PART II

BREEDING

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INTRODUCTION AND COLLECTION OF BREEDING MATERIALS

Preface

In April 1971, breeding experiments were first started. Breeding materials in Thailand and from foreign countries and the seeds used in the experiment were obtained from various sources, such as the Institute of Agricultural Science, Ministry of Agriculture and Forestry; some other Agricultural Experiment Stations in Japan; the Mae Jo Agriculture Experiment Station and the Kalasin Seed Multiplication Station in Thailand; and some countries where Japanese experts were resident.

Cooperations was extended by various institutions in defferent locations until December 1971. A total of about 1,500 materials of soybean seeds, including some overlapping ones, was obtained. We would like here to express our deep thanks for the cooperation extended by these various institutions and people concerned.

Each variety collected has been tested once or twice. However, the seeds obtained from planting were first stored in temporary storage at Mae Jo Agriculture Experiment Station since April 1971 then were transferred to the new grain storage in February 1972. The following are the scale of the temporary storage and the new one.

Temporary seed preserved - storage:	9.8m^2 area and 2.65m. High with air-conditioners. The temperature is kept at about 18°C while relative humidity is about 70%.
New seed preserved - storage :	There are 3 big rooms with an area of 55m^2, 25m^2 and 15m, respectively; each is 2.65 m high and all are air-conditioned. The temperature is kept at 18° C while relative humidity is about 70%.

Overlapping identical varieties together with varieties of different names but presumably the same and other different varieties were found among the introduced varieties. The adjustment and correction of names have not yet been carried out due to shortage of time.

Table - 1 shows the source and number of introduced and collected materials.

Table - 1 The List of Introduction

Time	Source	Number of materials	Plot No. in the rainy season of 1970	Plot No. in the dry or rainy season of 1971
May 1970	Institute of Agricultural Sceicne, Hiratsuka, Japan	194	1 - 194	1073 - 1234
May 1970	Institute of Agricultural Science, Kitamoto, Japan	22	195 - 216	1235 - 1235
May 1970	Tohoku National Agricultural Experiment Station, Japan	7	217 - 220	1254 - 1257
May 1970	Kyushu National Agricultural Experiment Station, Japan	7	221 - 226	1258 - 1263
May 1970	Nagano Agricultural Experiment Station, Japan	7	227 - 232	1264 - 1268
May 1970	Tokachi Agricultural Experiment Station, Hokkaido, Japan	15	233 - 246	1269 - 1283
June 1970	Mae Jo Agricultural Experiment Station and Kalasin Seed Multiplication Station, Thailand	116	247 - 362	1283 - 1357
September 1970	Kathmandu, Nepal	8	-	1016 - 1023
October 1970	Para, Brazil	3	-	1024 - 1026
October 1970	San Juan Agricultural Experiment Station, Bolivia	3	-	1027 - 1029
October 1970	Comilla E. Pakistan	2	-	1030 - 1031
October 1970	The College of Agriculture Taiwan Chung Hsing University Taichung, Taiwan	3	-	1032 - 1034
November 1970	Peru	1	-	1035

Time	Source	Number of materials	Plot No. in the rainy season of 1970	Plot No. in the dry or rainy season of 1971
November 1970	Paro, Bhutan	2	-	1036 - 1037
November 1970	Secretaria da Agricul-ture, Instituto Agrono-mico, Divisao de Agromia, Seccao de Legumnosas, Camdinas-Esi, San Paulo	19	-	1038 - 1056
November 1970	National Agricultural Experiment Station, Mexico	8	-	1057 - 1064
December 1970	Department of Agronomy, Agricultural Center, - Louisiana State Univer-sity, U. S. A.	6	-	1067 - 1072
December 1970	Institute of Agricultural Science, Hiratsuka, Ja-pan	866	-	1 - 866
December 1970	Tokachi Agricutural Experiment Station and Central Agricultural Experiment Station, Hokkadio, Japan	93	-	867 - 957 1065 - 1066
December 1970	Tohoku National Agricul-tural Experiment Station, Japan	58	-	958 - 1015
December 1970	Mae Jo Agricultural Experiment Station and Kalasin Seed Multiplica-tion Station, Thailand	23	-	1358 - 1359
December 1970	Indonesia	10	-	1360 - 1369
December 1970	Philippine	4	-	1370 - 1373
January 1971	Indonesia	2	-	1494 - 1495
January 1971	Department of Primary Industries, Brisbane, Australia	1	-	1433
March 1971	Nagano Agricultural Ex-periment Station, Japan	24	-	1395 - 1418

Time	Source	Number of materials	Plot No.in the rainy season of 1970	Plot No.in the dry or rainy season of 1971
March 1971	-	7	-	1419 - 1425
March 1971	Chanderer seed Farm, Mararashutra Station, India	3	-	1426 - 1428
June 1971	The N. I. Vavilov All-union Institute of Plant Industry, Leningrad, U. S. S. R.	10	-	1429 - 1438
June 1971	Department of Horicul-ture, University of Hawaii	1	-	1439
November 1971	Department of Agricul-ture, Ryukyu University, Okinawa	52	-	1440 - 1491*
February 1971	Mae Hongsong, Thailand	1	-	1492*
December 1971	Philippine	6	-	1496 - 1501*

* Planted in the dry season of 1972.

SELECTION OF INTRODUCED VARIETIES

Introduction

The experiment for the selection of introduced varieties was basically carried out in 3 steps as follows:

1. The experiment for the selection of introduced varieties (first and second season after the introduction). This was conducted at Mae Jo Agricultural Experiment Station, using one variety for each row, 1 plot = 2.0 m^2.

2. Preliminary performance tests of introduced varieties which were carried out at one or two more places besides Mae Jo Agricultural Experiment Station, 1 plot = 6.0 m^2. There were 2 replications.

3. Performance tests of introduced varieties which were carried out at Mae Jo Agricultural Experiment Station and several other places, 1 plot = 12 m^2. There were 4 replications.

Varieties selected from the first step were used in the second step of the experiment. Similarly, varieties selected from the second step were used in the third step. However, a portion of the seeds used had been continuously selected by the Thai researchers before the dry season of 1971 and those showing good prospect were used in the third step of the experiment in the rainy season of 1971. Part of the introduced varieties passed the selection in the first step in the rainy season and again in the dry season. However, most of them were selected in the dry season only and these are scheduled for testing in the rainy season of 1972. The first selection was done by observing the plants in the field during their growth but it was not quite perfect. There should be at least 2 - 3 repetitions so as to make a perfect selection.

Most of the introduced varieties had early maturity and short plant height. They would therefore be unsuitable in practice. However, varieties introduced from some countries in the same latitude as Thai showed good growth. It could be estimated from common sense that varieties showing early gorth and having short stems in the rainy season are not suitable for planting in the dry season. Likewise, varieties with late maturity and thick growth in the dry season are not suitable for planting in the rainy season. On the other hand, some of the varieties which grow too thick in the rainy season do well in the dry seaon, and some of the varieties having short stems in the dry season grow well in the rainy season.

A. Experiment for the Selection of Introduced Varieties (first season after the introduction)

Materials and Methods

(1) Place and Planting Season

Mae Jo Agricultural Experiment Station
Rainy Season 1970

(2) Materials

246 varieties contributed by the Soybean Research Institutions of Japan and 116 introduced and Thai varieties preserved in Thailand, making a total of 362 varieties.

(3) Cultivation Method

Planting date: 14th July
Density of plants: 50cm x 20cm, 1 plant per hill
Volume of fertilizer (kg/rai): applied 2 weeks after planting (27th July) using 3 kg/rai of P_2O_5 and 12kg/rai of K_2O.

Experimental Results and Discussion

Heavy rain just after planting and the left-over of old seeds resulted in poor germination. Hence, replanting of soybean seeds was carried out on the 19th and 20th of July while some varieties whose seeds were sent from Bangkok were planted on the 26th of July. However, many of varieties did not have enough plants. In the early stage there were attacks by leaf hopper followed by leaf roller and aphid during the middle of growth. Still, the use of insecticides Endren 1% for leaf hopper (22nd July), Malathion 0.5% for leaf roller (28th August) and aphid (4th September) was very effective. In the late stages of the growth, the symptom of rust disease was evident but caused no damage to plants. As a result of late planting and low soil fertility, the extent of growth during the last stage was not large.

Generally it could be summed up that the Japanese varieties grew well in the early stage but they had too early maturity and too short plant height and showed serious shattering. However, these varieties had strong stalks and good quality of the seeds. In particular, their size was superior to those of other varieties. Therefore, prospects for their being used as parents for crossing are bright. Some of the indeterminate type of the South American varieties also showed good growth and good pod-setting.

Most of the favorable varieties found were the Taiwanese ones. They grew well and had good pod-setting. However, the percentage of shattering was very high and this creates a serious problem. It was found that the 64 - 104, 64 - 64 and 0 - 38 (small seeds) varieties showed almost no sign of rust disease.

The Dalat - B, Palmetto, Pai Meiton Bean, Pakchong No. 1, Paimoet and Coker 102 varieties showed characteristics in plant type, period of growth and seeds similar to those of the recommended variety SJ-1. There were 31 varieties showing very poor germination and no seeds of harvesting.

Table 1. A List of Varieties Selected during the Rainy Season of 1970

*Variety	Flowering date	Flower color	Maturing date	Plant height	Number of nodes on the main stem	Number of pods	100 grain weight	Hilum color**
2. Hill	Aug. 16	W	Oct. 8	28.3cm	9.7	72.2	15.6g	LBr
11. Mansoy	13	P	12	46.7	13.0	62.8	16.8	Bl
18. Hongkong	10	W	6	46.8	15.2	75.8	12.3	Y
35. Dalat A	23	P	15	47.5	13.5	95.5	11.9	LBr
36. Dalat B	20	P	15	60.7	17.2	115.3	11.8	Bl
46. Australia	16	W	17	46.8	15.7	99.9	16.8	Y
89. Bly Voor DL/64/179	23	W	20	45.0	14.4	89.7	12.5	LBr
91. Gedlild DL/64/174	23	W	17	45.9	16.6	79.6	13.6	LBr
93. 53.S.44 DL/64/182	18	P	15	49.4	13.7	55.9	15.6	Br
95. 54.S.114 DL/64/184	16	W	8	52.2	16.0	83.5	14.9	LBr
104. Macoupin	13	W	20	58.2	15.1	82.9	16.3	LBr
107. Scott	10	P	12	33.2	13.5	71.3	12.4	Y
108. Wabash	10	W	12	38.5	13.4	64.4	13.8	LBr
112. S-100	10	W	17	53.1	15.8	80.4	14.9	LBr
119. Illington (B)	10	W	7	22.0	8.4	27.7	17.9	Y
146. Missoy	23	P	12	47.3	14.1	104.0	12.2	Gra
157. Hood	16	P	20	24.2	9.1	47.0	14.5	Y
163. Aksarben	16	P	12	49.4	16.0	90.4	12.9	Y
164. Edna	16	P	17	69.7	16.4	98.8	17.5	Y
166. R-485	16	W	12	42.2	12.3	74.3	13.9	LBr
169. Acadian	18	P	20	81.9	17.2	147.8	11.7	DBr
170. L-356	23	W	20	54.8	13.2	150.6	12.1	DBr
196. Hourai	8	P	12	47.0	13.7	57.9	16.0	Y
198. Oshima-shirome	8	P	12	41.9	11.2	44.4	18.4	Y
01. Mutsu-shiratama	14	W	8	19.0	8.8	41.2	23.6	Y
232. Tousan No. 26	16	W	5	25.0	11.4	40.9	17.0	Y
251. Alanea	28	P	20	41.0	15.4	128.1	10.8	Br
262. Tainung 3	23	W	15	45.7	13.2	90.0	13.7	DBr
278. E 27	18	P	17	50.4	14.5	117.9	16.1	Br
284. NTU K.S. No. 5	20	W	15	40.5	12.2	104.8	14.8	Br
286. Taichung No. 12	Sep. 4	W	Nov. 3	61.7	17.9	155.0	10.9	DBr
288. Palmetto	Aug. 23	P	Oct. 17	70.1	19.6	118.6	11.9	Bl
291. Pai Melton Bean	Sep. 4	P	17	69.4	19.0	145.9	11.7	Bl

*Variety	Flowering date	Flower color	Maturing date	Plant height	Number of nodes on the main stem	Number of pods	100 grain weight	Hilum color**
300. Chung Hsing (Unknown)	Sep. 4	W	Nov. 3	72.4	18.6	166.7	14.5	Br
306. Pakchong No. 1	Aug. 23	P	Oct. 17	52.2	17.3	92.3	11.5	Bl
309. Hampton	Sep. 2	P	17	61.1	17.7	124.6	11.3	Bl
312. Kurkur	Aug. 23	P	Nov. 3	56.3	17.3	112.4	20.1	LBr
316. Paimoet	Sep. 3	P	Oct. 20	56.5	17.2	115.9	11.6	Bl
319. 0-38 (Small seed)	Aug. 23	W	25	35.6	17.5	100.3	17.5	Br
324. 64-101	23	P	25	41.7	13.9	72.2	17.8	Br
327. Shiro-daizu	30	P	15	43.5	12.9	85.9	12.6	Br
341. Taitakho-shiung	23	P	20	40.9	12.9	91.2	16.3	DBr
351. 0-121	18	W	8	40.3	11.1	106.8	14.2	DBr
356. Coker 102	23	P	7	70.6	19.1	127.3	10.8	Bl
361. 64-64	23	W	17	40.1	11.9	89.1	16.4	Br
SB 60	Sep. 4	W	Oct. 29	63.2	20.1	151.1	8.3	LBr
Pakchong	4	P	28	44.4	16.9	139.6	11.4	LBr
SJ-3	Aug. 28	P	20	44.8	16.0	123.2	11.4	DBr

1. *; Plot No. **Y: Yellow, Br; Brown, LBr: Light brown, Bl: Black, Gra: Gray
2. Bly Voor DL/64/179, 53.S.44 DL/64/182, R-485, Acadian, E 27, Palmetto, Chung Hsing No.6, Kurkur, 0-38 (small seed) and Coker 102 showed little or middle degree of lodging
3. All varieties selected have yellow-colored seed coat.

B. Expeirment for the Selection of Introduced Varieties (1st and 2nd season after the introduction)

Materials and Methods

(1) Place and Planting Season

Mae Jo Agricultural Experiment Station

Dry Season 1971

(2) Materials

285 varieties not chosen from the experiment in the rainy season of 1970 and 1109 more of new varieties making a total of 1394 varieties.

(3) Cultivation Method

Planting time: 12 - 13th January

Density of plants: 50cm x 20cm, 2 plants per hill

Volume of fertilizer (kg/rai): 3, 12, 12 and 1.5 of N, P_2O_5, K_2O and $MgSO_4$ respectively were applied just before planting.

Irrigation: A sprinkler was used in the early stage and the field was watered after the middle stage about twice a week.

Experimental Results and Discussion

The materials of the second season had poor germination while the ones of the first season showed good germination. The growth during the early stage was very good but later the plants developed short stems and showed little growth due to short day length. The attack of leaf roller became evident after the middle stage of growth and was more serious than in the rainy season. Spraying of malathion 0.5% was carried out several times.

Most of the introduced varieties from the high latitude area produced many abnormal undeveloped pods. Some produced only abnormal pods. It was considered that the abnormal pod growth was caused by the short day length and low night temperature (10°C - 13°C) during the blooming period. It is not clear at the present time which of the two reasons was the main cause of the production of abnormal pods. However, when considering that many varieties from high latitude areas produced abnormal pods, the first mentioned reason probably was the main cause.

In the late stages of the growth, mosaic virus was found in many varieties and after harvesting the symptom of the disease was recognized on the seed coats.

Most of the varieties planted in this dry season shattered during the maturity period due to dryness. Harvesting was carried out 2 - 3 days prior the maturity to avoid the loss of seeds by shattering.

Selection of varieties was mainly based on the plant type, maturity and the quality of seeds.

Table 2 shows the experimental results of selected varieties.

Table 2. A List of Varieties Selected during the Dry Season of 1971

Variety	Flowering date	Flower color	Pubescence color	Maturing date	Plant height (cm)	Number of nodes on the main stem	100 grain weight	Seed coat color	Hilum color
3. A 425	Feb. 15	P	B	Apr. 9	31.2	7.0	18.6[8]	Y	DBr
6. A 455	21	P	B	13	33.5	10.3	22.5	Y	DBr
7. A 456	15	P	B	13	42.2	8.6	14.9	Y	DBr
60. Cabott	21	P	W	13	26.1	9.2	17.4	Y	Y
125. Mukden	15	W	W	9	38.3	8.7	18.7	Y	Y
128. Shinroku	21	P	B	13	40.4	9.2	23.7	Y	LBr
193. Akasaya-Chusei	15	P	B	9	28.5	8.7	22.2	Y	LBr
252. Takiya (Waseshu)	18	P	W	13	27.6	8.8	24.0	Y	LLBr
312. Thintaosan-Outou	21	P	B	13	27.0	7.7	20.7	Y	DBr
333. Chusei 11	18	P	W	9	19.2	7.9	24.4	Y	LBr
405. Manchi Kin	15	W	W	9	28.6	8.4	16.2	Y	Y
440. Shin-Ei-Daizu	15	W	W	13	27.0	8.7	16.7	Y	LLBr
456. Blackhawk	15	W	W	9	32.4	9.1	16.0	Y	LBr
461. Yougetsu	18	P	B	7	24.2	8.2	19.2	Y	Y
499. Ou Kei 2	18	P	B	5	24.8	9.5	16.5	Y	DBr
507. Ugo Daizu	21	P	B	9	31.7	9.1	21.7	Y	LBr
523. Kawanagare (Iwate)	18	P	W	Mar. 31	22.4	7.9	19.4	Y	Y
532. Turo No Tomo 1	21	P	B	Apr. 7	29.2	8.6	12.7	Y	LBr
559. Akita Ani	21	P	B	7	26.1	9.0	18.2	Y	LBr
561. Takiya	18	P	W	7	22.9	7.9	15.1	Y	LLBr
563. Yashirogi Mame (Yamagata)	18	P	B	5	32.3	9.2	16.0	Y	DBr
568. Kinoshita 4	21	W	B	13	24.4	8.8	24.0	Y	DBr
572. Kinoshita Mame	25	W	B	13	25.0	8.6	19.0	Y	DBr
596. Aze Minori	18	P	W	9	24.7	8.8	16.3	Y	Y
611. Daizu 2	21	P	B	9	26.2	8.4	18.0	Y	LBr
657. Jukkoku-Mame	18	P	W	7	23.8	8.4	19.7	Y	LBr
843. Tousan Kei B 497	18	W	W	1	19.3	7.7	23.5	Y	Y
863. Tousan 40	18	W	W	9	21.9	7.0	23.0	Y	Y
928. Toiku No. 129	18	P	W	14	36.5	6.3	31.5	Y	Y
1027. San Juan	25	P	W	26	47.6	12.1	12.7	Y	DBr
1049. IAC - 2	18	W	W	15	29.9	11.2	15.8	Y	LBr
1051. Vicoja	15	P	B	-	14.9	5.3	17.0	Y	DBr
1364. Merapi	Mar. 9	W	B	Apr. 26	58.4	13.7	8.3	BL	Bl
1367. Davros	Feb. 25	W	W	13	36.2	8.1	13.0	Y	LLBr
1368. TK 5	25	W	B	13	31.0	8.6	15.6	Y	DBr
SJ - 2	25	P	B	20	39.7	12.2	12.5	Y	DBr

C. Preliminary Performance Test of Introduced Varieties

Materials and Methods

(1) Place and Planting Season

Mae Jo Agricultural Experiment Station

Dry Season 1971

(2) Materials

45 varieties selected from rainy season 1970 and 5 compared varieties making a total of 50 varieties; the 5 compared varieties were SJ-1, SJ-2, SB 60, Pakchong and Bon-minori.

(3) Design of Experiment Plot

1 plot = 6.0m^2 Randomized blocks with 2 replications

(4) Cultivation Methods

Planting date: 13th January

Density of plants: 50cm x 20cm, 2 plants per hill

Volume of fertilizer (kg/rai): 3, 12, 12 and 1.5 of N, P_2O_5, K_2O and $MgSO_4$ respectively were applied before planting.

Irrigation: A sprinkler was used during the early stage and after the middle stage the field was irrigated about 2 times for a week.

Experimental Results and Discussions

Germination in general was not good. Due to short day length, the extent of growth was small but the plants efficiently produced pods. The occurrence of insects and its prevention were exactly the same as described in "B. Experiment for selection of introduced varieties." Varieties Tai-Chung No. 12, Bly Voor DL/64/179 and SB 60 were especially infected by the virus. Pulling out of infected plants by the virus was carried out twice during the middle stages.

Varieties from Taiwan had good germination and grew well in the early stage. The recommended varieties SJ-1 and SJ-2 grew well after the middle stage of growth and the native SB 60 had late maturity. The Pakchong matured early.

The percentage of lodging among most varieties was very low; some did not have any. Planting in dry season had no problem in lodging compared to that in the rainy season due to the short stem and the absence of rainfall.

The following is general comments on promising varieties;-

Bly Voor DL/64/179

The extent of growth in the early stage is small but becomes greater after the middle stage. It is characterized by non-shattering but is subject to a high percentage of lodging and virus disease.

R-485

Though early growth of this variety is not very good and there is little pod setting, it is characterized by non-shattering and high quality of seeds.

Tainung 3, NTU K.S. No. 5, Shiro-daizu, 0-121

All varieties show good germination and good growth in the early stage. However, they produce few pods due to their small plant type. The seeds are much bigger than those of SJ-2 but shatter to a great extent. It is considered that they are suitable for planting in the rainy season.

Shiro-daizu was actually a variety imported from Taiwan but mistaken to be Japanese due to mispronunciation of the Chinese characters.

64-104

This variety has late maturity compared to varieties Tainung 3, NTU K. S. No. 5 and Shiro-daizu. Besides the large size of the seed, it also has the same growth characteristics to the said three varieties. There was much cracking of seed coats, and the quality is inferior.

Taitakhaoshiung

This variety has good germination and good early growth. Its maturity is later than that of 64-104. There are variations among varieties but the selection of prospective plants among this variety is possible through diversification of families.

Acadian

Prosperous growth and good setting of pods are the characteristics of this indeterminate variety. It matures later than SJ-1 but earlier than SJ-2. The only weakness is the small size of its seed.

Chung Hsing (Unknown)

It has prosperous growth and good setting of pods, showing it to be an indeterminate type. Its maturing is later than SJ-2. The only weakness is its small seed size, but it is non-shattering. This is suitable for dry season planting.

Dalat B

This is an indeterminate type somewhat similar to SJ-1 with black hilums of seeds.

Table 3. Results of Growth

Variety	Flowering date	Maturing date	Growing period	Lodging score	Shattering score	Plant height	Number of nodes on the main stem	Number of pods in a hill	Flower color	Pubescence color
			days			cm				
1. Hill	Feb. 23	Apr. 17	94	0	1	22.7	7.3	57.6	W	B
2. Scott	20	17	94	0	0	21.4	8.7	58.6	P	W
3. Illington (B)	18	15	92	0	2	13.9	5.2	32.4	W	W
4. Hood	22	17	94	0	-	13.8	4.8	52.4	P	W
5. Horai	19	16	93	0	1	-	-	-	P	W
6. Oshima-shirome	18	17	94	0	1	-	-	-	W	W
7. Mutsu-shiratama	18	15	92	0	3	13.7	6.0	27.0	W	W
8. Tousan No. 26	22	17	94	0	3	23.7	7.7	48.5	W	W
9. Bon-Minori	22	15	92	0	3	16.6	7.6	46.9	W	B
10. Mansoy	20	17	94	0	0	-	-	-	P	B
11. Hongkong	18	17	94	0	0	27.6	8.9	68.1	W	W
12. Dalat A	22	14	91	0	3	26.0	7.3	56.7	P	W
13. Australia	18	20	97	0	0	25.5	9.2	33.3	W	W
14. Bly Voor DL/64/179	25	29	106	3	0	40.5	9.9	74.8	W	W
15. Gedlild DL/64/174	20	23	100	1	0	-	-	-	W	W
16. 53.S.44 DL/64/182	21	19	96	1	0	-	-	-	P	B
17. Wabash	18	17	94	0	0	-	-	-	W	W
18. Missoy	23	15	92	0	3	-	-	-	P	B
19. Aksarben	18	15	92	0	0	34.8	11.1	92.1	P	W
20. R-485	22	18	95	1	0	36.7	8.7	73.9	W	W
21. Alanea	20	15	92	0	2	23.4	7.5	57.0	P	B
22. Tainung 3	26	16	93	0	3	34.0	8.4	77.5	W	B
23. NTU K.S. No.5	26	16	93	0	3	30.6	9.2	71.9	W	B
24. 0-38 (Small seed)	22	15	92	0	1	23.1	9.1	74.6	W	B
25. 64-104	23	18	95	0	3	32.3	9.3	78.7	P	B
26. Shiro-daizu	25	17	94	0	3	31.6	9.5	75.2	P	B
27. Taitakao-shiung	25	25	102	0	3	37.4	9.0	90.8	-	B
28. 0-121	25	17	94	0	3	30.0	7.8	72.8	W	B
29. 64-64	20	17	94	0	3	24.7	8.9	53.6	W	B
30. 54/S/114 DL/64/184	20	20	97	0	0	-	-	-	W	W
31. Macoupin	20	23	100	1	0	31.4	8.8	73.2	W	W
32. S-100	18	17	94	0	0	24.7	7.2	42.1	W	W
33. Edna	23	18	95	1	0	37.6	9.6	86.0	P	W
34. Acadian	26	21	98	0	1	46.7	12.8	108.4	P	B
35. L-356	22	17	94	0	2	15.8	5.6	50.8	W	B
36. E-27	22	16	93	0	3	21.1	8.5	52.6	P	B
37. Taichung No. 12	33	29	106	3	3	70.7	14.3	140.8	W	B
38. Chung Hsing (Unknwon)*	24	29	106	1	0	69.3	15.6	126.0	W	B

Variety	Flowering date	Maturing date	Growing period	Lodging score	Shattering score	Plant height	Number of nodes on the main stem	Number of pods in a hill	Flower color	Pubescence color
			days			cm				
39. Kurkur	Feb. 10	Apr. 16	93	0	3	29.3	9.8	72.6	P	B
40. SJ-2	23	23	100	0	0	39.7	12.2	111.3	P	B
41. Pakchong	20	15	92	0	1	24.4	7.5	68.7	P	B
42. SB 60	33	24	101	1	0	62.8	16.5	121.8	W	W
43. Dalat B	22	17	94	0	2	46.9	12.2	111.0	P	B
44. Palmetto	22	18	95	1	2	62.5	15.7	91.5	P	B
45. Pai Meiton Bean	22	17	94	0	2	48.3	11.9	81.1	P	B
46. Pakchong No. 1	22	17	94	0	2	45.1	11.0	97.0	P	B
47. Hampton	22	17	94	0	2	45.6	12.0	88.2	P	B
48. Paimoet	22	17	94	0	2	49.7	13.1	131.0	P	B
49. Coker 102	22	17	94	0	2	54.8	13.4	128.3	P	B
50. SJ-1	23	17	94	0	2	48.8	12.6	98.2	P	B

1. Lodging and Shattering: 5: Very serious;
4: Serious;
3: Middle;
2: Little;
1: Very little
0: Zero

2. Seed quality: 5: Very good;
4: Good;
3: Middle;
2: Poor;
1: Very poor

Table 4. Results of Yield

Variety	Seed Yield		100 grain wieght	Seed** quality	Seed coat color	Hilum color	Promissing score in the field
	kg/rai	% to SJ-2					
1. Hill	306.7	69.9	15.0	2	Y-L	Br	2.0
2. Scott	200.6	45.7	15.0	2	Gre. Y	LBr	1.5
3. Illington (B)	187.3	42.7	22.3	2	Y	Y	1.3
4. Hood	346.9	79.0	18.7	2	Y	Y	1.8
5. Horai	-	-	17.3	3	Y	Y	1.8
6. Oshima-shirome	-	-	22.6	2	Y	Y	2.0
7. Mutsu-shiratama	172.8	39.4	29.0	1	Y	Y	1.0
8. Tousan No.26	364.6	83.1	27.5	2	Y	Y	2.3
9. Bon-minori	233.7	53.2	22.8	4	Y	DBr	1.0
10. Mansoy	-	-	18.8	2	Y	Bl	1.0
11. Hongkong	301.0	68.6	15.8	4	Y	LBr	2.0
12. Dalat A	214.3	48.8	13.5	4	Y	LBr	2.0
13. Australia	321.3	73.2	17.3	4	Y	Y	2.3
14. Bly Voor DL/64/174	408.6	93.0	12.4	2	Y	LBr	2.8
15. Gedlild DL/64/174	-	-	19.3	4	Y	LBr	2.5
16. 53 S.44 DL/64/182	-	-	19.2	2	Y	DBr	2.0
17. Wabash	-	-	16.9	2	Y	LBr	1.0
18. Missoy	-	-	14.3	2	Y	Bl	1.0
19. Aksarben	315.2	71.8	14.4	2	Y	Y	2.5
20. R-485	380.4	86.7	13.7	5	Y	LBr	2.5
21. Alanea	267.3	60.9	15.3	2	Y	LBr	2.8
22. Tainung 3	399.5	91.0	17.0	4	Y	DBr-Bl	4.0
23. NTU K.S. No.5	434.1	98.9	17.6	4	Y	DBr	4.3
24. 0-38 (Small seed)	189.2	43.1	18.0	2	Y	DBr	2.0
25. 64-104	457.5	104.2	23.7	2	Y	DBr	3.5
26. Shiro-daizu	455.5	103.8	18.2	2	Y	DBr	4.0
27. Taitakhaoshiung	342.2	77.9	18.0	2	Y	DBr	3.8
28. 0-121	446.0	101.6	18.0	4	Y	DBr-Bl	3.3
29. 64 - 64	291.1	66.3	23.1	2	Y	DBr	2.0
30. 54/S.114 DL/64/184	-	-	15.3	2	Y	LBr	1.5
31. Macoupin	268.8	61.2	16.1	2	Y	Y	1.5
32. S-100	239.5	54.6	15.1	4	Y	LLBr	1.3
33. Edna	347.0	79.0	15.1	5	Y	Y	2.5
34. Acadian	407.0	92.7	12.4	4	Y	DBr	3.5
35. L-356	302.9	69.0	16.8	2	Y	DBr	1.3
36. E-27	205.5	46.9	19.0	2	Y	DBr	2.3
37. Taichung No.12	288.5	65.7	8.4	4	Y	DBr	3.8
38. Chung Hsing (Unknown)*	441.2	100.5	11.8	2	Y	Br	4.3

Variety	Seed Yield		100 grain weight	Seed** quality	Seed coat color	Hilum color	Promissing score in the field
	kg/rai	% to SJ-2					
39. Kurkur	270.8	61.8	17.8	5	Y	DBr	1.8
40. SJ-2	439.0	100.0	12.5	4	Y	DBr	3.5
41. Pakchong	313.4	71.4	14.2	3	Y	LBr	2.5
42. SB 60	323.3	73.6	8.3	5	Y	LBr	3.5
43. Dalat B	412.7	94.0	11.7	5	Y	Bl	3.0
44. Palmetto	386.9	88.1	12.4	5	Y	Bl	3.0
45. Pai Meiton Bean	275.7	12.8	11.6	5	Y	Bl	3.0
46. Pakchong No. 1	420.0	95.7	12.2	5	Y	Bl	3.0
47. Hampton	293.2	66.8	12.3	5	Y	Bl	3.0
48. Paimoet	369.8	84.2	11.8	5	Y	Bl	3.0
49. Coker 102	336.6	76.7	12.4	5	Y	Bl	3.0
50. SJ-1	380.6	86.7	11.0	5	Y	Bl	3.0

1. *: The variety had been preserved as Chung No. 6 but Chung Hsing University informed us that they had never developed any strains named Chung Hsing No. 6.

