6. Studies on Causes of Abnormal Development of Pods and Optimal Planting Time of Soybean (1978—1979)

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The experiment was carried out to identify the causes of the failure of pods/seeds development of soybean which occurred in 1977 and 1978 apparently due to insect attacks, and set up a proper planting time to escape such failure.

Materials and methods

1. Variety: SJ 4
2. Treatment:
   1) Planting time:
      December 15, 1978
      January 15, 1979
      February 15, 1979
      March 15, 1979
      April 16, 1979
   2) Insect pest control:
      Control (the insecticide was applied in the ripening period*)
      Non-contorl (no insecticide was applied in the same period)

      In the control plots, water diluted 0.1 percent monocrotophos [3-(dimethyl-phosphinyloxy)-N-methylisocrotonamide], 'Azodrin' in a commercial name, was applied after pre-flowering stage as shown in Table 6-1. Before the initiation of this treatment, dimethoate, 'Rogor' in a commercial name, was applied once per about 2 weeks and monocrotophos twice to all the plots during the vegetative growth period (planting to flowering).
3. Experimental layout and plot size:
   Split plot design with 4 replications was applied disposing the planting time as the main plot and the insect pests control as the subplot. The size of a subplot was 60 m^2 (8 m × 7.5 m). The disposition of the main plots was not randomized for the convenience of farming practices such as land preparation and irrigation.
4. Fertilizer application: N: 20, P_2O_5: 50, K_2O: 50 (kg/ha)
5. Spacing: 75 cm × 20 cm, 2 plants/hill
6. Irrigation: Furrow irrigation was applied with the rate of 4 - 5 mm/day and 7 - 10 day interval.

Results

1. The climatic conditions before and after flowering of soybean with reference to each planting time are shown in Table 6-2; the figures relevant to the growth of soybean are presented in Table 6-3.

* The period covering from the pre-flowering stage to the pre-leaf-yellowing stage. This definition applied hereafter.

2. Soybean planted on January 15 flowered and matured in a shorter period than those planted on other dates irrespective of the treatment of insect pest control. The number of days from seeding to maturity was 95 to 105 days in the control plots while the non-control plots did not mature except the plants seeded on January 15.
3. A significant difference in number of pods per hill was noted between the plants with and without insect pest control since the initiation of pod development, as shown in Table 6-3. Soybean plants without control tended to bear few pods except those planted in January and February.
4. Seed weight and other relevant factors are presented in Table 6-4. As shown in the Table, the plots without insect pest control yielded very poor except the case planted in January. On the other hand, there was not a big difference in vegetative growth between the plots with and without control (see the stem height and stem plus shell weight in the Tables). Significant high yield was obtained in the plots planted in January in both the case controlled and non-controlled.
5. The number of seed-bearing pods per hill tended to increase as planting date was late in the case of insect pest control. On the contrary, there seemed to be a trend towards less seed number per pod and less 100 seed weight as planting was late.
6. The occurrence of and damages caused by the insect pests to soybean plants were studied. The major insect pests considered economically important were: a) *Piezodorus hybneri* Gmelin (Pentatomidae), b) *Orgyia turbata* Butler (Lymantridae), c) *Spodoptera litura* Fabricius (Noctuidae), d) *Lamprosema* sp., (Pyralidae), and e) *Laspeyresia glycinivorella* Matsumura (Pyralidae).
7. As indicated in Table 6-5, fauna of soybean insect pests differed between the control and non-control plots. For example, a total number of three and six species occurred in the control and non-control plots, respectively. Population density of each insect species was higher in the non-control plot than in the control plot. However, in the case of noctuid species occurring in either plot no difference in number was demonstrated. The lymantrid species, *Orgyia turbata*, occurred with a much higher density in the non-control than in the control plot. The same applied to the bean leaf roller, *Cnaphalocrosis* sp., and the unibanded stink bug, *Piezodorus hybneri* Gmelin.
8. It was observed that *Spodoptera* larvae were feeding on flowers of soybean plants in the non-control plot, whereas the flowers in the control plot were not attacked by the larvae at all. The larval feeding on the flowers of soybean plants is supposed to affect pod formation.

