Research article

Potential of Sunflower Varieties Grown under Different Input Levels

PANTIPA NA CHIANGMAI*
Faculty of Animal Sciences and Agricultural Technology, Silpakorn University, Phetchaburi, Thailand
Email: m_surin@yahoo.com, pantipa@su.ac.th

LAMDUAN KRITTAWONGWIMAN
Chaipattana-Mae Fah Luang Reforestation Project, Prachuap Khiri Khan Province, Thailand

PAISAN LAOSUWAN
Faculty of Science and Technology, Hatyai University, Songkhla Province, Thailand

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Abstract This experiment was aimed to investigate the potential of sunflower varieties (*Helianthus annuus* L.) grown under different levels of inputs. Sunflower varieties consisted of two hybrids (Pacific 77 and Olison 3) and two synthetic varieties (Suranaree (S) 471 and Suranaree (S) 473). Input levels were low, medium and high packages which were obtained from the combination of levels of weed control and fertilizer applications. The study was conducted in a strip-plot design in the dry season of 2010 and 2011 at Chaipattana-Mae Fah Luang Reforestation Project, Prachuap Khiri Khan, Thailand. The results showed that both synthetic varieties outyielded the two hybrids. S471 produced the highest yield of 2,269 kg ha^{-1}. However, the oil content of Pacific 77 was the highest, with 42 percent. The responses of sunflower varieties to levels of input were not significant almost for all characters except for oil content. Seed yields were 1,931, 2,025 and 2,375 kg ha^{-1} for low, medium and high input packages, respectively. Seed size showed positive association with the levels of input. However, the oil content did not increase with the increase of input levels. The net income of all varieties grown under different levels of input were estimated by using the farm gate price. The highest net income of 21,500 baht ha^{-1} was obtained from S471 grown under the lowest input level. For this study where the soil is quite fertile, the lowest input levels should be used for all varieties of sunflower.

Keywords Sunflower, *Helianthus annuus*, synthetic varieties, packages of input

INTRODUCTION

Sunflower (*Helianthus annuus* L.) has been grown widely in the central part of Thailand for oil, seed meal and tourist attraction. Hybrid varieties have been used mostly by farmers as they found that these varieties produced well and give uniform performance for most characters. However, the cost of seed is high because it has to be imported. To reduce this problem in Thailand, many synthetic varieties were developed to be used as stop gap varieties (Kaewmeechai et al., 1989; Laosuwan, 1997). High yield is usually favorable regardless the levels of inputs in terms of chemicals and labor. However, what farmers should need most is the highest net income. Therefore, certain measures for crop production were called package of input by Laosuwan and Macartney in 1992, which were tested in many crops; especially peanut (Laosuwan and Macartney, 1992). This also should be used to evaluate the potential of sunflower production on-farm. The objectives of this study were to evaluate the potential of hybrid and synthetic varieties of sunflower for yield and other characters. They were also evaluated for net income due to the application of different levels of input.

METHODOLOGY

This experiment was conducted at the Chaipattana Mae-Fah Luang Reforestation Project at Prachuap Khiri Khan in 2010-2011. Four varieties of sunflower including two hybrid varieties (Pacific 77 and Olison 3) and two synthetic varieties (Suranaree (S) 471 and Suranaree (S) 473) were used. Three input levels were formulated to explore the response of sunflower and to estimate the net income. These input levels were (1) low input level: no fertilizer was applied and weed control was made only once, (2) medium input level: 187.5 kg ha^{-1} of 15-15-15 NPK fertilizer was applied only once at planting and the weed control was made only once, and (3) high input level: 250 kg ha^{-1} NPK fertilizer was applied at planting and 1,250 kg ha^{-1} of organic fertilizer was applied before the flowering stage. In this treatment package, the weed control was continuously made to provide a weed free condition.

The study was conducted in a strip-plot design with four replications. Six rows each 5 m long were used for each plot with spacing of 0.75 m between rows and 0.25 m between hills. The data were recorded for seed yield and seed size. The seed sample was taken from each treatment to analyze for oil contents.

RESULT AND DISCUSSION

Data for seed yield, seed size and oil contents are shown in Tables 1 and 2. Although the results were not statistically different, S471 tended to give the highest yield, S473 ranked second, Pacific 77 ranked third and Olison 3 gave the lowest yield (Table 1). This study showed that synthetic varieties tended to give higher seed yield than hybrids or at least similar. However, other experiments showed that synthetic varieties usually yielded lower than hybrids (Kaewmeechai et al., 1989; Laosuwan, 1997; Satjawattana, 2001).

Table 1 Seed yield of 4 varieties of sunflower grown under 3 input levels in 2010-2011 at Chaipattana-Mae Fah Luang Reforestation Project, Prachuap Khiri Khan, Thailand

Variety	Input levels			Mean (kg ha^{-1})
	Low	Medium	High	
Pacific 77	1,988	2,138	2,294	2,150
Olison 3	1,506	1,506	2,231	1,775
Suranaree (S)471	2,231	2,262	2,319	2,269
Suranaree (S)473	1,981	2,075	2,675	2,238
Mean (kg ha^{-1})	1,931	2,025	2,375	
Environment (E)	*ns*	*V x I*	*ns*	
Varieties (V)	*ns*	*V x E*	*ns*	
Input levels (I)	*ns*	*I x E*	*ns*	
		V x I x E	*ns*	

Table 2 Seed size (1,000 seeds weight; g) and oil content (%) (in parentheses) of 4 varieties of sunflower grown under 3 input levels in 2010-2011 at Chaipattana-Mae Fah Luang Reforestation Project, Prachuap Khiri Khan, Thailand.