2. Seed quality is different from the usual commercial quality. It was evaluated from the standpoint of uniformity, damaged by insects and diseases, cracking of seed coat, and etc., not including seed size and hilum color.

Table 5. Variance Analysis of Seed Yield

Factor	d. f.	S. S.	M. S.	F Value
Total	45	336,439.03		
Replication	1	32,239.94	32,239.94	10.78**
Variety	22	238,426.27	10,837.56	3.63**
Error	22	65,772.82	2,989.67	

1. Excluded are those varieties which had poor emergence.
2. **Significant at 1 % level.
3. L. S. D. (5%) = 113.4 kg, L. S. D. (1 %) = 154.1 kg

D. Preliminary Performance Test of Introduced Varieties

Materials and Methods

(1) Place and Planting Season

Kalasin Irrigation Pilot Farm (F. A. O.)

Dry Season 1971

(2) Materials

41 varieties were picked out from selected varieties in rainy season 1970 and 4 compared varieties, making a total of 45 varieties.

(3) Design of Experiment Plot

1 plot = 10. 0 m^2 Randomized blocks with 2 replications

(4) Cultivation Methods

Planting date: 16th January

Density of plants: 50cm x 20cm, 1 plant per hill

Volume of fertilizer (kg/rai): 3, 12 and 12 of N, P_2O_5 and K O, respectively, were applied one month after planting.

Irrigation: the field was irrigated once a week.

Experimental Results and Discussions

On the data on the yield was collected due to shortage of labor. The extent of growth was small for the season because fertilizers were applied too late and insufficient prevention of weeds.

Table 6 shows yield figures of 23 varieties having good germination. Table 7 is the variance analysis of seed yield.

Table 8 shows the results of variance analysis of the yield including the ones in the previous Chapter C at Mae Jo.

The soil at Kalasin Irrigation Pilot farm is more fertile compared to generally poor soil in the North Eastern Region since there has been soil improvements in this particular place. However, as shown in Table 8, yield figures obtained from the experiment at Kalasin were lower than those at Mae Jo (C). This was not due to soil fertility but rather to poor controlling of time of applying fertilizer, weeding and irrigation.

This experiment resulted in a higher yield at Mae Jo, showing that varieties Tainung 3, NTU K.S. No. 5, 64-104, 0-121, SJ-2 and Dalat B had a high yield.

Table 6. Results of Yield

Variety	Seed Yield		100 grain weight
	kg/rai	% to SJ-2	
1. Hill	94.3	35.3	-
2. Scott	154.7	57.9	15.0
3. Aksarben	105.7	39.6	-
4. R-485	128.7	48.2	-
5. Alanea	141.3	52.9	14.1
6. Tainung 3	280.2	104.9	19.3
7. NTU K.S. No.5	299.1	111.9	16.6
8. 64-104	283.2	106.0	20.7
9. Shiro-daizu	242.7	90.8	-
10. Taitakhaoshiung	172.8	64.7	21.1
11. 0-121	290.8	108.8	20.4
12. Acadian	238.7	89.3	14.2
13. Taichung No. 12	244.1	91.4	11.1
14. Chung Hsing (Unknown)	193.2	72.3	-
15. Kurkur	146.9	55.0	18.2
16. SJ-2	267.2	100.0	14.5
17. Pakchong	184.5	69.0	-
18. SB 60	225.4	84.4	10.2
19. Dalat B	260.4	97.6	13.8
20. Pai Meiton Bean	212.6	79.6	14.4
21. Hampton	216.8	81.1	13.6
22. Coker 102	219.9	82.3	13.5
23. SJ-1	198.9	74.4	-

Table 7. Variance Analysis of Seed Yield

Factor	d. f.	S. S.	M. S.	F Value
Total	45	269, 651. 89		
Replication	1	55, 363. 92	55, 363. 92	21, 681**
Variety	22	158, 110. 51	7, 186. 84	2, 815**
Error	22	56, 177. 47	2, 553. 52	

1. C. V. = 21. 95 %

2. L. S. D. (5%) = 95. 0 kg. L. S. D. (1 %) = 129. 2 kg

Table 8. Variance Analysis of Seed Yield Including Locations

Factor	d. f.	S. S.	M. S.	F Value
Total	91	1, 094, 566. 59		
Variety	22	321, 003. 61	14, 591. 07	5, 267**
Location	1	498, 475. 68	498, 475. 68	179, 925**
Variety x Location	22	75, 533. 15	3, 433. 13	1, 239 NS
Replication	2	87, 603. 86	43, 801. 93	15, 810**
Error	44	75, 533. 15	2, 770. 46	

E. Preliminary Yield Trial of Introduced Varieties

Materials and Methods

(1) Place and Planting Season

Mae Jo Agriculture Experiment Station
Rainy Season 1971

(2) Materials

42 introduced varieties, 3 compared varieties, making a total of 45 varieties.

(3) Layout of Experiment Plot

1 plot = 6.0 m^2 split plot 2 replications

(4) Cultivation Methods

Planting date: 17th June

Density of plants: 50cm x 20cm, 2 plants per hill

Volume of fertilizers (kg/rai): 3, 12, 12 and 1.5 of N, P_2O_5, K_2O and $MgSO_4$ respectively were applied 10 days after planting.

Experimental Results and Discussions

Germination and growth in the early stage were satisfactory. But during the middle of August rust disease occurred, causing defoliation in most varieties. Thus the plants matured earlier than normal, resulting in remarkably low yield with poor developed seeds.

Although the variety 0-38 (small seed) was infected by rust disease, there was no damage to the plants. It seems that this variety has resistance to it. Likewise, varieties A 425, A 455 and 456 were able to avoid damage from rust disease because they matured early and the seeds grew quickly after the pods developed.

Whichever of the Japanese varieties is damaged by rust disease, the varieties Shinroku, Akasaya Chusei, Shin ei Daizu, Ugo-daizu, Tsuru no Tomoi, Yashirogi-mame and Kinoshita-mame had prosperous growth due to their strong stems and good plant characteristics.

Varieties San Juan, IAC - 2, Vicoja, Meraji and Davros had late maturity and hence were suitable for dry season planting.

Tables 9, 10 and 11 show the figures on growth, yield and variance analysis of yield, respectively.

Table 9. Results of Growth

Variety	Flowering date	Maturing date	Lodging score	Shattering score	Rust damage	Plant height	Number of nodes on the main stem	Number of branches per hill	Number of pods per hill
1. Horai	Jul. 18	Sep. 14	2.0	1.0	5.0	63.1 cm	13.8	8.1	77.3
2. Oshima-shirome	16	11	1.0	1.0	5.0	50.8	12.9	6.4	63.6
3. Dalat A	Aug. 4	22	4.0	0.0	5.0	84.6	16.0	10.5	100.5
4. Alanea	3	23	3.5	0.0	5.0	64.6	16.6	9.0	89.4
5. 0 - 38	1	Oct. 4	5.0	1.0	1.0	87.9	19.0	6.2	64.5
6. E-27 (Small seed)	Jul. 29	Sep. 16	3.0	0.5	4.0	67.2	15.5	6.7	100.5
7. 53 S. 44 DL/64/182	21	14	3.0	0.0	4.0	77.0	18.2	5.9	91.5
8. A 425	15	11	1.5	0.5	2.0	75.1	13.7	5.6	75.0
9. A 455	16	12	3.5	2.5	2.0	75.4	14.5	5.4	49.7
10. A 456	13	11	2.5	1.0	2.0	89.1	14.0	2.5	76.1
11. Cabott	14	11	1.0	0.5	5.0	63.0	13.1	6.1	77.7
12. Mukden	16	12	1.5	0.5	4.0	74.6	12.8	4.4	69.8
13. Shinroku	23	10	0.0	3.0	5.0	59.0	11.9	5.4	51.4
14. Akasaya Chusei	23	11	0.0	2.0	5.0	60.1	11.5	4.8	51.8
15. Takiya (Waseshu)	21	10	1.0	3.0	4.0	51.1	11.7	6.9	69.9
16. Chusei 11	23	10	0.5	1.5	4.0	48.3	12.3	9.0	79.6
17. Manchi Kin	18	14	0.5	0.0	5.0	52.2	14.0	4.8	75.3
18. Shin Ei Daizu	18	11	0.0	0.5	5.0	68.9	15.0	4.5	103.4
19. Blackhawk	19	10	3.0	0.5	5.0	75.5	14.9	5.8	105.6
20. Yougetsu	21	9	0.0	3.0	5.0	46.5	12.1	9.0	89.7
21. Oukei 2	22	10	0.0	3.5	5.0	36.5	10.8	6.2	57.3
22. Ugo-daizu	23	10	1.5	2.5	4.0	54.4	12.2	5.3	66.9
23. Kawanagare	22	9	0.0	2.5	5.0	46.8	11.5	7.5	64.9
24. Tsuru No Tomo 1	23	10	2.0	2.5	5.0	59.8	11.1	5.7	60.5
25. Akita-ani	23	10	0.5	3.5	5.0	47.2	11.7	6.3	69.5
26. Takiya	21	9	0.0	3.5	5.0	44.2	11.3	7.2	69.0
27. Yashirogi-mame (Yamagata)	26	11	2.5	3.0	5.0	59.0	12.7	6.5	95.4
28. Kinoshita	Jul. 26	Sep. 11	0.5	2.0	5.0	51.0	11.7	6.8	74.5
29. Kiroshita-mame	26	12	1.5	3.5	5.0	56.8	12.2	7.8	75.6
30. Aze-minori	22	9	0.0	4.0	5.0	43.4	11.6	8.2	66.8

Variety	Flowering date	Maturing date	Lodging score	Shattering score	Rust damage	Plant height	Number of nodes on the main stem	Number of branches per hill	Number of pods per hill
						cm			
31. Daizu 2	Jul. 23	Sep. 10	0.0	3.0	4.0	52.2	12.1	7.0	69.4
32. Jekkoku Mame	21	10	0.0	3.0	4.0	36.2	12.2	9.4	88.6
33. Thintaosan Outou	23	10	0.0	2.5	5.0	52.5	10.9	5.8	59.1
34. Tousan Kei B497	22	9	0.0	2.5	5.0	36.0	10.1	8.1	64.2
35. Tousan 40	25	10	1.0	3.0	5.0	43.7	11.2	8.8	73.5
36. Toiku No. 129	18	12	0.0	1.5	5.0	35.2	8.3	5.9	33.6
37. San Juan	Aug. 9	Oct. 2	2.5	0.0	4.0	93.4	19.7	13.6	94.6
38. IAC - 2	3	Sep. 27	3.0	0.0	4.0	99.3	19.7	7.7	69.8
39. Vicoja	2	27	1.5	0.0	4.0	60.6	12.5	9.3	52.7
40. Merapi	9	25	5.0	0.0	5.0	85.0	15.7	8.8	29.2
41. Davros	9	27	4.0	0.0	5.0	104.5	18.0	6.4	36.5
42. T.K. 5	Jul. 29	14	3.5	1.0	5.0	80.4	12.7	5.6	56.7
43. SJ-1	Aug. 2	20	2.5	0.0	4.0	99.5	16.3	9.4	82.4
44. SJ-2	5	27	4.0	0.0	5.0	95.7	17.5	12.9	55.3
45. SB 60	10	Oct. 4	4.5	0.0	5.0	111.1	20.6	5.2	41.8

Table 10. Results of Yield

Variety	Seed Yield		100 grain weight	Seed quality	Seed coat color	Hilum color	Flower color	Pubescence color
	kg/rai	% to SJ-1						
			g					
1. Horai	137.8	131.7	15.1	2.5	Y	Y	P	W
2. Oshima-shirome	-	-	13.7	3.0	Y	Y	W	W
3. Dalat A	123.2	117.7	9.7	4.0	Y	LLBr	P	W
4. Alanea	56.0	53.5	8.6	2.0	Y	LLBr	P	B
5. 0-38 (small seed)	277.2	265.0	20.2	2.5	Y	Br	W	B
6. E-27	169.0	161.0	11.5	2.5	Y	DBr	P	B
7. 53 S.44DL/64/182	116.2	111.0	14.8	2.8	Y	Br	P	B
8. A 425	154.6	147.8	13.9	2.5	Y	DBr	P	B
9. A 455	146.5	140.0	13.1	2.8	Y	DBr	P	B
10. A 456	147.6	141.1	11.8	2.8	Y	DBr	P	B
11. Cabott	65.2	62.3	15.3	2.5	Y	Y	P	W
12. Mukden	151.5	144.8	15.4	3.0	Y	LBr	W	W
13. Shinroku	143.9	137.5	13.2	3.5	Y	DBr	P	W
14. Akasaya Chusei	139.6	133.4	15.5	3.8	Y	DBr	P	B
15. Takiya (Waseshu)	190.8	182.4	13.2	4.0	Y	LBr	P	W
16. Chusei II	189.4	181.0	16.6	3.3	Y	DBr	P	B
17. Manchi Kin	-	-	15.3	3.5	Y	Y	W	W
18. Shin Ei Daizu	154.6	147.8	10.7	2.8	Y	LLBr	W	W
19. Blackhawk	133.9	128.0	12.1	2.5	Y	LBr	W	W
20. Yougetsu	197.3	188.6	13.1	4.3	Y	Y	P	W
21. Oukei 2	123.7	118.2	12.4	2.5	Y	DBr	P	B
22. Ugo-daizu	198.7	189.9	14.9	4.0	Y	DBr	P	B
23. Kawanagare	175.7	167.9	13.1	4.5	Y	Y	P	W
24. Tsuru No Tomo 1	149.7	143.1	12.6	2.5	Y	DBr	P	W
25. Akita-ani	144.0	137.6	12.8	3.5	Y	Y	P	B
26. Takiya	227.6	217.5	14.8	4.0	Y	DBr	P	W
27. Yashirogi-mame (Yamagata)	223.1	213.2	10.4	2.0	Y	DBr	P	W
28. Kinoshita 4	241.6	230.9	18.8	3.3	Y	DBr	W	B
29. Kinoshita-mame	268.4	256.4	16.0	3.3	Y	DBr	W	B
30. Aze-minori	166.7	159.3	11.9	3.3	Y	LBr	P	W
31. Daizu 2	188.6	180.3	14.4	4.0	Y	Y	P	W
32. Jukkoku Mame	254.9	243.6	13.9	4.3	Y	Y	P	W
33. Thintaosan Outou	139.3	133.1	13.5	3.8	Y	DBr	P	B
34. Tousan Kei B 497	278.5	266.2	17.1	4.0	Y	Y	W	W
35. Tousan 40	189.7	181.3	15.7	3.0	Y	Y	W	W
36. Toiku No. 129	-	-	19.0	3.0	Y	Y	P	B
37. San Juan	166.6	159.2	9.2	2.3	Y	DBr	P	B
38. IAC-2	89.7	85.7	8.6	2.0	Y	DBr	W	W
39. Vicoja	109.8	104.9	8.6	2.0	Y	DBr	P	B

Variety	Seed Yield		100 grain weight	Seed quality	Seed coat color	Hilum color	Flower color	Pubescence color
	kg/rai	% to SJ-1						
40. Merapi	34.5	32.9	6.7g	2.0	Bl	Bl	W	B
41. Davros	89.5	85.5	10.8	2.0	Y	LLB	W	W
42. T.K. 5	130.1	124.3	11.2	2.5	Y	DBr	W	B
43. SJ-1	104.6	100.0	7.5	2.8	Y	Bl	P	B
44. SJ-2	100.2	95.7	8.9	2.5	Y	DBr	P	B
45. SB 60	37.8	36.1	6.7	2.0	Y	LBr	W	W

Table 11. Variance Analysis of Seed Yield

Factor	d.f.	S.S.	M.S.	F Value
Total	59	214,911.0660		
Replication	1	9,215.6827	9,215.6827	7.2933**
Variety	29	169,051.5560	5,829.3640	4.6134**
Error	29	36,643.8273	1,263.5803	

F. Performance Test of Introduced Varieties

Materials and Methods

(1) Place and Planting Season

Mae Jo Agriculture Experiment Station
Rainy Season 1971

(2) Materials

27 introduced varieties, 5 compared varieties, making a total of 32 varieties. Compared varieties were SJ-1, SJ-2, SB 60, Pakchong and Tousan NO. 26 (Japanese varieties).

(3) Design of Experiment Plot

1 plot = 12.0 m^2 Randomized blocks with 4 replications

(4) Cultivation Method

Planting date: 16th June

Density of plants: 50cm x 20cm, 2 plants per hill

Volume of fertilizers (kg/rai): 3, 12, 12 and 1.5 of N, P_2O_5, K_2O and $MgSO_4$ respectively were applied 10 days after planting.

Experimental Results and Discussions

With the exception of some varieties, most varieties had good germination and good growth in the early stage. Due to heavy rainfall during mid-August, many varieties showed serious lodging. At nearly the same stages, there was a severe occurrence of soybean rust disease. As a result, most varieties showed defoliation and a large decrease of seed yield with poorly developed seeds.

The damage by stem miner at this experimental field was still small compared to that in the nearby fields which were seriously damaged during the gorwth period. The early planted varieties were subject to less damage than those planted at a later date.

Downy mildew was evident during the middle stage of growth in early August but caused no damage to plants. Varieties Hamp, L-356 and SB 60 were the most susceptible to downy mildew. There are some mixtured plants for flower color and leaflets in 63 - 8 (Large seed) and flower color in Shiro-daizu. Some varieties 64 - 4 (Large seed), 64-62, 64-64 and 64-104 were resistant to rust disease, which showed some symptoms on leaves but did not spread widely. Thus there was no defoliation in these varieties and the plants matured as usual. Some plants of 64-4 (Large seed) variety were resistant to the disease and some were not. As for varieties 64-62 and 64-64 which had low germination, the yield figures could not be obtained. It was found that varieties having high resistance to the disease mostly came from Taiwan and originated from same materials because of the common number on their linages.

Varieties with thick growth were damaged most by rust disease and some were seriously infected resulting in abnormal pod fall. On the other hand, small plant types varieties, such as Hill, Gedlild DL/64/174, 54 S, 114 DL/64/184 and Tausan No. 26, were little infected by the disease.

As mentioned earlier, most of the varieties used in this experiment were susceptible to lodging due to heavy rainfall in mid-August. Precautions should be taken especially in fertile areas during the rainy season regarding the volume of fertilizers applied and the density of plants.

Tables 12, 13 and 14 show the figures on growth, yield and results of variance analysis of seed yield.

Table 12. Results of Growth

Variety	Flowering date	Maturing date	Lodging score	Shattering score	Rust damage	Plant height	Number of nodes on the main stem	Number of branches per hill	Number of pods per hill
						cm			
1. Acadian	Aug. 4	Sep. 28	3.8	0	4.0	96.5	18.5	11.5	110.0
2. 64-4 (Large seed)	27	25	4.0	1.3	3.0	80.9	44.4	6.6	101.7
3. K.S. 167 (Small seed)	30	19	4.0	1.5	5.0	73.1	14.4	6.4	72.5
4. K.S. 167 (Tall type)	30	19	3.5	0.8	5.0	73.6	13.9	5.9	81.4
5. K.S. 252	28	17	4.0	1.8	4.8	82.7	15.9	7.2	83.3
6. Hamp	2	26	3.3	0	3.8	74.6	15.0	8.9	79.2
7. Hill	Jul. 23	13	0.5	0	4.3	38.0	9.5	8.4	73.6
8. Tailong	30	22	4.0	1.3	4.5	63.9	14.2	6.8	-
9. 63-8 (Large seed)	28	22	2.8	0	4.0	74.1	17.2	7.6	-
10. Taichung No. 12	Aug. 7	Oct. 3	5.0	0.3	4.8	114.9	16.9	7.9	59.2
11. 64-62	Jul. 28	Sep. 26	3.3	1.0	2.0	64.1	13.7	7.7	107.6
12. NTU K.S. No. 5	29	13	3.8	2.5	5.0	78.4	14.0	7.7	61.2
13. Bly Voor DL/64/179	28	23	4.0	0	4.8	59.4	16.5	11.7	-
14. 64-64	28	25	4.3	0.5	2.0	59.9	13.0	6.9	-
14. L-356	Aug. 2	26	0.5	0.5	5.0	50.5	15.9	9.3	-
16. SJ-1	1	18	3.5	0	4.3	101.4	16.9	8.5	71.5
17. SJ-2	3	26	4.5	0	5.0	85.2	17.0	10.6	90.1
18. Australia	Jul. 21	22	3.3	0	5.0	65.7	19.5	9.9	124.4
19. Gedlitd DL/64/174	29	18	1.3	0	4.8	63.2	18.3	10.6	93.3
20. Aksarben	22	12	4.0	0	5.0	68.1	14.8	5.9	65.9
21. R-485	25	19	4.8	0	5.0	70.2	14.5	6.2	92.8
22. Tainung 3	28	13	4.3	1.3	5.0	79.2	12.9	6.2	52.1
23. 64-104	31	26	4.0	0.5	1.8	76.8	15.0	5.5	103.1
24. Shiro-daizu	28	13	4.0	0.8	5.0	85.4	14.3	6.2	51.8
25. 0-121	28	13	4.3	2.5	5.0	80.7	13.9	6.6	54.5
26. 54 S. 114 DL/64/184 DL/64/184	22	21	3.3	0	4.8	61.1	16.0	8.9	133.6
27. Edna	23	11	4.5	0	5.0	81.6	14.1	8.0	63.6
28. Chung Hsing (Unknown)	Aug. 3	Oct. 3	4.5	0.8	4.3	118.8	20.8	12.7	74.9
29. Pakchong	1	Sep. 25	5.0	0	4.8	73.6	16.3	8.4	69.0
30. SB 60	14	Oct. 3	4.8	0.3	4.5	123.9	19.2	6.5	54.3
31. Dalat B	1	Sep. 18	3.3	0	4.3	102.8	17.1	9.0	114.3
32. Tousan No. 26	Jul. 23	10	0.0	4.3	4.5	46.4	11.4	7.7	60.8

Table 13. Results of Yield

Variety	Total dry weight kg/rai	Seed Yield		% of seed to total dry weight	100 grain weight	Seed quality	Seed coat color	Hilum color
		kg/rai	% to SJ-1					
1. Acadian	928.1	192.1	117.4	20.6	9.2	2.5	Y	DBr
2. 64-4 (Large seed)	1001.6	259.3	158.4	25.8	12.4	2.5	Y	LBr-DBr
3. K.S. 167 (Small seed)	605.1	119.1	72.7	19.6	9.0	2.0	Y	DBr
4. K.S. 167 (Tall type)	628.4	131.7	80.5	20.9	8.8	2.0	Y	DBr
5. K.S. 252	671.4	149.6	91.6	22.2	9.5	2.0	Gre	Gra
6. Hamp	886.8	142.3	86.9	16.0	12.8	2.5	Y	Y-LBr
7. Hill	429.7	115.0	70.2	26.7	11.2	3.0	Y	LBr-Gra
8. Tailong	-	-	-	-	(11.1)	2.5	Y	Br-Dbr
9. 63-8 (Large seed)	-	-	-	-	(16.7)	2.0	Y	DBr-Bl
10. Taichung No. 12	760.0	86.8	53.0	11.4	9.1	3.0	Y	DBr
11. 64-62	-	-	-	-	(17.4)	2.0	Y	LBr-DBr
12. NIU K.S. No. 5	498.1	82.6	50.4	16.5	10.5	2.0	Y	LBr-DBr
13. Bly Voor DL/64/179	-	-	-	-	-	-	-	-
14. 64-64	-	-	-	-	(14.7)	2.0	Y	LBr-DBr
15. L-356	-	-	-	-	(6.9)	2.8	Y	DBr
16. SJ-1	675.0	163.6	100.0	24.2	8.7	2.5	Y	Bl
17. SJ-2	619.4	111.4	68.0	17.2	8.6	2.3	Y	DBr
18. Australia	890.2	130.1	79.5	14.6	13.4	2.3	Y	Y
19. Gedlild DL/64/174	1029.4	250.3	152.9	24.3	10.6	2.5	Y	LBr
20. Aksarben	471.3	89.8	54.8	19.0	10.8	2.3	Y	Y
21. R-485	571.2	123.8	75.6	21.6	11.5	2.3	Y	Y-LBr
22. Tainung 3	988.2	68.4	41.8	6.9	10.9	2.3	Y	LBr-DBr
23. 64-104	1096.1	308.0	188.2	28.0	19.3	2.5	Y	LBr-DBr
24. Shiro-daizu	592.4	92.7	56.6	15.6	9.5	2.0	Y	LBr-DBr
25. 0-121	571.8	116.3	71.0	20.3	10.4	2.3	Y	LBr-DBr
26. 54 S. 114 DL/64/184	862.6	211.5	129.2	24.2	11.7	2.0	Y	LBr
27. Edna	505.3	95.2	58.1	18.8	10.3	2.5	Y	Y
28. Chung Hsing (Unknown)	1492.6	75.5	46.1	5.0	12.5	2.8	Y	LBr-Br
29. Pakchong	473.0	91.0	55.6	19.2	10.6	2.0	Y	LBr-LGre
30. SB 60	667.9	33.6	20.5	5.0	6.4	2.8	Y	LBr
31. Dalat B	640.0	163.1	99.6	25.4	8.3	2.8	Y	Bl
32. Tousan No. 26	593.6	183.6	112.2	30.9	16.1	2.5	Y	Y

Table 14. Variance Analysis of Seed Yield

Factor	d. f.	S. S.	M. S.	F Value
Total	91	424,288.9391		
Replication	33	23,504.7017	7,834.9006	8.3522**
Variety	22	388,871.6841	15,403.2584	16.4202**
Error	66	61,912.5533	938.0690	

1. Excluding 9 varieties which had poor germination.

2. C. V. = 23.52 %, L. S. D. (5%) = 43.2 kg
L. S. D. (1%) = 57.5 kg

G. <u>Performance Test of Introduced Varieties</u>

Materials and Methods

(1) Place and Planting Reason

Srisamrong Agriculture Experiment Station

Rainy Season 1971

(2) Materials

27 introduced varieties plus 1 native kind of black bean and 4 compared varieties, making a total of 32 varieties. The 4 compared varieties were SJ-1, SJ-2, SB 60 and Pakchong.

(3) Design of Experiment Plot

1 plot = 12.0 m^2 Randomized block with 4 replications

(4) Cultivation Methods

Planting date: 18th June

Density of plants: 50cm x 20cm, 2 plants per hill

Volume of fertilizers (kg/rai): 3, 12 and 12 of N, P_2O_5 and K_2O respectively were applied 10 days after planting.

Experimental Results

Some varieties had poor germination due to heavy rainfall after planting. There were about 20 - 30 % ungerminated seeds. The extent of growth in the early stage was large since the soil was very fertile. During the middle stages of growth, there was a shortage of rainfall, and as a result, soybean growth was not vigorous, although pod-setting was fairly. The percentage of lodging was small. Seed quality was also poor because of greater rainfall during the maturity period.

Leaf hopper and aphid appeared during the early stage of growth, but treatment by means of spraying was effective. Thus there was practically no damage to plants. During the late stages of growth, quite a number of stink bugs developed resulting in the production of poor pods and damaged seeds. The damage was particularly seen among varieties with late maturity. Bly Voor DL/64/179 was pulled out and discarded since this variety was seriously damaged by mosaic virus.

Yield figures in kg/rai were estimated by taking into consideration all the plants available except the ones on the border rows and hills. However, the figures may not be so accurate because there were many missing hills.

Tables 15 and 16 showed the results of growth and yield.

Table 15. Results of Growth

Variety	Flowering date	Maturing date	Growing period	Lodging score	Shattering score	Plant height	Number of nodes on the main stem
1. Acadian	Aug. 5	Oct. 5	109	3.8	1.3	93.4	20.8
2. 64-4 (Large seed)	2	8	112	2.0	1.8	66.0	16.0
3. K.S. 167 (Small seed)	2	Sep. 26	100	2.5	2.5	56.7	16.4
4. K.S. 167 (Tall type)	2	Oct. 1	105	2.0	3.0	49.3	12.0
5. K.S. 252	1	Sep. 29	103	3.0	3.3	49.5	14.5
6. Hamp	4	Oct. 18	122	1.0	1.0	45.8	12.4
7. Hill	Jul. 29	Sep. 21	95	0.5	1.5	21.5	7.7
8. Tailong 3	Aug. 1	29	103	1.5	2.8	41.2	12.4
9. 63-8 (Large seed)	Jul. 29	29	103	1.3	1.3	38.0	13.8
10. Taichung No. 12	Aug. 2	Oct. 13	117	2.5	2.0	50.5	13.3
11. 64-62	Jul. 31	Sep. 29	103	1.3	2.3	35.0	11.0
12. NTU K.S. No. 5	Aug. 1	22	96	2.5	3.8	45.3	11.5
13. Bly Voor DL/64/179	2	-	-	-	-	-	-
14. 64-64	1	Oct. 4	108	0.8	2.3	29.7	10.0
15. L-356	2	8	112	1.0	1.0	22.0	9.1
16. SJ-1	1	4	108	1.8	2.0	73.6	17.9
17. SJ-2	3	9	113	2.3	1.0	58.2	16.0
18. Australia	Jul. 31	Sep. 27	101	0.8	1.0	37.5	13.2
19. Gedlild DL/64/174	Aug. 1	-	-	-	-	-	-
20. Aksarben	Jul. 29	Sep. 21	95	1.8	2.3	34.9	2.4
21. R-485	29	-	-	-	-	-	-
22. Tainung 3	Aug. 1	Sep. 24	98	3.0	4.0	48.1	11.8
23. 64-104	Jul. 31	29	103	1.5	3.0	42.5	12.4
24. Shiro-daizu	Aug. 2	26	100	3.0	3.8	55.7	12.2
25. 0-121	2	26	100	3.0	3.8	52.5	11.9
26. 54 S. 114/DL/64/184	Jul. 31	Oct. 1	105	1.0	1.0	47.9	13.4
27. Edna	30	Sep. 28	p02	1.8	1.3	49.8	13.4
28. Chung Hsing (Unknown)	Aug. 3	Oct. 15	119	2.3	1.5	72.0	18.8
29. Pakchong	6	15	119	1.5	1.0	45.9	15.4
30. SB 60	11	18	122	3.8	1.0	92.1	19.9
31. Dalat B	2	2	106	2.0	2.3	85.1	18.5
32. Black seed var.	2	Sep. 21	95	1.0	4.5	42.6	13.3

Table 16. Results of Yield

Variety	Seed Yield		100 grain weight	Seed quality
	kg/rai	% to SJ-1		
1. Acadian	196	73.4	14.8	2
2. 64-4 (Large seed)	158	59.2	16.3	2
3. K.S. 167 (Small seed)	178	66.7	16.0	2
4. K.S. 167 (Tall type)	180	67.4	15.5	2
5. K.S. 252	184	68.9	12.5	1
6. Hamp	128	47.9	19.1	2
7. Hill	-	-	15.9	2
8. Tailong 3	107	40.1	16.3	2
9. 63-8 (Large seed)	-	-	13.9	2
10. Taichung No. 12	151	56.5	11.3	3
11. 64-62	89	33.3	15.9	2
12. NTU K.S. No. 5	226	84.6	16.7	3
13. Bly Voor DL/64/179	-	-	-	-
14. 64-64	-	-	14.9	1
15. L-356	-	-	14.6	2
16. SJ-1	267	100.0	14.7	2
17. SJ-2	259	97.2	13.2	2
18. Australia	-	-	13.9	2
19. Gedlild DL/64/174	-	-	13.0	2
20. Aksarben	-	-	12.9	2
21. R-485	-	-	11.8	2
22. Rainung 3	229	85.8	17.2	3
23. 64-104	203	76.0	17.4	2
24. Shiro-daizu	180	67.4	17.3	2
25. 0-121	243	91.0	16.4	3
26. 54 S. 114 DL/64/184	87	32.6	13.8	2
27. Edna	-	-	13.6	2

Variety	Seed Yield		100 grain weight	Seed quality
	kg/rai	% to SJ-1		
28. Chung Hsing (Unknown) (Unknown)	161	60.3	15.3	2
29. Pakchong	165	61.8	15.5	2
30. SB 60	138	51.7	10.7	1
31. Dalat B	326	122.1	15.1	2
32. Black seed var.	275	103.0	12.8	2

H. Performance Test of Introduced Varieties

Materials and Methods

(1) Place and Planting Season

Prabudabart Agriculture Experiment Station

Rainy Season 1971

(2) Materials

24 introduced varieties plus 4 compared varieties, making a total of 28 varieties.

