Indian Journal of Agronomy **44** (2) : 408–412 (June 1999)

Influence of nitrogen and sulphur on growth, yield and oil content of sunflower (*Helianthus annuus*) grown in spring season

P.K. LEGHA AND GAJENDRA GIRI

Division of Agronomy, Indian Agricultural Research Insitute, New Delhi 110 012

Received: December 1997

ABSTRACT

An experiment was conducted at New Delhi during 1994 and 1995 in sandy loam soil low in available N and S. Nitrogen application up to 80 kg/ha significantly improved the growth, yield attributes and seed and oil yields of sunflower (*Helianthus annuus* L.). Sulphur at 30 kg/ha significantly increased the number of seeds and seed weight per capitulum resulting in significantly higher seed yields. Application of 60 kg S/ha also increased the seed and oil yields in both the years. Optimum doses of N and S were 112 and 53.6 kg/ha respectively.

Key words: Sunflower, Nitrogen, Sulphur, Yield, Oil content

The nitrogen requirement of sunflower is quite high (Singh *et al.*, 1987 and Kumar *et al.*, 1991). However, the level of N for the highest yield fluctuates to a wide range depending upon soil type, season and sequence of cropping. Among secondary nutrients, sulphur is considered as an important nutrient for oilseeds. Response of sunflower to applied sulphur has been reported by Aulakh *et al.* (1990) and Sreemannarayana and Raju (1994). However, most of these studies pertain to *kharif* season crop. Considering the importance of spring season sunflower in north-west India, an experiment was conducted to study the effect of N and S on growth, yield and oil content of spring sunflower and to work out the optimum doses of N and S.

MATERIALS AND METHODS

The experiment was conducted during spring seasons of 1994 and 1995 at the Indian Agricultural Research Institute, New Delhi. The soil was sandy loam having low organic carbon (0.4%) and available S (7.3 ppm), medium available P (14.0 kg/ha) and available K (221 kg/ha) with pH 7.2. The treatments comprising 4 levels of N (0,40,80 and 120 kg/ha) and 3 levels of S (0, 30 and 60 kg S/ha) were tested in a randomised block design with 3 replications. The sunflower hybrid 'MSFH 8' was sown on February 8 and 10 in respective seasons with 50 × 25 cm spacing pattern. N was applied in 2 splits (half at sowing and half 30 DAS) through urea. Sulphur was supplied through gypsum containing 13.5% S. A basal dose of

Table 1. Effect of N and S doses on final plant height and dry matter production by sunflower

Treatment	Plant height (cm)		Dry matter/plant (g)	
	1994	1995	1994	1995
Nitrogen (kg/ha)				
0	166.9	170.1	84.4	83.4
40	186.3	185.2	99.5	98.8
80	185.2	194.4	112.5	109.9
120	192.5	191.1	111.1	109.5
CD (P = 0.05)	16.4	5.4	4.5	5.2
Sulphur (kg/ha)				
0	175.6	185.1	100.1	98.1
30	186.6	186.2	104.0	103.2
60	186.0	184.5	101.5	100.0
CD (P = 0.05)	NS	NS	3.8	4.5

40 P_2O_5/ha as D.A.P. was applied at the time of sowing. Crop was given 4 irrigations each with 60 mm depth.

RESULTS AND DISCUSSION

Effect of N

N application significantly increased plant height and dry matter/plant (Table 1). However, significant increase in plant height was recorded up to 40 kg N/ha in 1994 and up to 80 kg N/ha in 1995.

Dry matter/plant at harvest significantly increased up to 80 kg N/ha in both seasons.

Application of N significantly improved the size of the capitulum, seeds/capitulum, 1,000 seed weight and seed weight/plant up to 80 kg N/ha in both the seasons (Table 2). As a result of improvement in yield attributes, application of N due to 80 kg/ha increased seed yield in both the years (Table 3). Increase in seed yield by 80 kg N/ha over 0 and 40 kg N/ha was 40.3 and 10.8%, respectively. Stalk yield and harvest index (Table 2) also showed increase up to 80 kg N/ha.

Oil content (Table 4) showed significant decrease with successive increase in the dose of N up to 80 kg/ha. However, oil yield increased up to 80 kg N/ha because of increase in seed yield.

An increase in growth and yield parameters of sunflower up to 80 kg/ha might be attributed to adequate availability of N. The soil had poor N status, hence the applied N caused favourable effect on plant growth and development due to proper partitioning of the photosynthates from source to sink. Increased availability of N resulted in higher dry matter production and better translocation of photosynthates which finally led to increased harvest index (Table 2).

Reduction in oil content in seed by N application might be due to degradation of carbohydrates in tricarboxylic acid (TCA) cycle to acetyl COA. By reductive amination and

