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A study on the effect of
plant population on

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RESEARCH PROGRAMME NO. 44
PRODUCTION AND UTILIZATION OF GRAIN LEGUMES

RESEARCH PROJECT NO. 44/2
IMPROVEMENT OF CULTURAL PRACTICES OF GRAIN LEGUMES

REPORT NO. 2
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ON SOYBEAN GRAIN YIELD

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A STUDY ON THE EFFECT OF PLANT POPULATION ON SOYBEAN GRAIN YIELD

By Pradit Piramarn* and Prapandh Boonklinkajorn*

SUMMARY

The investigations were conducted both in rainy and dry seasons at Northeast Agricultural Center, Khon Kaen, and Non Sung Agricultural Experiment Station, Nakhon Ratchasima. Spacings of 15, 20, and 25 cm between hills, 50 cm between rows were used with 1, 2, and 3 plants per hill.

The results showed that soybean grain yield was increased when spacing between hills was closer. More plants per hill gave more grain weight per unit area. The experiments also showed that 50 x 15 cm spacing with 3 plants per hill gave more grain per hill than 50 x 20 cm spacing with 2 plants per hill as previously recommended. The difference, however, was not significant.

INTRODUCTION

Soybean cultivation in northeastern Thailand is comparatively limited. The possible reasons are basically the lack of technical know-how on the one hand and the social problems on the other hand. Research work in this region has only been activated recently with the hope that soybean production could be commercially undertaken there in addition to northern and central Thailand. Suitable spacing and optimum plant populations are two methods of increasing yield, although climatic as well as environmental conditions generally cause certain degree of variation to the yield component.

Cultivation of soybean in the northeastern region, though in smaller acreage compared with northern and central regions, has been adopting the cultural techniques employed in northern Thailand. A limited number of research conducted in northeastern Thailand demonstrated variable findings. Reports of the Research and Experiment Station Division, Department of Agriculture (1968, 1969) showed that planting soybean in

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Roi Et at 4-5 plants per hill, spacing of 30 x 40 cm, gave better grain yield than 1-3 plants per hill. Experiments at Kalasin (Ministry of Agriculture 1970) also indicated that planting 6-7 plants per hill gave the best grain yield at the spacing of 30 x 40 cm. At the same location, Yodtirik et al. (1971) reported that closer spacing, 15 cm, produced more grain weight than wider spacings and that 3 plants per hill showed better grain yield than both 1 and 5 plants per hill. However, the recommended spacing employed in northern Thailand (20 x 50 cm, 2 plants per hill) showed unfavourable results in northeastern Thailand.

As an approach to determine a proper spacing between hills and optimum number of plants per hill for soybean under different climatic conditions, the present study was carried out in rainy and dry seasons at Nakhon Ratchasima and Khon Kaen provinces.

MATERIALS AND METHODS

The experiments were conducted in a factorial design with 4 replications. Fertilizer—3, 12, and 12 kg per rai of N, P₂O₅, and K₂O respectively—was broadcasted before planting. In all treatments, distance between rows was kept at 50 cm, while spacing between hills were 15, 20, and 25 cm. Number of seedlings per hill were 1, 2, and 3 plants. A treatment had an area of 2 x 6 m. Soybean variety S.J. 2 was planted in all experiments. There were 9 treatments in each experiment as tabulated in Table 1.

TABLE 1. PERTINENT DATA ON THE EXPERIMENTS

| Treatment | Row spacing (cm) | Hill spacing (cm) | Plants/hill | No. of plants/rai |
|-----------|---------------------|----------------------|-------------|-------------------|
| 1 | 50 | 15 | 1 | 21,333 |
| 2 | " | " | 2 | 42,666 |
| 3 | " | " | 3 | 63,999 |
| 4 | " | 20 | 1 | 16,000 |
| 5 | " | " | 2 | 32,000 |
| 6 | " | " | 3 | 48,000 |
| 7 | " | 25 | 1 | 12,800 |
| 8 | " | " | 2 | 25,600 |
| 9 | " | " | 3 | 38,400 |

The experiments were conducted at Northeast Agricultural Center (NEAC) at Khon Kaen, and Non Sung Agricultural Experiment Station (Non Sung AES). At both locations, the dry season experiments were started in December 1970, and the wet season experiments, in July 1971. Furrow irrigation was given to the dry season planting when desirable.

The dry season experiments were harvested in March 1971, and those of the wet season, in November 1971. Two borders were discarded from the harvests. Only measurement on grain yield was made and the data were statistically analysed.

RESULTS

Dry season tests (1970-71)

1. The results of the experiment at NEAC (Khon Kaen) showed no significant difference in regard to hill spacing, but a highly significant difference was observed in respect of the number of seedlings per hill. The 3 plants per hill treatment gave higher grain yield than both 1 and 2 plants per hill treatments. However, a significant difference was detected only between 1 plant per hill and the rest. No interaction between the number of plant per hill and hill spacing was shown. The highest grain yield of the experiment, 154.2 kg/rai, was received by planting the crop at the spacing of 50 x 15 cm, 3 plants per hill (Table 2).