(3) Design of Experiment Plot

1 plot = 12.0 m^2 Randomized block with 3 replications

(4) Cultivation Methods

Planting date: 11th August

Density of plantation: 50cm x 20cm, 2 plants per hill

Volume of fertilizer (kg/rai): 3, 12 and 12 of N, P_2O_5 and K_2O respectively were applied 10 days after planting.

Experimental Results

The germination in general was poor. The extent of growth was small due to small amount of rainfall after the middle stage of growth resulting in less number of pods produced. Thus the yield was low.

This experiment was carried out in order to introduce suitable soybean varieties to be planted as a second crop after maize in the central parts (the center of maize plantation). It was noticed from the results of the experiment that the amount of rainfall during the planting time was uncertain. Thus precise conclusions could not be made from just one experiment. However, the factors on varieties of maize, such as planting time, growing period, and harvesting time, have to be taken into consideration with those of soybean.

Table 17. shows the results of growth and yield obtained.

Table 17. Results of Growth and Yield

Variety	Flowering date	Maturing date	Shattering score	Plant height	Number of nodes on the main stem	Seed yield kg/rai
1. Acadian	Sep. 16	-	1.7	39.2	13.2	71.9
2. 64-4 (Large seed)	10	Nov. 6	3.7	34.2	10.7	57.8
3. K.S. 167 (Small seed)	14	2	3.7	33.1	12.4	64.9
4. K.S. 167 (Tall type)	-	-	3.0	39.0	12.3	91.2
5. K.S. 252	Sep. 12	Nov. 7	3.7	35.4	12.3	66.5
6. Hamp	11	6	1.7	35.6	11.9	83.1
7. Hill	10	2	2.3	28.0	10.9	56.9
8. Tailong 3	10	7	3.0	31.8	11.1	64.9
9. Taichung No. 12	19	5	2.0	44.7	12.1	79.1
10. 64-62	10	2	2.3	30.0	10.4	54.5
11. NTU K.S. No. 5	13	2	4.3	32.5	11.6	67.4
12. Dly Voor DL/64/179	10	7	1.0	30.9	10.8	42.7
13. 64-64	10	2	3.7	27.8	10.5	49.2
14. L-356	16	7	4.5	21.4	9.8	-
15. SJ-1	16	-	2.3	38.8	12.6	50.5
16. SJ-2	14	Sep. 8	1.3	34.1	12.1	53.2
17. Australia	10	7	1.7	28.1	10.9	30.4
18. Aksarben	-	-	-	-	-	-
19. R-485	Sep. 10	Sep. 2	3.0	19.9	10.1	-
20. Tainung 3	15	7	3.3	37.0	12.3	56.3
21. 64-104	14	2	4.0	32.6	11.3	52.7
22. Shiro-daizu	14	4	4.3	34.1	11.3	48.1
23. 0-121	14	2	4.3	31.9	11.4	52.1
24. Edna	10	2	1.0	34.9	11.7	53.8
25. Chung Hsing (Unknown)	22	-	1.7	43.8	15.2	55.3
26. Pakchong	15	Sep. 6	1.0	25.4	11.9	42.5
27. SB 60	23	6	1.0	36.7	13.8	36.7
28. Dalat B	13	5	2.7	41.1	12.1	50.8

I. Experiment for Late Planting Suitability of Introduced Varieties in the Rainy Season

Materials and Methods

(1) Place and Planting Season

Mae Jo Agriculture Experiment Station

Rainy Season 1971

(2) Materials

20 varieties which are common to those in Chapter F "Performance test of introduced varieties"

(3) Design of Experiment Plot

1 plot = 8.0 m^2 Randomized block with 4 replications

(4) Cultivation Method

Planting date: 3rd July

Density of plants: 50cm x 20cm

Volume of fertilizer (kg/rai): 3, 12, 12 and 1.5 of $MgSO_4$ respectively were applied 10 days after planting.

Experimental Results and Discussions

Varieties Aksarben, Hill, Edna and Chung Hsing (unknown) had poor germination and were excluded from the experiment. Other varieties showed good germination with small extent of growth in the early stage due to low soil fertility. But growth increased after the middle stage resulting in high pod-setting. However, there were less major branches and numbers of nodes on the main stem since the period of growth was short because of late planting time. The advantage of the small plants resulted in the low percentage of lodging. Seeds in general were highly qualified, since there was little rain during harvesting time and the average yield was higher than 300 kg/rai.

The extent of growth of variety SJ-1 was not so good and less pods were produced. It yielded about 302.4 kg/rai, whereas varieties SJ-2, K. S. 252 and Taichung No. 12 produced a number of pods and yielded more. During the maturity period, the pods of SJ-1 variety matured before the branches and leaves.

Varieties R-485, SJ-2 and SB-60 had high resistance to shattering even after the maturity date for 10 days.

In the early stage of growth, there were symptoms of stem miners, but this did not cause such great obstacle during the experiment. In the middle stage of growth there were symptoms or rust disease and also some illness at the leaves. But it did not expand and caused no any damage.

Tables 18, 19 and 20 show the results of growth, yield and variance analysis of seeds yield, respectively.

Table 18. Results of Growth

Variety	Flowering date	Maturing date	Lodging score	Shattering score * (1)	Shattering score * (2)	Plant height	Number of nodes on the main stem	Number of branches per hill	Number of pods per hill
1. R-485	Aug. 30	Oct. 14	0	0	0	30.7	11.2	2.7	52.5
2. Aksarben	24	-	-	-	-	-	-	-	-
3. SJ-2	Sep. 2	Oct. 31	1	0	0	50.7	13.9	9.4	127.0
4. SJ-1	2	18	0	2.5	2.5	52.9	14.2	8.6	90.0
5. NTU K.S. No.5	Aug. 30	17	0	3.0	5.0	54.6	12.8	8.0	84.6
6. Taichung No.12	Sep. 6	27	2	2.5	2.5	60.8	14.3	9.8	111.9
7. Hill	Aug. 26	-	-	-	-	-	-	-	-
8. K.S. 252	30	Oct. 22	0	3.0	3.5	53.5	14.0	9.3	120.6
9. K.S. 167 (Tall type)	Sep. 1	22	0	1.0	2.5	51.9	12.3	7.4	81.7
10. K.S. 167 (Small seed)	2	22	0	0	2.5	48.5	12.0	7.1	77.1
11. Tainung 3	Aug. 31	16	0	3.0	5.0	52.7	12.5	6.9	72.3
12. 64-104	31	22	1	0	2.0	50.8	12.6	4.0	62.3
13. Shiro-daizu	30	16	0	3.0	5.0	59.0	12.4	5.3	81.0
14. 0-121	30	15	0	3.0	5.0	57.0	12.5	7.4	66.1
15. Edna	26	-	-	-	-	-	-	-	-
16. Chung Hsing (Unknown)	Sep. 2	-	-	-	-	-	-	-	-
17. Pakchong	7	Oct. 25	0	0	0	37.0	13.2	6.0	89.8
18. SB60	9	Nov. 1	1	0	0	56.4	16.4	7.1	108.9
19. Dalat B	3	Oct. 18	0	0.5	0.5	46.8	13.4	6.4	72.9
20. Tousan No.26	Aug. 26	15	0	1.0	4.0	33.4	10.6	6.1	42.0

* (1) 5 days after maturing
(2) 10 days after maturing

Table 19. Results of Yield

Variety	Seed Yield		100 grain weight	Seed quality
	kg/rai	% to SJ-1		
1. R-485	225.6	74.6	11.8	3.0
2. Aksarben	-	-	-	-
3. SJ-2	379.2	125.3	11.6	3.5
4. SJ-1	302.4	100.0	12.6	4.0
5. NTU K. S. No. 5	318.4	150.2	16.1	2.5
6. Taichung No. 12	372.8	123.2	12.3	4.0
7. Hill	-	-	-	-
8. K. S. 252	462.4	152.9	14.0	3.0
9. K. S. 167 (Tall type)	326.4	107.9	13.9	3.0
10. K. S. 167 (Small seed)	297.6	98.4	13.3	3.0
11. Tainung 3	312.0	103.1	15.3	3.5
12. 64-104	318.4	105.2	19.7	2.0
13. Shiro-daizu	329.6	108.9	15.4	3.5
14. 0-121	288.0	95.2	16.5	3.5
15. Edna	-	-	-	-
16. Chung Hsing (Unknown)	-	-	-	-
17. Pakchong	289.6	95.7	13.8	3.5
18. SB 60	246.4	81.4	9.0	4.0
19. Dalat B	259.2	85.7	12.8	4.0
20. Tousan No. 26	220.8	73.0	19.8	4.0

Table 20. Variance Analysis of Seed Yield

Factor	d. f.	S. S.	M. S.	F Value
Total	31	143, 372. 48		
Replication	1	2, 312. 00	2, 312. 00	1, 1586 NS
Variety	15	111, 131. 84	7, 408. 79	3, 7132**
Error	15	29, 928. 64	1, 955. 24	

1. C. V. = 14. 44 %
2. L. S. D. (5%) = 95. 19 kg, L. S. D. (1%) = 131. 64 kg

J. Experimental Designs of Preliminary Performance Tests and Performance Tests of Introduced Varieties and Breeding Strains in Dry Season 1972

a. Preliminary Performance Tests of Breeding Strains and Introduced Varieties

(1) Place

Mae Jo Agriculture Experiment Station
Kalasin Seed Multiplication Station

(2) Materials

17 introduced varieties plus 18 of pure lines (off-type) from SJ-2, 12 of F_4 line and 3 compared varieties, making a total of 50 varieties or lines. The F_4 lines are tested at Mae Jo only.

(3) Design of Experiment Plot

1 plot = 6.0m^2 Randomized block with 2 replications

b. Performance Tests of Introduced Varieties

(1) Place

Mae Jo Agriculture Experiment Station
Kalasin Seed Multiplication Station
Chainat Agriculture Experiment Station

(2) Materials

15 introduced varieties and 5 compared varieties, making a total of 20 varieties.

(3) Design of Experiment Plot

1 plot = 12.0m^2 Randomized block with 4 replications

K. Total Discussions of Introduced Varieties

Early growth and short stems are general characteristics of Japanese varieties, and so they are not suitable in practice. They had a strong tendency to produce shorter stems when planted in dry season, but some of them developed good growth when planted early in the rainy season between May and mid-June. However, there is no definite conclusion since the experiment was carried out for a short period of time. It is considered that if their inferior characteristics such as shattering and susceptibility to rust disease can be solved, it might be possible to use them in practice only in the early rainy season. Among the Japanese varieties, Hourai and Oshima-Shirome have rich growth but low germination, while Shinroku, Akasayachusei, Shined-daizu, Yashirogi-mame (Yamagata) and Kinoshita-mame varieties have both good growth and quality. Further study will be conducted to find out the productivity and regional adaptability of these varieties. It is recognized that Japanese varieties in general have big and qualified seeds, after several experiments it was found that they produced smaller seeds.

Most varieties with determinate type of growth from Taiwan have good germination and early growth. Although they produce a high yield even when planted in dry season, they are not resistant to shattering. Therefore they are suitable for planting in the rainy season only. Examples of these varieties are N. T. U. , K. S. No.5, Tainung 3, Shiro-daizu and 0-121. Particularly N. T. U. , K. S. No.5 and 0-121 varieties show prospective growth. There is another promising variety K. S. 252 (with late maturity and green seed coat) which yields more than the above mentioned 4 varieties and has one more percent of oil content than that of SJ-2. This is suitable for use in oil production.

The determinate type 64-104 matures later than the N. T. U. K. S. No. 5 and 0-121 with good early growth and high yield but is more susceptible to cracking on the seed coat resulting in low quality seeds. However, this variety is resistant to rust disease and hence is useful for breeding materials.

The introduced variety from U. S. A., Acadian, which is a long stem indeterminate type, matures between the maturity dates of SJ-1 and SJ-2. It has no resistance to shattering but the quality of seeds is better than that of SJ-1, and it is promising for planting in the rainy season.

All introduced varieties have been tested once in the dry season and parts of them in both dry and rainy season. Further selection must be carried out so as to find more prospective varieties. Meanwhile, introduced varieties from high latitude areas generally have too short a growing period and produce too small plant type, resulting in low yield, to be used in practice. It is planned to study especially the introduced varieties from the same lattitude area to find out the prospective ones to be used in practice and for parents for crossing.

Detailed study on regional adaptibility of these prospective varieties could not be obtained since only a few experiments were conducted and the data was incomplete due to lack of good field management. But by observing the results, it can be seen that there is a wider range of areas with similar soil and weather conditions in Thailand than in Japan. Thus it is possible that one variety is widely adaptable to the local region.

PURE-LINE SELECTIONS

Preface

The experiment was divided into two parts:

(i) Experiment on pure-line selections from the recommended variety SJ-2,

(ii) Experiment on pure-line selections from the rust disease-resistant varieties 64-62, 64-64 and 64-104.

The second experiment has only begun in the dry season, 1972, however, no experimental results are yet obtainable because the varieties are still first year materials.

Variety SJ-2 is a late maturing variety and is considered suitable for late planting in the rainy season and also in the dry season. It gives a higher and more consistent yield than the native varieties. Moreover, the variety has a non-shattering characteristic, showing little loss even when harvested during dry spells, and is therefore considered superior to other varieties. Some of its major weak points lie in lodging-resistance and seed quality.

As far as seed size is concerned, 100 seeds of the SJ-2 variety weigh 13.0 - 14.0 gms. Hence it is considerably smaller in size than other types of seeds which are circulating in the world today.

When materials were collected in seed multiplication fields of SJ-2 at several Agricultural Experiment Stations and Seed Multiplication Stations, there occurred some off-type which were different from the original SJ-2 variety, mainly for their long stems, white pubescents and white flowers. Basing their judgment on the different characteristics of the off-types and their frequency of occurrence, the writers agreed that these off-type did not result from a combination of simple but rather, for some reason, from some complex factors. Among the discovered off-types, those growing in sandy soil at the North-East also showed better growth than the original SJ-2.

Hence the object of the experiment on pure-line selection of the SJ-2 variety is to select big seed and good quality types from original SJ-2 and good growing type in the Northeast from off-types.

A. Pure-Line Selection from SJ-2

Materials and Methods

(1) Place and Planting Season

Mae Jo Agriculture Experiment Station
Dry Season of 1971

(2) Material

SJ-2 variety with original plant type, 352 lines off-types of SJ-2 35 lines

All were obtained from SJ-2 seed multiplication station at Mae Jo Agriculture Experiment Station, Uthong Agriculture Experiment Station, Roi-et Agriculture Experiment Station, Kalasin Seed Multiplication Station and Mahasalakam Seed Multiplication Station.

(3) Design of Experimental Field

2.0 m^2 plots. Two replications for only some of the lines arranged in 10 standard plots.

(4) Methods of Cultivation

Planting date: 15th January

Density of plants: 50cm x 20cm 1 plant per hill

Volume of fertilizer (kg/rai): 3, 12, 12 and 1.5 of N, P_2O, K_2O and $MgSO_4$ respectively were applied just before planting

Irrigation: Sprinkler was used during the early stage of growth and the field was irrigated in the late stages twice for a week.

Experimental Results

Germination was not good but most of the lines showed uniformly good growth. Other general conditions of growth followed those in Chapter C. "Experiment for the selection of introduced-varieties."

There were 33 lines from the original type of SJ-2 selected in the field. Investigation on the shelled seeds was carried out but none of them was of a specially large size and so they were all discarded.

The off-type lines in general were late maturing with long stems and very small seeds. There were three families showing segregation in visible characters such as flower and pubescent colors. In the last stage 18 off-type lines were selected.

Table 1 shows the results of the selection of the lines tested.

Table 1. Results of the Selection

Kind of material	No. of lines tested	No. of lines selected	Notice
Original type	352	-	Discarded
Off-type	38	18	

The survey on nodule-setting of some lines of the off-types was carried out in the rainy season 1971 at Roi-ed Agriculture & Equipment Station in the North Eastern region. It showed that the recommended type SJ-2 had no nodule setting and had poor growth. Some lines of the off-types, on the other hand, had opposite results in both the nodule setting and growth plus the efficiency in producing many pods. Hence its yield was far superior to SJ-2. The analysis results on the seed component of these lines showed that the percentage of fat is between 18 - 20 which is a little lower than that of SJ-2. Therefore it was considered that these lines are highly acceptable.

The following lines were put in the preliminary performance tests in the dry season of 1972.

Ka-3-255, Ka-6-258, Ka-8-260, Ma-4-266, Ma-6-268, Ma-10-272, Ma-11-273, Ro-1-275, Ro-2-276, Ro-3-277, Ro-6-28, R-7-281, Ro-8-282, Ro-11-285, Ro-12-286, Ro-13-287, Ro-14-288, Ro-15-289.

B. Pure-Line Selections from Varieties (or Lines) Which Are Resistant to Rust Disease

Materials and Methods

(1) Place and Planting Season

Mae Jo Agricultural Experiment Station

(2) Materials

Materials were selected at random (in the rainy season of 1971) from 64-62, 64-64 and 64-104 varieties which were recognized as varieties resistant to rust desease.

(3) Design of Experimental Field

1 plot = 2.0m^2, no replication, and SJ-2 arranged in 10 plots as check.

(4) Cultivation Methods

Planting date: 18th January

Density of plants: 50cm x 20cm, 1 plant per hill

Volume of fertilizer (kg/rai): 3, 12, 12 and 4 of N, P_2O_5, K_2O and $MgSO_4$ respectively were applied.

Irrigation: the field was irrigated twice a week.

Progress of the Experiment

Seeds of these 3 varieties (or lines) are of poor quality with cracks on the seed coat. A selection for good seeds is being carried out at present and there is a schedule for trial of rate of resistance to rust disease in each line to be conducted in the rainy season 1972.

All materials are now in their stage of growth.

SOYBEAN BREEDING EXPERIMENTS BY HYBRIDIZATION IN THAILAND

1. The Outline of Experiments

Artificial crossings were started on 25 August 1970 at Mae Jo Agri. Exp. Sta. In most of the combinations, we used Thai or Taiwan varieties as one of the crossing parents as they showed good performances in the old data. We often used Japanese varieties also in many crosses and tried to combine their stiff stalk and good seed quality with desirable maturity and resistance to shattering of Thai varieties.

As we can grow soybean plants at any time of a year, we planted F_1 generation just after harvesting and drying of the crossing seeds. F_2 growings also were started just after harvesting of F_1. As a result, we were able to finish crossing, F_1, and F_2 of some crosses in the first year.

We grew most of the F_1 plants in pots with careful management to get as much seed production for the next generation.

Selections of F_2 plants were mainly based on their maturity, plant type and seed size. Some F_2 plants were harvested in bulk because they were injured by soybean rust.

F_3 generations were planted in pedigrees and bulks. In the rainy season, some F_3 materials were grown at Srisamrong Agri. Exp. Sta., Sukhothai, where they have the biggest soybean growing area during rainy seasons. Most F_3 lines were classified into rainy season type, dry season type and intermediate or both types. When dry season types were grown during the rainy season, we did not have individual selections and harvested in bulk.

Some F_4 lines with a high degree of fixation in practical characters were put in the preliminary yield trials.

2. Results of the Experiments

(1) Artificial Crossing

1) Growing of Parents

We planted crossing parents several times with about 10. day intervals to get the same flowering periods in the different maturing varieties. Spacing of parents was 50cm x 20cm with one or two plants on a hill. Some of them were planted in clay pots.

2) Results and Discussions

Combinations of crossing parents and results of crossing are shown in Table 1. Main characteristics of crossing parents are shown in Table 2.

Usually we conducted pollinations immediately after the emasculations. We were able to harvest a sufficient number of crossing seeds in most crosses. The percentage of success, calculated from the number of flowers pollinated, the number of pods harvested and the number of successful F_1 plants certified is 11.3% on the average in crossing No. 7001, 7002, 7003, 7005, 7006, 7007 and 7008.

During the rainy season, the morning was suitable for the artificial crossing works. Usually pollens scattered out afternoon, but it was too hard to do the crossing work in the afternoon because the temperature and air humidity were very high.

Usual temperatures in the field during the end of August, 1970, were as follows:

6:00	23° - 24°C
8:00	25° - 26°
10:00	29° - 30°
12:00	30° - 32°

Even in the rainy season, it was fine in the morning and the temperatures were not much different between the periods from May to September. We could recognize the breaking of another coats at 6:00 in the morning during the rainy season and could gather the pollens.

Table 3 shows the relation between the success of crossing and the times in the mornings during the rainy season.

Although the data shown in Table 3 is not adequate, we can assume that very early morning, such as 6:00 to 8:00, is not suitable but that the time after 8:00 seems to be better for the artificial crossing during the rainy season. The temperature began to go down on October and we could not obtain the pollens early in the morning during October to December. Crossing work could be conducted from late morning to early afternoon.

From the end of December to the middle of February, the daily minimum temperature was very low and sometimes went down to below 10°C. It was very difficult to conduct the crossing work in the fields during this period. And some varieties had bud-pollination without the opening of flower petals and some showed very small abnormal pods during this cold season.

The crossing seeds were usually harvested in several days before maturing. Otherwise, they would be lost by shattering. Most of the crossing seeds were planted as F_1 generations just after harvesting and drying to hasten the work.

Table 1. Combinations and Results of Crossing (Mae Jo Agri. Exp. Sta.)

Cross No.	Pareins Female x Male	Date of crossing	Time of crossing	Number of flower pollinated	Number of pods matured	Number of seed harvested
7001	Bon-minari x SJ-2	Aug. 25, 1970	7:00-11:00	89	31	48
02	SJ-2 x Tokachi-Nagaha	Aug.28-Sep.1	8:00-12:00	114	21	35
03	SJ-2 x Nema-shirazu	Aug. 27	7:00- 9:00	103	13	20
04	Hougyoku x K. S. 167 (Tall type)	Aug. 26	6:00-10:00	73	12	20
05	Shin No. 4 x SJ-2	Aug. 26	6:00- 9:00	63	10	17
06	SJ-2 x Kogane-jiro	Aug. 27-31	10:00-11:00	131	6	10
07	SJ-1 x Nema-shirazu	Sep. 3	9:00-10:00	43	5	7
08	Taichung No. 12 x Nema-shirazu	Sep. 1-2	9:00-11:00	171	8	14
09	SJ-2 x Hougyoku	Oct. 4-5	7:00- 9:00	51	10	22
10	SJ-2 x Shin No. 4	Oct. 4-5	8:00- 9:00	25	5	11
11	Shiro-daihachirin x Taicheng No. 12	Oct. 21	10:00-12:00	43	6	12
12	Karikachi x SJ-2	Oct. 21	-	44	3	3
13	Tousan No. 26 x SJ-2	(1)Oct. 17 (2)Dec. 26	9:00-14:00 10:00-12:00	61 55	5 11	8 15
14	Aki-yoshi x Taichung No. 12	Oct. 21	10:00-11:00	53	8	11
15	Lincoln x SJ-2	Sep. 1	-	10	1	2
16	E-27 x 7001(F_1)	Nov. 23	10:00-13:00	56	6	12
17	7001 (F_1) x E-27	Nov. 24	10:00-14:00	42	11	22
18	E-27 x 7002(F_1)	Nov. 21	10:00-13:00	53	17	34
19	Acadian x 64-104	Nov. 27	12:00-13:00	21	4	7
20	SJ-2 x K. S. 252	Dec. 4-5 Dec. 16	(1)99:00-16:00 (2)10:00-12:00	28 52	15 7	29 14
21	K. S. 252 x SJ-2	Nov. 27	15:00-16:00	30	9	13
22	L-356 x Acadian	No. v25-27	9:00-18:00	59	19	37
23	L-356 x SJ-2	Nov. 27	10:00-12:00	30	7	7
24	64-104 x SJ-2	Nov. 25 Jan. 2, 1971	(1)11:00-13:00 (2)14:00-15:00	25 24	8 0	12 0
25	SJ-2 x 64-104	Dec. 16, 1970 Jan. 2, 1971	(1)15:00-16:00 (2)13:00-14:00	68 23	8 5	15 6
26	SJ-2 x Acadian	Dec. 11, 1970	16:00-17:00	86	24	41
27	K. S. 252 x E-27	Dec. 15	10:00-14:00	97	20	19
28	0-38(Large seed) x E-27	Dec. 12	10:00-12:00	31	10	12
29	Fusanari x SJ-2	Dec. 30	13:00-15:00	45	5	6
30	0-38(Small seed) x SJ-2	Dec. 26	12:00-13:00	17	4	5
7101	Ouhouju x SJ-2	Jan. 6, 1971	15:00-16:00	8	0	0
02	SJ-2 x Taichung No. 12	Jan. 2	14:00-15:00	24	5	8
7012	Karikachi x SJ-2	-	-	-	10	14
7103	SB 60 x SJ-2	Mar. 28	-	-	0	0

Table 2. Main Characteristics of Crossing Parents

Variety	Source	Maturity	Neight	Seed size	Remarks
Don-Minori	Japan	Very early	Very short	Big	
SJ-2	Thailand	Late-middle	Middle-tall	Small	Non-shattering
Tokachi-nagaha	Japan	Very early	Very short	Middle	Narrow leaflets
Nema-shirazu	Japan	Very early	Very short	Big	
Hougyoku	Japan	Very early	Very short	Big	
K. S. 167(Tall type)	Taiwan	Early	Middle	Small	
Shin No. 4	Japan	Very early	Very short	Big	
Koganejiro	Japan	Very early	Short	Middle	Little shattering
SJ-1	Thailand	Middle	Tall	Small	Indeterminate-growth
Taichung No. 12	Taiwan	Late	Tall	Small	Thick growing
Shiro-daihachirin	Japan		Very short	Big	
Karikachi	Japan	Very early	Short	Big	
Tousan No. 26	Japan	Very early	Short	Big	
Aki-yoshi	Japan	Very early	Very short	Big	
Lincoln	U. S. A.	Very early	Short	Middle	Non-shattering
E-27	Taiwan	Early	Short-middle	Middle	
Acadian	U. S. A.	Middle	Tall	Small	Indeterminate-growth
64-104	Taiwan	Middle	Short-middle	Middle	Rust resistance High protein
K. S. -252	Taiwan	Middle	Middle	Small	Green seed coat High oil
L-356	-	Middle	Short	Small	Strong stem
0-38 (Large seed)	Taiwan	Middle	Middle	Middle	
Fusanari	Japan	Very early	Very short	Big	
0-38 (Small seed)	Taiwan	Middle	Short-middle	Middle	Rust resistance
Ouhouju	China	Very early	Very short	Middle	Non-shattering
SB 60	Thailand	Late	Tall	Very small	Non-shattering Good nodule setting in the North-east

Table 3. Relation between the Success of Crossing and the Times in the Morning during the Rainy Season

(Mae Jo Agri. Exp. Sta.)

3-a 7001 (Bon-minori x SJ-2)

Time	Number of flowers pollinated	Number of pods harvested
7:00 - 8:00	19	7
8:00 - 9:00	32	12
9:00 - 10:00	26	10
10:00 - 11:00	12	2
Total	89	31

3-b 7002 (SJ-2 x Tokachi-negaha)

Time	Number of flowers pollinated	Number of pods harvested
8:00 - 9:00	11	2
9:00 - 10:00	38	4
10:00 - 11:00	25	4
11:00 - 12:00	40	11
Total	114	21

3-c 7003 (SJ-2 x Nema-shirazu)

Time	Number of flowers pollinated	Number of pods harvested
7:00 - 8:00	30	0
8:00 - 9:00	73	13
Total	103	13

3-d 7004 (Hougyoku x K. S. 167 (Tall type))

Time	Number of flowers pollinated	Number of pods harvested
8:00 - 7:00	12	1
7:00 - 8:00	5	0
8:00 - 9:00	9	2
9:00 - 10:00	47	9
Total	73	12

3-e 7005 (Shin No. 4 x SJ-2)

Time	Number of flowers pollinated	Number of pods harvested
6:00 - 7:00	14	1
7:00 - 8:00	23	2
8:00 - 9:00	26	7
Total	63	10

(2) Growing of F_1 Generation

1) Materials and Methods

F_1 generations of 26 crosses were tested during the period from 21 October 1970 to 26 April 1971. Most of the F_1 plants were grown in 1/2000 one Wagner pots with careful management to get enough seeds for the next generation. Fertilizer (kg/rai) was supplied before planting with formula 12, 48 and 48 of N, P_2O_5 and K_2O, respectively.

2) Results and Discussions

Most of the F_1 plants were grown under the condition of short daylength and showed short plant height and low number of nodes on the main stem. But their pod-setting was very good, and we could produce among seeds for F_2 generation in most crosses.

Confirmation of hybridization of F_1 is made by flower color, pubescence color, shape of leaflets, flowering time, maturing time, plant type, color of seed coat, hilum color etc.

Usually F_1 plants were harvested several days before maturing, and we avoided the losses of seed by shattering. Table 4 shows number of plants and number of seeds harvested in each cross of F_1 generation.

Table 4. Number of Plants and Seeds Harvested in F_1 Generation (Mae Jo Agri. Exp. Sta.)

