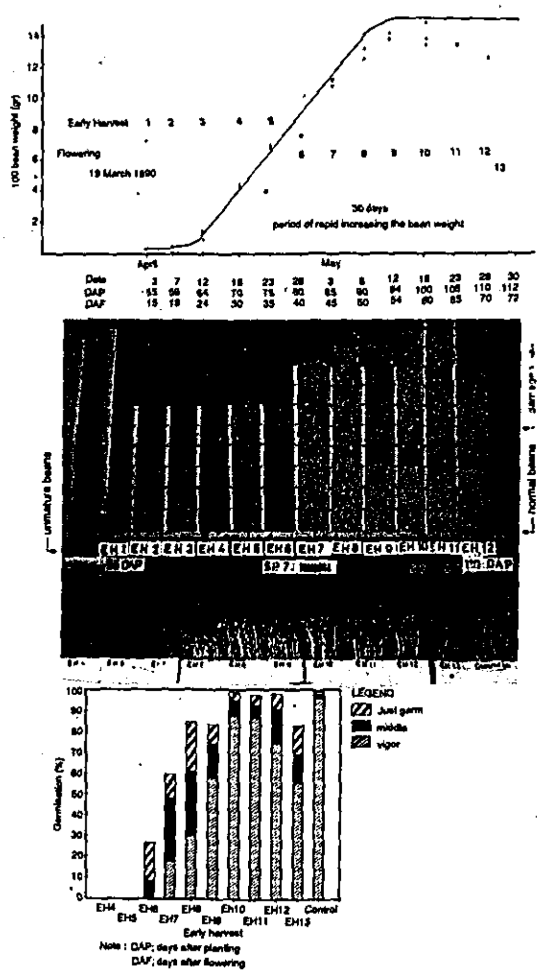


Fig. 1. The germinability at different harvest times on cultivar Tambora.

It is important to consider the relationships between the germinatiom ability and the bean size related to growth characteristic of bean. The maximum bean weights of early harvest (EH) were No. 9 for Tambora, No. 6 for Kerinci and No. 7 for Tidar and high germination ability were EH. 10 for Tambora, EH. 7 for Kerinci and EH. 8 for Tidar.

It was found that the seeds obtained from harvesting at 5 days after from the time of maximum 100 - bean weight showed that 2/3 of total pods at the plant has been changed to brown color at that time and was the best time to harvest for high yield and germination ability.

During the period of experimentation, the precipitation in the rainy season was so high that a lot of beans were damaged by insects and diseases and the damage further increased by late harvest. Therefore, the harvesting time is very important and crops could be avoided from damage by insects and diseases at ripening period using early maturity cultivar.

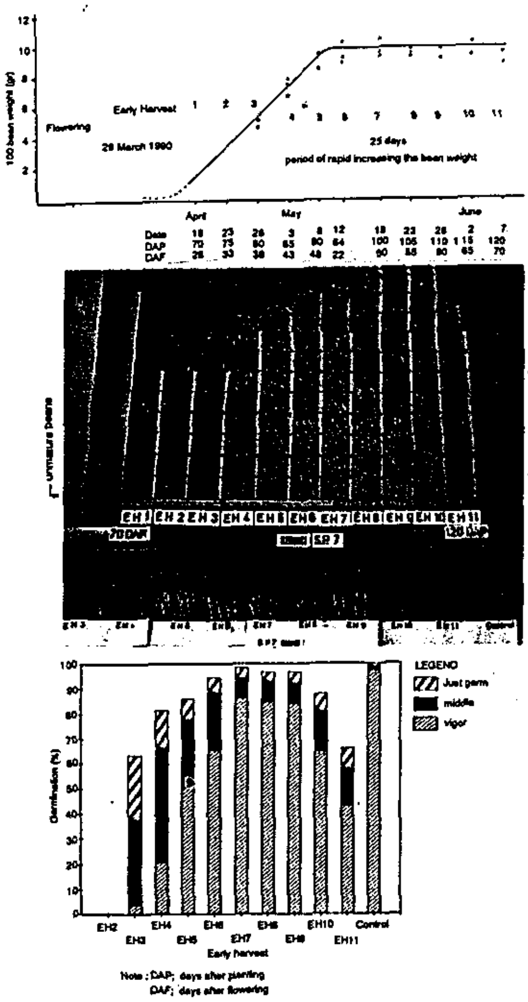


Fig. 2. The germinability at different harvesting times on cultivar Kerinci.

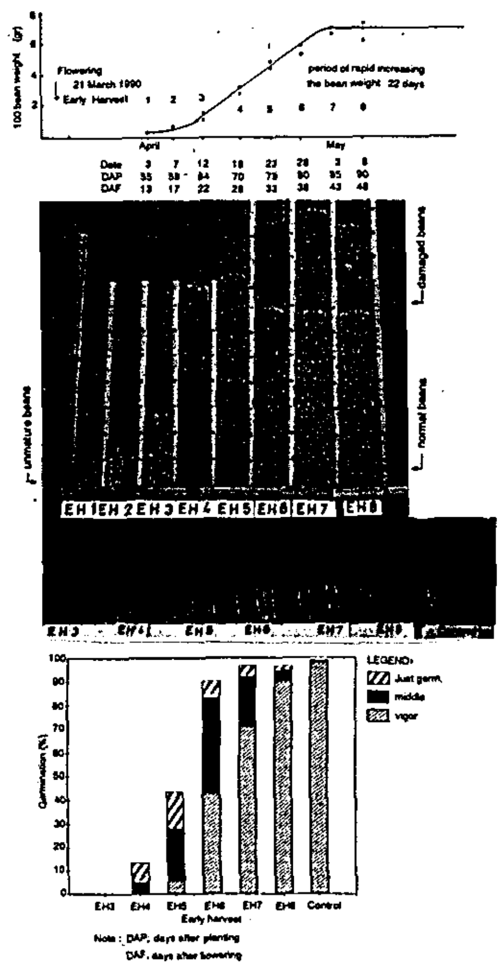


Fig. 3. The germinability at different harvesting times on cultivar Tidar.