TABLE 2. GRAIN YIELD OF SOYBEAN AT NEAC, KHON KAEN, IN DRY SEASON

| Row spacing (cm) | Hill spacing (cm) | Grain yield | | | |
|---------------------|----------------------|----------------------|----------------------|----------------------|------------------|
| | | 1pl/hill (kg/rai) | 2pl/hill (kg/rai) | 3pl/hill (kg/rai) | Mean (kg/rai) |
| 50 | 15 | 116.87 | 130.38 | 154.21 | 133.82 a |
| 50 | 20 | 100.33 | 132.02 | 145.91 | 126.09 a |
| 50 | 25 | 94.04 | 119.65 | 142.87 | 118.85 a |
| Mean | | 103.75 | 127.35 | 147.67 | |
| | | b | a | a | |

CV 12.60%

2. The results of the experiment at Non Sung AES (Table 3) showed that hill spacing of 15 cm gave significantly higher grain yield than 20 and 25 cm spacing. But there was no statistical difference between the treatments 20 and 25 cm spacing. So far as the number of plants per hill is concerned, it was seen that more plants per hill produced greater grain yield; however, the difference was not significant. No interaction between the number of plants per hill and hill spacing was observed.

TABLE 3. GRAIN YIELD OF SOYBEAN AT NON SUNG AES IN DRY SEASON

| Row spacing (cm) | Hill spacing (cm) | Grain yield | | | |
|---------------------|----------------------|----------------------|----------------------|----------------------|------------------|
| | | 1pl/hill (kg/rai) | 2pl/hill (kg/rai) | 3pl/hill (kg/rai) | Mean (kg/rai) |
| 50 | 15 | 144.20 | 140.28 | 137.31 | 140.60 a |
| 50 | 20 | 109.61 | 123.41 | 126.97 | 120.00 b |
| 50 | 25 | 102.57 | 102.76 | 113.44 | 106.26 b |
| Mean | | 118.79 | 122.15 | 125.91 | |
| | | a | a | a | |

CV 12.28%

Rainy season tests (1971)

1. The results of the experiment at NEAC (Khon Kaen) showed that hill spacings at 15 and 20 cm apart produced statistically the same yield, and also those of 20 and 25 cm spacings did in the same manner. However, the plot of 15 cm hill spacing demonstrated significantly higher yield than the plot of 25 cm spacing (Table 4).

Taking the number of plants per hill into consideration, Table 4 shows that planting 3 plants per hill significantly outyielded that with 1 plant per hill. The highest grain yield was obtained from two treatments, i.e. the treatment 50 x 15 cm spacing, 2 plants per hill and 50 x 15 cm, 3 plants per hill; the yields are 163.26 and 162.04 kg/rai respectively.

2. The results of the experiment at Non Sung AES showed that the spacing of 15 cm gave better grain weight than the 20 cm spacing, and the 20 cm treatment was better than the 25 cm treatment. Only the yield of the closest and widest spacings were statistically different. The same phenomenon is seen in the plant population treatment, i.e. 3 plants per hill produced significantly higher grain yield than that of 1 plant per hill (Table 5). The interaction between hill spacing and the number of plants also showed significant difference. The treatment with 50 x 15 cm spacing, 3 plants per hill gave the highest grain yield, followed by the 50 x 15 cm, 2 plants per hill, and 50 x 20 cm, 2 plants per hill treatments in that order. However, the differences among these treatments are not pronounced.

TABLE 4. GRAIN YIELD OF SOYBEAN AT NEAC, KHON KAEN, IN RAINY SEASON

| Row spacing (cm) | Hill spacing (cm) | Grain yield | | | |
|---------------------|----------------------|----------------------|----------------------|----------------------|------------------|
| | | 1pl/hill (kg/rai) | 2pl/hill (kg/rai) | 3pl/hill (kg/rai) | Mean (kg/rai) |
| 50 | 15 | 130.94 | 163.26 | 162.04 | 152.08 a |
| 50 | 20 | 139.17 | 150.81 | 154.77 | 148.25 ab |
| 50 | 25 | 123.86 | 123.32 | 134.61 | 127.26 b |
| Mean | | 131.32 b | 145.80 ab | 150.47 a | |

CV 8.40%

TABLE 5. GRAIN YIELD OF SOYBEAN AT NON SUNG AES IN RAINY SEASON

| Row spacing (cm) | Hill spacing (cm) | Grain yield | | | |
|---------------------|----------------------|----------------------|----------------------|----------------------|------------------|
| | | 1pl/hill (kg/rai) | 2pl/hill (kg/rai) | 3pl/hill (kg/rai) | Mean (kg/rai) |
| 50 | 15 | 137.28 | 156.15 | 156.62 | 150.02 a |
| 50 | 20 | 119.14 | 151.34 | 135.43 | 135.30 ab |
| 50 | 25 | 112.60 | 111.69 | 151.07 | 125.12 b |
| Mean | | 123.01 b | 139.73 ab | 147.71 a | |

CV 8.52%

LSDR 15.148

DISCUSSION

The experiments indicated, on the whole, that the closer the hill spacing, the more the grain yield. An indication, as shown in Figure 1, is seen that it might be feasible to produce even higher grain yield if soybean is planted at hill spacings of closer than 15 cm apart. Thus spacings of 10 and 5 cm and row drilling should be thoroughly studied.