Cross No.	Parents Female x Male	Date of planting	Number of plants harvested	Number of seeds harvested	Characters to confirm hybridization
7001	Bon-minori x SJ-2	Oct. 21, 1970	28	5088	Flower color
02	SJ-2 x Tokachi-nagaha	Oct. 22	31	5527	Leaf shape, Maturity
03	SJ-2 x Nema-shirazu	Oct. 27	20	2457	Maturity, Hilum color
04	Hougyoku x K.S. 167 (Tall (Tall type)	Oct. 27	13	1505	Pubescence color
05	Shin No. 4 x SJ-2	Nov. 18	15	2207	Maturity
06	SJ-2 x Kogane-hiro	Nov. 18	10	2047	Hilum color
07	SJ-1 x Nema-shirazu	Nov. 18	5	572	Hilum color
08	Taichung No. 12 x Nema-shirazu	Nov. 18	11	1258	Flower color
09	SJ-2 x Hougyoku	Jan. 26, 1971	11	961	Maturity
10	SJ-2 x Shin No. 4	Jan. 26	8	1159	Pubescence color
11	Shiro-daihachirin x Taichung No. 12	Jan. 26	7	1159	Pubescence color
13	Tousan No. 26 x SJ-2	Jan. 26	7	715	Pubescenceccolor
16	E 27 x 7001 F_1	Jan. 26	8	1340	
17	7001 F x E 27	Jan. 26	17	2655	
18	E 27 x 7002 F	Jan. 26	30	4673	
19	Acadian x 64-104	Jan. 28	6	1908	Plant type
20	SJ-2 x K.S. 252	Feb. 25	17	5661	Seed coat color
21	K.S. 252 x SJ-2	Feb. 25	11	4058	Plant type
22	L 356 x Acadian	Feb. 25	27	9682	Flower color
23	L 356 x SJ-2	Feb. 25	6	1970	Flower color
24	64-104 x SJ-2	Feb. 25	10	3416	Plant type
13	Tousan No. 26 x SJ-2	Feb. 25	10	1579	Pubescence color
26	SJ-2 x Acadian	Feb. 25	17	5619	Plant type, Hilum color
29	Fusnari x SJ-2	Feb. 25	4	679	Pubescence color
30	038 (Small seed) x SJ-2	Feb. 25	2	595	Flower color
7102	SJ-2 x Taichung No. 12	Feb. 25	6	2223	Plant type
7012	Karikachi x SJ-2	Apr. 26	12	2851	Maturity

We made many combinations of Thai variety x Japanese variety (or its reciprocal) and tried to introduce stiff stalk, big seed size and good quality of Japanese varieties to Thai varieties.

Table 5 shows the growth of parents and F_1 in some crosses originated from Thai variety x Japanese variety.

Table 5. Growth of Parents and F_1 in Some Crosses Originated from Thai Variety x Japanese Variety

Cross No.	Parents and F_1	Flowering date	Plant height cm	No. of nodes on the main stem	No. of pods	Yield g.	No. of seed per pod	100 grain weight
7001	P_1	Nov.20	22.1	9.3	38.5	21.5	1.68	26.7
	P_2	25	51.5	12.6	133.4	39.6	1.96	15.6
	F_1	22	38.8	11.8	99.8	36.3	1.95	18.7
7002	P_1	Nov.24	49.4	13.1	118.1	35.4	2.00	15.1
	P_2	18	19.9	8.0	38.8	16.8	2.09	21.1
	F_1	21	33.2	9.9	84.8	34.0	2.26	17.9
7003	P_1	Nov.23	20.3	8.0	32.5	16.1	2.05	24.1
	P_2	Dec. 2	44.8	13.3	92.0	21.8	1.97	12.1
	F_1	Nov.26	32.8	10.1		18.9	1.93	19.4
7005	P_1	Dec.20	22.2	9.8	39.0	17.9	1.94	27.2
	P_2	22	41.0	12.3	117.2	26.8	1.73	13.4
	F_1	22	29.3	10.0	84.9	30.9	1.86	19.6
7006	P_1	Dec.23	35.8	12.2	112.5	24.4	1.67	13.7
	P_2	17	28.3	12.8	44.3	13.8	1.74	18.0
	F_1	17	42.9	14.9	116.9	34.9	1.99	15.1

(3) Individual Selection of F_2 Generation

1) Materials and Methods

6 crosses in the dry season of 1971, 10 crosses in the rainy season of 1971 and 6 crosses during the dry season of 1972 were tested. Spacing was 50cm x 20cm, one plant on a hill. Fertilizer (kg/rai) was supplied after planting (before planting in the dry season of 1971) with the formula 3, 12, 12 and 1.5 (4.0 in the dry season of 1972) of N, P_2O_5, K_2O and $MgSO_4$.

2) Results and Discussions

Most of the F_2 plants in the dry season of 1971 had short plant height and low number of nodes on the main stem because all 6 crosses had a very early and short Japanese variety as one of their parents, and they were grownunder the short daylenth condition. All materials in the rainy season of 1971 showed very good growth but most of them were injured by soybean rust in their late stages of growth. 2 crosses which have a resistant variety as one of the parents showed a segregation into resistant types and susceptible ones.

The selections were mainly based on maturity, plant type, seed size and seed quality. In the two crosses which showed the segregation in resistance to soybean rust, we selected only resistant types.

Table 6 shows the selection and evaluation of each cross.

Table 6. Selection and Evaluation of Each Cross in F_2 Generation

Cross No.	Parents Female x Male	Date of planting	Number of plants tested	Number of plants selected	Evaluation** Plant type	Matu-rity	Qua-lity	Remarks
7001	Con-minori x SJ-2	Jan. 13, 1971						
02	SJ-2 x Tokachinagaha	Jan. 13	2400	127	3	3	3	
03	SJ-2 x Nemashirazu	Jan. 13	1200	74	2	3	3	
04	Hougyoku x K. S. 167 (Tall type)	Jan. 13	1200	-	1	3	3	Discarded
05	Shin No. 4 x SJ-2	Feb. 25	1200	144	4	4	4	Promising
06	SJ-2 x Kogane-hiro	Feb. 25	1200	-	4	4	1	Much virus discarded
11	Shiro-daihachirin x Taiching No. 12	Jun 18	1000	*	2	3	2	
13	Tousan No. 26 x SJ-2	Jun. 18	1000	*	4	4	3	
16	E 27 x 7001 F	Jul. 29	1000	*	3	3	3	
17	7001 F x E 27	Jul. 29	1000	*	3	3	3	
18	E 27 x 7002 F	Jul. 29	2000	*	2	3	3	
19	Acadian x 64-104	Jun. 18	1000	208	4	4	2	Promising
23	L 356 x SJ-2	Jun. 18	1200	-	4	4	1	Discarded
24	64-104 x SJ-2	Jun. 18	1700	314	4	4	3	Promising
29	Fusanari x SJ-2	Jun. 18	600	*	3	3	3	
12	Karikachi x SJ-2	Sep. 2	1500	562	2	2	4	
20	SJ-2 x K. S. 252	Jan. 28, 1972	1780	-	-	-	-	Now growing
21	K. S. 252 x SJ-2	Jun. 28	1580	-	-	-	-	
22	L 356 x Acadian	Jan. 28	2120	-	-	-	-	
26	SJ-2 x Acadian	Jan. 28	1860	-	-	-	-	
30	0-38 (Small seed) x SJ-2	Jan. 29	600	-	-	-	-	
7102	SJ-2 x Taichung No. 12	Jan. 29	900	-	-	-	-	

* Harvested in bulk because of much damage by soybean rust.

** 5: Very good, 4: Good, 3: Middle, 2: Poor, 1: Very poor

General comments of each cross are as follows.

7001 (Bon-minori x SJ-2)

We expected to get SJ-2 plant type with big seed size but most of the F_2 plants had small seed size than that of Bon-minori and were shorter SJ-2 (See Fig. 1). It is quite difficult to find SJ-2 plant type with big seed size. Seed quality was very good in many plants. Most materials seemed to be more adaptable to rainy season.

7002 (SJ-2 x Tokachi-nagaha)

Most of the plants had very short plant height and seemed not to be adaptable to dry season. Some parts of the field had a shortage of water supply in the late stage of growing.

7003 (SJ-2 Nema-shirazu)

Most of the plants had very short plant height and seemed not to be adaptable to dry season. Many plants selected in the field showed a dull color of seed coat.

7004 (Hougyoku x K. S. 167 (Tall type)

Most of the plants had very short plant height and showed serious shattering in the field. All materials were discarded.

7005 (Shin No. 4 x SJ-2)

The growth was very good and most of the plants showed desirable plant height. We could select many big seed size of plants. It seemed to be very promising.

7006 (SJ-2 x Kogane-juro)

The growth was good but we found symptoms of mosaic virus on the leaves and seed coats in many plants. All materials were discarded.

7011 (Shiro-daihachirin x Taichung No. 12)

Most of the plants grew very well but showed much lodging. All plants were injured by soybean rust and were harvested in bulk.

7013 (Tousan No. 26 x SJ-2)

The growth and plant type were very good. All plants, except the very short and early types, were harvested in bulk because they had rust damages in the late stages of growth.

7016 (E 27 x 700 F_1), 7017 (7001 F_1 x E 27)

Most plants showed short plant height. The late planting would be one of the reasons for this. Some of them were injured by stem miner. We harvested them in bulk.

7018 (E 27 x 7002 F_1)

Most plants showed similar growth with those of 7016 and 7017. They showed damages by stem miner. We harvested them in bulk.

7019 (Acadian x 64-104)

The growth and pod-setting were very good. They had lodging in the late stages. One of the parents, 64-104, showed some resistance to soybean rust and no damages. F_1 plants in this cross showed segregation into resistant types and susceptible types. We selected only these resistant types in the field. Many plants showed cracking of seed coat. We made a second selection for seed quality.

7023 (L 356 x SJ-2)

All plants showed very serious damages by soybean rust and were discarded.

7024 (64-104 x SJ-2)

Most plants showed good growth and good pod-setting but had much lodging in their late stages of growth. They showed segregation in the resistance to soybean rust.

First selection was made for the resistance to rust in the field, and second for the seed quality after harvesting. Seed size distributed was bigger than that of 7019.

7029 (Fusanari x SJ-2)

The growth was good but most plants had serious damages by rust. We harvested them in bulk.

7013 (Karikachi x SJ-2)

We made no detailed selection because they were planted very late.

7020 (SJ-2 x K. S. 252), 7021(KS. S252 x SJ-2), 7022(L. 356 x Acadian),7026 (SJ-2 x Acadian), 7030 (038(Small seed) x SJ-2), 7102 (SJ-2 x Taiching No. 12)

They are growing now.

Fig 1. shows the frequency distributions of random F_2 plants of 7001 (Bon-minori x SJ-2) in plant height, number of pods and 100 grain weight.

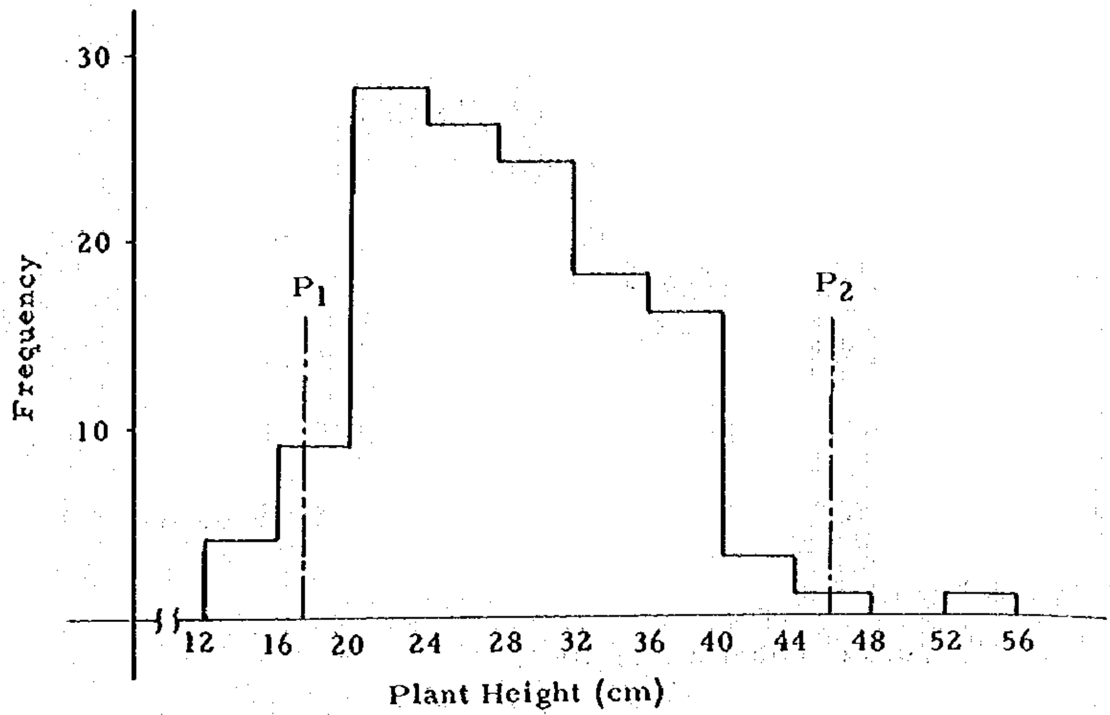

Fig. 1-a Frequency Distribution of Random F2 Plants (7001) in Plant Height

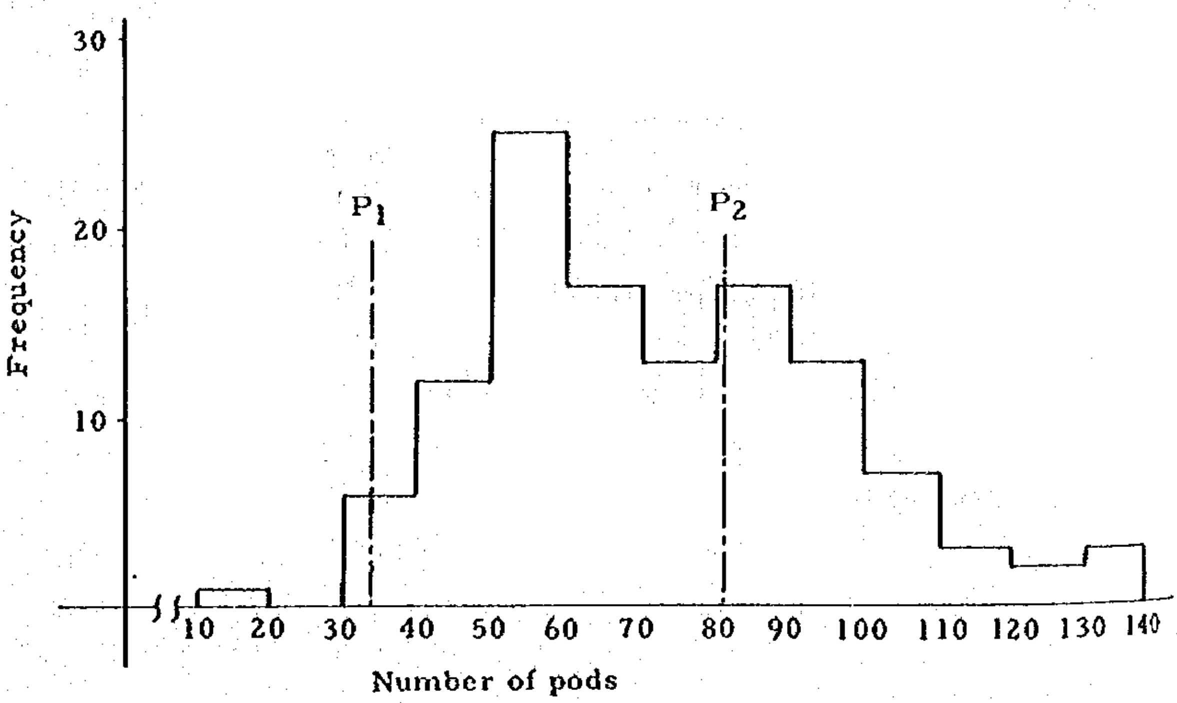

Fig. 1-b Frequency Distribution of Random F2 Plants (7001) in Number of Pods

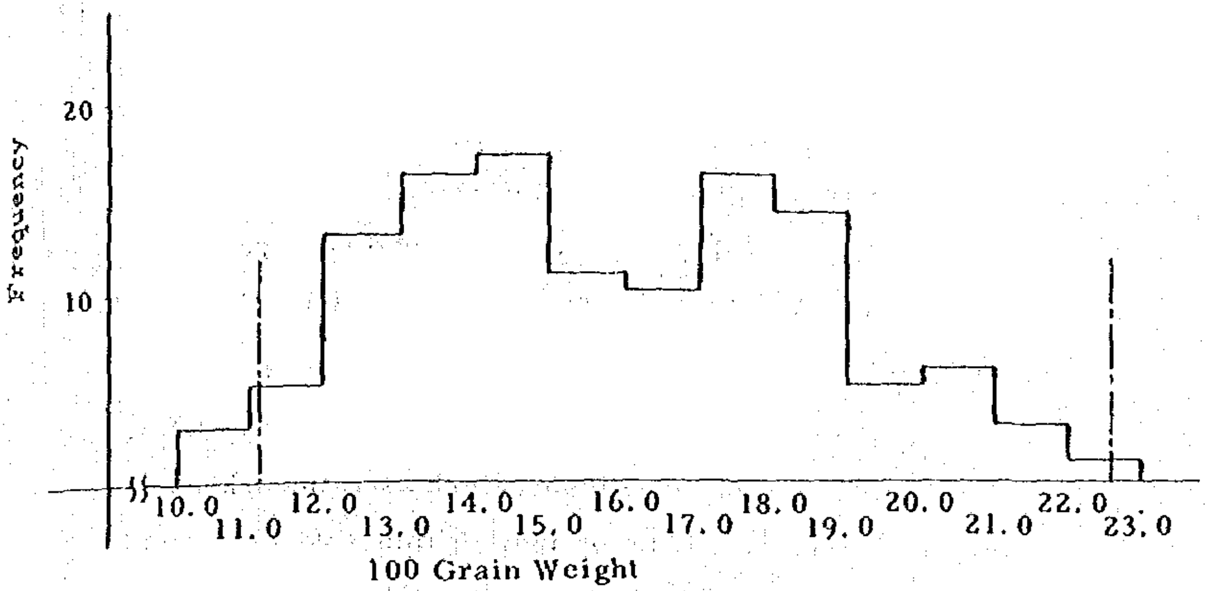

Fig. 1-c Frequency Distribution of Random F_2 Plants (7001) in 100 Grain Weight

(4) *Line and Individual Selection of F_3 Generation*

1) Materials and Methods

497 lines of 3 crosses in the rainy season of 1971 and 722 lines of 3 crosses and 4 bulks of 4 crosses in the dry season of 1972 were tested. 100 F_3 lines were grown at Srisamrong Agri. Exp. Sta., Sukhotahi, in the rainy season of 1971.

Spacing was 50cm x 10cm, one plant on a hill. Fertilizer (kg/rai) was supplied after emergence with the formula 3, 12, 12 and 1.5 (4.0 in the dry season of 1972) of N, P_2O_5, K_2O and $MgSO_4$, respectively. Plot size was 2.0 m^2.

2) Results and Discussions

Most materials of the three crosses grown at Mae Jo Agri. Exp. Sta. during the rainy season of 1971 showed very good growth.

But 7001 (Bon-minori x SJ-2) and 7005 (Shin No. 4 x SJ-2) had much lodging due to the heavy rainfall in the middle of August. 7002 (SJ-2 x Tokachi-nagaha) had many lines with stiff stalks and showed very little lodging. In the late stages of growth after flowering, all crosses showed damages by soybean rust. This interfered greatly with the selection work.

7001 (Bon-minori x SJ-2) grown at Srisamrong Agri. Exp. Sta. during the rainy season of 1971 had very good growth and no lodging. We did not recognize any damages by rust in these materials.

By the observation during growth periods, we classified our materials into three types, such as rainy season type, dry season type, middle or indiscriminative type, for the sake of convenience. The classification was mainly based on maturity and plant type of each line, but it was not conclusive. As a result, most lines of 7002 were rainy season types and those of 7005 were dry season or indiscriminative types. 7001 included three types.

Table 7 shows the selection and evaluation of each cross.

Table 7. Selection and Evaluation of Each Material in F_3 Generation

Cross No.	Parents Female x Male	Date of planting	Number of lines (or plants) tested	Number of lines selected	Number of plants selected	Evaluation			Remarks
						Plant type	Matu-rity	Qual-ity	
7001	Bon-minori x SJ-2	Jun. 17, 1971	156	42 21	276 *	3	4	4	2 Rep.
		Jun. 22	100	100	*	4	4	3	Sisamrong
02	SJ-2 x Tokachi-nagaha	Jun. 18	127	22	110	5	5	3	
05	Shin No. 4 x SJ-2	Jun. 18	114	44	*	3	3	3	
11	Shiro-daihachirin x Taichung No. 12	Jan. 29, 1972	1600**	-	-	-	-	-	Now growing
12	Karikachi x SJ-2	Feb.	200	-	-	-	-	-	
13	Tousan No. 26 x SJ-2	Jan. 29	2200**	-	-	-	-	-	
16	E 27 x 700 F_1	Jan. 29	1360**	-	-	-	-	-	
18	E 27 x 7002 F_1	Jan. 29	1730**	-	-	-	-	-	
19	Acadian x 64-104	Jan. 31	208	-	-	-	-	-	
24	64-104 x SJ-2	Feb. 2	314	-	-	-	-	-	

* Harvested in bulk ** Number of plants

General comments of each cross are as follows.

7001 (Bon-minori x SJ-2)

The growth was good but most of the materials had much lodging and damages by rust. This made the selection work difficult. We had individual selections within lines for the rainy season types. And we had no individual selection for the dry season types and the indiscriminative types and harvested them in bulk for each line.

The following lines which had a large degree of fixation in practical characters were used in the preliminary yield trials in the dry season of 1972.

7001-P_2-17; 7001-P_2-01; 7001-P_2-104; 7001-P_2-111; 7001-P_2-113; 7001-P_2-122; 7001-P_2-148. 7002 (SJ-2 x Tokachi-nagaha)

Most of the lines had strong stems and showed very little lodging. We recognized all materials as rainy season types.

7005 (Shin No. 4 x SJ-2)

Most of the lines showed very good growth but had serious lodging in their late stages. Selected lines were harvested in bulk.

The following lines were tested in the preliminary yield trials in the dry season of 1971.

7005-P -5; 7005-P -72; 7005-P -95; 7005-P -105; 7005-P -107. 7011 (Shiro-daihachirin x Taichung No. 12), 7012 (Karikachi x SJ-2), 7013 (Tousan No. 26 x SJ-2), 7016 (E 27 x 7001 F_1), 7018 (E 27 x 7002 F_1), 7019 (Acadian x 64-104), 7024 (64-104 x SJ-2)

All of them are growing now.

(5) Line and Individual Slection in F_4 Generation

(1) Materials and Methods

386 lines with 64 families and 163 F_2 derived-lines from 3 crosses were tested in the dry season of 1972. Spacing was 50cm x 10cm, one plant on a hill. Fiertilizer (kg/rai) was supplied after emergence with the formula 3, 12, 12 and 4 of N, P_2O_5, K_2O and $MgSO_4$.

(2) Results and Discussions

Materials are shown in Table 8. All of them are now growing.

Table 8. Materials of F_4 Generation

Cross No.	Parents Female x Male	Date of planting	Number of families tested	Number of lines tested	Remarks
7001	Bon-minori x SJ-2	Jan. 24, 1972	42	276	
		Jan. 24	*	21	
		Jan. 27	*	98	2 replications
02	SJ-2 x Tokachi-nagaha	Jan. 24	22	110	
05	Shin No. 4 x SJ-2	Jan. 25	*	44	

* Derived lines from F_2

PROTEIN AND OIL CONTENTS OF SOYBEAN PRODUCED IN THAILAND AND ITS VARIETAL DIFFERENCES

Preface

It was reported that soybean cultivation in Thailand had begun many years ago in the North (Wood house & Taylor, 1913). Japanese soybean researchers (1969) reported that Thai native varieties had high protein and low oil contents. We assume that soybeans in Thailand was very important as protein food and that high protein type of varieties was selected, consciously and unconsciously, during the long years of soybean cultivation. In Thailand there are several soybean foods such as "Toa-nao" (fermented soybean), "Taojice" (pickled soybean), "Tofu" (soybean cake), "Naam-tofu-kao" (soybean milk) and the others which are very useful as protein nutrition. Recently Thailand has come to require much soybean as oil materials. It is said that leading varieties SJ-1 and SJ-2 have a higher oil content than native varieties, but the data about the chemical composition of Thai soybeans is not adequate.

We analyzed the protein and oil contents of Thai soybean varieties and some introduced varieties which were grown in various environmental conditions. And we confirmed the protein and oil content levels of Thai soybean seeds and estimated the fluctuations of these chemical contents of each variety in different environmental conditions.

Materials and Methods

(1) Materials

23 varieties from Experiment-A, preliminary yield trial of introduced varieties. They were planted on January 13, 1971, at Mae Jo Agri. Exp. Sta.

13 varieties from Experiment-B preliminary yield trial of introduced varieties. They were planted on January 16, 1971, at Kalasin Seed Multi. Sta.

23 varieties from Experiment-C, yield trial of introduced varieties. They were planted on June 18, 1971, at Srisamrong Agri. Exp. Sta.

13 varieties from Experiment-D, yield trial in the late planting time of rainy season. They were planted on July 23, 1971, at Mae Jo Agri. Exp. Sta.

(2) Analysis

The analysis was carried out by the Yokohama Branch, Nippon Yuryo Kentei Kyokai, using the method of the Japan Oil Chemists Society. Protein content (%) was calculated by the following formula.

Protein content (%) = Total nitrogen content (%) x 6.25

Results

Table 1 shows chemical analyses of 23 varieties from Experiment A (Exp. A) and Experiment C (Exp. C). Exp. -A corresponds to the normal dry season soybeans in Thailand, and Exp. C to the normal rainy season soybeans. Variance analyses of protein and oil contetns are shown in Table 2a and Table 2b, respectively, and the multiple range test of oil content is shown in Table 3.

As Table 1 and Table 2 show, the differences between A and C in protein and oil contents were highly significant. All varieties except 64-104 showed higher protein contents in Exp. C than in Exp. A and showed higher oil contents in Exp. A than in Exp. C. One of the recommended varieties, SJ-1, showed 21.33% oil content in Exp. A and 20.63% in Exp. C, and the another recommending variety, SJ-2, showed 22.66% oil content in Exp. A and 21.43 % in Exp. C. Thai native varieties Pakchong and SB 60 belonged to the lowest group in oil content of all materials tested. Oil contents of K.S. 167 (Tall type) and K.S. 252 were very high though they were not significantly different from that of SJ-2.

Table 1. Comparison of Chemical Components between Dry Season and Rainy Season Soybeans

Variety	Protein (%)		Oil (%)		Acid Value	
	A (Dry season)	C (Rainy season)	A	C	A	C
1 Acadian	38.81	47.38	23.23	19.85	0.95	1.08
2 64-4 (Large seed)	39.81	44.44	23.13	19.54	0.84	0.92
3 K.S. 167 (Small seed)	39.81	44.75	24.04	21.04	0.65	1.04
4 K.S. 167 (Tall type)	39.00	43.31	24.06	22.60	0.65	1.07
5 K.S. 252	40.88	43.06	24.24	21.94	0.68	1.21
6.Hill	37.31	42.88	23.63	20.84	1.10	1.22
7 Taiching No. 12	43.18	44.44	21.48	21.23	0.72	0.80
8 NTU K.S. No. 5	41.25	44.00	21.13	21.12	0.68	0.93
9 L-356	42.06	46.81	23.60	20.22	1.34	1.05
10 SJ-1	39.69	44.31	21.33	20.63	0.95	1.05
11 SJ-2	41.81	44.0	22.65	21.43	0.94	0.84
12 Australia	40.88	43.25	22.41	21.54	0.88	1.00
13 Aksarben	44.75	46.06	19.90	16.99	1.46	0.91
14 R-485	39.50	45.13	24.34	21.09	0.72	0.91
15 Tainung 3	42.56	43.50	21.54	19.92	0.74	0.97
16 64-104	47.19	45.56	16.60	19.80	0.66	1.03
17 Shiro-daizu	42.13	43.81	20.16	19.55	0.72	0.79
18 0-121	41.31	45.44	21.30	20.28	0.63	1.06
19 Chung Hsing (Unknown)	39.19	44.81	23.89	20.33	0.98	0.88
20 Pakchong	42.94	46.25	18.80	17.37	0.96	0.90
21 SB 60	40.25	48.13	19.55	15.04	0.80	0.81
22 Dalat B	40.88	45.81	20.05	18.98	0.70	1.03
23 Edna	43.25	45.56	19.99	19.04	0.90	0.95
Average	41.24	44.90	21.78	20.05	0.85	0.98
Variance	4.7005	1 9877	4.2373	3.0265	-	-

Table 2a. Variance Analyses of Protein Content

Factor	d. f.	S. S.	M. S.	F Value
Total	45	301. 4471		
Season (Location)	1	154. 3057	154. 3057	56. 7651**
Variety	22	87. 3384	3. 9699	1. 4604 N. S.
Error	22	59. 8031	2. 7183	

** Exceeds the 1% level C. V. = 3. 83 %

Table 2b. Variance Analyses of Protein Content

Factor	d. f.	S. S.	M. S.	F Value
Total	45	194. 3786		
Season (Location)	1	34. 5742	34. 5742	25. 4197**
Variety	22	129. 8816	5. 9037	4. 3405**
Error	22	29. 9228	1. 3601	

C. V. = 5. 58 %

Table 3. Duncan's Multiple Range Test of Oil Content

Variety	Average Oil Content
4 K. S. 167 (Tall type)	23. 33 a
5 K. S. 252	23. 09 a
3 K. S. 167 (Small seed)	22. 94 a
14 R-485	22. 72 a
6 Hill	22. 24 ab
19 Chung Hsing (Unknown)	22. 11 abc
11 SJ-2	22. 04 abc
12 Australia	21. 98 abc
9 L-356	21. 91 abc
1 Acadian	21. 54 abc
7 Taichung No. 12	21. 36 abc
2 64-4 (Large seed)	21. 34 abc
8 NTU K. S. No. 5	21. 13 abdc
10 SJ-1	20. 98 abcd
15 0-121	20. 79 abcd
15 Tainung 3	20. 73 abcd
17 Shiro-daizu	19. 86 abcd
22 Dalat B	19. 52 abcd
23 Edna	19. 52 abcd

Variety	Average Oil Content
13 Aksarben	18.44 bcd
16 64-104	18.20 bcd
20 Pakchong	18.09 cd
21 SB 60	17.30 d

Values of average oil content followed by same letter are not significantly different; those not followed by the same letter are significantly different at the 5% level.

In order to estimate the fluctuations of protein and oil contents in various environmental conditions, we calculated the variance of each variety between experiments and the regression coefficient of each variety on the mean of all varieties in each experiment, selecting 13 common varieties in Exp. A, B, C and D. The results are shown in Table 4a and Table 4b.

Variance analyses and multiple range test of protein and oil contents are shown in Tables 5a, 5b and Tables 6a, 6b, respectively.