- Agronomy Division -

The beanfly *O. phaseoli* is a major insect pest of soybean. The damage caused by this insect appears as a destruction of the plant tissues under the epidermis at the junction of the stem and root, when the soybean growing stage is still young, during one or two weeks after sowing. The soybean plants infested by the insect wilt and finally die.

Studies on the varietal resistance of soybean, field screening tests and some experiments on the mechanism of the resistance were conducted several times repeatedly.

Resistant varieties: Our results showed th some varieties such as Kerinci, No. 29 and som breeding lines were resistant. Variety Orba and Wili were susceptible.

Mechanism of resistance: The number of eggs oviposited on soybean resistant varieties No. 29, MLG 2675 and MLG 2511 was not a few, but the larval mortality in these varieties was higher than susceptible ones. The mechanism may be antibiosis which is inherent in the resistant varieties.

Fig. 1. Field screening test on the beanfly

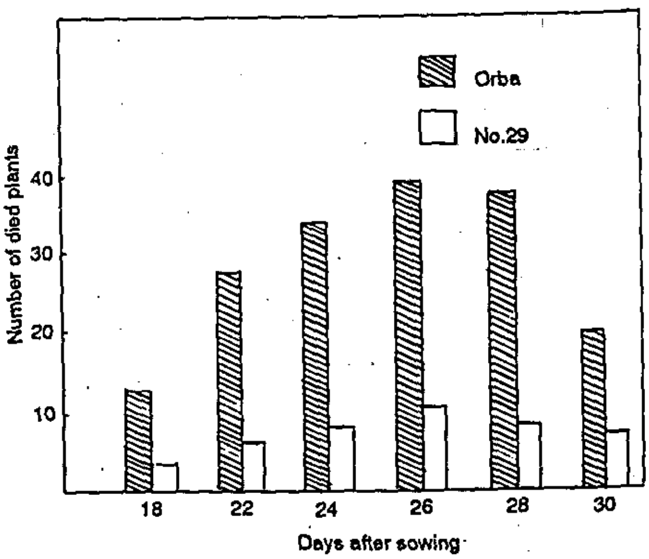


Fig. 2. A comparison of the amount of soybean damage caused by the beanflies, between susceptible variety Orba and resistant variety No. 29.

Fig. 3. Damage caused by the beanfly.

Table 1. Varietal differences of the dead plants infested by the beanflies, Cikeumeuh experiment farm, Bogor, March 1990

No.	Varieties lines	No. of plant dead/plot	%	No.	Varieties lines	No. of plant deat/plot	%
1*	MLG 2505	29.0	18.9	13	Lamp/1248-4-4	11.7	34.7
2*	MLG 2690	31.0	21.0	14	MLG 2799	15.0	35.4
3*	MLG 2675	25.0	23.9	15	1315	25.7	35.7
4*	MLG 2524	38.0	24.9	16	MLG 2812	24.0	36.2
5*	Kerinci	15.7	26.1	17	MLG 2511	17.7	37.8
6	2677	22.0	28.5	18	630/1343-4-1	18.7	42.1
7	Wilis	13.0	29.2	19	MLG 2803	17.3	42.6
8	MLG 2791	34.7	30.5	20	Lok/29-I-10	10.3	45.1
9	Gunt/29-3-1	14.0	30.8	21	Lumajang Bewok	11.7	47.9
10	MLG 2800	11.3	33.6	22	MLG 2514	22.0	51.6
11	MLG 2521	22.0	33.6	23	Rinjani	5.0	52.8
12	MLG 2689	21.3	33.8	24	Petek	13.0	72.7

* Lower damage was also observed in the previous experiments

- Entomology Division -

Soybean (var. Wilis) was grown in Cimanggu field (Latosol, pH 5.2) (Table 1) in July 1990, and effect of lime, triplesuperphosphate, fused magnesium phosphate and fused magnesium phosphate with boron and manganese on its growth was examined under standard nitrogen (N: 25 kg/ha) and potassium (K_2O: 30 kg/ha)) application. The treatments are shown in Table 2. Ten times phosphorous application (FMP.600 and BM-FMP .600) of standard increased soil pH compared to Non-P and two kinds of standard phosphorous treatment (TSP and FMP), although, those values are still lower than three kinds of lime treatment (L, L + TSP and L + FMP .600) (Fig. 1). Fresh nodule weights of the plants in Non P, FMP, FMP .600 and L + FMP 600 were obtained at 37 days after planting (Table 2). Comparing the values in Non P and in FMP, phosphorous application did not increase nodule weight. On the other hand, the weight augmented as increase in soil pH. It was observed that the plant leaves were greener in higher pH plots. It was suggested that the nitrogen was suppied to the plants more at higher soil pH because of enxhanced nodulation, so that leaf area index (LAI) increased as increase of the pH resulted in a higher yield. Soil pH dominated the growth more than phosphorous did at this field (Table 2), and it was more obvious in early stage. As far as soil PH increased sufficiently enough, standard amount of phosphorous fertilization resulted in satisfactory yield. In this trial, the highest yield was obtained in BM-FMP treatment, although its soil pH was lower than in three kinds of lime treatment. Soluble manganese was sufficient (Table 1); but boron has not determined. Boron contained in BM-FMP might have enhanced the plant growth.