Discussion

Most of the soybean plants grown without insect pest control during the ripening period exhibited such phenomena as: a) little pod setting, b) pod shedding or c) setting a number of empty pods. These plants did not reach normal maturity remaining green. However, plants applied with monocrotophos during the ripening period developed well, bore a lot of pods and reached maturity irrespective of the planting time. Thus, it may be concluded that the failure in maturity which occurred in this experiment was caused by insect pest injuries. However, insect species responsible for the aforementioned phenomena was not identified in this experiment. It is necessary, in the future, to study the insect species and their behavior. Minimum application of insecticides have to be established to keep insect populations below the economic injury level.

With regard to the optimal planting time of soybean in the Central Plain in dry

season, several experiments were carried out by Sasiprapa et al.[3] and Nakeerug et al.[2] but a precise answer was not obtained. In this experiment, the highest yield was obtained in the crop seeded on January 15 in both the cases with and without insect pest control during the ripening period. The results suggest that there may be an optimal planting time around the middle of January to avoid the insect pest damages which bring about abnormal development of pods.

The main reason for attaining high yield in the plot of January planting accompanied with insect pest control during the ripening period, is the relatively higher value of multiplied yield component characteristics derived from the number of pods per hill, number of seeds per pod and 100 seed weight. Nakeerug et al. (1978)[2] described a trend for a higher number of seeds per pod and 100 seed weight corresponding to early planting time. The same tendency has been found in this experiment.

As Figure 6-1 shows, it can be said that the higher number of seeds per pod and 100 seed weight were brought by larger temperature variations between maximum and minimum range. Sato et al. (1979)[4] and Takeshima (1952)[5] have already reported the fact that seed size was increased by low minimum temperature and large difference between maximum and minimum values.

Feferences

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2) Nakeerug, S. and Walcott, J., 1978. Effect of time of planting on soybean yields. Thai-Australian Chao Phya Research Project, Fourth Report to the Ministry of Agriculture of the Kingdom of Thailand, Australian Development Assistance Bureau, 52-53.
3) Sasiprapa, V., Klyprayong, B., Yongyuthavichai, C. and Kengwa, T., 1973. Study on optimum time of planting soybean in paddy field soil after rice (In Thai. with English abstract). Report of experiment and research, Technical Division, Horticulture Division and Field Crop Division, Department of Agriculture, Bankhen, Bangkok, 679-683.
4) Sato, K. and Ikeda, T., 1979. The growth responses of soybean plant to photoperiod and temperature IV. The effect of temperature during the ripening period on the yield and characters of seeds (In Japanese, with English abstract). Japanese Journal of Crop Science, 48: 283-290.
5) Takeshima, H., 1952. Studies on the relation between the temperature difference of day and night and the fructification of soybean (In Japanese, with English abstract). Proceedings of the Crop Science Society of Japan, 21: 119-120.
6) Watanabe, Y. et al.: The effect of planting time on the growth, yield and insect damage of a dry season crop in the paddy fields of the northwestern central plain of Thailand. Proceedings of legumes in the tropics; Universiti Pertanian Malaysia (1980).

Table 6-1. Monocrotophos treatment for five planting times in the plots with insect pest control during the ripening period

Planting time	Beginning of flowering	Beginning of application	Finishing of application	Number of application time	Days from the finishing to maturity
Dec. 15	Jan. 17	Jan. 17	Feb. 21	5	32
Jan. 15	Feb. 15	Feb. 14	Mar. 26	6	25
Feb. 15	Mar. 21	Mar. 19	Apr. 26	6	31
Mar. 15	Apr. 17	Apr. 16	Jun. 8	8	20
Apr. 16	May 21	May 22	Jul. 13	8	17

Remarks: Water diluted 0.1% monocrotophos with 80, 100 and 150 litre per hectare were applied to the 1st and 2nd times, 3rd and 4th times and 5th to the 8th times respectively.