As Table 4a shows, the fluctuations of protein content were large in SB 60, Pakchong, Dalat B, Chung Hsing (Unknown), 0-121 and K. S. 167 (Tall type) and very little in Taichung No. 12 and Tainung 3. Those of K. S. 252, NTU K. S. No. 5, SJ-2 and Shiro-daizu were lower than the average of all varieties. 64-104 showed the different performance of fluctuation from other varieties. The fluctuations of oil content in SB 60, Chung Hsing (Unknown), K. S. 252 and Pakchong were large, and those in Taichung No. 12, NTU K.S. No. 5, 0-121, Shiro-daizu and K. S. 167 (Tall type) were small. SJ-2, Tainung 3 and Dalat B showed nearly the same fluctuations as the average of all varieties, and 64-104 showed different performance from other varieties.

The fluctuations of protein and oil contents were not closely related (Fig. 1).

As Tables 5a, 5b and Tables 6a, 6b show, the protein content of Exp. C, which corresponds to the typical soybean growth of the rainy season in Thailand, was significantly higher than those of Exp. A, B and D. And the oil content of Exp. C was significantly lower than those of others.

Table 4a Protein Content (%) and Its Fluctuation of Each Variety in Various Environments

Variety	A (Dry season)	B (Dry season)	D (Rainy season)	D (Late rainy season)	Variance	b*
1 K. S. 167 (Tall type)	39.00	40.94	43.31	40.81	3.1250	1.5839
2 K. S. 252	40.88	39.94	43.06	40.88	1.7505	0.6528
3 Taichung No. 12	43.18	44.00	44.44	44.50	0.3708	0.2890
4 NTU K. S. No. 5	41.25	41.25	41.25	44.06	1.6834	0.7900
5 SJ-2	42.81	42.94	44.00	42.06	0.9831	0.7467
6 Tainung 3	42.56	44.00	43.50	42.25	0.6607	0.4207
7 64-104	47.19	47.69	45.56	44.88	1.7615	0.2402
8 Shir0-daizu	42.13	55.13	43.81	41.75	2.4481	0.7725
9 0-121	41.31	44.81	45.44	41.88	4.2739	1.4767
10 Chung Hsing (Unknown)	39.19	43.81	44.81	43.88	6.3996	1.4996
11 Pakchong	42.94	44.31	46.25	41.25	4.4847	1.3735
12 SB 60	40.25	42.81	48.13	43.38	10.8029	2.3119
13 Dalat B	40.88	42.50	45.81	41.81	4.6022	1.5792
Mean	41.74	43.39	44.78	42.41	-	-
Variance	4.3483	4.0930	2.0433	1.7637	-	-

*: Regression coefficient of each variety on the mean of all varieties.

Table 4b. Oil Content (%) and Its Fluctuation of Each Variety in Various Environments

Variety	A (Dry season)	B (Dry season)	C (Rainy season)	D (Late rainy season	Variance	b*
1 K.S. 167 (Tall type)	24.06	23.23	22.60	22.53	0.5044	0.7297
2 K.S. 252	24.24	24.26	21.94	22.62	1.3708	1,7506
3 Taichung No. 12	21.48	22.14	21.23	21.39	0.1002	0.4854
4 NTU K.S. No.5	21.13	22.45	21.12	21.29	0.4093	0.5998
5 SJ-2	22.65	22.79	21.43	21.62	0.5853	0.9850
6 Tainung 3	21.54	21.124	19.92	21.07	0.4851	1.0536
7 64-104	16.60	18.63	19.80	19.26	1.9578	1.5111
8 Shiro-daizu	20.16	20.60	19.55	20.83	0.3174	0.6685
9 0-121	21.30	21.00	20.28	21.63	0.3314	0.6273
10 Chung Hsing (Unknown)	23.89	22.37	20.33	21.39	2.2900	2.0156
11 Pakchong	18.80	19.44	17.37	18.51	0.7490	1.3756
12 SB 60	19.56	19.02	15.04	18.29	4.0954	3.1938
12 Dalat B	20.05	20.54	18.98	20.66	0.5056	1.0415
Mean	21.19	21.35	19.97	20.85	-	-
Variance	1.9178	2.9009	4.0265	1.8813	-	-

Table 5a. Variance Analysis of Protein Content

Factor	d. f.	S. S.	M. S.	F Value
Total		215. 0017		
Envirnnment	3	68. 0213	22. 6738	13. 1616**
Variety	12	84. 9624	7. 0802	4. 1009**
Error	36	62. 0178	1. 7227	

C. V. = 3. 05 %

Table 5b. Variance Analysis of Oil Content

Factor	d. f.	S. S.	M. S.	F Value
Total	51	179. 6159		
Environment	3	14. 8980	4. 9660	6. 7906**
Variety	12	138. 3910	11. 5326	15. 7699**
Error	36	26. 3270	0. 7313	

C. V. = 4. 10 %

Table 6a. Multiple Range Test of Protein Content

Variety	Average Protein Content
7 64-104	46. 33 a
3 Taichung No. 12	44. 03 b
11 Pakchong	43. 69 b
12 SB 60	43. 64 b
9 0-121	43. 36 bc
8 Shiro-daizu	43. 21 bcd
6 Tainung 3	43. 08 bcd
10 Chung Hsing (Unknown)	42. 92 bcd
13 Dalat B	42. 75 bcd
5 SJ-2	42. 70 bcd
4 NTU K. S. No. 5	42. 14 bcd
2 K. S. 252	41. 19 cd
1 K. S. 167 (Tall type)	41. 02 d

Environment	Average Protein Content
C (Rainy season)	44. 78 a
B (Dry season)	43. 39 b
D (Late rainy season	42. 41 bc
A (Dry season)	41. 74 c

Table 6b. Multiple Range Test of Oil Content

Variety	Average Oil Content
2 K. S. 252	23.27 a
1 K. S. 167 (Tall type)	23.11 a
5 SJ-2	22.12 ab
10 Chung Hsing (Unknown)	22.00 ab
3 Taichung No. 12	21.56 bc
4 NTU K. S. No. 5	21.50 bc
9 0-121	21.05 bcd
6 Tainung	20.92 bcd
8 Shiho-daizu	20.29 dc
13 Dalat B	20.06 d
7 64-104	18.57 e
11 Pakchong	18.53 e
12 SB 60	17.98 e

Environment	Average Oil Content
B (Dry season)	21.35 a
A (Dry season)	21.19 a
D (Late rainysseason)	20.85 a
C (Rainy season)	19.97 b

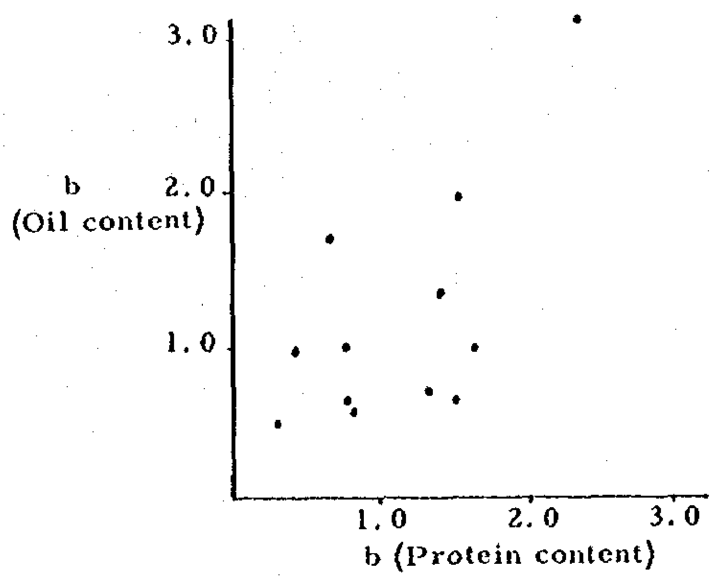

Fig. 1 Relation between Fluctuations of Protein and Oil Contents

Discussion and Conclusion

We recognized the the leading Thai varieties SJ-1 and SJ-2 had high oil content and were comparable to world commercial varieties with high oil content. SJ-2 has about 1 % higher oil content than SJ-1 and is most promising for oil materials. On the other hand, Thai native varieties, SB 60 and Pak-chong, have low oil content.

Most varieties showed large fluctuations in protein and oil contents between different environmental conditions, and especially rainy season soybeans grown at Srisamrong Agri. Exp. Sta. showed a higher protein content and a lower oil content than other soybeans. According to the purpose of use, not only varieties but also cultivating conditions of soybeans should be considered.

Varietal difference in the fluctuations of protein and oil contents between environmental conditions was clear. The breeding of varieties with high as well as stable protein or oil content will be greatly expected in the future.

GROWTH STABILITY BETWEEN PLANTING TIMES IN SOME CHARACTERS OF THAI SOYBEAN VARIETIES

Preface

In Thailand, there are several soybean growing season such as dry season, early rainy season and late rainy season, and each growing season has long planting periods from the beginning to the end. The purpose of this experiment is to estimate the stability between planting times of typical Thai soybean varieties and to find out useful information for selection of varieties for practical use and for breeding work. The relation between soybean growing and climatical condition is also discussed.

Most of the statistical analyses in this experiment was carried out by Mr. Sophon Sinthuprama and other staff of the Statistic Research Laboratory, Department of Agriculture. We are deeply grateful to them for their kindness and co-operation.

Materials and Methods

(1) Place

Mae Jo Agricultural Experiment Station, Chiengmai

(2) Materials

Ten varieties were tested.

Thai varieties: SJ-1, SJ-2, Pakchong SB 60

Introduced varieties: Tainung 3 (Taiwan), Chung Hsing (Unknown) (Taiwan), Bon-minori (Japan), Tousan No. 26 (Japan), Acadican (U. S. A.), Ouhouju (China).

(3) Time of Planting

Four times with one month interval.

May. 31, June 30, July 30 and August 30 in 1971.

(4) Planting Methods

Two plants were grown in a 1/2000 are plastic Wager pot with triplication. Fertilizer was supplied before planting with the formula (kg/rai) 12, 48 and 48 of N, P_2O_5 and K_2O, respectively.

Results

(1) Daylength and Average Temperature

Daylength and average temperature during the soybean growing are shown in Table 1. Soybeans planted first had the longest daylength, and the daylength became shorter month by month. Average temperatures were not much different from June to September.

Temperature began to go down on October.

Table 1. Daylength and Temperature (Chiengmai)

	June	July	August	September	October	November
Daylength	13:16	13:09	12:45	12:15	11:44	11:15
Average temperature (°C)	27.17	26.45	26.12	26.78	24.84	21.65

(2) Growing Periods

(a) Number of Days from Planting to Flowering.

Number of days from planting to flowering in each variety and each planting time are shown in Table 2. To estimate the stability of each variety, we calculated the variances between planting times, the monthly average decreases and the regression coefficients of each variety on the mean of all varieties at each planting time. These are shown in Table 3.

Most of the varieties decreased their number of days from planting to flowering in the late planting times, but Bon-minori, Tousan No. 26 and Ouhouju, which were introduced from the northern countries with high degree of latitude, fluctuated very little between planting times. Among four Thai varieties, SB 60, which is a local variety for dry season in the northern parts of Thailand, showed the most decrease, bollowed by Pak-chong and SJ-2. SJ-1 had the lease fluctuation of the four Thai varieties.

Average temperatures and accumulated average temperatures of each variety during the period from planting to flowering are shown in Table 4.

Because the difference of average temperatures between planting times was very little in all varieties, the decrease in number of days from planting to flowering by delayed plantings would be caused mainly by the short daylength.

Fig. 1 shows the relation between the number of days from planting to flowering and the regression coefficient of each variety on the mean of all varieties. As Fig. 1 shows, the decrease by dalayed planting is closely related with the growing period but SJ-1. Bon-minori had less decrease than those of other varieties with similar growing periods to flowering.

Type 2. Number of Days from Planting to Flowering

Variety \ Time of planting	May 31	June 30	July 30	August 30
SJ-1	39.2	38.0	36.5	35.2
SJ-2	41.5	40.2	37.3	34.2
Pakchong	43.3	40.6	36.5	34.7
SB 60	52.6	47.6	42.2	40.8

Variety \ Time of planting	May 31	June 30	July 30	August 30
Tainung 3	37.8	36.7	34.0	31.2
Chung Hsing (Unknown)	41.1	40.0	36.7	34.2
Bon-minori	28.8	30.0	30.0	29.0
Chung Hsing (Unknown)	41.1	40.0	36.7	34.2
Bon-minori	28.8	30.0	30.0	29.0
Tousan No. 26	31.3	30.6	30.0	29.0
Acadian	44.7	41.2	38.3	36.2
Ouhouju	25.0	26.0	26.0	24.0
Mean	38.56	37.09	34.75	32.87
Variance between varieties	67.43	41.57	22.98	21.80

Table 3. Averages and variances between planting times, monthly average decreases and regression coefficients of each variety on the mean of all varieties in the number of days from planting to flowering

Variety \ Time of planting	Average of planting times	Variance between planting times	Monthly average decrease	Regression coefficient on the main
SJ-1	37.23	3.04	1.35	0.693
SJ-2	38.30	10.55	2.48	1.283
Pakchong	38.78	9.68	2.99	1.538
SB 60	45.80	29.15	4.08	2.084
Tainung 3	34.93	8.72	2.25	1.166
Chung Hsing (Unknown)	38.08	10.56	2.49	1.289
Bon-minori	29.45	0.41	-0.06	-0.018
Tousan No. 26	30.28	0.80	0.69	0.353
Acadian	20.10	13.61	2.84	1.446
Ouhouju	25.25	0.92	0.30	0.166
Mean	35.82	8.74	1.94	1.000

Table 4. Average temperatures and accumulated average temperatures during the period from planting to flowering

Variety	May 31		June 30		July 30		August 30	
	AT*	AAT*	AT	AAT	AT	AAT	AT	AAT
SJ-1	27.06	1055.5	26.42	1003.8	26.18	968.8	26.72	935.2
SJ-2	27.11	1130.7	26.38	1055.3	26.18	968.8	26.71	908.2
Pakchong	27.11	1165.9	26.38	1081.6	26.18	968.8	26.72	935.2
SB 60	26.93	1427.1	26.35	1265.0	26.17	1099.0	26.64	1092.1
Tainung 3	27.04	1027.7	26.44	978.1	26.17	889.8	26.81	831.2
Chung Hsing (Unknown)	27.11	1111.4	26.38	1055.3	26.18	968.8	26.71	908.2
Bon-minori	27.18	788.1	26.46	793.7	26.06	781.7	26.79	777.0
Tousan No. 26	27.14	841.4	26.45	820.0	26.06	781.7	26.79	777.0
Acadian	27.03	1216.4	26.38	1081.6	26.19	995.2	26.74	962.5
Ouhouju	27.15	678.7	26.40	686.5	26.15	679.9	26.80	643.2

* AT: Average temperature
AAT: Accumulated average temperature

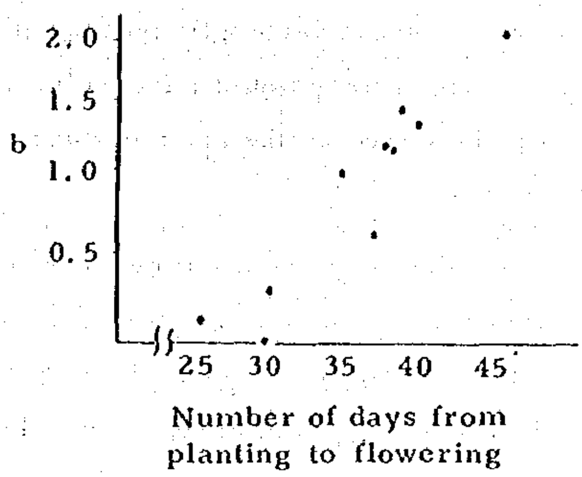

Fig. 1 Relation between number of days from planting to flowering and regression coefficients (b) of each variety on the mean of all varieties

(b) Number of Days from Flowering to Maturing

In Table 5, we showed the number of days from flowering to maturing in the planting on May 31 and August 30. We did not obtain reliable data for those in the planting on June 30 and July 30 because soybean rust injured our materials in their late stages of growing. As Table 5 shows, all varieties decreased their growing periods from flowering to maturing by delayed plantings. Among four Thai varieties, Pakchong decreased the most, and SB 60 was next. The decreases of SJ-1 and SJ-2 were much smaller than those of Pakchong and SB 60. The decreases of growing periods from flowering to maturing were not closely related with the decreases of those to flowering as Fig. 2 shows.

Average temperatures and accumulated average temperature of each variety during the growing periods from flowering to maturing are shown in Table 6. The average temperatures in the planting on August 30 were lower than those on May 31. We assume that the decreases by delayed plantings are caused mainly by the short daylength because it was considered that the low temperatures would adversely affect the decreases. The soil moisture and the air moisture also might be somewhat effective.

Fig. 3 shows the relation between the number of days from flowering to maturing and regression coefficient of each variety on the mean of all varieties. The regression coefficients were related with the growing periods, but the decrease of Pakchong was very serious, and those of Ouhouju and SJ-2 were not serious compared with other varieties with similar growing periods.

Table 5. Number of Days from Flowering to Maturing

Variety	May 31	Aug. 30	Average of planting times	Monthly average decrease	Regression coefficient on the main
SJ-1	57.8	48.8	53.30	3.00	0.96
SJ-2	63.5	56.8	60.15	2.23	0.72
Pakchong	68.7	45.6	57.15	7.70	2.47
SB 60	64.4	50.2	57.30	4.73	1.52
Tainung 3	48.2	45.8	47.00	0.80	0.26
Chung Hsing (Unknown)	69.8	56.8	63.30	3.33	1.39
Bon-minori	55.2	48.0	51.60	2.40	0.77
Tousan No. 26	53.4	47.8	50.60	1.87	0.60
Acadian	59.1	48.8	53.95	3.43	1.10
Ouhouju	59.0	57.0	58.00	0.67	0.21
Mean	59.91	50.56	55.24	3.02	1.00

Table 6. Average temperatures and accumulated average temperatures during the period from flowering to maturing

Variety	May 31		August 30	
	AT	AAT	AT	AAT
SJ-1	26.24	1522.2	23.49	1150.8
SJ-2	26.20	1650.3	23.15	1319.7
Pakchong	26.29	1814.0	24.02	1080.8
SB 60	26.37	1687.5	22.72	1135.8
Tainung 3	26.27	1261.1	24.60	1131.5
Chung Hsing (Unknown)	26.32	1868.5	23.15	1319.7
Bon-minori	26.31	1446.8	24.70	1185.7
Tousan No. 26	26.29	1419.6	24.70	1185.7
Acadian	26.19	1545.3	24.06	1179.0
Ouhouju	26.38	1556.2	24.40	1390.8

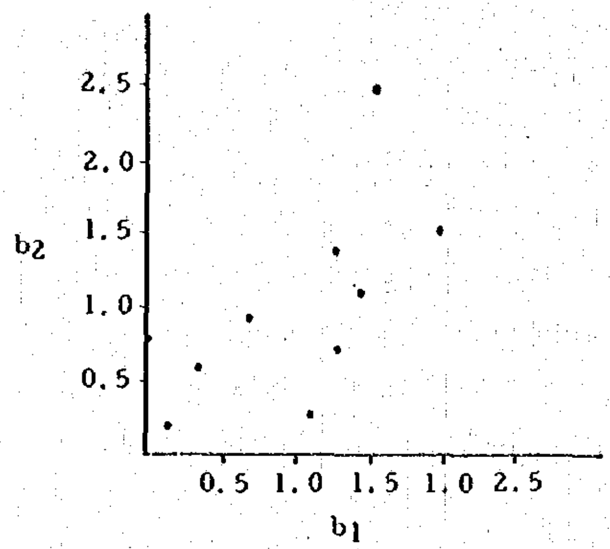

Fig. 2 Relation between regression coefficients (b_1) of number of days from planting to flowering and those (b_2) of number of days from flowering to maturing

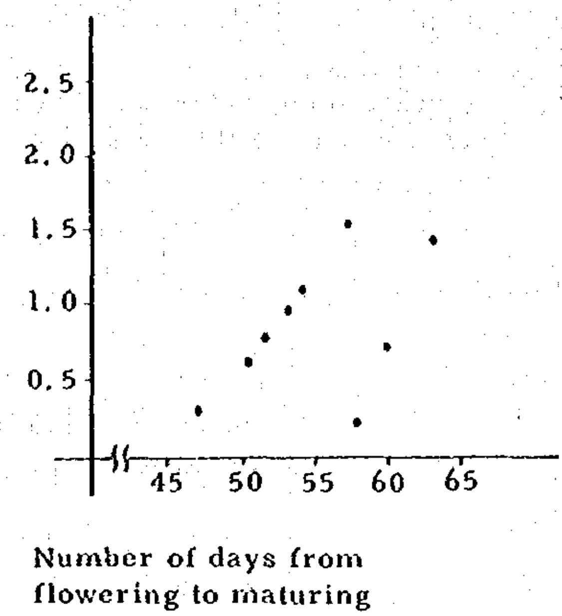

Fig. 3 Relation between number of days from flowering to maturing and regression coefficients (b) of each variety on the mean of all varieties

(c) Number of Days from Planting to Maturing

Number of days from planting to maturing, except those on June 30 and July 30, are shown in Table 7, and average temperatures and accumulated temperatures during the gorwing periods are shown in Table 8.

Among Thai varieties, Pakchong showed the greatest decrease in the growing periods by delayed plantings, followed by SB 60. The decreases of SJ-1 and SJ-2 are less than those of Pakchong and SB 60.

The average temperatures and the accumulated average temperatures during the growing of all varieries planted on May 31 were higher than those planted on August 30.

The relation between growing periods and regression coefficient on the average of all varieties is showed in Fig. 4. The decreases of Ouhouju, SJ-1 and SJ-2 by delayed planting were less than those of other varieties with similar growing periods. On the other hand, the decrease of Pakchong was much larger than those of other varieties with similar growing periods.

Table 7. Number of Days from Planting to Maturing

Variety	May 31	Aug. 30	Average of planting times	Monthly average decrease	Regression coefficient on the main
SJ-1	97.0	84.0	95.50	4.33	0.86
SJ-2	105.0	91.0	98.00	4.67	0.93
Pakchong	112.0	80.3	96.15	10.57	2.11
SB 60	117.0	91.0	104.00	8.67	1.73
Tainung 3	86.0	77.0	81.50	3.00	0.60
Chung Hsing (Unknown)	111.2	91.0	101.10	6.73	1.34
Bon-minori	84.0	77.0	80.50	2.33	0.47

Variety	May 31	Aug. 30	Average of planting times	Monthly average decrease	Regression coefficient on the main
Tousan No. 26	84.7	77.0	80.85	2.57	0.51
Acadian	103.8	85.0	94.40	6.27	1.25
Ouhouju	84.0	81.0	82.50	1.00	0.20
Mean	98.47	83.43	91.45	5.01	1.00

Table 8. Average temperatures and accumulated average temperatures during the period from planting to maturing

Variety	May 30		August 30	
	AT	AAT	AT	AAT
SJ-1	26.57	2577.7	24.83	2086.0
SJ-2	26.56	2789.0	24.48	2227.9
Pakchong	26.61	2979.9	25.20	2016.0
SB 60	26.62	3144.6	24.48	2227.9
Tainung 3	26.61	2288.8	25.49	1962.7
Chung Hsing (Unknown)	26.61	2979.9	28.48	2227.9
Bon-minori	26.61	2234.9	25.49	1962.7
Sousan No. 26	26.60	2261.0	25.49	1962.7
Acadian	26.55	2761.7	25.19	2141.5
Ouhouju	26.61	2234.9	25.11	2034.0

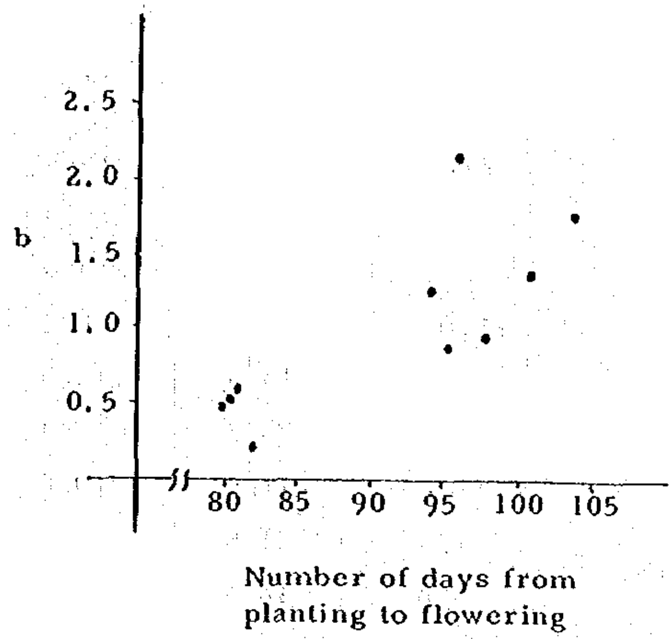

Fig. 4 Relation between number of days from planting to maturing and regression coefficients (b) of each variety on the mean of all varieties

(3) Number of Nodes on the Main Stem

Number of nodes on the main stem and the fluctuations between planting times are shown in Table 10 and Table 11, respectively.

As these tables show, all varieties decreased their number of nodes on the main stem by delayed planting. The decreases of Acadian, Chung Hsing (Unknown) and SJ-1 were very large, SB 60 and Tainung 3 came next. Those of Pakchong and SJ-2 were not so large, and Bon-minori, Tousan No. 26 and Ouhouju changed very little in the number of nodes.

Fig. 5 shows the relation between the number of nodes on the main stem and the regression coefficient of each variety on the mean of all varieties.

Table 9. Number of Nodes on the Main Stem

Variety \ Time of planting	May 31	June 30	July 30	August 30
SJ-1	21.3	17.2	15.8	16.0
SJ-2	19.0	16.6	16.5	15.5
Pakchong	16.8	16.2	14.5	14.2
SB 60	23.0	21.0	20.2	18.2
Tainung 3	15.3	13.3	12.3	11.0
Chung Hsing (Unknown)	24.0	2-.3	18.3	18.7
Bon-minori	11.e	11.0	10.0	9.7
Tousan No. 26	11.0	11.5	9.8	9.2
Acadian	23.0	16.6	16.3	16.2
Ouhouju	13.7	13.2	11.8	13.0
Mean	17.84	15.71	14.55	14.17
Variance between varieties	24.30	11.72	12.26	11.34

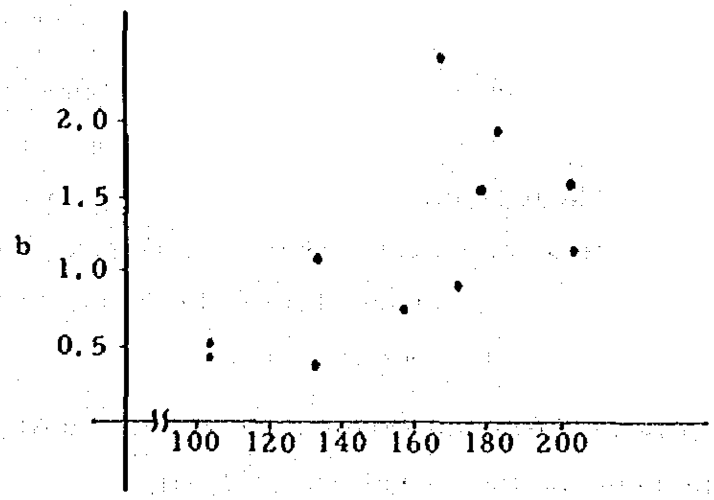

Fig. 5 Relation between number of nodes on the main stem and regression coefficients (b) of each variety on the mean of all varieties

Table 10. Averages and variances between planting times, monthly decreases and regression coefficients of each variety on the mean of all varieties in the number of nodes on the main stem

Variety	Average of planting times	Variance between planting times	Monthly average decrease	Regression coefficient on the main
SJ-1	17.58	6.55	1.73	1.52
SJ-2	16.95	2.18	1.08	0.87
Pakchong	15.43	1.62	0.95	0.72
SB 60	20.60	3.95	1.52	1.13
Tainung 3	12.98	3.29	1.39	1.07
Chung Hsing (Unknown)	20.33	6.75	1.79	1.55
Bon-minori	10.56	0.59	0.58	0.43
Tousan No. 26	10.38	1.12	0.71	0.47
Acadian	18.03	11.03	2.07	1.89
Ouhouju	12.93	0.65	0.35	0.35
Mean	15.58	3.77	1.21	1.00

(4) Plant Height

Plant heights and the fluctuations between planting times are shown in Table 12 and Table 13, respectively. We did not show plant heights on July 30 of planting time because of serious rust damages.

Most varieties decreased in plant height by delayed planting, but Bon-minori, Tousan No. 26 and Ouhouju changed their plant height very little between planting times. The decreases of Acadian and Chung Hsing (Unknown) were very serious and those of SB 60 and SJ-1 followd. The decreases of SJ-2 and Pakchong were not very large.

Fig. 6 shows the relation between plant height and regression coefficient of each varieties on the mean of all varieties. The decrease by delayed plantings were closely related with the plant height. The decreases of Ouhouju and SJ-2 were less than those of other varieties with similar plant height.

Fig. 7 shows the relation between regression coefficients of number of nodes on the main stem and plant height. In Table 14, length of average internode is shown.

The length of average internode was not much changed between planting times. The decreases of plant height were closely related with the number of nodes on the main stem.