Table 1. Chemical characteristics of Cimanggu soil

pH (H_2O)	pH (KCl)	Brayll-P (ppm)	Olsen-P (ppm)	CEC	Base sat.%	Ex. cation (me/100g) Ca	Mg	K	Sol. Mn (ppm)
5.2	4.3	5.0	2.7	20.3	26.9	3.2	1.6	0.4	40.9

Phosphorous in fertilizers is easily fixed by the soil, although the solubility of fused magnesium phosphate is lower than that of the triplesuperphosphate. Consequently, the effect of fused magnesium phosphate lasts longer. It is necessary to examine how long large amount of two kinds of fused magnesium phosphate can keep soil pH high and can keep supplying phosphorous. The residual effects are going to be considered from an economic point of view, comparing with the ordinary treatment (L + TSP).

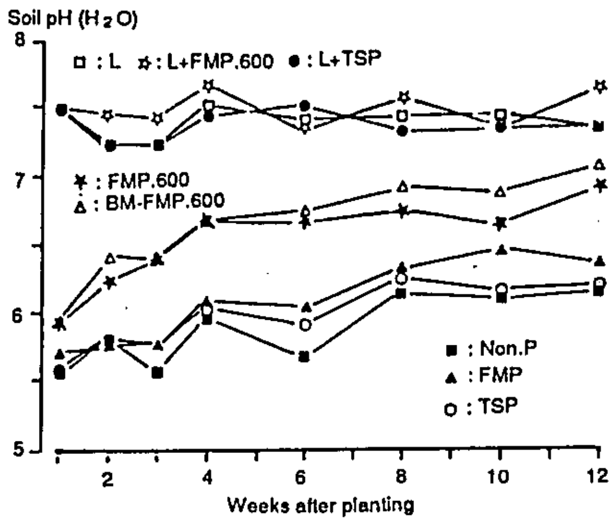


Fig. 1. Change of soil pH induced by lime and/or phosphorous fertilizers during crop growth

Table 2. Soybean yield treated by lime and/or phosphorous fertilizers, and factors having affected the yield

Treatment*	Applied amount		Fresh nodule wt. (37DAP**)	LAI*** (42DAP)		Yield	
	P_2O_5 (kg/ha)	Lime (t/ha)	(g/2plants)	LAI	Relative value****	t/ha	Relative value
Non P	0	0	2.68	2.67	62	1.21	53
TSP	60	0	-	2.79	65	1.53	68
FMP	60	0	2.28	2.86	67	1.50	67
FMP.600	600	0	4.48	4.13	96	1.87	83
BM-FM.600	600	0	-	4.19	98	2.48	110
L	0	5	-	3.69	86	1.43	63
L+TSP	60	5	-	4.29	100	2.26	100
L+FMP.600	600	5	4.63	4.44	103	2.46	109

* TSP;triplesuperphosphate, FMP;fused magnesium phosphate, BM-FMP; fused magnesium phosphate with boron and manganese, L; Lime

** Days after planting

*** Leaf area index

**** Relative values are calculated assuming that a value in L+TSP treatment is 100%.

- Plant Physiology Division -

Soybean roots are attacked by many kinds of soil-borne root infecting fungi during all growing seasons throughout the country. Their symptoms show damping-off at young growth stage and root rot or foot rot, with sometimes wilting or yellowing of foliage, at middle and old stage.

Pathogen

1. Damping-off :
   - *Phythium aphanidermatum*
   - *Phythium* sp.
   - *Sclerotium rolfsii*
   - *Rhizoctonia solani* (AG-4, -7)
   - Binucleate *Rhizoctonia*
2. Root rot or foot rot :
   - *Rhizoctonia solani*
   - *Fusarium solani*
   - *Cylindrocladium floridanum*

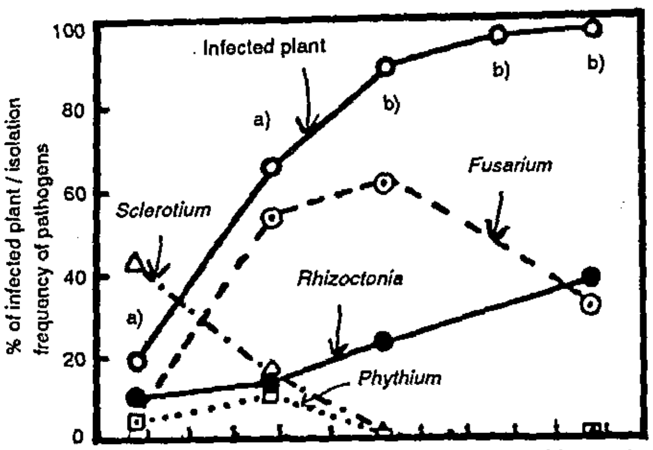


Fig. 1. Seasonal changes of damping-off (a), root rot (b) diseases, and their pathogens in soybean continuous cropping field at Citayam branch of BORIF. Sowing time of soybean: 28 June 1989

Damping-off disease of soybean occasion ly has resulted in severe missing plants at young gro th stage.

Fig. 2. Pre-emergence damping-off

Fig. 3 Post-emergence damping-off

In Java, many plants at middle or old stage usually have been attacked by root rot or foot rot disease chronically, even if their foliages look like health at a glance. In North Aceh, however, healthy plants have grown with no discoloration of roots, except stem rot caused by *Sclerotium rolfsii.*

Fig. 4. Root rot symptom in Java

Fig. 5. Healthy roots grown in North Aceh

Root rot or foot rot diseases can be an important factor for soybean seed production. Our survey data indicate that the rate of infected plants and disease severity in Java island are usually up to 60% and 1, respectively. Yield losses of soybean seed due to light, moderate and severe infection are 1/4, 1/2 and 3/4 in comparison with helathy plants, respectively.

