

Strategies on Cultural Improvement for Yield and Quality of Vegetable Soybean in Chia-Nan Area

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Introduction

Around 8,000 ha of vegetable soybean, as a cash crop, are grown annually in Taiwan. Before 1990, vegetable soybeans were grown in autumn season in Kao-Ping area. The export of vegetable soybean from Taiwan earns around US\$50 million/annum.

After 1990, the vegetable soybeans were shifted from Kao-Ping to Chia-Nan area gradually. The area and production in Chia-Nan increased from 152 ha and 5,662 kg/ha in 1989 to 4,143 ha and 7,945 kg/ha, at present.

Chia-Nan area is located at around 23°N latitude. Average air temperature is 25°C, which is 1°C lower than Kao-Ping area. Spring crop sown in early February and autumn crop sown in late September are recommended for Chia-Nan area.

Vegetable soybean grows well on sandy loam soil. The soil in Chia-Nan area is light in texture and fertile. Irrigation is available. Vegetable soybean could be grown after rice, corn or sorghum. Tainan DAIS focused its research on cultural practices for vegetable soybean in Chia-Nan area. The objectives of the research were:

1. To investigate the appropriate cropping system for Chia-Nan area.
2. To ascertain the optimum depth of bed for vegetable soybean.
3. To study the optimum fertilizer application for different seasons and varieties.
4. To determine appropriate plant population density for different varieties and seasons.

The above objectives will enable the researchers to obtain answers to develop appropriate cultural practices for farmers to successfully produce vegetable soybeans.

1. Cropping System

Four cropping systems were evaluated: 1) spring rice – fall vegetable soybean, 2) spring sorghum – fall vegetable soybean, 3) summer rice – spring vegetable soybean and, 4) autumn corn – spring vegetable soybean. The trials were conducted using Kaohsiung No. 1 in 1997-98. Results showed that graded pod yield was significantly higher in rice-vegetable soybean than either sorghum- or corn-vegetable soybean system (Table 1). The proportion of graded pod to total pods was 70 to 75% in rice-vegetable soybean system compared to 63 to 65% in sorghum- and corn-vegetable soybean system, respectively.

Table 1. The yield of vegetable soybean in different cropping systems.

Cropping system		Pods/500 g	Total pod yield (kg/ha)	Graded pod yield (kg/ha)
1997	1997			
1 st rice – 2 nd vegetable soybean		176	12,416	8,745*
1 st sorghum – 2 nd vegetable soybean		184	11,508	7,226
1997	1998			
2 nd rice – 1 st vegetable soybean		161	11,059*	8,291*
2 nd corn – 1 st vegetable soybean		170	9,399	6,149

*Significant at 5% level.

2. Bed Height in Different Seasons

Vegetable soybeans were grown in raised beds. Normally two rows were planted on the bed. Furrows facilitate irrigation, drainage and intercultural operations. An experiment was conducted to evaluate 15 cm (low) and 30 cm (high) bed height in the spring and autumn seasons in 1997.

The results showed that in the spring season, the difference in yield between the two bed heights were insignificant. However, in the autumn season, the low bed height gave significantly higher total and graded pod yield than high bed (Table 2). Therefore, it is concluded that 15cm bed height is better in both spring and autumn seasons in Chia-Nan area.

Table 2. Effect of bed height on the growth and yield of vegetable soybean during different seasons.

Season crop	Bed height (cm)	Plant height (cm)	Position of the 1 st pod (cm)	Pods/plant	Total pod yield (kg/ha)	Grade pod yield (kg/ha)	Graded pod rate (%)
Spring 1997	Low bed (15 cm)	35.8	7.7	16.6	10,480	7,920	75.6
	High bed (30 cm)	40.0	9.1	13.4	9,950	7,170	72.1
Autumn 1997	Low bed (15 cm)	36.2	8.3	11.3	8,356*	5,560*	66.5
	High bed (30 cm)	37.4	6.7	10.7	7,055	4,473	63.4

* Significant at 5% level.

3. N-Fertilizer Use and Rhizobium Inoculation

Two N-fertilizer rates were compared in the 1997 autumn season: 180 kg N/ha, the farmer's practice and 60 kg N/ha the recommended practice.

In 1998 spring season, another experiment was conducted to compare 20 kg N/ha + rhizobium against 60 kg N/ha and 180 kg N/ha without rhizobium inoculation.

The data from the 1997 autumn season trial showed that the differences between treatments for graded pod yield were insignificant. However, ungraded pods were significantly higher in 180 kg N/ha compared to 60 kg N/ha. The net profit from lower N was 18% higher than high N application (Table 3).

The results of 1998 spring season trial showed that 20 kg N/ha plus rhizobium gave similar graded pod yield as 60 kg N/ha. However, 180 kg N/ha gave significantly lower yield than the other two treatments (Table 4). The proportion of graded pods were 16% higher in 20 kg N/ha plus rhizobium compared to 180 kg N/ha plot.

Table 3. N-fertilizer effects on yield and profit of vegetable soybean in the fall 1997.