Table 11. Plant Height (cm)

Variety / Time of planting	May 31	July 30	August 30
SJ-1	81.0	62.0	65.0
SJ-2	66.0	61.9	57.0
Pakchong	46.8	40.5	37.8
SB 60	83.4	70.0	62.0
Tainung 3	53.7	45.5	40.8
Chung Hsing (Unknown)	99.4	76.7	69.8
Bon-minori	25.5	26.2	22.2
Tousan No.26	30.7	295.	26.0
Acadian	93.5	61.1	63.0
Ouhouju	32.2	31.6	33.3
Mean	61.22	50.50	47.69
Variance between varieties.	746.64	328.33	309.65

Table 12. Averages and variances between planting times, monthly average decreases and regression coefficients of each variety on the mean of all varieties in the plant height

Variety	Average of planting times	Variacne between planting times	Monthly average decrease	Regression coefficient on the main
SJ-1	69.33	104.33	5.93	1.35
SJ-2	61.63	20.30	2.86	0.59
Pakchong	41.70	21.33	3.02	0.64
SB 60	71.80	116.92	7.07	1.49
Tainung 3	46.67	42.62	4.27	0.90
Chung Hsing (Unknown)	81.97	239.84	10.08	2.17
Bon-minori	24.63	4.56	0.89	0.16
Tousan No. 26	28.73	5.96	1.43	0.28
Acadian	72.53	330.60	11.03	2.47
Ouhouju	32.37	0.74	-0.27	-0.04
Mean	53.14	88.72	4.63	1.00

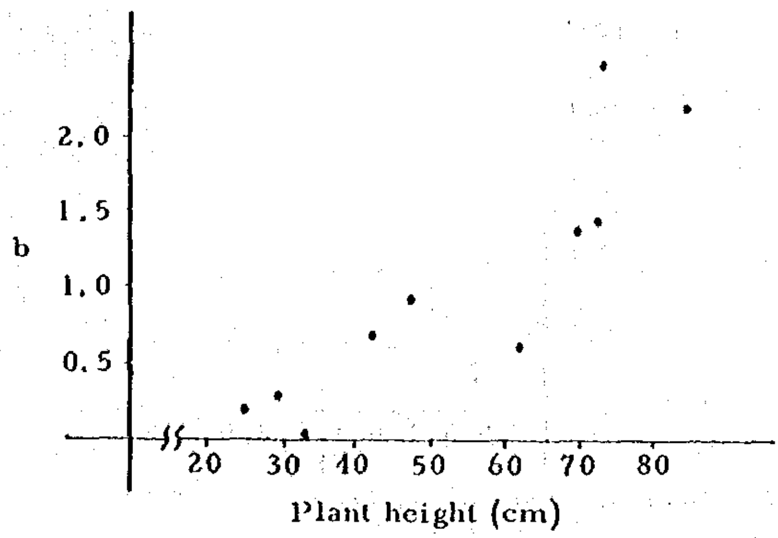

Fig. 6. Relation between plant height and regression coefficient (b) of each variety on the mean of all varieties

Table 13. Length of Average Internode on the Main Stem (cm)

Variety	May 31	June 30	August 30
SJ-1	3.80	3.92	.06
SJ-2	3.47	3.75	3.68
Pakchong	2.79	2.79	2.66
SB 60	3.63	3.47	3.41
Tainung 3	3.51	3.70	3.71
Chung Hsing (Unknown)	4.14	4.19	3.73
Bon-minori	2.26	2.26	2.29
Tousan No. 26	2.79	3.01	2.83
Acadian	4.07	3.75	3.89
Ouhouju	2.35	2.68	2.56
Mean	3.28	3.39	3.28

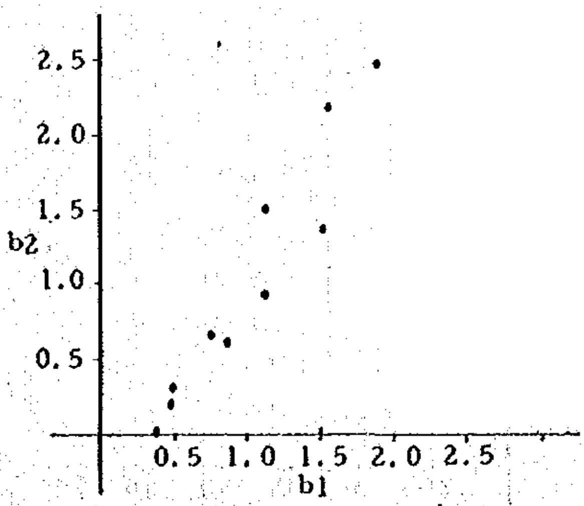

Fig. 7. Relation between regression coefficients of each variety on the mean of all varieties in number of all varieties in number of nodes on the main stem (b_1) and plant height (b_2)

(5) Degree of Indeterminate Type of Growth

Degree of indeterminate type of growth was dealt with as a quantitative charactor in this experiment and was calculated by the following formula.

$$\text{Degree of indeterminate type of growth} = \frac{A - B}{A} \times 100\ (\%)$$

A: Number of nodes on the main stem in maturing time.
B: Number of nodes on the main stem in flowering time.

Degree of indeterminate type of growth and the fluctuation between planting time are shown in Table 14 and Table 15, respectively.

Chung Hsing (Unknown), Ouhouju, SJ-1 and Acadian had a high degree of indeterminate type of growth. SJ-2 also showed a high degree although SJ-2 usually seems to be determinate with a pod cluster on the top of the main stem. The degree of indeterminate type of Pakchong and SB 60 is lower than that of SJ-1 and SJ-2.

Table 15 shows the fluctuation of degree of indeterminate growth between planting times. All varieties decreased their degree of indeterminate growth by delayed plantings. The decreases of Thai varieties except SJ-1 were lower than those of all other varieties.

Table 14. Degree of Indeterminate Type of Growth

Variety	May 31	June 30	July 30	August 30
SJ-1	38.0	30.2	26.5	26.8
SJ-2	31.5	29.7	27.2	29.0
Pakchong	24.4	22.2	20.8	19.7
SB 60	26.0	27.6	24.2	18.2
Tainung 3	15.0	11.2	0.8	4.5
Chung Hsing (Unknown)	42.5	32.5	27.8	28.8
Bon-minori	13.2	10.9	0.0	4.1
Tousan No. 26	9.0	17.3	0.0	2.1
Acadian	38.2	23.4	26.3	27.7
Ouhouju	41.6	39.3	27.1	23.0
Mean	27.94	24.43	18.07	18.39
Variance between varieties	15 .05	85.81	154.97	118.21

Table 15. Averages and variances between planting times, monthly average decreases and regression coefficients of each variety on the mean of all varieties in the degree of indeterminate type of growth

Variety	Average of planting times	Variance between planting times	Monthly average decrease	Regression coefficient on the main
SJ-1	30.38	28.66	3.73	1.05
SJ-2	29.35	3.16	1.00	0.35
Pakchong	21.78	4.11	1.55	0.40
SB 60	24.00	16.88	2.68	0.59
Tainung 3	7.88	41.09	4.19	1.30
Chung Hsing (Unknown)	32.90	45.05	4.58	1.31
Bon-minori	7.05	37.02	3.82	1.21
Tousan No. 26	7.10	61.02	3.80	1.18
Acadian	28.90	41.64	2.86	0.81
Ouhouju	32.75	82.74	6.80	1.81
Mean	22.23	36.14	35.01	1.00

Discussion

An experiment of planting time, in which typical Thai soybean varieties and some introduced varieties were planted with a one-month interval, was carried out at Mae Jo Agri. Exp. Sta. during the rainy season of 1971.

We estimated the growth stability of each variety as to growing periods, number of nodes on the main stem, plant height and degree of indeterminate type of growth. To estimate them we calculated variances between planting times, monthly average of decreases and regression coefficients of each variety on the mean of all vareities at each planting times.

Most characters decreased by delayed plantings. It is considered that the decreases by delayed plantings are caused mainly by short daylength in late planting times.

The decreases of SJ-1 in growing periods by delayed planting were not great, but those in number of nodes on the main stem and plant height decrease much in the late plantings.

The decreases of SJ-2 were small in the growing periods from flowering to maturing and not very large in the periods from planting to maturing. SJ-2 had less decrease in number of nodes on the main stem and plant height by delayed plantings than those of other varieties with similar plant types. We considered that SJ-2 sould have higher stability between planting times than those of three other Thai varieties.

The behavior of Pakchong was much in contrast to that of SJ-1. Pakchong decreased the growing periods considerably but not the number of nodes on the main stem and plant height in the late planting.

SB 60 considerably decreased most characters in late planting, and it is considered that the stability of SB 60 between planting times would be low.

Bon-minori, Tousan No. 26 and Ouhouju, which were introduced from northern countries with high degree of latitude, fluctuated very little between planting times in most characters. We assumed that the daylength was much shorter than their critical points and their vegetative growths were close to basic sizes.

In this experiment we studied only about growing periods and some vegetative growth type of characters. But usually they have highly genetical and environmental correlation with yield characters. Therefore we can guess the behavior of yield in various planting times.

VARIETAL DIFFERENCE OF SOYBEAN NODULE SETTING IN THE NORTHEASTERN PARTS OF THAILAND

Preface

The soil in the Northeastern parts of Thailand is very poor in fertility, and the productivity of crops in this area is much lower than those in other areas such as in the Central and Northern plains. The soil is sandy and acid with little content of organic matter.

In the rainy season 1970, we had varietal trials and seed multiplication of Thai recommending varieties, SJ-1 and SJ-2, without inoculation at Kalasin Seed Multi. Sta., Mahasarakan Seed Multi. Sta. and Roi-Ed Agri. Exp. Sta. in the Northeast. We could not see any nodules in their soybean plants, except for a certain Thai native variety and some off-type in SJ-2 multiplication fields. In the rainy season 1971, we had several kinds of experiments and SJ-1 and SJ-2 seed multiplication, but the nodule setting was very poor again. On the other hand, we found very good nodule setting in SJ-2 grown in the fertile farm fields of Khonkean in the rainy season 1971. Certain native Thai varieties and some off-types in SJ-2 showed good nodule setting in all cases.

From the results of our observations, we surmised that poor nodule setting of soybean in the Northeast is caused by the poor soil condition. But some genotype to set nodules fully on the soybean plants even in this area might be found. To clarify the varietal difference in nodule setting and to find breeding materials for this area, we carried out the following two experiments.

Experiment A

Materials and Methods

(1) Place

The soil was gathered from Roi-Ed Agri. Exp. Sta. field. The field where soybeans had not been grown for many years had a common type of soil in the Northeast.

(2) Materials

10 varieties were tested.

Tahi recommended varieties: SJ-1, SJ-2

Thai native varieties : SB 60, Pakchong

Introduced varieties : Taichung No. 12 (Taiwan), E 27 (Taiwan), Tokachi-nagaha (Japan), Bon-minori (Japan), Lincoln (U. S. A.)

Off-types selected from SJ-2: Ro-8-282, Ro-15-289

(3) Fertilizing treatments (before planting)

Non-fertilizing: : 0

Fertilizing (kg/rai): 12, 48 and 48 of N, P_2O_5 and K_2O respectively.

(4) Planting methods

All materials were planted without inoculation on 11 February 1971, and four plants were grown in 1/2000 are Wager pot with duplication.

Results and Discussion

We observed nodule setting of all materials in their late stage of growth. The results are shown in Table 1.

As Table 1 shows, recommended varieties SJ-1, SJ-2 and most of the introduced varieties, except E 27, had no nodules on their roots in all of their pots. E 27 had very little nodules in a plant of non-fertilizing condition. On the contrary, Thai native varieties SB 60, Pakchong and off-types selected from SJ-2 showed nodule setting in all of their pots, and their nodule setting in non-fertilizing condition was more than those in fertilizing conditions.

Table 1. Index of Nodule Setting (Dry season 1971, Roi-Ed Agri. Exp. Sta.)

Variety and Strain	Source	Index of Nodule Setting	
		Non-fertilizing	Fertilizing
SJ-1	Thai recommended var.	0	0
SJ-2	Thai recommended var.	0	0
SB 60	Thai native var.	3	2
Pakchong	Thai native var.	4	1
Taichung No. 12	Introduced from Taiwan	0	0
E 27	Introduced from Taiwan	1	0
Tokachi-nagaha	Introduced from Japan	0	0
Bon-minori	Introduced from Japan	0	0
Lincoln	Introduced from U. S. A.	0	0
Ro-8-282	Off-type selected from SJ-2	3	2
Ro-15-289	Off-type selected from SJ-2	3	2

* 5: Very good, 4: Good, 3: Middle, 2: Little, 1: Very little, 0: Zero.

Although we used the soil from Roi-Ed Agri. Exp. Sta. field where they had never grown soybeans for at least 5 years and we did not inoculate, some of the materials had nodule setting. This may mean that there were some native races of nodule bacteria in the soil from the beginning and these races are suitable only to certain genotypes of varieties such as SB 60 and Pakchong and not to those of SJ-1 and SJ-2.

Experiment B

Materials and Methods

(1) Place

Roi-Ed Agr. Exp. Sta. The fields where they had not grown soybean for many years had the common type of soil in the Northeast.

(2) Materials

Thai recommended variety : SJ-2

Thai native variety : SB 60

Off-type selected from SJ-2: Ka-6-258, Ro-6-280, Ro-7-281, Ro-8-282, Ro-9-283, Ro-11-285, Ro-12-286, Ro-15-289

(3) Planting methods

All materials were planted without inoculation on 26 July 1971. Spacing was 50cm x 20cm with two plants on a hill. Fertilizer was supplied 10 days after planting with 3:12:12 formula (kg/rai) of $N:P_2O_5:K_2O$. We set single planting and mixed planting for SJ-2 and SB 60. In the mixed planting plot, one plant of SJ-2 and one plant of SB 60 were grown on a same hill.

(4) Field design

One plot size is 6.0 m^2. No replication.

Results and Discussions

Soybean growth was not so good because of very poor soil fertility and late planting. For about one month after planting, SJ-2 and SB 60 were not much different in their growth but later SB 60 showed much better growth than SJ-2 and had good branching and pod-setting. Most off-types selected from SJ-2 showed similar growth to SB 60.

Table 2 shows index of nodule setting.

Table 2. Index of Nodule Setting (Rainy season 1971, Roi-Ed Agri. Exp. Sta.)

Variety and Strain	Index of Nodule Setting
SJ-2 A	0
SB 60 A	5
SJ-2 B	0
SB 60 B	5
Ka-6-258	5
Ro-6-280	5
Ro-7-281	5
Ro-8-282	4
Ro-9-283	5
Ro-11-285	5
Ro-12-286	5
Ro-15-289	5

* 5: Very good, 4: Good, 3: Middle, 2: Little, 1: Very little, 0: Zero

** A: Simple planting, B: Mixed planting

As Table 2 shows, SJ-2 ahd no nodules in both single planting and mixed plantings, but SB 60 showed very good nodule setting in both plantings. All off-types selected from SJ-2 had good or very good nodule setting, same as SB 60.

It is clear that the difference of nodule setting between these materials was caused not by the soil condition in each plot but by their genotypes. Good nodule setting in off-types from SJ-2 means that these strains may have the same genotypes to SB 60 as to nodulation. Plant growth of all materials is shown in Table 3. As Table 3 shows, SJ-2 had poor branching and pod-setting and low yield. SB 60 and most off-types from SJ-2 showed much better growth than SJ-2. This means that nodule setting affects the yeilds very much in this area.

Table 3. Plant Growth*

Variety and Strain	Plant height (cm)	No. of nodes on the main stem	No. of nodes on the main stem	No. of pods	Weight of dry stalk (g)	Seed yield (g)	100 grain weight(g)
SJ-2 A	43.2	12.0	16.0	25.0	4.5	2.5	8.5
SB 60 A	42.8	15.7	34.6	90.8	13.1	12.8	9.6
SJ-2 B	26.8	11.2	22.4	1 .6	-	-	-
SB 60 B	35.6	15.7	33.0	111.6	-	-	-
Ka-6-258	31.9	13.4	38.4	81.6	9.9	77.7	8.2
Ro-6-280	27.6	14.8	39.8	92.8	11.5	11.2	9.9
Ro-7-281	25.1	14.5	35.6	104.8	12.5	10.6	8.5
Ro-8-282	30.9	13.8	51.6	122.8	12.5	12.1	6.9
Rp-9-283**	41.8	15.4	60.6	170.6	-	-	-
Ro-11-285	37.7	16.3	41.6	137.0	17.6	16.2	8.2
Ro-12-286	38.4	15.5	24.0	55.8	7.5	6.0	7.2
Ro-15-289	42.1	16.5	30.6	73.2	9.0	8.1	8.0

* Average per hill. But twice of a plant in No. of nodes on the branches, and No. of pods of SJ-2B and SB 60B.

** Showed segregation in pubescence color and hilum color.

Conclusion

As a result of these two experiments, we found that there was a clear varietal difference in soybean nodule setting in the Northeastern soil, that Thai leading varieties SJ-1 and SJ-2 could not have nodules in this soil, but that Thai native varieties SB 60 showed good nodule setting and much better growth than SJ-2.

We consider that normal races of nodule bacteria which are suitable to most varieties such as SJ-1 and SJ-2, cannot live in the poor Northeastern soil condition and that certain native races which are suitable to only some genotypes such as SB 60 and Pakchong can live even in the poor soil condition.

When SJ-1 and SJ-2 are planted in the improved fertile soil, good nodule setting and growth can be seen, even in the Northeast. But if soil improvement of the farmer's fields cannot be expected in the near future, it is recommended that SJ-1 and SJ-2 should be replaced by some native varieties such as SB 60 although most of the native varieties have poor seed quality. Also, nodule bat-terial race-soybean genotype suitability in breeding work for the Northeast must always be considered.

We believe that more studies about this problem should be undertaken not only from the standpoint of breeding but also soil chemistry and bacteriology.

VARIETAL DIFFERENCE OF SOYBEAN RUST DAMAGES AND THE BREEDING FOR RESISTANT TYPES IN THE NORTHERN PARTS OF THAILAND

Preface

Soybean rust is a minor disease in Japan but it is one of the very serious diseases in Taiwan. Yuan-Ping Hung (1965) explained the symptoms of soybean rust in Taiwan. According to his explanation, rust injuries occur in the late growing stage of soybean plants. First, yellow-green or yellow-brown spots come out on the surface and the back of the leaves, and these spots grow bigger and bigger as the plants grow. When the damage is serious soybean plants defoliate before maturing and seed development is seriously interrupted. As a result, seed size and yield is seriously decreased.

Soybean rust damages occurred in the Northern parts of Thailand during the rainy season of 1970 and 1971, and showed similar symptoms.

Soybean rust damage in Thailand is the most serious in early plantings of soybeans during the riny season in the Northern parts and very little in late plantings of the rainy season and dry season. Damages are very small in the Central and Northeastern part.

I. Varietal Difference in Soybean Rust Damages

In the rainy season 1970, our breeding materials were planted very late at Mae Jo Agri. Exp. Stan. and suffered little damage by rust diseases. During the rainy season of 1971, our materials of yield trials and preliminary yield trials were planted on 16 June and after flowering most of the plants were seriously damaged by rust and many varieties defoliated before maturing.

In these experiments we found some varietal differences in their symptoms and damages.

First, none of the varieties showed any symptoms until a certain late stage of growth, and earlier maturing varieties showed damages earlier than later ones. Sometimes it was observed that late varieties did not show any symptoms although early varieties in adjacent rows were seriously damaged, and when they reached a certain stage, they were injured also.

Secondly, some varieties which had thick growth or serious lodging showed rapid progress of damages once they had been damaged.

Thirdly, five of the introduced varieties showed some resistance to soybean rust and very little damages. Although they had rust spots, the symptoms did not progress and they matured quite normally.

The index of rust damage, 100 grain weight and seed yield compared with typical Thai varieties shown in Table 1, and 100 grain weight from other experiments where we had no rust damages is also shown. Index of rust damage is estimated from the intensity of rust spots on the leaves. D/C will be useful to show the approximate decrease of 100 grain weight by rust damage although D and C would have environmental effect in each location.

As Table 1 shows, four Thai varieties injured by rust decreased their 100 grain weight and their yields were very low. On the other hand, resistant varieties changed their 100 grain weight very little and their yields were much higher than four Thai varieties.

Table 1. 100 grain weight, seed yield and index of rust damages of typical Thai varieties and resistant types in soybean rust occuring condition

Character	100 grain weight (g)					Index of* rust damage	Seed yield (kg/rai)
Experiment	A	B	C	D	D/C	D	D
Location	Mae Jo Chiengmai	Mae Jo Chiengmai	Srisamrong Sukhothai	Mae Jo Chiengmai	-	Mae Jo Chiengmai	Mae Jo Chiengmai
Date of planting	Jan. 13 1971	Jul. 23 1971	Jun. 18 1971	Jun. 16 1971	-	Jun. 16 1971	Jun. 16 1971
Variety \ Rust occurence	-	-	-	+	+/-	+	+
SJ-1	11.0	12.6	14.7	8.7	0.59	4.3	163.6
SJ-2	12.5	11.6	13.2	8.6	0.63	5.0	111.4
Pakchong	14.2	13.8	15.5	10.6	0.68	5.0	91.0
SB 60	8.3	9.0	10.7	6.4	0.60	4.8	33.6
64-4 (Large seed)	-	-	16.3	12.4	0.76	3.0	259.3
64-62	-	-	15.9	17.4	1.09	2.0	-**
64-64	23.1	-	14.9	14.7	0.99	2.0	-**
64-104	23.7	19.7	17.4	19.3	1.11	0.5	308.0
0-38 (Small seed)	18.0	-	-	20.2	-	1.0	277.2

* ; 5: Very serious, 4: Serious, 3: Middle, 2: Little, 1: Very little, 0: Zero
**; No data on seed yield because of poor germination.

2. Breeding for Rust Resistance

We observed that 64-4 (Large-seed) 64-62 and 64-64 had individual variation for rust resistance, and some important characters such as maturity, plant height and seed quality and 64-104 were not uniform in maturity and seed quality.

To select more desirable types, we started pure-line selections from 64-62, 64-64 and 64-104 for the 1972 dry season. We showed the number of lines tested in each materials in the 1972 dry season.

Table 2. Number of Lines Tested in Pure-line Selection and Selective Direction

Material	Number of Lines	Selective Direction
64-62	162	Rust resistance. Resistance to lodging. Good seed quality (Non-cracking of seed coat, etc.)
64-64	162	
64-104	217	

We made three crosses using 64-104 and 0-38 (Small seed) as parents for the period from November 1970 to January 1971. Two of them were grown as F_2 generation in rust occurring condition for the rainy season of 1971 at Mae Jo Agri. Exp. Sta. They showed clear segregation in resistance to rust. We selected resistant types in the field and selected good quality types as the result of desk work.

Table 2 shows the progress until now, and Figure 1 and Figure 2 show frequency distributions of F plants selected, in 100 grain weight. The peak of distribution in the first step of selection was nearer to resistant parents than to susceptible ones.

Table 3. Hybrid Materials and Selection for Resistance to Soybean Rust (Mae Jo Agri. Exp. Sta.)

No. of crossing	Parents Female x Male	No. of plants tested	F2 No. of plants selected	F3 No. of lines planted
7019	Acadian x 64-104	1000	208	208
7024	64-104 x SJ-2	1700	314	314
7030	0-38 (Small seed) x Taichung No. 22	600	-	-

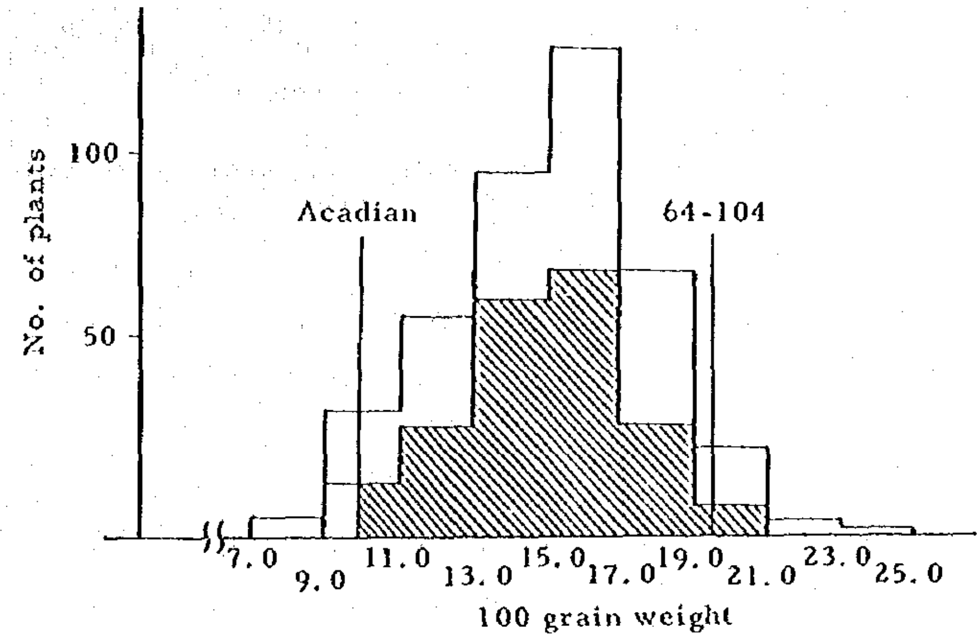

Figure 1 Frequency Distribution of F2 (7019) Plants Selected, in 100 Grain Weight

▭ : First step of selection
▨ : Final selection

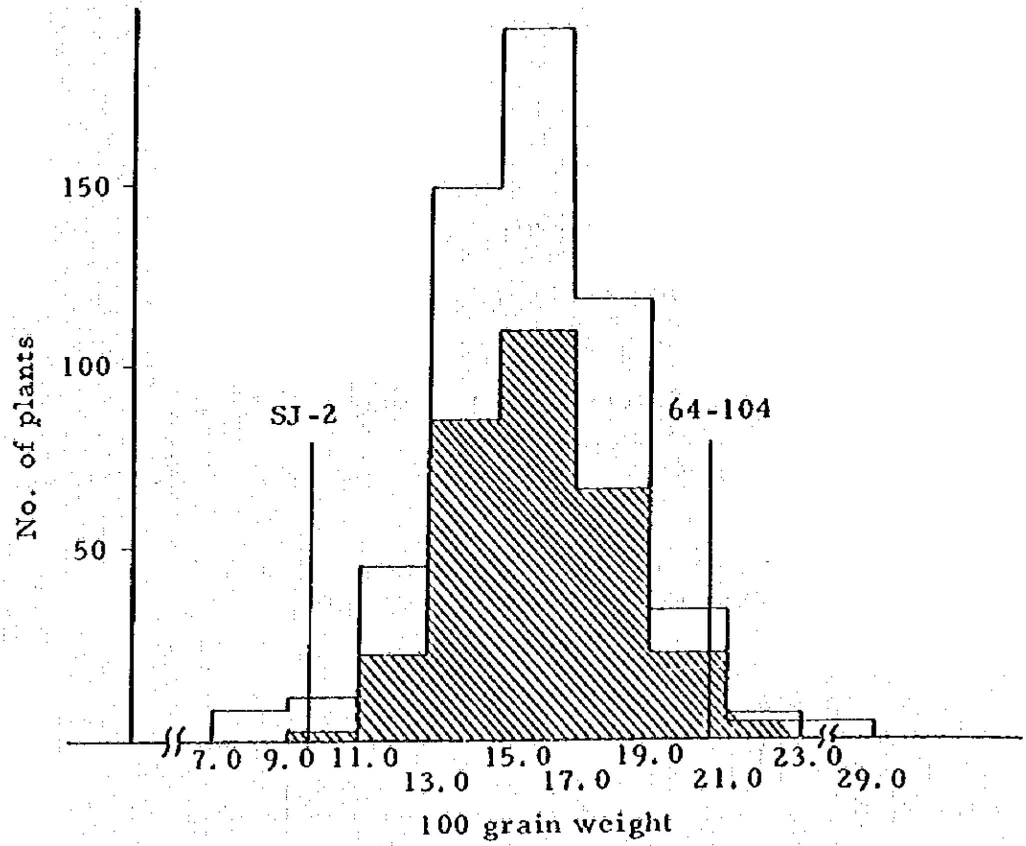

Figure 2 Frequency Distribution of F_2 (7024) Plants Selected, in 100 Grain Weight

[ ] : First step of selection
[hatched] : Final selection

Conclusion

Soybean rust damage usually does not affect vegetative growth characters such as plant height, number of nodes on the main stem and branching because it occurs in the late stage of soybean growing. When damage is serious, soybean plants change their leaf color to yellow and the defoliate before normal maturing. As a result, maturity in appearance is earlier than usual and seed size decrease. Therefore, degree of decrease in 100 grain weight may be useful as a indicator of degree of soybean rust damage.

We must continue resistance tests of the said five varieties for verification. But we assume that varietal difference of rust damages would be caused by their genotypes because F_2 generations, one of whose parents is resistant, showed segregation for resistance and that four of the said varieties may be sister lines each other.

We are now planning to test all of our preservating varieties for rust resistance next rainy season, and we may find more resistant varieties.

The said five resistant varieties are not genetically uniform and are poor in resistance to lodging and shattering and in seed quality. Therefore they are not useful for practical cultivation.

Much better types which will show high resistance to soybean rust and other important characters may be selected from our pure-lines and hybrid materials.

PART III

MARKETING

HARUHIKO SETO

PRODUCTION COST FOR THAI SOYBEAN

Purpose

A survey by questionnaires was carried out to investigate the production costs for Thai soybeans and to compare them with those of maize, mungbeans and peanuts. Another objective was to get as much information as possible relating to the financial situation, indebtedness to middlemen, and opinions of the farmers.

Time of Investigation

The investigation was carried out during the wet season (May-October) in 1971. At present, a similar investigation is being carried out for dry season soybeans (January-April 1972). The results will be reported as soon as they are available.

Method of Investigation

The questionnaire is attached to the end of this report. After it was translated into Thai language, it was distributed to schools, agricultural cooperatives, and extension officers of each local district in the soybean producing area. Preliminary consent was obtained and explanations of the questionnaires were provided.

Area Investigated

Area investigated consists of Chiengmai, Swankaloke and the Central Highlands. These are the main wet season soybean producing areas. The Central Highlands include parts of the Changwats of Nakornswan, Lopburi, Saraburi, and Petchbul. The areas where late wet-season soybeans are grown include Amphoes Thakli, Chaibadan, Praphutabaht, Vichiengburi, and Moklek of these Changwats.

Collection of the Questionnaires

The questionnaires were collected during October-November, but the rate of response was rather poor. The collection ratios were 68% for soybeans, 30% for maize, 32% for mungbeans, and only 7% for peanuts. The collection ratio of questionnaires from extension officers in each Changwat and Amphoe was especially poor. It is evident that this kind of investigation can only succeed when many responses are accumulated to provide abundant material for study. The present survey lacks this point because the collection rate was so poor. However, the following is the result of this study for the Soybean Project.

Results of Investigation

Results of the investigations are uniformly calculated by the principle of cash base on unit area. In the table of Chiengmai wet-season soybean (Table 1), for example, the cost of ploughing indicated 51.80 ฿, 31%. This means that 23 farmers out of the total 50 investigated paid cash for ploughing. The cumulative area of these 23 farmers who paid cash for ploughing comes to 31% of the total area planted to soybeans. Then the cost of ploughing is obtained by dividing the total expenditure of soybean farmers who paid cash for ploughing by the corresponding area which is equivalent to 31% of the total soybean area. The ploughing of the remaining 69% of the total soybean planted area is conducted with family labor, and so is excluded from the the cost calculation since there is no good method of appraising family labor. In addition, although it is anticipated that family labor might be involved in the area where cash-based ploughing is applied, it was treated as negligible. The cash based cost mentioned above is handled as a cost in this report. By calculating, in this way, every other item of costs, it is expected that more accurate cost data can be obtained. It is obvious, however, that the accuracy of the cost calculation becomes lower when the examples investigated are small in number. It must be admitted that the authenticity of the results of the present calculation should be discounted somewhat because only a small number of investigation cases were collected this time.

The area tested with fertilizer or agricultural chemicals was usually very small. Consequently, they were mostly dropped from the cost calculation, because the yield itself would be affected to a degree that a different calculation of cost and returns would result if the use of fertilizer or agricultural chemicals is extended to most of the area investigated.

In the item of labor, family labor and animal labor are shown by their number divided by the whole arable area including paddy fields. Temporary and permanent hired labor are shown, firstly, with their average number to the area of farmers employing such labor. Secondly, the percentage of the above area to the total area investigated is shown.

Indebtedness of the farmers to middlemen is also calculated in the same manner as temporary and permanent hired labor. That is, the average amount of debt is calculated by dividing the total debt of the farmers who are in debt by their areas including paddy fields. Then the percentage of the area in debt to the whole area is shown in the next column.

A. <u>Chiengmai Wet Season Soybean - Table 1</u>

(a) Farming households investigated numbered 50. These were 2 from Sampatong, 8 from Handong, 20 from Maerim, and 20 from Sansai. Average farm consists of 9.4 rai of paddy and 4 rai of upland. About 76% of the upland area is planted with soybeans, as seen in the table.

(b) The yield was extraordinarily low, some 30% down from the average, because rust disease was so rampant in this season. 14% of the soybean area lacked information on selling price, and was dropped fromt the calculation.

(c) The selling price is rather good because the wet-season crop is usually sold as seed to the dry-season growers for the continuationof viability. Moreover the total harvest of the season was poor.