Table 6-2. Some climatic data for each soybean growing period

Planting time	Period	Mean temperature			Day length	Rainfall	
		Max.	Min.	Vari.			
		°C	°C	°C	h m	mm	(days)
Dec. 15	Before flowering	31.7	20.3	11.4	11.16	0.0	
	After flowering	35.4	23.0	12.4	11.48	0.0	
Jan. 15	Before flowering	33.7	22.3	11.4	11.30	0.0	
	After flowering	36.4	24.3	12.1	12.06	3.4	(1)
Feb. 15	Before flowering	36.3	23.2	13.1	11.54	0.0	
	After flowering	36.3	25.7	10.6	12.33	77.8	(10)
Mar. 15	Before flowering	36.5	25.3	11.2	12.15	3.4	(1)
	After flowering	35.5	25.8	9.7	12.50	183.7	(23)
Apr. 16	Before flowering	36.3	26.0	10.3	12.36	74.4	(9)
	After flowering	35.4	25.0	10.4	12.56	216.5	(24)

Table 6-3. Number of days to flowering and maturity, number of pods per hill and final stem height for five planting times in plots with and without insect pest control

Planting time	Insect pest control	Days to flowering	Days to maturity	Number of pods		Final stem height
				8 weeks after planting	10 weeks after planting	
Dec. 15	Control	35	100	90	174	47.1
	Non-control	35	a	11	16	45.7
	Mean			51	95	46.4
Jan. 15	Control	32	95	158	180	52.6
	Non-control	32	105	119	175	49.7
	Mean			139	178	51.2
Feb. 15	Control	35	102	137	228	51.7
	Non-control	35	a	137	208	52.1
	Mean			137	218	51.9
Mar. 15	Control	35	103	71	232	46.0
	Non-control	35	a	13	28	43.3
	Mean			42	130	44.7
Apr. 16	Control	37	105	17	219	62.7
	Non-control	37	a	1	10	58.7
	Mean			9	115	60.7
L.S.D. 0.05 to compare means between with and without insect pests control in each planting time				22	59	N.S.
L.S.D. 0.05 to compare planting time means				9	35	5.6

Remarks: 1) a: Retaining green coloration until the maturity of the plants of insect pest control plots.
2) Number of pods were counted for those more than 7 mm in width.

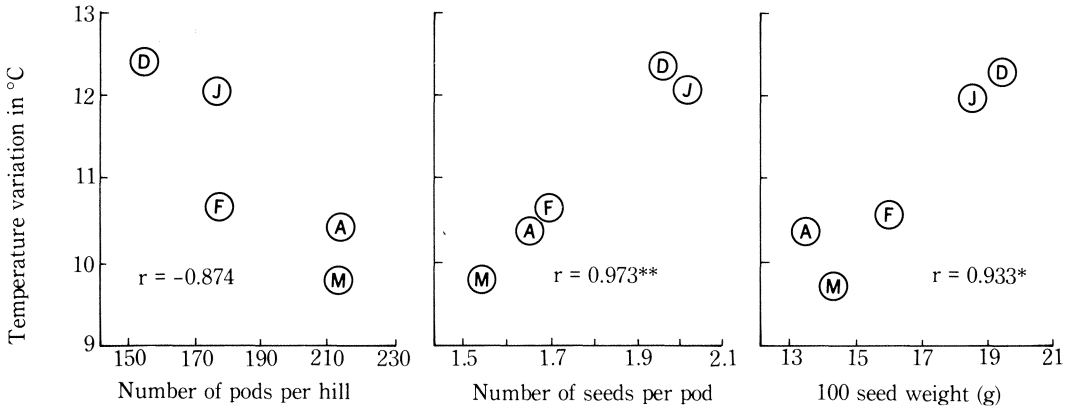
Table 6-4. Yield and yield related characteristics for five planting times in plots with and without insect pest control