Similar phenomenon, which is seen in Figure 2, also demonstrates that more grain yield might be obtained if soybean is planted more than 3 plants per hill. Further study regarding this aspect is desirable.

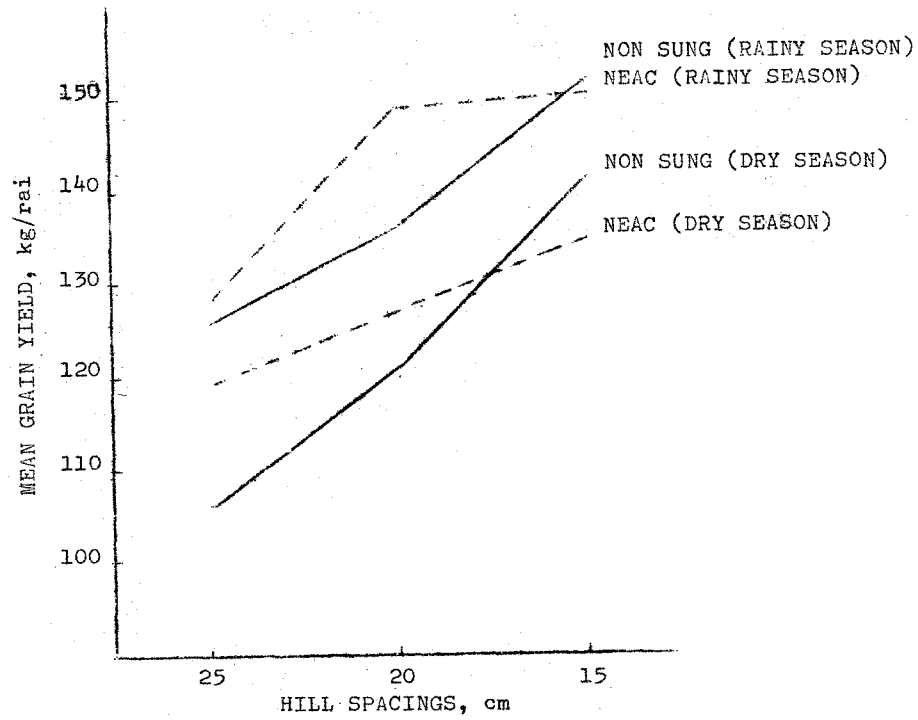


Figure 1. Response of soybean grain yield to hill spacings.

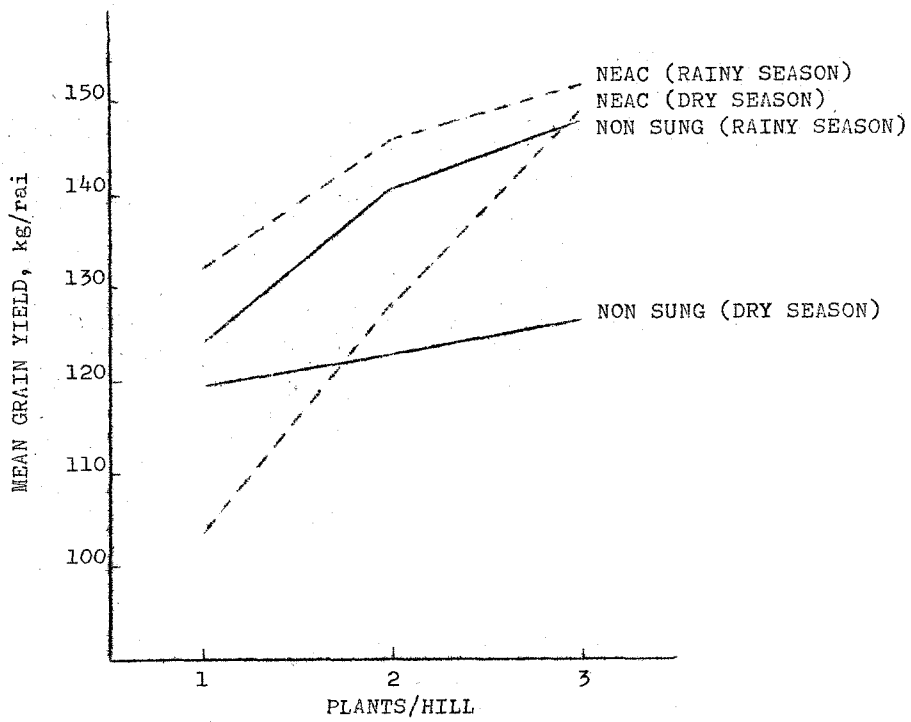


Figure 2. Response of soybean grain yield to plant populations.

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