Table 1. Chiengmai Wet Season Soybean 1971

Classification I	Classification II	Av. Area per Family	Percentage to the Total Areas	Note
Soybean Planted Area	Owned	3.13 rai	20%	a
	Rented	1.93 rai	2%	
	Total	3.00 rai	22%	
Whole Upland Arable Area	Owned	4.10 rai	27%	
	Rented	1.93 rai	2%	
	Total	3.92 rai	29%	
Paddy Field	Owned	9.45 rai	60%	
	Rented	9.28 rai	10%	
	Total	9.42 rai	70%	
Item		Av. per Rai	Percentage of the counted Area	
Soybean Yield		121.93 kg	86%	b
Selling Price		2.55 ฿	86%	c
Gross Income per Rai		310.92 ฿		
Cost of Seeds		21.91 ฿	41%	d
Cost of Ploughing		51.80 ฿	31%	e
Cost of Seeding		28.06 ฿	10%	
Cost of Weeding Cost of Intertillage		65.35 ฿	9%	f
Cost of Harvesting Cost of Threshing		29.78 ฿	12%	
Cost of Fertilizer & Fertilization		0	0	
Cost of Pesticide & Spraying		(13.33) ฿	1%	
Cost of Transportation		-		g
Cost of Land Rent		(87.58) ฿	10%	h
Total Cost per Rai		196.90 ฿		
Return		114.02 ฿		
Number of Family Labor		0.30	100%	
Number of Labor Animal		0.13	100%	
Number of Temporary Hired Labor		0.13	0.02 %	
Number of Permanent Hired Labor		-	-	
Money borrowed from Middlemen		0	0	i

(d) 59% of the total soybean area should be considered as being planted with seeds kept by the farmers.

(e) The questionnaire requested power breakdown into 3 categories: tractor, buffalo and human power. But data was not collected about all other areas. In this connection, refer to the agronomic survey of soybean producing farmers.

(f) Weeding is done once by almost all farmers, twice by 20% of them, thrice by almost none, according to the agronomic survey. Accordingly, the table shows that weeding of 90% of the area is done by family labor.

(g) Transportation cost from farmer to middleman falls usually on the farmer's side and requires 2 - 4 ฿ per sack (115-120 kg) by ox-cart. This cost is put in item 4 of the questionnaire. There was no information in the Chiengmai area.

(h) Rent for soybean land appears to be too expensive. It might have involved other rent because of multiple cropping in the area. The personal investigation of the present writer suggests that it should be 20 - 50 ฿ per rai according to the fertility of the soil.

(i) The column on indebtedness to middlemen in Chiengmai area remains blank. For dry-season soybeans (after paddy) in the area, there are many cases of advance payment from middlemen to the farmers for the purpose of their securing the purchase of future crop, according to the survey of the present writer. But, for wet-season soybeans the same does not seem to occur.

(j) The years of soybean growing experience of the farmers investigated range from 1 to 20 years and averaged 5.2 years. It was somewhat interesting to find there are obvious differences in experience among Amphoe. That is, farmers in Sampatong and Handong had the most average experience years of 13, Sansai 4, and Maerim the least of 2.5 years.

(k) On the item of agricultural implements collected, the result is as follows: buffalo tiller 22 (44%); power tiller 3 (6%); and sprayer 7 (14%).

(l) 25 out of 50 farmers had the opinion that soybean growing had improved the productivity of the land, and also 25 out of 50 felt that the market price of soybeans is rather stable compared to the other crops. It is interesting to note that the former opinion is expressed chiefly by the Amphoe Maerim farmers who are thought to be rather new in developing double cropping with wet-season soybeans.

(m) The answers to the most needed items were tried. The results are as follows:

1.	Better market price	37 cases 74%
2.	Fertilizer	36 cases 72%
3.	New variety	23 cases 46%
4.	Agricultural credit	23 cases 46%
5.	Land and good drainage	18 cases 36%
6.	Insecticide	18 cases 36%
7.	Tractors	15 cases 30%
8.	Good seeds	15 cases 30%

The opinion that none was needed was expressed only once.

(n) On opinions about cooperatives, the following results were collected:

1.	Good	23 cases	46%
2.	No comment	17 cases	34%
3.	Disadvantageous	6 cases	12%
4.	Uninterested	2 cases	4%
5.	Do not utilize	1 case	2%
6.	Blank	1 case	2%

(o) On opinions about public silo, all the farmers questioned approved the idea, except 2 who answered it was unnecessary, 16 who preferred store rooms (probably for personal use), and 5 who gave no comments.

B. Swankaloke Black Soybean - Table 2

(a) 99 of a hundred questionnaires to the farmers growing wet-season black soybeans were retrieved, thanks to the officers in Swankaloke Land Co-operative. Being situated principally in upland area, the entire land of 99 farmers contains only 5% of paddy fields. They grow maize, cotton, mungbeans, black soybeans, etc. The area planted with black soybeans occupied 36% of the total upland area of 99 farmers investigated. There were only 2 cases of land rent out 99, both of which possessed paddy fields besides rated up-land.

(b) The yield of black soybeans, 175kg. per rai, is quite appropriate. It is easier to cultivate black soybeans but their yield is lower than SJ strains. This is the reason why the black soybean area is gradually diminishing in Swankaloke.

(c) An area equivalent to 24% of the total lacked data on selling prices and so was excluded from calculations, (weighed average). Black soybeans are traded with a lower price than the yellow colored ones.

(d) This cost seems too low compared to that in Chiengmai. Family labor is probably involved to a considerable degree.

(e) Family labor is also probably involved in the cash cost calculation. Weeding one time through whole growth of the plant is practiced in almost 100% of the area, weeding twice in 6% of the area, thrice almost zero, according to the agronomic survey. Weeding of 52% of the area is done by pure family labor. Weeding by tractor, buffalo and human power was not reported separately.

(f) There was no report on land rent although there appeared to be very few rent cases.

(g) The amount of debt to middlemen ranges from 300 ฿ to 5,000 ฿, (av. 2,000 ฿) in the 45 cases investigated. There were some descriptions concerning interest rates but they were notu understandable.

(h) 15 cases out of 99 borrowed rice from middlemen (the average quantity reaching 466 kg.)

(i) 16 cases out of 99 reported borrowing soybean seeds from middlemen, averaging 75 kg. Returning the same quantity to the middlemen is reported.

(j) Experience in cultivating black soybeans by the farmers investigated ranges from 1 to 12 years and the average was 7 1/2 years.

Table 2. Swankaloke Cooperative Black Soybean 1971

Classification I	Classification II	Av. Area per Family	Percentage to the Total Areas	Note
Soybean Planted Area	Owned	10.45 rai	34%	a
	Rented	7.50 rai	-	
	Total	10.51 rai	34%	
Whole Upland Arable Area	Owned	28.79 rai	94%	
	Rented	7.50 rai	-	
	Total	28.94 rai	94%	
Paddy Field	Owned	13.54 rai	5%	
	Rented	10.00 rai	-	
	Total	13.25 rai	5%	
Item		**Av. per Rai**	**Percentage of the counted Area**	
Soybean Yield		175.24 kg	100%	b
Selling Price		1.56 ฿	76%	c
Gross Income per Rai		273.37 ฿		
Cost of Seeds		23.59 ฿	47%	
Cost of Ploughing		41.23 ฿	92%	
Cost of Seeding		3.95 ฿	22%	d
Cost of Weeding Cost of Intertillage		10.24 ฿	48%	e
Cost of Harvesting		37.88 ฿	41%	
Cost of Threshing		13.18 ฿	30%	
Cost of Fertilizer & Fertilization		-	-	
Cost of Pssticide & Spraying		-	-	
Cost of Transportation		0.03	59%	
Cost of Land Rent		-	-	f
Total Cost per Rai		130.10 ฿		
Return		143.27 ฿		
Number of Family Labor		0.12	100%	
Number of Labor Animal		0.04	100%	
Number of Temporary Hired Labor		0.08	57%	
Number of Permanent Hired Labor		0.03	8%	
Money borrowed from Middlemen		65.23 ฿	43%	g
Rice borrowed from Middlemen		17.72 kg	13%	h
Soybean Seeds borrowed from Middlemen		9.38 kg	12%	i

(k) Those who wished to increase soybean production numbered 64%; those who are satisfied with the present level of production numbered 31%.

(l) Those who needed agricultural credit amounted to 28% of all farmers. The other needed items were tractors, feeder roads, irrigation and drainage, etc., each with a few percentage points.

(m) Majority rated cooperatives as good.

(n) Relating to public silos, there were 59 pros and 38 cons.

C. Swankaloke Thung Salium Soybean Table 3

(a) Swankaloke produces more than 60% of all Thailand's soybeans. Production is increasing steadily. Being the most important area for wet-season soybeans, research of this area was stressed. The writer met repeately with the extension officers in the area, but the collection of the questionnaires turned out to be disappointing. Only 3 samples were obtained from Amhoe Thung Salium. The significance of this kind of study lies in collecting a large number of samples and analyzing them as mentioned earlier. Significance is entirely lost when only three cases are treated. Thus, the table was compiled only to respond to the sincere cooperation of the extension officer of the Amphoe.

(b) Because one of the three lacked descriptions, the corresponding ratios of the area to the total are very low in every item of calculated cost.

(c) The same as above.

(d) The average years of cultivating soybeans is 5.

(e) In the item of opinions, it was mentioned also that soybean cultivation increased the productivity of the land, and the market price is comparatively steady. Good market price and extension service were cited as the most needed items.

Table 3. Swankaloke Thung Saliam Soybean

Classification I	Classification II	Av. Area per Family	Percentage to the Total Areas	Note
Soybean Planted Area	Owned	11.50 rai	26%	a
	Rented	4.00 rai	5%	
	Total	9.00 rai	31%	
Whole Upland Arable Area	Owned	14.00 rai	31%	
	Rented	30.00 rai	34%	
	Total	19.33 rai	66%	
Paddy Field	Owned	5.00 rai	11%	
	Rented	20.00 rai	23%	
	Total	10.00 rai	34%	
Item		Av. per Rai	Percentage of the counted Area	
Soybean Yield		286.29 kg	100%	
Selling Price		2.00 ฿	100%	
Gross Income per Rai		572.58 ฿		
Cost of Seeds		27.50 ฿	15%	
Cost of Ploughing		55.71 ฿	26%	b
Cost of Seeding		-	-	
Cost of Weeding		41.66 ฿	11%	
Cost of Intertillage		-	-	
Cost of Harvesting		69.33 ฿	11%	
Cost of Threshing		-	-	
Cost of Fertilizer & Fertilization		-	-	
Cost of Pesticide & Spraying		-	-	
Cost of Transportation		-	-	
Cost of Land Rent		(100.00 ฿)	14%	
Total Cost per Rai		194.20 ฿		
Return		378.38 ฿		
Number of Family Labor		0.06	26%	c
Number of Labor Animal		-	-	
Number of Temporary Hired Labor		-	-	
Number of Permanent Hired Labor		-	-	
Money borrowed from Middlemen		17.46 ฿	71%	

D. Petchbul - Vichiengnuri Soybean Table 4

(a) The questionnaires were distributed to the extension officers in the soybean producing areas in the Central Highlands. The collection results turned out to be five examples from Amphoe Vichiengburi, Changwat Petchbul. The remaining vast areas did not respond. In the Central Highlands, soybeans are usually grown as a second crop to maize, etc. Soybeans are planted in 35% of the total upland area from these 5 examples.

(b) The soybeans are sold at a good price because of their good quality. They are harvested towards the end of the rainy season.

(c) Since family labor is scattered thinly and the size of the area per family is large, the ratio of the area worked by hired labor to the total is 100% in most of the cost items. No buffalos were counted in these cases and tractors are presumed to be widely used in the area. The item on agricultural implements shows, sprayers 4, tractors 1, and pumps 1.

(d) Permanently hired labor is more available than family labor in the area. If these permanently hired laborers do not have the land of their own, it will be necessary to study the problem in detail from the viewpoint of rural sociology.

(e) It is evidently over-borrowing.

(f) The farmer's years of soybean cultivation experience range from 2 to 4 years, averaging 3.2 years.

(g) The farmer's most needed items included agricultural credit, numbering 5 cases; next came insecticide and fertilizer, each numbering 2 cases; then came requirements for improved varieties and good seeds, each with 2 cases.

(h) 4 farmers out of 5 voted for co-op. The idea of a public silo was supported by all.

Table 4. Petchbul - Vichiengburi Soybean

Classification I	Classification II	Av. Area per Family	Percentage to the Total Areas	Note
Soybean Planted Area	Owned	23.75 rai	28%	a
	Rented	5.00 rai	1%	
	Total	20.00 rai	29%	
Whole Upland Arable Area	Owned	69.75 rai	82%	
	Rented	5.00 rai	1%	
	Total	56.80 rai	83%	
Paddy Field	Owned	58.00 rai	17%	
	Rented	-	-	
	Total	58.00 rai	17%	
Item		**Av. per Rai**	**Percentage of the counted Area**	
Soybean Yield		149.50 kg	100%	
Selling Price		2.24 ฿	100%	b
Gross Income per Rai		334.88 ฿		
Cost of Seeds		35.50 ฿	100%	
Cost of Ploughing		34.00 ฿	100%	c
Cost of Seeding		18.66	100%	
Cost of Weeding		22.66 B	100%	
Cost of Intertillage		15.00	50%	
Cost of Harvesting Cost of Threshing		54.70 ฿	100%	
Cost of Fertilizer & Fertilization		-	-	
Cost of Pesticide & Spraying		17.77 ฿	45%	
Cost of Transportation		-	-	
Cost of Land Rent		(100 ฿)	5%	
Cotal Cost per Rai		198.29 ฿		
Return		136.59 ฿		
Number of Family Labor		0.04	100%	
Number of Labor Animal		-	-	
Number of Temporary Hired Labor		0.07	72%	
Number of Permanent Hired Labor		0.06	100%	d
Money borrowed from Middlemen		354.16 ฿	42%	e
Rice borrowed from Middlemen		3.37 kg	26%	

E. <u>Swankaloke Maize Table 5</u>

(a) This Table is the result of calculation of 12 collected examples of farmers. Area planted to maize reaches 94% of all the upland area of the farmers.

(b) 9 farmers out of 12 possess paddy fields.

(c) In 1970, the maize boom continued owing to a bad crop in the United States. This price appears to be influenced by that fact.

(d) Although there is 4% rented land, no values were mentioned.

(e) This indebtedness is obviously excessive.

(f) The farmer's cultivation experience for maize ranges from 4 to8 years, averaging 5.7 years.

(g) The most needed item is agricultural credit with 10 votes out of 12. This is followed by better varieties and chemicals each with two votes, and tractors with one vote.

(h) With regard to cooperatives, eight farmers were looking forward to multi-purpose cooperatives; the other 4 offered no comment.

(i) As to public silos, there were 3 pros, 3 cons and 6 no comments.

Table 5. Swankaloke Maize

Classification I	Classification II	Av. area per Family	Percentage to the Total Areas	Note
Maize Planted Area	Owned	23.90 rai	67%	a
	Rented	12.00 rai	3%	
	Total	22.91 rai	70%	
Whole Upland Arable Area	Owned	25.45 rai	72%	
	Rented	12.00 rai	3%	
	Total	24.33 rai	75%	
Paddy Field	Owned	11.00 rai	25%	b
	Rented	-	-	
	Total	11.00 rai	25%	
Item		**Av. per Rai**	**Percentage of the counted Area**	
Maize Yield		295.28 kg	100%	
Selling Price		0.93 ฿	100%	c
Gross Income per Rai		274.61 ฿		
Cost of Seeds		-	-	
Cost of Ploughing		74.40 B	77%	
Cost of Seeding		19.07 ฿	39%	
Cost of Weeding Cost of Intertillage		15.82 ฿	42%	
Cost of Harvesting Cost of Threshing		20.00 ฿	5%	
Cost of Fertilizer & Fertilization		-	-	
Cost of Pesticide & Spraying		-	-	
Cost of Transportation		-	-	
Cost of Land Rent		-	-	d
Total Cost per Rai		127.29 ฿		
Return		147.32 ฿		
Number of Family Labor		0.08	100%	
Number of Labor Animal		0.03	100%	
Number of Temporary Hired Labor		0.17	57%	
Number of Permanent Hired Labor		-	-	
Money borrowed from Middlemen		132.99 ฿	100%	e

F. Pitsanulike Maize Table 6

(a) This part of the survey was carried out by the students of Pitsanuloke Agricultural School through the directorate. Out of eight farmers under survey, seven were very small land-holders with 2 to 8 rai of upland without any paddy. Only one was a rather big farmer with 40 rai of paddy and 15 rai of up-land. This produced a sizeable in balance among the farmers surveyed. Maize was planted by all farmers.

(b) The yields of the farmers showed a wide range from 10 tang per rai to 50 tang per rai. The smaller yield is supposed to have resulted from the thin population of the plants interplant-ed with some other crops or vegetables.

(c) Tang was adopted as the unit in this Table, because most of the questionnaires was answered in terms of tang.

(d) The agriculture in the area appears to be rather intensive. Input use is a bit larger than in other areas. This is seen in the cost structure.

(e) This cost per rai of fertilizer is excessively small. Possibly, some farmers applied fertilizer on only a very small portion of their maize for testing purposes.

(f) On about 27% of the area, family labor was reported to be zero. There farmers are presumed to be part-time since the area is situated near the city of Pitsanuloke.

(g) Their experience in growing maize is comparatively long, rang ing from 3 to 14 years, averaging 9 years.

(h) Four farmers out of eight said they needed good varieties, two said land and fertilizer, and three gave no comment.

(i) As to agricultural cooperatives, 4 had no knowledge about coops and 4 had no comments.

(j) About public silos, one replied in the affirmative, and the others made no comments.

Table 6. Pitsanuloke Maize

Classification I	Classification II	Av. Area per Family	Percentage to the Total Areas	Note
Maize Planted Area	Owned	4.66 rai	32%	a
	Rented	5.66 rai	19%	
	Total	5.62 rai	51%	
Whole Upland Arable Area	Owned	5.16 rai	35%	
	Rented	5.66 rai	19%	
	Total	6.00 rai	55%	
Paddy Field	Owned	40.00 rai	45%	
	Rented	-	-	
	Total	40.00 rai	45%	
Item		Av. per Rai	Percentage of the counted Area	
Maize Yield		30.22 tang	100%	
Selling Price		12.80 ₿	66%	b
Gross Income per Rai		386.82 ₿		
Cost of Seeds		16.07 ₿	64%	c
Cost of Ploughing		34.67 ₿	69%	
Cost of Seeding		5.33 ₿	44%	
Cost of Weeding		5.32 ₿	33%	
Cost of Intertillage Cost of Harvesting Cost of Threshing		35.84 ₿	55%	
Cost of Fertilizer & Fertilization		1.06 ₿	33%	d
Cost of Pesticide & Spraying		10.00 ₿	33%	
Cost of Transportation		-		
Cost of Land Rent		(35.00 ₿)	9%	
Total Cost per Rai		108.29 ₿		
Return		278.53 ₿		
Number of Family Labor		0.15	73%	e
Number of Labor Animal		0.04	100%	
Number of Temporary Hired Labor		0.11	68%	
Number of Permanent Hired Labor		0.01	62%	
Money borrwed from Middlemen		-	-	

G. Petchbul - Vichiengburi Maize - Table 7

(a) The data for this Table were obtained through the valuable collaboration of an extension officer in Amphoe Vichiengburi, Changwat Petchbul. The area investigated belongs to the frontier of the Thai corn belt. Only one farmer out of 5 examples collected had paddy fields. All the farmers had a large arable area of 40 to 194 rai.

(b) Land retn was mentioned on just half of the total area said to be rented.

(c) The borrowing from middlemen seemed moderate in this case.

(d) The years of experience for cultivating maize ranges from one to ten years, averaging four years.

(e) Agricultural implements for the five farmers are as follows: sprayers 5; pumps 1; tracters 1; and power tillers 1.

(f) The most needed items are as follows: agricultural credit 5; fertilizer 5; insecticides 3.

(g) All the five farmers supported the idea of coops and public silos.

Table 7. Petchbul Maize

Classification I	Classification II	Av. Area per Family	Percentage to the Total Areas	Note
Maize Planted Area	Owned	103.75 rai	76%	a
	Rented	40.00 rai	15%	
	Total	99.00 rai	91%	
Whole Upland Arable Area	Owned	103.75 rai	76%	
	Rented	40.00 rai	15%	
	Total	99.00 rai	91%	
Paddy Field	Owned	54.00 rai	9%	
	Rented	-	-	
	Total	54.00 rai	9%	
Item		**Av. per Rai**	**Percentage of the counted Area**	
Maize Yield		522.72 kg	100	
Selling Price		0.92 ฿	100%	
Gross Income per Rai		480.90 ฿		
Cost of Seeds		5.24 ฿	100%	
Cost of Ploughing		81.93 ฿	100%	
Cost of Seeding		6.79 ฿	54%	
Cost of Weeding Cost of Intertillage		35.47 ฿	54%	
Cost of Harvesting		27.24 ฿	100%	
Cost of Threshing		15.00 ฿	92%	
Cost of Fertilizer & Fertilization		-	-	
Cost of Pesticide & Spraying		-	-	
Cost of Transportation		25.21 ฿	46%	
Cost of Land Rent		(70.00 ฿)	8%	b
Total Cost per Rai		196.88 ฿		
Return		284.02 ฿		
Number of Family Labor		0.03	100%	
Number of Labor Animal		0.001	100%	
Number of Temporary Hired Labor		0.14	84%	
Number of Permanent Hired Labor		0.02	76%	
Money borrowed from Middlemen		142.85 ฿	57%	c

H. Central North Mungbean Table 8

(a) Since only two examples of mungbean producers were collected from the Swankaloke area, it was difficult to decide how to handle them. Finally they were combined with the data from Pitsanuloke under the title of Central North. But it must be noted that since ten farmers in Pitsanuloke are all small farmers (cultivating areas of 5.6 rai on the average) while Swankaloke farmers have 76 rai on the average, the figures for average area in the Table are absolutely meaningless. In Pitsanuloke, all the upland areas were utilized for growing mungbeans, while in Swankaloke, 45% of the upland area was utilized for mungbeans. Mungbean is usually planted as a second crop to maize.

(b) As most of the cases were expressed in the unit of tang, the yield and the selling price were based on tang.

(c) The figures show that seeding of 79% of the total mungbean area was done by family labor. But since the cost calculated from the corresponding 21% area is comparatively low, it is assumed that family labor cooperated with hired labor to some degree. This makes an unavoidable defect in this kind of study by questionnaires.

(d) The two cases in which fertilizer was applied got a comparatively high yield. Since fertilizer is not yet generally used, it has been excluded from the cost calculation.

(e) All the questionnaires for Pitsanuloke reported family labor to be zero.

(f) All of the figures in the column resulted from Pitsanuloke.

(g) The seeds borrowed from middlemen are reported to be returned in double the volume after harvest.

(h) The answers to the item on agricultural implements were as follows: out of all 12 cases, tractors 4, power tillers 6, sprayers 3, and water pumps 1. Since the owners of tractors have only very small areas to cultivate, they probably earn money as contractors.

(i) The years of experience for cultivating mengbeans range from 3 to 25 years. The average is high at 8.7 years.

(j) The most needed items of the farmers are as follows: good varieties 3, good seeds 2, agricultural chemicals 2 and tractors, credits and good market price 1 each.

(k) As for cooperatives, one answered good. The others gave no comment.

(l) As for public silos, two answered good, one preferred cooperative silo, and nine gave no comments.

Table 8. Central North Mungbean

ClassificationII	Classification II	Av. Area per Family	Percentage to the Total Areas	Note
Mungbean Planted Area	Owned	8.59 rai	45%	a
	Rented	5.00 rai	2%	
	Total	8.29 rai	47%	
Whole Upland Arable Area	Owned	13.50 rai	71%	
	Rented	5.00 rai	2%	
	Total	12.79 rai	73%	
Paddy Field	Owned	13.62 rai	26%	
	Rented	-	-	
	Total	13.62 rai	26%	
Item		Av. Area	Percentage of the counted Area	
Mungbean Yield		11.43 tang	100%	b
Selling Price		36.49 ฿	100%	
Gross Income per Rai		417.08 ฿		
Cost of Seeds		28.60 ฿	40%	
Cost of Ploughing		26.53 ฿	74%	
Cost of Seeding		3.41 ฿	21%	c
Cost of Weeding		-	-	
Cost of Intertillage		22.00 ฿	20%	
Cost of Harvesting Cost of Threshging		27.30 ฿	58%	
Cost of Fertilizer & Fertilization		(30.83 ฿)	12%	d
Cost of Pesticide & Spraying		16.84 ฿=	42%	
Cost of Trasnportation				
Cost of Land Rent		(55.00 ฿)	5%	
Total Cost per Rai		124.68 ฿		
Return		292.40 ฿		
Number of Family Labor		0.06	73%	e
Number of Labor Animal		0.01	73%	
Number of Temporary Hired Labor		1.59	16%	f
Number of Permanent Hired Labor		0.75	2%	f
Money borrowed from Middlemen		57.35 ฿	81%	
Mungbean Seeds borrowed from Middlemen		0.28 tang	52%	g

I. Petchbul - Vichiengburi Mungbean Table 9

(a) Five examples for this Table were returned through the valuable cooperation of the Vichiengburi extension officer. The area belongs to the corn belt as mentioned before. Mengbeans are planted after maize and account for 81% of all the upland area, according to the Table.

(b) The unit of tang was adopted here for the same reason as mentioned before.

(c) Instead of cost of seeds, all the questionnaires reported the price of mungbeans per tang. So the cost was calculated from their average price on the assumption that a half tang of seeds are planted per rai.

(d) Threshing is reporetd to cost 3 to 4 ฿ per tang, that is, 29 to 39 ฿ per rai. So, in this cost some family labor must have been included.

(e) The price of land rent seems too expensive. Probably, the rent for maize land was also included.

(f) Shows evidently over-borrowing. Borrowing is usually excessive in reclaimed upland areas.

(g) The years of cultivating mungbeans range from 1 to 5 years, averaging 2.6 years.

(h) Only 5 sprayers were reported as agricultural implements.

(i) The most needed items are as follows: credit 5, insecticide 5, fertilizer 2, and good varieties 1.

(j) All the farmers agreed to the idea of a coop and public silo.

Table 9. Petchbul Vichiengburi Mungbean

Classification I	Classification II	Av. Area per Family	Percentage to the Total Areas	Note
Mungbean Planted Area	Owned	33. 33 rai	47%	a
	Rented	20. 00 rai	19%	
	Total	28. 00 rai	66%	
Whole Upland Arable Area	Owned	40. 00 rai	56%	
	Rented	26. 50 rai	25%	
	Total	34. 60 rai	81%	
Paddy Field	Owned	40. 00 rai	19%	
	Rented	-		
	Total	40. 00 rai	19%	
Item		Av. per Rai	Percentage of the counted Area	
Mungbean Yield		9. 71 tang	100%	
Selling Price		40. 11 ฿	100%	
Gross Income per Rai		389. 47 ฿		
Cost of Seeds		47. 00 ฿	100%	c
Cost of Ploughing		34. 85 ฿	100%	
Cost of Seeding		17. 14 ฿	100%	
Cost of Weeding Cost of Intertillage		33. 33 ฿	43%	
Cost of Harvesting		43. 57 ฿	100%	
Cost of Threshing		10. 00 ฿	100%	d
Cost of Fertilizer & Fertilization		-	-	
Cost of Pesticide & Spraying		50. 00 ฿	57%	e
Cost of Transportation		-	-	
Cost of Land Rent		(77. 50 ฿)	29%	
Total Cost per Rai		235. 89		
Return		153. 58		
Number of Family Labor		0. 06	100%	
Number of Labor Animal		0. 01	100%	
Number of Temporary Hired Labor		0. 22	95%	
Number of Permanent Hired Labor		0. 11	52%	
Money borrowed from Middlemen		344. 44	42%	f

J. Petchbul Vichiengburi Peanut Table 10

(a) Examples collected numbered 5. Peanuts were planted on 19% of all the upland area.

(b) Not cost, but price of the seeds was reported. So the cost was calculated on the supposition that two-thirds of a tang of the seeds are planted per rai.

(c) No price of rent was reported, although there was some land rented to the farmers.

(d) The amount of the debt is not serious.

(e) Cultivating years for peanuts is 4.2 years on the average.

(f) Only five sprayers were reported in the item of agricultural implements.

(g) Most needed items were: credit 5, agricultural chemicals 5, fertilizer 4, and good varieties 4.

(h) Coop and public silo were agreed to by all the farmers.

Table 10. Petchbul Vichiengburi Peanuts

Classification I	Classification II	Av. Area per Family	Percentage to the Total Areas	Note
Peanut Planted Area	Owned	10.75 rai	9%	a
	Rented	10.00 rai	2%	
	Total	10.60 rai	11%	
Whole Upland Arable Area	Owned	65.00 rai	54%	
	Rented	40.00 rai	8%	
	Total	60.00 rai	62%	
Paddy Field	Owned	185.00 rai	38%	
	Rented	-	-	
	Total	185.00 rai	38%	
Item		Av. per Rai	Percentage of the counted Area	
Peanut Yield		281.45 kg	100%	b
Selling Price		3.78 ฿	100%	
Gross Income per Rai		1063.8E ฿		
Cost of Seeds		50.62 ฿	100%	
Cost of Ploughing		33.00 ฿	100%	
Cost of Seeding		34.72 ฿	100%	
Cost of Weeding Cost of Intertillage		43.49 ฿	100%	
Cost of Harvesting		133.02 ฿	100%	
Cost of Threshing		-	-	
Cost of Fertilizer & Fertilization		-	-	
Cost of Pesticide & Spraying		23.13 ฿	91%	
Cost of Transportation		-	-	
Cost of Land Rent		-	-	c
Total Cost per Rai		317.98 ฿		
Return		745.90 ฿		
Number of Family Labor		0.03	100%	
Number of Labor Animal		0.01	100%	
Number of Temporary Hired Labor		0.10	41%	
Number of Permanent Hired Labor		0.06	33%	
Money borrowed from Middlemen		80.86 ฿	96%	d

Considrations

To examine the farmers costs in the present study, the procedure of sampling was not adopted. Sampling is complex and was beyond the range of possibility for a foreign expert who has only limited time and supporting personnel. The poor collection rate of the questionnaires also was a factor which impeded the present study, as mentioned before. It must be admitted also that many points could have been improved in the questionnaire itself. Moreover, there was a lack of experience on the part of both the client and assignees, which affected the results of the investigation itself, because this type of questionnaire survey was tried for the first time.

In spite of all the short-comings enumerated above, the following considerations and conclusions are presented.

(a) Economical Comparisons by Crop and by Area (Table 11)

Mixing of family labor in a hopefully small degree into cash-based cost was inevitable, as can be seen in the calculations from Table 1 to Table 10. But there is also the area in which the work was done purely by family labor. This is seen from the percentage of the corresponding area in each column, where cash is paid for hired labor and other inputs. So to estimate as near as possible the actual cash-based cost per rai excluding family labor cost, another system of cost for each crop and district is calculated. It decreased proportionately to the percentage of the area where cash is actually paid. For the sake of convenience, let us call the former which appears in Tables 1-10 Cost A and latter Cost B.