Variety	Input levels			Mean
	Low	Medium	High	
Pacific 77	46 (42 ab)	50 (44 a)	59 (40 ab)	52 b (42 a)
Olison 3	43 (38 ab)	50 (35 ab)	50 (41 ab)	47 c (38 b)
Suranaree (S)471	56 (40 ab)	60 (39 ab)	61 (33 ab)	59 a (37 c)
Suranaree (S)473	50 (32 b)	57 (35 ab)	54 (32 b)	53 b (33 d)
Mean	49 b (38 a)	54 a (38 a)	56 a (36 b)	
Environment (E)	*** (**)*	*V x I*	*ns (**)*	
Varieties (V)	*** (**)*	*V x E*	*ns (**)*	
Input levels (I)	*** (**)*	*I x E*	*ns (**)*	
		V x I x E	*ns (**)*	

Data for seed size (Table 2) showed that S471 gave the largest seed and the smallest seed was found for Olison 3. However, both synthetic varieties gave lower oil content than hybrids, while the highest oil content was given by Pacific 77 and the lowest by S473.

Responses to levels of input were found for all characters observed in the study except seed yield. However, the high input level gave the highest seed yield and the low input gave the lowest. The same responses were found for seed size where the character increased due to the increase of input levels. However, the low and medium input levels gave higher oil contents than the high input level, indicating that a negative response was obtained for this character.

The cost of input levels were roughly estimated for this experiment and many details may have not been considered (Table 3). However, it was considered that input levels are important for economic yield of all crop production by subsistent farmers.

Table 3 Cost of different input levels used in the experiment at Chaipattana-Mae Fah Luang Reforestation Project, Prachuap Khiri Khan, Thailand

Input cost	Low input	Medium input	High input
Fertilizer input	0	3,125	5,000
Fertilizer	0	1,875	3,125
Labor	0	1,250	1,850
Weed control	1,250	2,500	3,750
Others [1]	10,125	10,125	10,125
Total	11,375	15,750	18,875

[1] *Cost due to land preparation, disease and pest controls; labors for planting, harvesting, threshing, etc.*

Table 4 Net income for all varieties of sunflower grown under different levels of input estimated by using the farm gate price

Variety	Cost-income	Input levels		
		Low	Medium	High
Pacific 77	Yield (kg ha^{-1})	1,988	2,138	2,294
	Farm gate price (baht kg^{-1})	15	15	15
	Gross income (baht ha^{-1}) [1]	29,820	32,070	34,410
	Production cost (baht ha^{-1})	11,375	15,750	18,875
	Seed cost (baht ha^{-1})	2,125	2,125	2,125
	Net income (baht ha^{-1}) [2]	16,320	14,195	13,410
Olison 3	Yield (kg ha^{-1})	1,500	1,588	2,231
	Farm gate price (baht kg^{-1})	15	15	15
	Gross income (baht ha^{-1})	22,500	23,820	33,465
	Production cost (baht ha^{-1})	11,375	15,750	18,875
	Seed cost (baht ha^{-1})	2,125	2,125	2,125
	Net income (baht ha^{-1})	9,000	5,945	12,465
S471	Yield (kg ha^{-1})	2,225	2,262	2,319
	Farm gate price (baht kg^{-1})	15	15	15
	Gross income (baht ha^{-1})	33,375	33,930	34,785
	Production cost (baht ha^{-1})	11,375	15,750	18,875
	Seed cost (baht ha^{-1})	500	500	500
	Net income (baht ha^{-1})	21,500	17,680	15,410
S473	Yield (kg ha^{-1})	1,975	2,075	2,675
	Farm gate price (baht kg^{-1})	15	15	15
	Gross income (baht ha^{-1})	29,625	31,125	40,125
	Production cost (baht ha^{-1})	11,375	15,750	18,875
	Seed cost (baht ha^{-1})	500	500	500
	Net income (baht ha^{-1})	17,750	14,875	20,750

[1] *Gross income = Yield x farm gate price* *(1)*

[2] *Net income = Gross income - production cost - seed cost* *(2)*

The net income for all varieties of sunflower due to the applications of all input levels are shown in Table 4. The highest net income of 21,500 bath ha^{-1} was obtained from S471 grown under the low input level followed by 20,750 bath ha^{-1} from S473 grown under the high input level. The

net incomes obtained for hybrid varieties were lower than those of synthetic varieties for all input levels. This partly due to the high seed cost which was about four times higher than that of synthetic varieties.

CONCLUSION

This experiment showed that sunflower can have a good production at the location where farmers may grow sunflower for seeds and tourist attraction. In this study, synthetic varieties gave comparable seed yield as hybrid varieties but their oil contents were lower. However, the advantages of synthetic varieties are that farmers can continuously produce their own seeds for the next planting without having to buy expensive imported hybrid seeds. This experiment showed that S471 can be used for further planting, although it is too early to recommend at this stage. The responses of sunflower to input levels were found for all characters. All characters, except oil content, increase when increasing input level. However, the high net income may be obtained from certain varieties grown under the low input level.

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