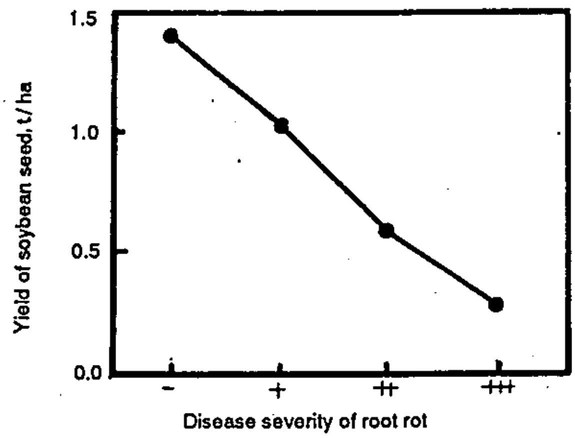


Fig. 6. Yield loss of soybean seeds due to chronical root rot or foot rot diseases. Disease severity 0(-) : health, 1(+) : light, 2(++) : moderate, 3(+++) : severe

- Plant Pathology Division -

Soybean is widely grown in Indonesia at present. However, only limited farmers can produce reasonable high yields, more than 1.5 t/ha. It is true that most of farmers could get less than 1.2 t/ha regettably. One of the main reasons is inadequate plant stands with uneven growth and irregular plant spacings.

High temperature and high relative humidity under tropical conditions seem to thrive conditions that are detrimental to soybean seeds. Under these conditions, soybean seeds deteriorate rapidly and their seed germinability is commonly lost within 4 to 5 months after harvesting. Even now, the certified seeds could contribute to only 10% of the total seed required.

At laboratory for seed technology which was donated by Goverment of Japan, agronomy division of BORIF under JICA project conducted basic studies on seed germinability related to moisture content in the bean by different temperature (20^{0}C, 23^{0}C and 30^{0}C), and have found out the key points to maintain high germinability which are easily done by farmers.

The seed used was cultivar Tidar harvested in early 1989. The seeds were mostly separated into different moisture content under air tight condition. The germination tests were done at 6, 9, 12, 15, 18 and 21 months after harvest. The results of the germinability tests, the moisture content in the bean 21 months after harvest were shown in Fig. 1-2. Seeds with the moisture content in the bean of less than 10% were germinated vigorously, while the others with moisture content more than 11% did not emerge or they emerged with poor vigor.

Fig. 3 shows the relationships between per centage germination and moisture content in the bean at different temperature of storage. At 20^{0}C of incubator storage condition, the germinatio percentage was not affected by moisture content in the bean. At 23^{0}C of dark room storage condition and at the 30^{0}C of incubator condition, seed germinability was strongly affected by the moisture content in the bean. However, seed with moisture content of 7 to 8% could keep high germinability even after 21 months of storage.

Normally, seed moisture content can be kept at 11 to 13% depending on the atmospheric temperature and the relative humidity of the environment. In the other studies, it was observed that soybean deeds can be dried to 6% moisture content easily by exposing the seeds to sunshine with more 100,000 lux for 10 hours. When the seeds are then put under ambient air, the moisture content of seeds increased to reach an equlibrium moisture content at the open air. Therefore, the seeds should be kept under the sealed conditions, or otherwise the seed moisture content increases to 11% in a night.

The study on the germinability of soybean seeds after taking out from a cold storage indicated that good germinability can be kept after putting the seeds under expose at open air for 10 weeks.

From these studies, it is recommended to the farmers that for maintaining high quality seeds, simple steps of observations and the treatments are needed. They are: (1) to select the seeds free from mechanical damage and/or insects and diseases damage, (2) to put sundrying the seeds to less than 7% moisture content, (3) to put the seeds in air tight container or air tight plastic bag and (4) to keep the seeds under relatively cool place at the farmer's house.

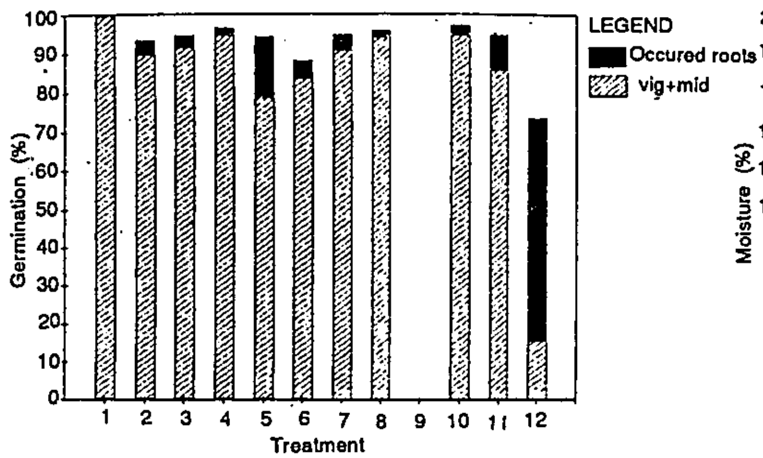


Fig. 1. Germinability of cultivar Tidar stored at different temperatures and moisture contents of beans 21 months after harvesting.

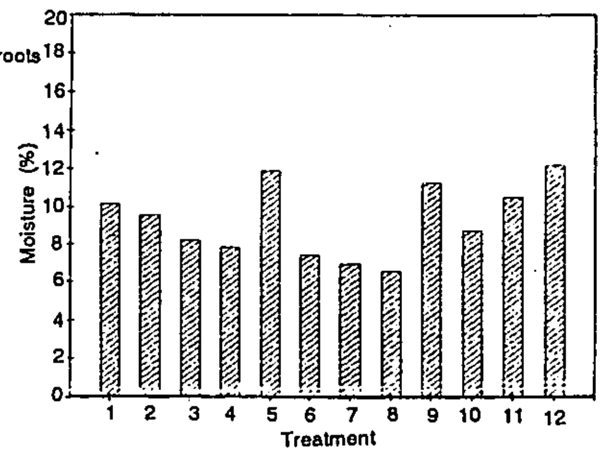


Fig. 2. Moisture contents in the bean during the period of storage.