Planting time	Insect pest control	Weight of seeds and stems plus shells			Number of pods		Number of seeds	100 seed weight
		Good seeds	Injured seeds	Stem plus shells	Full	Empty		
		ton/ha			no./hill		no./pod	g
	Control	2.74	0.03	1.82	153	2	1.94	19.6
Dec. 15	Non-control	0.19	0.16	1.12	12	30	1.46	15.4
	Mean	1.47	0.10	1.47	83	16	1.70	17.5
	Control	3.16	0.10	2.04	178	2	2.02	18.5
Jan. 15	Non-control	2.31	0.40	2.15	166	10	1.80	17.8
	Mean	2.74	0.25	2.10	172	6	1.91	18.2
	Control	0.99	1.14	2.61	180	19	1.70	16.0
Feb. 15	Non-control	0.03	0.29	2.97	110	90	1.57	15.0
	Mean	0.51	0.72	2.79	145	55	1.64	15.5
	Control	1.66	0.58	2.50	215	19	1.54	14.3
Mar. 15	Non-control	0.00	0.00	1.49	1	24	1.40	5.5
	Mean	0.83	0.29	2.00	108	22	1.47	9.9
	Control	1.96	0.25	2.40	215	13	1.66	13.4
Apr. 16	Non-control	0.08	0.19	1.59	9	43	1.42	10.4
	Mean	1.02	0.22	2.00	112	28	1.54	11.9
L.S.D. 0.05 to compare means between with and without insect pests control in each planting time		0.33	0.18	0.56	31	45	0.13	2.2
L.S.D. 0.05 to compare planting time means		0.32	0.19	0.56	27	31	0.07	1.7

Table 6-5. Kinds of the insect pests attacking soybean plants in control and non-control plots

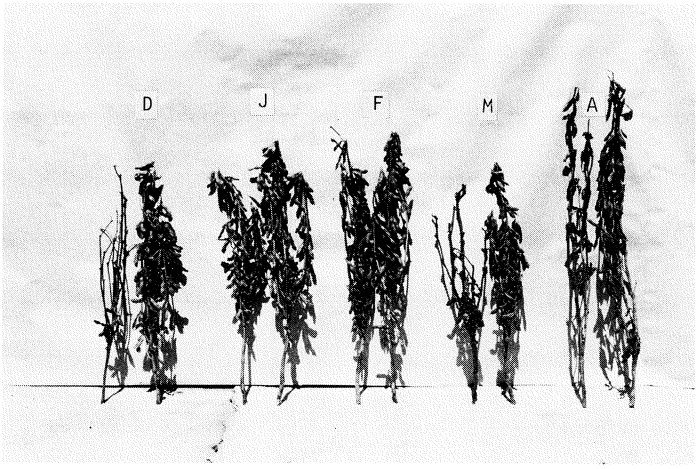
Plot	Number of plants observed	Insect pests						Number of species
		A	B	C	D	E	F	
Control	40	0	11	0	2	1	0	3
Non-control	44	1	10	15	8	7	1	6

Remarks: 1) Planting date; April 16, checking date; June 7
2) Insect pest;
A. Chrysomelid sp.
B. Noctuid sp.
C. *Orgyia turbata* Butler (Lymantridae)
D. *Cnaphalocrosis* sp. (Phyralidae)
E. *Piezodorus hybneri* Gmelin (Pentatomidae)
F. Curulionid sp.