Fertilizer treatment N- P ₂ O ₅ -K ₂ O (kg/ha)	Pods/500 g	Non-graded pod yield (kg/ha)	Graded pod yield (kg/ha)	Net profit per ha (NT dollar)
60-60-60	152	1,554 b*	8,732 a	44,488
180-60-60	166	1,786 a	8,252 a	37,548

*Data followed by the same letter in each column set indicate that the difference was not significant by the Duncan's Multiple Range Test (P = 0.05).

Table 4. Effect of chemical N and rhizobium on the yield of vegetable soybean in the spring 1998.

Treatment	Pods/500 g	Total pod yield (kg/ha)	Graded pod yield (kg/ha)
20 kg N/ha + Rhizobium	158	9,972 a*	8,752 a
60 kg N/ha + No-rhizobium	163	9,957 a	8,208 ab
180 kg N/ha + No-rhizobium	172	10,129 a	7,557 b

*Data followed by the same letter in each column set indicate that the difference was not significant by the Duncan's Multiple Range Test (P = 0.05).

4. Variety and Fertilizer Requirement

An early maturing line, TS 85-21V (E) and a late maturing line, TS-82-01V (L) were used. Five different fertilizer rates were tested (Table 5).

The results showed that the late line was higher yielding than the early line (Table 5). The yield increased upto 60:60:60 (N:P₂O₅:K₂O) in both lines but thereafter the yield did not change much (Table 5).

Table 5. The fertilizer response of late maturing line TS82-01V (L) and early maturing line TS85-21V (E) in the spring 2000.

Entry	Fertilizer treatment (N:P ₂ O ₅ :K ₂ O)	Plant height (cm)	Pods/ 500 g	Graded pod yield (kg/ha)	Shelling rate (%)	100 fresh seed wt (g)
TS82-01V (L)	0:0:0	51.1	146	10,187	49.0	74.8
	40:60:60	48.5	145	11,413	49.0	72.9
	60:60:60	50.4	146	12,440	47.9	75.9
	80:60:60	52.9	140	12,267	50.0	73.4
	100:60:60	47.3	151	12,973	50.0	71.9
TS85-21V (E)	0:0:0	26.9	213	4,667	50.0	59.6
	40:60:60	26.3	177	4,560	50.1	60.7
	60:60:60	27.7	199	5,560	51.4	61.8
	80:60:60	26.3	201	4,553	50.5	61.3
	100:60:60	27.9	197	5,320	49.2	61.1

5. Variety and Plant Population Density

The early and late lines were used. Three plant population densities were evaluated: 260,000, 320,000 and 380,000 plants/ha in 1999 autumn and 2000 spring seasons. For late line in the fall season 260,000 plants/ha gave significantly higher graded pod yield than 380,000 plants/ha. However, for the early maturing short stature line 380,000 plants/ha gave significantly higher graded pod yield than the other two plant densities both in fall and spring seasons (Tables 6 and 7).

Table 6. The response of plant population densities on late maturing line TS82-01V (L) and early maturing line TS85-21V (E) in the fall 1999.

Entry	Plant density (plants/ha)	Plant height (cm)	Days to pick	Pods/500 g	Graded pod yield (kg/ha)	Shelling rate (%)	100 fresh seed wt. (g)
TS82-01V (L)	260,000	35	76	166	6,966 a*	50.5	83.7
	320,000	34	76	174	7,330 a	49.4	80.2
	380,000	37	76	178	5,367 b	49.8	81.5
TS85-21V (E)	260,000	28	64	225	3,582 b	54.1	58.0
	320,000	27	64	228	4,004 b	53.9	58.0
	380,000	28	64	238	5,228 a	54.5	60.0

*Data followed by the same letter in each column set indicate that the difference was not significant by the Duncan's Multiple Range Test (P = 0.05).

Table 7. The response of plant population densities on late maturing line TS82-01V (L) and early maturing line TS85-21V (E) in the spring 2000.

Entry	Plant density (plants/ha)	Plant height (cm)	Days to pick	Pods/500 g	Graded pod yield (kg/ha)	Shelling rate (%)	100 fresh seed wt. (g)
TS82-01V (L)	260,000	47	85	135	11,053 a*	49.6	78.6
	320,000	48	85	145	8,884 b	48.6	76.2
	380,000	46	85	148	8,400 b	47.2	71.5
TS85-21V (E)	260,000	29	69	178	5,540 c	54.2	68.2
	320,000	29	69	185	6,933 b	54.0	67.8
	380,000	27	69	188	9,120 a	521.7	61.3

*Data followed by the same letter in each column set indicate that the difference was not significant by the Duncan's Multiple Range Test (P = 0.05).

Conclusions

In Taiwan, the vegetable soybean production has moved from Kao-Ping area to Chia-Nan area. Research on cultural practices required for Chia-Nan suggests that a 15-cm bed height and 20 to 60 kg N/ha, 60 kg P₂O₅/ha and 60 kg K₂O/ha plus rhizobium inoculation were appropriate. For early and late maturing varieties, a plant population density of 380,000 and 260,000 plants/ha respectively are recommended. The above recommendations differ substantially from those for Kao-Ping area. Following the above recommendations farmers in Chia-Nan area can maximize their profit.

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