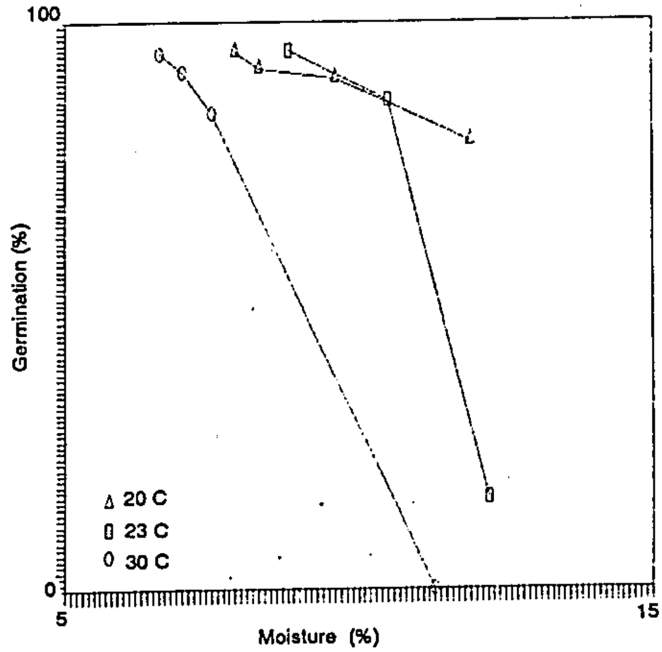


Fig. 3. Relationship between the germinability and moisture content in the bean.

- Agronomy Division -

Sucking bugs are the potentially important pests of soybean which attack the seeds by sucking and not only yield loss but also degrading seed quality and its germination ability. However, these insects are not so easily controlled by chemicals.

We tried to control the bugs by trap crops for finding practical alternative control method instead of the chemical control or to decrease chemical application in the soybean field.

Firstly, several possible trap crops were tested for finding a suitable plant. Among them, *Sesbania rostrata* was chosen as a good one, then it was cultivated surrounding soybean field at Muara experimental farm, Bogor. Approximately one hectare area was used for the experiment, and trap crop plot and control plot (soybean only) were arranged in three replications.

Fig. 1. *Nezara viridula* on the trap crop *sesbania rostrata.*

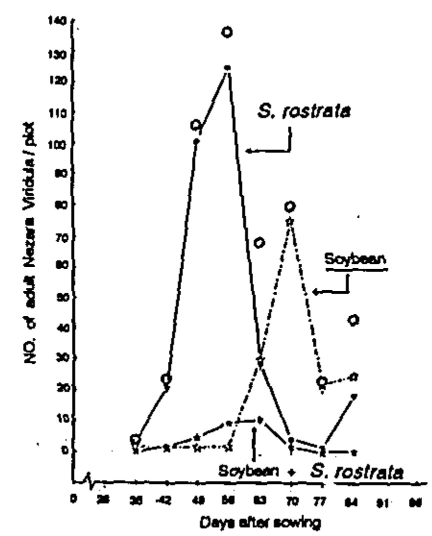


Fig. 2. Population fluctuation of *Nezara viridula* on soybean with and without trapping crop, *Sesbania rostrata*

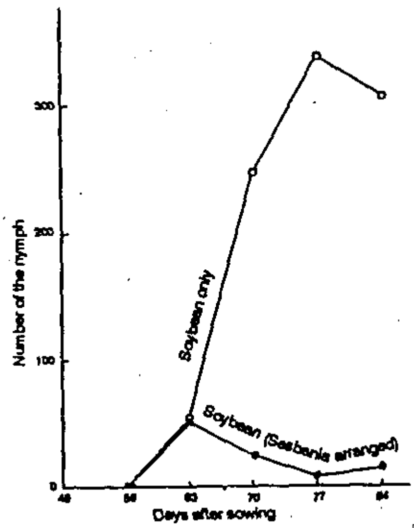


Fig. 3. Pupulation of the *N. viridula* nymph in the soybean arranged trap crop and not arranged (soybean only) plot.

ffect of trap crop:

1. Southern green stink bug *Nezara viridula* L. was attractively trapped by *Sesbania* after flowering
2. Effective period for the bugs on the *Sesbania* was longer than that of soybean
3. The number of the damage seeds was decreased about 1/3 level in the plot with trap crop arranged, compared with no trap crop arranged (soybean only).

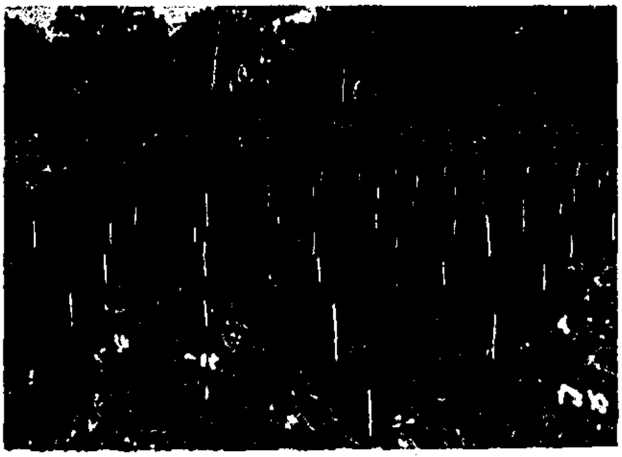


Fig. 4. Field experiment ot trap crop.