In Table 11, figures obtained by dividing Return by Cost A are indicated in the column P, and those obtained by dividing Return by Cost B in column Q. Also, averages of family labor per rai are shown in column R. The average incomes are obtained by multiplying (1) the return calculated by deducting purely cash-based Cost B from Gross Income with (2) the average areas per farmer. These are shown in column S for each crop and district.

It must be added here that Swankaloke Soybean-Table 3 is excluded from the considerations because the examples are so few.

Table 11. Return to Cost

Crop	Place	P	Q	R	S
Soybean	Chiengmai	0.57	7.34	0.30	821 ฿
	Swankaloke	1.10	2.55	0.12	2,064 ฿
	Petchbul	0.68	0.79	0.04	2,963 ฿
Maize	Swankaloke	1.15	2.87	0.08	4,669 ฿
	Pitsanuloke	2.57	5.27	0.15	1,827 ฿
	Petchbul	1.44	1.95	0.03	31,510 ฿
Mungbean	Central North	2.34	6.05	0.06	2,968 ฿
	Pechbul	0.65	0.99	0.06	5,434 ฿
Peanut	Petchbul	2.34	2.36	0.03	7,928 ฿

According to column P in Table 11, soybean seems to be inferior to other crops, each ranking the 9th, 6th and 7th, respectively. Pitsanuloke maize, Central North mungbeans and Petchbul peanuts show a high return rate. Chiengmai wet-season soybeans showed the lowest return rate. But the situation is entirely different, when we look at the cash based Q column, which excluded cost of family labor. Chiengmai wet-season soybeans ranks at the top despite its bad crop at the time of investigation. The differenc not by crop but by district appears more obviously in this column than in the other. Petchbul, where family labor is very small per unit area, holds the 6th, 7th, 8th, and 9th ranks. (The fact that each figure for family labor per unit area in column R corresponds proportionately to the change from column P to column Q reinforces the assumtpion of accuracy in the calculation). Far more permanently-hired labor than family labor is put into cultivation in Petchbul as mentioned before. If there are big proprietors of land on one hand and many workers on the other, this might be an element of hindrance to agricultural production, because a big proprietor of land would lose incentive for multiple cropping for economic and technical reasons, since he can get more than ₿ 30,000 on one crop as seen in Table 11. Proper political guidance might be necessary for the optimum agricultural area, when the situation becomes serious.

(b) Comparison by Item of Cost (Table 12)

Percentages by item of Cost for each crop and district are shown in Table 12. The cost is based on real payment, that is, Cost B. The items weeding, intertillage, harvesting, and threshing were separately requested in the questionnaires. But because of the mixed answers, they were combined in the Table.

A general view of the Table shows that the biggest item of payment falls on ploughing, next comes payment for harvesting and threshing, then payment for seeds. Since family labor is excluded, none of the other labor cost comes up to 16%. Expenses for fertilizer and agricultural chemicals proved to be very low. But, when they are examined in detail, many differences are found by crop and by district.

The percentage of ploughing in Soybean Petchbul seems low. This is not because the expenditure for ploughing is small, but because the payments for other management labor are considerably large, since family labor is very small there. The percentage of harvesting and threshing for maize in Swankaloke is extraordinarily small. There is no other remedy but to understand that it is because the work is mostly done by family labor. In mungbean culture, the importance of insecticides is rather high. In peanuts, harvesting is by far the most expensive item of all.

Table 12. Comparison by Item of Cost

Cost Item	Soybean CH	Soybean SW	Soybean PE	Maize SW	Maize PI	Maize PE	Mungbean CN	Mungbean PE	Peanut PE
Seeds	24	14	19	-	17	3	19	24	16
Ploughing	42	49	18	79	39	50	33	18	10
Seeding	8	1	10	10	4	2	1	9	11
Weeding and Intertillage	16	6	16	9	3	12	7	7	14
Harvesting and Threshing	9	29	29	1	32	25	27	27	42
Fertilizer	-	-	-	-	1	-	-	-	-
Insecticide	-	-	7	-	5	-	12	15	7
Transportation	-	-	-	-	-	7	-	-	-
Total %	100	100	100	100	100	100	100	100	100
Total Cost B ฿	37	77	187	71	62	163	59	195	316
Total Cost A ฿	197	130	198	127	108	197	125	236	318

CH = Chiengmai PI = Pitsanuloke
SW = Swankaloke CN = Central North
PE = Petchbul

On the other hand, the most nedded items for farmers were investigated, and the result was that the need for agricultural credit got the overwhelming majority. Then follow fertilizer, agricultural medicine and good varieties in that order. Some other items mentioned included tractors, good seeds, good market prices, etc. Although ploughing and threshing hold account for a large percentage of the expense items in cash payment costs, farmers' desire for appropriating them proved to be rather feeble in the needed items. The reason is presumed to be either the their purchase is unthinkable because of lack of funds, or there are professional contractors available for the purpose in Thailand. As to seed cost, its magnitude is correctly reflected on the needed items, the request for excellent varieties and good seeds ranging next only to fertilizer and agricultural chemicals. The ardent request for agricultural credit will be discussed later. It is remarkable that fertilizer and other agricultural chemicals, which are little used at present in Thailand, held second and third rank next only to agricultural credit among most needed items. It is confirmed again that the supply to Thai farmers of good quality and inexpensive fertilizer and other agricultural chemicals, is one of the most important tasks in the development of Thai agriculture.

(c) Credit Relations with Middlemen

Definite conclusions should not be made here since the data are not too strong. It should be mentioned, however, that notwithstanding the poor data collected, the situation of indebtedness for each crop and district shown in Table 1 to 10 coincides remarkably with the degree of strength in which the farmers' request for agricultural credit were expressed in the most needed item.

When they are classified by the amount of borrowing from middlemen, farmers can be divided into three groups as follows:

(1) Obviously over-borrowing

Petchbul Soybean
Petchbul Mungbean

(2) Heavily in debt

Swankaloke Co-op Soybean
Swankaloke Maize
Petchbul Maize
Petchbul Peanut

(3) Insignificant or no debts

Chiengmai Soybean
Swankaloke Thung Salium Soybean
Pitsanuloke Maize
Central North Mungbean

When they are examined in the most needed item, groups 1 and 2 held the need for agricultural credit to be most important, while group 3 put it in low ranking or showed no need. Therefore, it is presumed that these requests for agricultural credit are directed to credit institutions. Those who are deeply in debt with middlemen wanted credit from institutions in order to extract themselves from the middlemen.

The above classification of 3 groups in relation to middlemen's credits is amazingly in accord with the return to cost ratios in column Q, Table 11. But this must be viewed with reservation, since the content of Table 11 relates solely to the case of monocropping, while the debt might have been reported from the standpoint of multiple-cropping, because there were no rigid prescriptions about the item of indebtedness in the questionnaire.

On the other hand, comparing the years of experience in cultivating each crop in each district with indebtedness to middlemen, a certain tendency was found. It is that the newer the experience is, the deeper the indebtedness to middlemen. When the cultivating experience is longer, the indebtedness becomes more insignificant.

This fact leads to a probable conclusion that the middlemen's credit has been playing the role of a development fund, especially in newly reclaimed areas. To sum up, more institutional credit is very much desired by farmers, especially the farmers in newly developed areas.

In the item with relation to middlemen, interest and borrowing of rice and seeds were also investigated at the same time. However, there were no answers about interest and only a few fragmented answers for the others. Since the monetary relations between farmers and middlemen are considerably important at the present stage of Thai agriculture, it is recommended that an investigation with more detailed questionnaires be carried out on this subject.

(d) Others

Land rent was excluded altogether from the present cost calculation, because the rented land was small this time, and the price data also often appeared to be incomplete. It could be one of the more interesting problems to study from the production economic point of view by separating farmers into two big categories of land owners and tenants. Then they could be compared and checked in evey point of agricultural management, performance, and behavior.

As for agricultural cooperatives and public silos, the farmers' responses were fewer, when the agricultural area concerned was older. This was contrary to the present writer's expectations. As the marketing system of overseas Chinese merchants is very efficient (as will be analyzed in another report), the growth of agricultural cooperatives should involve a peaceful coexistence as well as fair competition with these established marketing systems.

Conclusion

Needless to say, agricultural production is the base of Thailand economy. In order to formulate a proper agricultural policy, a proper investigation from the actual standpoint of agriculture is needed. This modest report concerns itself with the production cost of soybeans and a few other crops, based on the data from actual agriculture. If this kind of agricultural investigation is repeated periodically, the accuracy of investigation will be raised gradually each time. When similar investigations are tried, it is hoped that the unavoidably incomplete and inadequate parts in this initial trial will be improved the next time.

It is assumed that Thai agriculture will proceed in the future in the direction of multiple cropping. Therefore, it is hoped that the dimension of investigation would be expanded, by taking into consideration the relations of principal crops and secondary crops, and analyzing production costs and returns from the standpoint of the yearly farming operation.

Even school pupils can collect the investigation data by questionnaire if they are in the higher grades. By broadly mobilizing and training rural youths, it would become possible to accumulate abundant data of good quality at comparatively small expense. The importance of agricultural investigation can not be overestimated. Effective policy of agricultural promotion can only be established on the basis of abundant materials from agricultural investigations.

Last but not least, I wish to express here my deep gratitude to all who cooperated with me in both the urban and up-country areas during the six months of questionnaire investigation. I thank especially Mr. Wallop and Mr. Panom of Swankaloke Cooperative Association, Mr. Woodhi Tobamroong, Extension Officer of Amphoe Tungsalium, and Mr. Stit Puypuii, Extension Officer of Amphor Vichiengburi, without whose cooperation the present report could not have been completed.

QUESTIONNAIRE ON SOYBEAN PRODUCING FARMERS

Date:

Place:

Gross Income:

1. Area of Soybean

   Own .... rai Rent .... rai Total ..... rai

2. Area of All Arable Land

   Upland: Own ..... rai Rent .... rai Total ..... rai

   Paddy field: Own .... rai Rent ...... rai Total ..... rai

3. Yield per Rai

   .... tang or .... kg per rai

   (Yield per rai) x (Total area) = (Total produced)

   ....

4. Selling Price to a Middleman and Means of Transportation

   .... baht per tang or .... baht per kg

5. Settlement of Accounts with a Middleman

   a. Borrowing money, how much?

   b. Borrowing rice, how much and repaying how much?

   c. Borrowing seeds, how much and repaying how much?

   d. Interest

   e. Other kinds of borrowing and conditions of repayment?

   Production Cost:

6. Cost of Seed (Also note about variety and means to keep viability).

7. Cost of Plowing (Also note own or hire a tractor, buffaloes or human labor.)

8. Cost of Labor of Seeding (Also note number of persons hired and how much payment made to each of them).

9. Cost of Weeding (Also note means of weeding, number of persons hired, how much payment to each of them and cost of herbicide when used.)

10. Cost of Intertillage (Ditto)

11. Cost of Labor of Harvesting (Ditto)

12. Cost of Threshing (Cost of drying if necessary)

13. Fertilizer:

  a. Manure
  b. Chemical
  c. Cost of Labor of Applying Fertilizer

14. Pesticide:

  a. Cost of Pesticide
  b. Cost of Labor of Spraying

15. Land Rent and its Condition

16. a. How many family laborers?

  b. How many labor livestock?

  c. How many temporarily hired laborers?

  d. How many permanent hired laborers?

17. What kind of agricultural implements do they have? (Tractor, Power tiller, Pump, Sprayer, etc.)

18. How many years of experience in growing soybeans?

19. Farmer's Opinion:

a. In increasing soybean production?

b. What is the most needed at present?

c. How about organizing cooperatives?

d. How about constructing a public silo?

MARKETING CHANNELS FOR THAI SOYBEANS

Preface

The marketing channels for Thai soybeans are shown in the plan scheme.

The details of the local circulation of soybeans in the plan came from an analysis of the marketing system both in Chieng-Mai (the oldest soybean growing area in Thailand) and in Sukothai, a relatively new area but presently producing over 60% of Thailand soybeans. The part on the metropolitan circulation of soybeans in the plan was made, taking into consideration the soybean and its by-product trade with respect to the oil crushers, whose trade has grown at a rapid pace in recent years, and also the new trend where the Federation of Agricultural Co-operative Association is emerging as a new channel. Therefore, some parts of the present plan may not exactly apply to the soybean marketing channels in the new frontier to soybean production or in those areas where soybean production is inconsistent. On the other hand, when the soybean production is successfully increased to a much greater figure than the present quantity (according to the new Five Year Plan), it is beyond question that the marketing channels will become more complicated, especially with respect to the complex role of the oil crushers.

The point that must be stressed here is that the production and the marketing system are inter-related in the same manner as the two sheels of a vehicle. If production is increased and the marketing system is not developed in proportion, the farmer will not be able to continue production. If there is limited production, a simple marketing system will be sufficient, but if production is on a large scale, it naturally follows that the marketing system, including transport and the supply of production funds, will have to be larger and on a more complex scale. If the marketing system is not developed in proportion to the amount of production, the only party that will be losing is the farmer and at the end will result in a decline of production instead of progress in the agricultural sector.

The history of the marketing system for Thai soybeans is not so old. It developed gradually after the Second World War. In the initial stage, with the progress of multiple cropping in the Chieng Mai area, there developed a trading channel to supply those products to the Bangkok market by railway. Later on, the possibility of multiple cropping in upland areas of Swankaloke Province, where the soil and climate provide an ideal environment for cotton and soybean culture, and the Central Highlands, where the Thai corn belt is making rapid progress, and the possibility of transporting products to the Bangkok market with the opening of modern highways have come to be united under the arduous commercial activities of overseas Chinese merchants. And as the production increases, the trading system will be more developed. It is a well-known fact that, with the achievements in material distribution system, these areas have developed rapidly to become a rich agricultural zone, producing such cash crops as maize and mungbeans for expert.

It cannot be denied that the Chinese merchants have contributed a great deal to the development of the marketing system. Coming from oversea countries and spreading into the hinterland of Thailand, the Chinese merchants possess deep knowledge about both Bangkok and overseas markets, and so they are in a position to be able to find out, develop and distribute marketable agricultural products in inland Thai. In fact, it is they who stimulate production by supplying the funds to the Thai farmers and buying the crops from the farmers for distribution in the Bangkok and foreign markets, thus helping to promote the opening of markets for Thai agricultural products. In some areas they even invested a great amount of money in reclaming land to open up new cultivation areas and leasing it to farmers (in Tak and Kampang Petch Province). Up to the present stage, the commercial activities of the Chinese merchants have contributed positively to the development of Thai agriculture. But, in the stage where the production increases at a rapid pace into a gigantic scale, perhaps the policy hitherto based on the principle of laissez-faire should be changed, and possibly powerful instructions and guidance from the government would become necessary.

The present report will deal with the investigation of each channel of trade for soybeans. The investigation was carried out with the co-operation and assistance of the officials of the Department of Agricultural Extension and agricultural divisions of each Provincial Office concerned, to whom the present writer would like to take this opportunity to express his sincere gratitude.

Village Agents

The village agent is a Thai, not a Chinese, and consequently does not speak Chinese. He plays the role of buying crops such as soybeans, peanuts, mung beans, maize, garlic, onions, etc., from the farmers for resale to the Chinese business in the town. Rice and cotton are traded through other channels since rice mills and grinneries are directly related to such crops. The village agents are farmers by birth but, in practice, some of them farm on a part-time basis, and others do not farm at all. Their business form is very varied. Some are big landlords who rent out their land to other farmers and work themselves solely as buying agents; some are important people having the responsibility of village headmen at the same time; some are small farmers and become buying agents during the harvesting season only. However, one thing that they all have in common is that they distinguish themselves in commercial talent and are completely trusted by the villagers.

The leading villate agents have been trading for 20-25 years. It is presumed that, when the overseas Chinese spread into the Thai hinterland, some Thai nationals, who were probably commercially talented, began to engage in commercial activities as their counterparts, bridging the gap and providing a means of contact between the two. That is a very interesting fact from the viewpoint of the history of commercial development in Thailand.

The village agent works on an independent individual basis, and does not have any particular affiliation with Chinese businessmen. He usually has a few regular customers cemented by many years of mutual trust, as will be explained again later in the item on dealers. On the other hand, a village agent deals with about 30 farmers in Chieng Mai and about 60 in Swankaloke, about 80% of wh m remain as regular customers every season. As to the quantity of soybeans, one of the many other upland crops which the village agents buy from the farmers, there is a wide range of variation among the village agents. A leading village agent in Chieng Mai will buy an average of 250 sacks of soybeans (one sack being equivalent to 115 - 120 kgs). Each of them usually has storage space for 50 - 100 tons and will stock soybeans for about 3 months waiting for the price to increase and then will sell their stock to the Chinese merchants in the local towns.

The basic function of the village agent is to buy and sell, that is, to play the part of a middleman between the farmers and the ultimate buyers. A closer look shows that he has the following functions.

(a) Usually at the time of planting, he advances money from 200 to 2,00 baht per family to the farmers in need, giving stimulus to the agricultural production. At the same time, from the standpoint of the village agent, the money advanced serves as a deposit securing the future crop at the time of harvest for him, because the agricultural product in a certain district is limited in quantity and there are so many village agents that competition among them is very keen. The source of the money advanced comes sometimes from his own fund and sometimes through financing by the Chinese merchants. The loan is paid back with the product itself at the time of harvest, that is, deducting the amount of the loan from that of the purchase, with no interest. This point will be referred to again in another report by the present writer.

(b) He supplies price information to the farmers, which he gets from the Chinese merchants in local towns, usually once a week, and every day at the time of harvest. On the other hand, the farmers also go round to village agents and dealers asking the prices at the harvesting time.

(c) He supplies seeds to the farmers. As is well-known, the soybean seeds will lose their viability by nearly 50% within 4 months in Thailand. For this reason, the majority of the farmers will not keep their own seeds but will buy them from the village agent or a dealer. As it is possible to grow soybeans almost all the year round in various districts in Thailand, the village agent or a dealer obtains comparatively fresh soybean seeds with good germination where they are available, and sells them to the farmers at planting time, at more than double the price.

(d) As almost all of the village agents live in the same village with the farmers and have a good knowledge of the market conditions of each agricultural product, they advise the farmers in regard to marketing and most profitable cropping, thus gaining considerable influence among farmers.

The transportation of the products from the farmers to the village agent is usually by means of ox carts. If there is a sizable volume of production, the farmers will bring them to the village agent. If the production is small, the village agent will sometimes go to the farmers to collect the yields. The transportation from the village agent to the dealer is usually by small truck or mini-bus from specialized transporters, the cost being paid by the village agent.

Dealers

There are several big dealers, in certain streets of Chieng Mai and Swankaloke, who transact business in peanuts, soybeans, maize, mungbeans, castor beans, etc. In wider areas, scattered in the town, there are small dealers, numbering about 15 in Chieng Mai and about 30 in Swankaloke. The big dealers buy principally from the village agent, whereas the small dealers buy principally from the farmers directly. The big dealers will send the crops to the Bangkok market, whereas the small dealers will sell the crops mainly to the big dealers or for local consumption.

Big Dealers:

Usually the big dealers have been in business for 20 - 35 years. Their commercial activities cover an extremely large range of territory, through the village agents and the small dealers. For instance, a big dealer in Chieng Mai will buy soybeans from Amphoe Sansai, Sampatong, Maesarieng, Doisaket, and peanuts from Hod, Maetal, Lampoon, maize from Pao, Chiengadao, Fang, etc., covering all upland crops in Changwat Chieng Mai, Lampoon and Maehonsong. Also, the peanut dealers in Lampan buy the crops, from as far as Chieng Rai.

During the harvesting season of each crop, from 40 to 60 sacks will be brought into the yard of the warehouses of the dealer by small truck or mini-bus for inspection and measuring. Each big dealer has storage space capable of holding more than 2000 tons (especially the godowns in Swankaloke), and sells to Bangkok according to Hansheng or price information letter sent daily by Yong or brokers there. The dealers in the city of Pakchong in the Thai corn belt, where a telephone system has been recently completed, receive price information from Bangkok 2 - 3 times every day.

A big dealer buys from an average of about 500 customers, and sells to 2 - 4 Yong in Bangkok, although he receives far more Hansheng. The connection between village agents, dealers and Yong is similar to that between farmers, village agents and dealers, 80% being constant and 20% changing every season. The chief reasons for the change are advanced credit and good prices. The connection between the dealer and Yong remains usually stable and close for many years, but recently there has appeared some sings of transformation as the competition has grown very keen. The relation between the dealer and Yong is usually very fluid and uncertain because Yong deals on a 2 - 4 % commision basis, but as there is no specific commission agent contract, the dealer can sell at any time to Yong offering the best price. Marketing order seems to be maintained by a kind of transaction series based on a typically Oriental system of mutual trust. Sometimes the dealer receives an order directly from the oil crushers or the exporters, and sells to them when their price is met, but such cases are quite rare.

The dealer, like the village agent, extends loans to the farmers to be spent as subsistance and production fund, directly or indirectly through the village agent. The loan has two meanings as mentioned before. The first is to stimulate production and the second is to secure future crops. According to an investigation result reported by the team from the Kasetsart University, the middleman's interest to the farmers reaches nearly 3.5 % monthly, while, on the other hand, the big dealer is in a position to be able to draw a large amount of credit from the bank due to the abundance of his security with the bank interest coming to only 1.0% monthly. Thus creates a problem. The present writer's effort to grasp the actuality of the problem has ended in vain up to date. It can be said, however, that the statement of "no interest" mentioned equally by the farmers, the village agents and the dealers would be rather nearer the truth, and that the middleman's credit to the farmers is showing a declining trend with the increase of extension of institutional credit in the rural areas. Anyway, it is certain that a detailed survey of the problem is greatly needed.

Small Dealers:

The small dealers are scattered around the big dealers in Swankaloke and Chieng Mai. Also, the small dealers exist in the small local towns, that is, Muang Amphoe, in a small separated soybean producing area. They collect soybeans and sell them to the big dealers in the cities, that is, Muang Changwat. The small dealers are all Chinese merchants. Among the dealers, the principle of fair competition and cooperation dominate. But, as already mentioned, due to the fact that the big dealer has adequate storage facilities to keep the upland crops, enough money to advance to the farmers and village agents, and has good connections in the Bangkok market, it can be said that his position is very stable. Also, he is often a shareholder of a rice mill or a grinnery. This big dealers are often relatives of each other.

The reason for the existence of the small dealer is as follows. He absorbs more or less 2% of the margin of the village agent by buying directly from the farmers. When he sells to the big dealer, he gets a special price because of the large quantity. The big dealer often gives credit to the small dealer to collect crops. The small dealer has contacts with various trade channels, as is shown in the plan, selling to Yong in Bangkok as well as to the big local dealers, and supplying also for local consumption. That means he has much opportunity to gain profits by short-term speculation, although the margin might be low.

The small dealer often pursues the trade as a side business, selling principally agricultural implements or sundry goods. It was found that many small dealers in the minor soybean producing areas like Maesod, Tak, Kampangpetch and Pijit, who sell to the big dealers in Nakornswan fall under this case. In the Central Highlands, in the same minor soybean producing areas inside of the Tahi corn belt, like Takli, Chaibadarn, Phraputabaht, Moklek, etc., some of the corn dealers specialize also in the trade of soybeans. In Phrae, peanut dealers and, in Nan, cotton dealers are also engaged part-time in the trade of soybeans, too.

One explanation for the origin of the small dealers is that a big dealer will let his clerk of many years' service open his own shop, a system traditionally observed by Chinese merchants. A study to clarify the relationship between the big dealer and the small dealer may be one clues that will explain the commercial habits of Chinese merchants.

Yong

Yong is a Chinese word meaning commission agent, but in reality it is not a commission agent in a strict sense but rather a correspondent. Most of the Yong are located at Songwad Road in Bangkok, and they number more than a hundred. Some of them are also engaged in the import business (for example, import of onions from Holland, garlic from Taiwan) but not in export. The reason they give for this is that there is too much competition among the exporters.

The Yong plays the most important part in the marketing of upland crops, because his position is, just like the rivet of a fan, connecting producers with all end-users including exporters, as is shown in the chart. Thus he plays the part of a price maker, concentrating all information about prices.

There is an association of the Yong as an organization for caretaking etc., which was established many years ago when the railway was the main means of transportation between Bangkok and Chieng Mai. At present, about half of the Yong are outsiders, and the competition among the Yong is so severe that they almost quarrel and fight, in the opinion of some dealers.

Each of these over a hundred Yong is specialized to some extent by crops and by the district of collection. About twenty Yong deal in beans. Some of them specialize in trade of Swankaloke soybeans which are used mainly for oil crushing, and others in trade of Saraburi soybeans from Central Highlands, which are of high protein content as well as of good quality and so generally used for manufacturing Tofu, soy sauce, soybean milk, etc. Some of them have a steady trade background especially in the Chieng Mai district, dealing in all the upland products there. In this manner, each Yong has his own particular trade field to some extent, but the competition among them is none the less keen, as mentioned before.

Concentrating the information on the market, the Yong issues daily price information called Hanshen and sends it to his correspondent dealers in the up-country. A Yong sends usually about 60 Hanshen to different dealers. However, as regular customers, he is connected usually with 10 - 20 dealers. It was explained earlier that the relation between the dealer and Yong is fixed as well as fluid and flexible, and the same applies to the relation between Yong and the end-users, although the regular customers are treated with priority. The storage space of Yong is usually not so big, and the goods are often transported from the up-country dealer directly to the godown of the oil crusher or the exporter That is to say, Yong is a business which gains by market information, not by storage space, being well versed in the prices of every deal concluded in Bangkok, estimated quantities in stock, in transportation, and in shipment, etc.

Many years ago, there was a period when Yong had his own agents in up-country, giving them advanced credit for the collection of crops, but the system went out of use, as the competition among them became keener.

Oil Crusher

The oil crushing industry is concentrated on the line of Bangkok, Nonthaburi and Ayutaya. There are two oil crushers also in Chieng Mai, but they are engaged mostly in trade of oil seeds and not in oil extraction, because their equipment imported from Taiwan is too obsolt and inefficient. Vegetable oil produced by Bangkok manufacturers has vast competitive power even in Chieng Mai, and small merit is found only in the sale of meal. There are small oil crushers scattered in the South of Thailand who use coconuts and rubber fruits. (The Ministry of Welvare has already announded measures to stop the use of rubber fruit because the oil is harmful to the human body.)

There are several oil crushers with first rate equipment, including three plants by solvent extraction, and about forty smaller scale oil crushers, of which about twenty have a capacity of more than 15 tons daily consumption of raw material, and others which are considered to be border line oil crushers. Total installed capacity is estimated to be more than 100,000 tons.

Soybeans have recently become to be sought after incessingly as one of the most important vegetable oil materials. It is said that the per capita consumption of soybeans in Thailand more than doubled during ten years, that is, from 0.74 kgs in 1960 to 1.63 kgs in 1970. The principal reason for this increase is the increase in soybean oil consumption in the last four years. It is said also that the shares of the various vegetable oils in consumption in 1970 are as follows: coconut oil 48%; peanut oil 14%, rice bran oil 14%; soybean oil 11%; cotton seed oil 5%; etc. The fact that soybeans have come to be increasingly sought resulted from the fact that the other vegetable oil materials have had problems of their own. Popular taste has been gradually changing from coconut oil to other vegetable oils. As to the rice bran oil, most of the rice mills in this country are obsolete and cannot separate rice bran in the polishing stage. Therefore the collecting of bran is very limited, although Thailand is one of the big producers of rice in the world. Cotton seed production diminished rapidly owing to insect damage since 1967. The operation rate of all the oil crushing plants is estimated to be about 40% of the capacity in 1970. The reason is the lack of raw materials for oil extraction. The big oil crusher tries to contact directly with the representatives in the producing areas, for eliminating the middle men's margin, in order to obtain cheaper raw soybeans. As a new tendency, they are also making efforts to play the role of sole buyer for the soybeans produced by the agricultural cooperatives through a newly established Federation.

The marketing of soybean meal looks bright, having good prospects for export, although the protein content is rather lower than that of U.S.A. Feed assembly plants have been established domestically. On the other hand, the marketing of soybean oil is very slow at present. Thai nationals, especially people in the countries, consume much lard in their daily meal as it is cheap. The position of lard in Thai daily food will not be replaced by vegetable oils, for many years to come. However, taking into consideration the fact that people's taste especially in the metropolis is changing from lard to vegetable oils for nutritional reasons as well as the fact that the import of vegetable oils amounts yearly to a sizable foreign exchange spending, the future domestic marketing of Thai soybean oil cannot be said to be gloomy.

A decade ago, Thai soybeans had been produced only for the purpose of manufacturing traditional food, such as Tofu, soy sauce, sprouts, etc., and partially exported to Singapore and Makaysia, etc. for the same purpose. From the present to the future, it is certain that the oil crushing industry will become the biggest consumer of Tahi soybeans, and will be a big influence in their production and marketing.

Exporters

The exporters buy soybeans from Yong and export them according to oversea market prices. Their agents and correspondents there are mostly their own compariots. The exporters who trade in soybeans number over ten. Soybeans have yet only minor significance among Thai export crops, because their competitive power in the international market is not strong enough and they are comparatively high-priced and lack standardization of quality. They are exported chiefly to Malaysia and Singapore in December and January, when the soybeans from China Mainland comes to a terminal gap period. The competitiveness of Chinese soybeans in Hongkong and of U.S.A. soybeans in Taiwan are so strong that the export of Thai soybeans to these destinations is small in quantity and sporadic as well.

At present, Thai soybeans for export are mostly composed of Saraburi soybeans, because exported soybeans are used mostly for the purpose of food manufacturing at the destination. Soybean meal and peanut oil and meal are shipped from the oil crusher directly to oversea markets through the exporter. The exporter has usually a big godown, and purchases crops from Yong tostock there when the price is low. If he does not have a big godown, Yong would force up the price, taking advantage of the situation, when enquiries came from overseas. One lot of shipment of soybeans is less than 150 tons at the most, and either sold CIF or FOB.

One of the marketing problems of Thai soybeans, as seen from the side of the exporter, is that the production of soybeans is so small that the quotations fluctuate sharply. When some of them are exported, for instance, a quotation of 130 - 140 ฿ per picul will rise suddenly to 170 - 200 ฿ per picul on account of increases in export prices. In case of maize, the production is so big that the price tends to be more steady. Another point is that, in the case of maize, the production is big and the period for export is over nine months, so that, if one loses in the first speculation, one has sufficient time to recover within the period. But in the case of soybeans, the production is so small that a loss in one speculation does not give sufficient opportunity to recover owing to the time factor.

Conclusion

The marketing channel net-work by overseas Chinese merchants is so efficient that no major problems have been found in the domestic market. The system covers the principle of fair competition in almost all phases of the channels as has been reviewed so far, although it has occasionally been observed that competition is being carried too far as there are too many small traders in the business, especially in the Bangkok market, who do not have sufficient capital to enable them to meet the scale merit and to conform to international marketing standards.

The problem of marketing is though to lie rather in the facilities of transportation, such as roads, canals, raiways, cargo terminals, sea and river port facilities, etc., where the infrastructure, which needs financial investment, is much more related than the private sector is. Their improvement will help to cut down the cost, augmenting the competitive power of Thai products in international markets.

Plan of Trade Channels for Thai Soybean