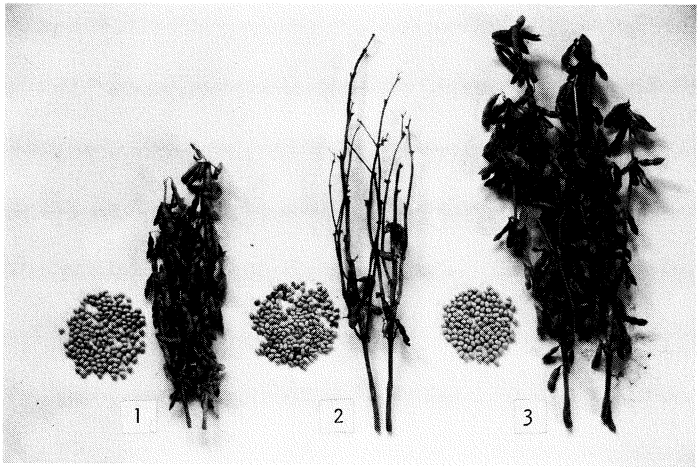


Remarsk: D, J, F, M and A indicate the planting time respectively.

Fig. 6-1. Relationship between the maximum and minimum temperature variation during the period from flowering stage to maturity and yield component characteristics

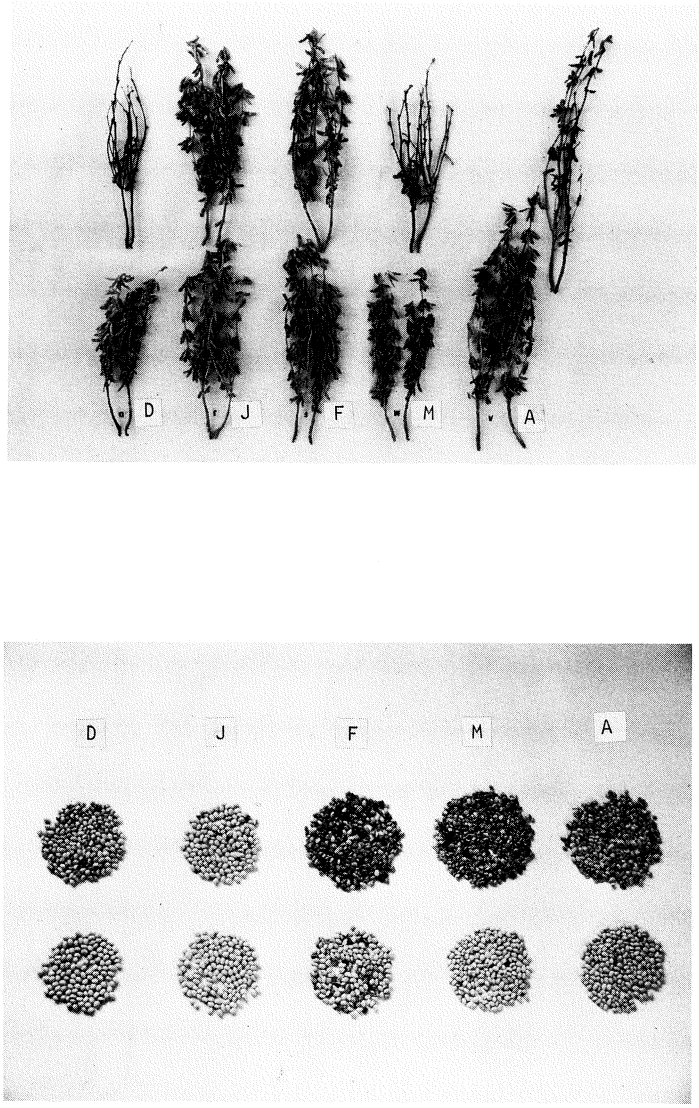


(1) The plant samples of each planting time, with (right) and without (left) insect pests control during the ripening period. D, J, F, M and A indicate the months planting soybean.



(2) The plants and grains with insect pests control during 1) the ripening period, 2) the vegetative growth period and 3) the entire growth period, of the plot, December 15 planting.

Fig. 6-2. The plant samples at harvest with reference to the treatment of insect pests control



The upper part of the pictures: without insects pest control. The lower part: with insect pests control. D, J, F, M and A indicate the months planting soybean.

Fig. 6-3. Soybean plants and grains at harvest with and without insect pests control