Table 1. Amount of damaged soybean seeds caused by sucking bugs in the no trap crop plot and the trap crop arranged plot

Plot	No.of hilis surveyed	No.of seeds surveyed	Damaged seeds	%
No Trap crop	18	4460.7	1903.7	42.7
Trap crop	18	3166.3	552.7	17.5

Muara experimental field, Bogor
Survey: June 1990

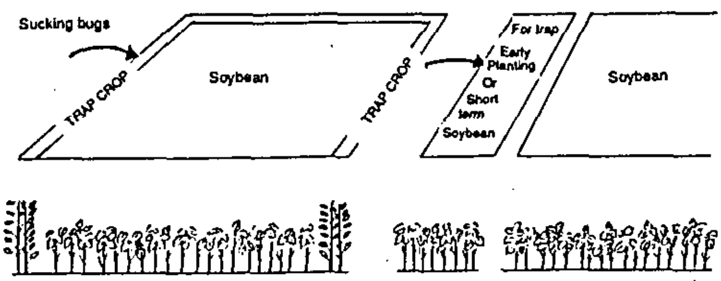


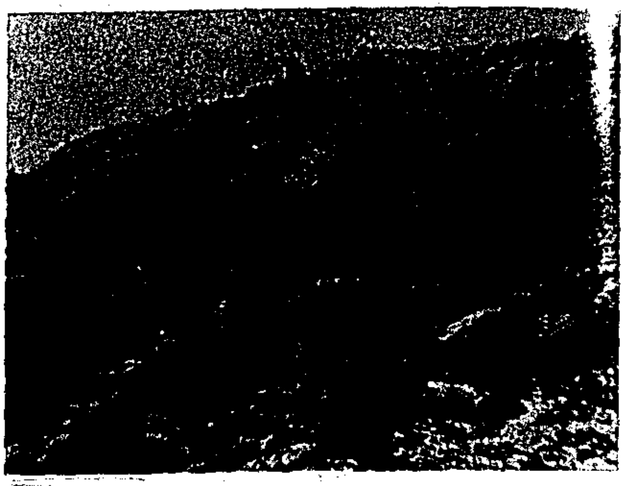
Fig. 5. Schematic figure of trap crops arranged in soybean field
1) To protect sucking bugs invading soybean field from surrounding areas
2) Sucking bugs trapped on the trap the crops can easily be controlled by the chemicals.

- Entomology Division -

Life of soybean seeds is closely related to moisture content of seeds, temperature and humidity at storage (Table 1). Three kinds of soybean seeds (Lokon, Kerinci and Galunggung) were prepared with the same pre- and postharvest handling, and their moisture contents were adjusted to 9.6%. Half of each variety was stored in a natural limestone cave (Ciampea, Bogor, West Java) (Fig. 1), and the rest in a store house (Cimanggu, Bogor, West Java), packed in nylon bags, respectively. During storage, the average temperature in the cave was 23.2^{0}C at 93.2% relative humidity, and in the store room 28.4^{0}C at 91.2% realtive humidity.

Table 1. Germination rations after eleven months storage at different temperature

Soybean variety	Germination ratio (%)	
	22.3^{0}C	24.3^{0}C
Galunggung	92.5	84.0
Lokon	95.5	94.5
Kerinci	95.0	92.0



(a)

(b)

Fig. 1. (a) A limestone cave in a mountain slope.
(b) Entrance of the cave used for the storage trial.

All the varieties stored in the cave were kept over 80% of germination ratio after eleven months. On the other hand, the ratios of Lokon and Kerinci kept in the store room decreased to 65.9 and 66.5%, respectively, after four months, and that of Galunggung 55.7% after seven months. At the time of viability check, all the varieties kept in the cave had higher moisture content than those in the store room (Table 2). The results showed that a natural cave can be an economical and efficient way to store soybean seeds bacause of its low temperature.

Table 2. Moisture content after four to eleven months storage at a limestone cave and a store room

Soybean variety	Place stored	
	cave	store room
	M.C.(%)	
Galunggung	10.4	10.0
Lokon	10.5	10.0
Kerinci	10.6	10.3

- Plant Physiology Division -

11. FUNGAL FOLIAR DISEASE

Many kinds of fungal foliar diseases have occurred in Indonesia. Some of them were caused by seed-borne fungi. Rhizoctonia pod rot and frogeye leaf spot were newly found in this country.

Anthracnose of soybean is a seed-borne disease and widely spread throughout the country. The disease usually occurs severely on pod, stem and leaf at later stage of the plant under high humid conditions. There were some differences in pathogenicity among the isolates of *Colletotrichum dematium.*

Fig. 1. Anthracnose caused by *Colletotrichum dematium*

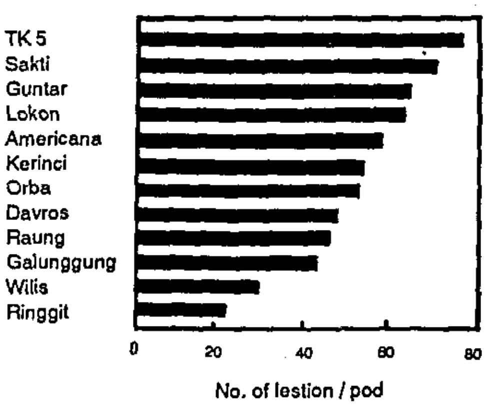


Fig. 2. Varietal reactions to Anthracnose

Frogeye leaf spot was found in Lampung 1988. Pathogen was identified as *Cercospora sojir* . The disease occurs severely on pod, leaf and ste under high humid conditions.