Table 2. Effect of nitrogen and sulphur on yield attributes of sunflower

Treatment	Capitulum diameter (cm)		Seeds/ capitulum		1,000-seed weight (g)		Seed weight/ capitulum (g)		Stalk yield (q/ha)'		Harvest index (%)	
	1994	1995	1994	1995	1994	1995	1994	1995	1994	1995	1994	1995
Nitrogen (kg/ha)												
0	11.6	11.3	690	669	29.4	29.1	20.4	19.5	42.2	39.3	25.0	29.3
40	14.8	14.5	987	964	33.9	33.3	33.5	33.2	46.8	44.6	29.4	32.3
80	17.7	17.1	1210	1167	39.1	38.5	47.3	44.9	51.1	50.3	31.8	36.8
120	16.8	16.1	1208	1171	36.4	35.7	44.1	42.0	50.2	46.4	32.2	36.4
CD (P = 0.05)	2.6	2.8	132	125	3.5	3.2	6.2	5.1	3.6	2.9	4.5	2.9
Sulphur (kg/ha)												
0	14.3	13.8	924	891	33.8	33.2	31.2	29.6	49.3	45.3	26.0	30.5
30	15.6	15.0	1064	1032	35.1	34.5	37.4	35.6	48.0	45.0	30.7	34.5
60	15.9	15.4	1084	1056	35.2	34.7	38.2	37.7	44.3	42.1	34.4	36.8
CD (P = 0.05)	NS	NS	114	109	NS	NS	5.4	4.5	3.0	2.6	3.9	2.6

Table 3. Interaction effects of N and S on seed yield of sunflower

Nitrogen (kg/ha)	Sulphur (kg/ha)							
	1994				1995			
	0	30	60	Mean	0	30	60	Mean
0	13.8	14.1	14.3	14.1	15.2	16.9	16.8	16.3
40	15.5	20.4	22.5	19.5	17.8	22.3	23.9	21.3
80	19.6	25.6	26.4	23.9	23.6	28.0	29.6	27.0
120	20.7	25.0	25.9	23.9	23.9	27.9	28.1	26.6
Mean	17.4	21.3	23.3		20.1	23.8	24.6	
	CD (P = 0.05)				*CD (P = 0.05)*			
N	1.1				1.1			
S	1.1				0.9			
N × S	1.9				1.8			

transamination processes more amino acids are formed rather than fatty acids.

Effect of S

A significant increase in dry matter/plant, number and weight of seeds/capitulum were recorded up to 30 kg S/ha (Tables 1 and 2).

The seed yield increased up to 60 kg S/ha in 1994 and up to 30 kg S/ha only in 1995 (Table 3). On an average, 30 and 60 kg S/ha increased the seed yield by 16.7 and 21.7% over control, respectively. Addition of 60 kg S/ha significantly increased the harvest index (Table 2).

Application of S also significantly increased the oil content up to 30 kg S/ha in both seasons, and oil yield up to 60 kg S/ha in 1994 and up to 30 kg S/ha in 1995 (Table 4).

Sulphur is known to play a vital role in the formation of amino acids. It had favourable effect on dry matter/plant and yield components due to proper partitioning of photosynthates from source to sink. This is also confirmed by the trend in harvest index (Table 2). Higher dry matter production and better translocation of photosynthates led to increase in yield components which in turn caused increase in the seed yield (Table 3). Increase in oil content by S application might be attributed to involvement of S in the biosynthesis of oil. The higher oil yield by S application was obviously because of higher seed yield and oil content.

Effect of N and S interaction

Application of S in the absence of N had no effect on seed yield. Nitrogen in combination with S was more effective in enhancing the seed yield. However, response was confined to 30 kg S/ha in both years, except at 40 kg N/ha in 1994, where response was up to 60 kg S/ha. Application of 80 kg N/ha in combination with 30 kg S/ha increased the seed yield significantly over lower levels of N at the same level of S or lower level of S with 80 and 120 kg N/ha.

Response studies

The relationship of seed yield and applied

Table 4. Content and yield of oil as affected by nitrogen and sulphur

Treatment	Oil content (96)		Oil yield (q/ha)	
	1994	1995	1994	1995
Nitrogen (kg/ha)				
0	39.8	40.1	5.6	6.5
40	37.9	37.0	7.4	8.0
80	35.9	36.2	8.6	9.8
120	34.3	35.0	8.2	9.3
CD (P = 0.05)	1.8	1.2	1.1	1.3
Sulphur (kg/ha)				
0	35.4	35.0	6.2	7.0
30	37.9	38.1	7.9	9.0
60	38.2	38.8	8.9	9.5
CD (P = 0.05)	1.6	1.0	0.9	1.2

N and S was studied with the help of regression equations as given below :

Response equation for

$$N : Y = 14.9 + 0.1897 x - 0.00084 x^2$$

Response equation for

$$S = 18.8 + 0.1683 x - 0.90015 x^2$$

The response of sunflower to N and S was quadratic in nature. The optimum dose of N was worked out to be 112 kg/ha which gave response of 10.7 q/ha. The response/kg N was 9.56 kg. The optimum dose of S was 53.6 kg/ha with a response of 4.7 q/ha. The response/kg S was 8.75 kg.

REFERENCES

Aulakh, M.S., Pasricha, N.S. and Azad, A.S. 1980. Phosphorus and sulphur application boosts oilseed production in coarse textured soils. *Indian Farming* **39** (10) : 29-30.

Kumar, S., Dixit, R.S. and Tripathi, H.P. (1991). Effect of nitrogen and nutrient uptake and oil content of sunflower (*Helianthus annuus*) under different moisture regimes. *Indian Journal of Agricultural sciences* **61** (10) : 766-768.

Singh, S.P., Singh, O.P. and Singh, V. 1987. Studies on the growth and yield of sunflower varieties in relation to nitrogen rates. *Journal of Oilseeds Research* **4** (2) : 169-174.

Sreemannarayana, B. and Raju, A.S. 1994. Effect of source and level of sulphur on yield and sulphur content of plant parts of sunflower. *Indian Journal of Agricultural Sciences* **64** (3) : 147-151.