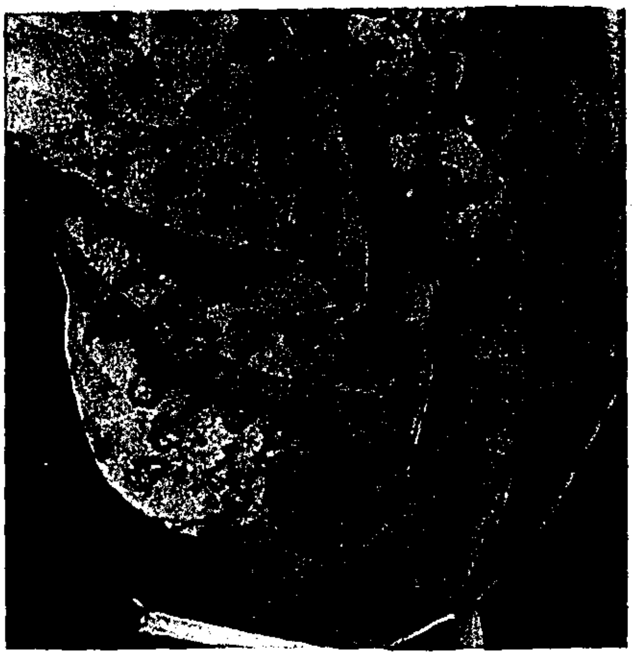


Fig. 3. Frogeye leaf spot

Symptom:

On leaf: 1-2 mm in diameter, gradually changed to 2-5 mm pale brown to grayish brown spot lesion. Second leaf from the top is the most susceptible with many lesions.

On pod: Dark grayish brown, concaved spot lesion with 3-5 mm in size.

Direct damage on pods occurs severely at growth stage R_6 (before pod turns to brown in color).

On stem: Dark grayish brown, concaved lesion, 3-8 mm in length.

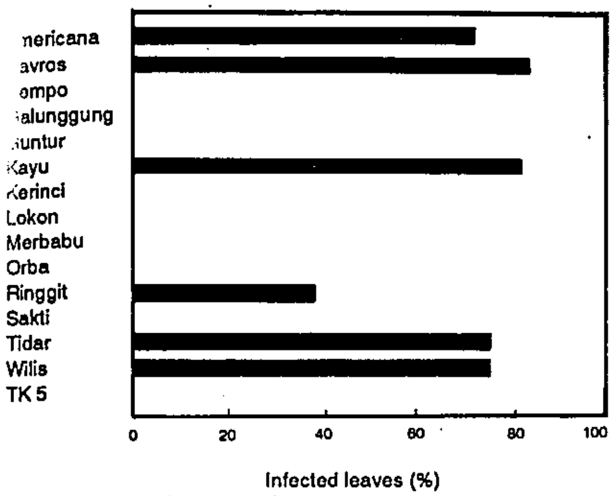


Fig. 4. Varietal reactions of soybean to frogeye leaf spot

Rhizoctonia pod rot disease of soybean was first found in Lampung in the rainy season, 1986/1987. The pathogen was identical to *Rhizoctonia solani* anastomosis group AG-1 of culture type IA. The disease occurred severely under high humid conditi - ons and occasionally caused crop failture in farmer's fields.

Symtom:

Pale grayish brown to deep brown, irregular-shaped lesion on pod, leaf, petiole, stem and flower.

White, cottony mycelium grows over the infected parts of the plant in spreading phase of disease.

Grayish white to dark brown sclerotia sometimes develops on the lesion and the healthy tissue around it.

Fig. 5. Rhizoctonia pod rot

Table 1. Chemical control of Rhizoctonia pod rot in a field (Jabung, Lampung province)

Chemical[a]		Dosage (dilution)	% of diseases plants
Mepronil	(75%)	1:2,000	4.2
Benomyl	(50%)	1:2,000	6.1
Fultroanil	(25%)	1:2,000	2.7
Iprodione	(50%)	1:2,000	6.1
Validamycin	(3%)	1:2,000	7.1
Control		-	49.5

a) 750 liter/ha of each chemical was sprayed two times

- Plant Pathology Division -

Ridging-up is a common practice for the soybean cultivation in the temperature region. In Indonesia, however, soybean cultivation is used to dense population and the growth of soybean is not so vigorous and therefore the farmers apply rarely this practice. The research results on reddish brown latosol at Citayam and on brown latosol at Muara experimental farm of Bogor Research Institute for Food Crops showed that ridging-up cultivation increased soybean yields significantly in 4 out of 5 trials.

Ridging-up along the soybean rows was done by fully covering the soybean stem up to above the unifoliate leaf node (Fig. 1 and 4) at 15 to 21 days after sowing which was concomitantly with the time of first weeding. Land preparation was well done properly. The yield increase obtained from ridging-up ranged from 5 to 60% (Fig. 2 and 3).

The benefits of ridging-up to soybean plant :

- Develope new roots at the ridging-up parts of the stem (Fig. 8)
- Increase the growth of roots, nodules and top of the plant
- Suppress weed growth
- Conserve soil moisture
- Increase plant support and decrease plant lodging (Fig. 5 and 6)
- Increase soybean yield (Fig. 7)

The Limitations in low-land areas for soybean grown after rice harvest are often without soil tillage. In such conditions where the soil textures are heavy, ridging-up practice is rather difficult due to relatively big size of soil clods and degrated structure after puddling low-land rice. Therefore, further considerations are needed for the benefits of ridging-up to soybean yields that it may depend on the soil texture or soil types where the soybean are grown. Some soil-borne diseases were developed after ridging-up of the soil to the hills, so that disease control should be done at the field.

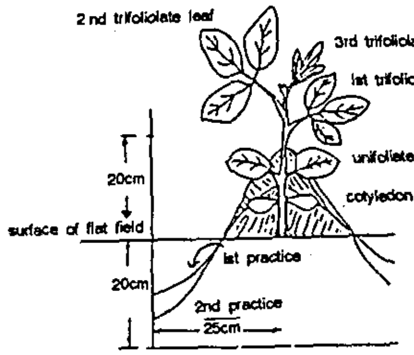


Fig. 1. Practice of ridging-up cultivation.

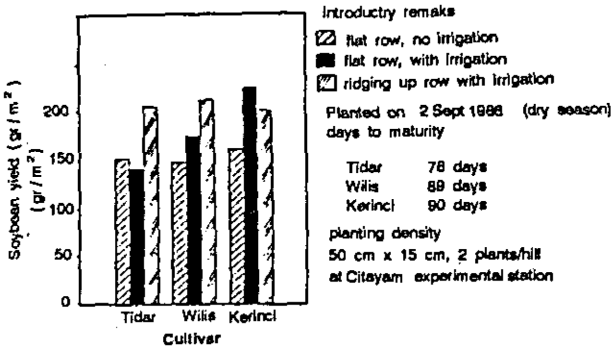


Fig. 2. Effect of ridging-up cultivation and irrigation.

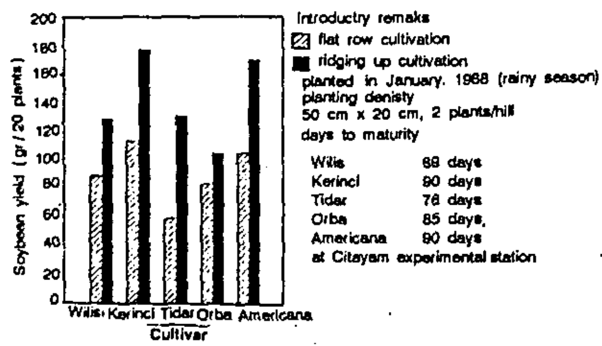


Fig. 3. Varietal differences on the effect of ridging-up cultivation.

Upper half : ridging-up

Lower half : flat

Fig. 4. Cultivation at Muara experimental station

Fig. 5. Tidar cultivar at Muara experimental station

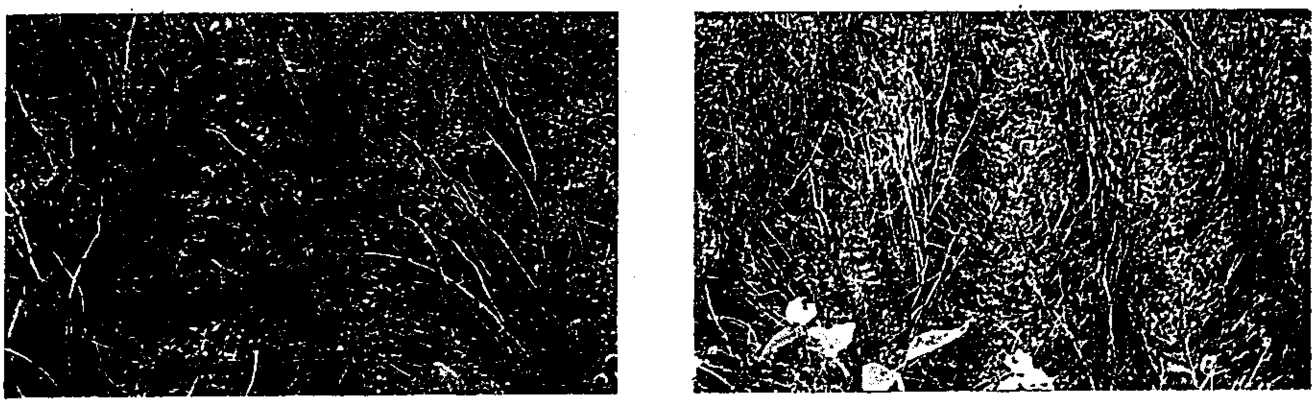


Fig. 6. Effect of ridging-up on the lodging of plants.

flat ridging up

Tidar cultivar at Muara experimental station

50 x 20 cm, 2 plant/hill 28 Sept 1989

Fig. 7. Effect of ridging-up on the top growth.

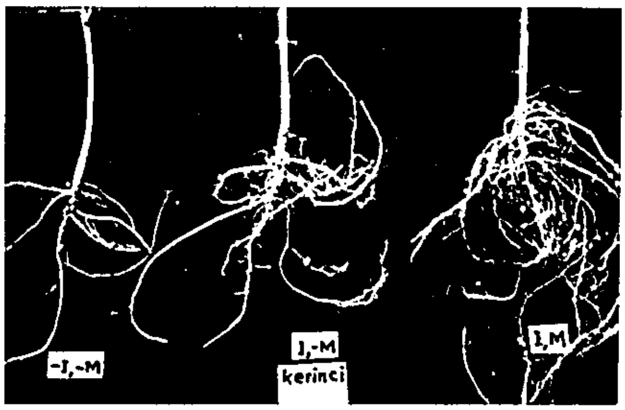


Fig. 8. Effect of ridging-up on the root development.

Note: M: ridging-up -M: no ridging-up

I: irrigation -I: no irrigation

- Agronomy Division -

Contents by Divisions

ERRATA

PAGE	LINE (Right/Left)	ERROR	CORRECTION
3	Fig. 1(b) external left	NoIo	NoIo
5	3 (L)	tranmitted	transmitted
11	5 (R)	enxhanced	enhanced
20	9 (L)	The results showed that a natural cave	The results showed that utilization of a natural cave ....
23	2 (L)	temperature	temperate
	33 (L)	degrated	degraded
24	Fig. 6		
	the photo in the left		without ridging-up
	the photo in the right		with ridging-up

JICA

JICA ATA-378 Project
c/o. Central Research Institute for Food Crops
Jalan Merdeka no. 147, Bogor 16111

Bogor Research Institute for Food Crops (BORIF)
Jalan Tentara Pelajar no. 3A, Bogor 16002

Japan International Cooperation Agency (JICA)
Indonesia Office,
Jalan M.H. Thamrin no. 59, Jakarta Pusat