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Growth and yield of sunflower (*Helianthus annuus*) as influenced by levels of phosphorus, sulphur and zinc

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ABSTRACT

A field study conducted with 'KBSH' sunflower (*Helianthus annuls* L.) in soils deficient in phosphorus, sulphur and zinc showed that graded levels of P from 0 to 112.5 kg/ha, 0 and 10 ppm of S and 0 to 5 ppm of Zn promoted the growth as well as seed and oil yields. The height, head diameter, 1,000-seed weight were improved and resulted in higher seed and oil yields of sunflower.

Sunflower (*Helianthus annuus* L.) being a photo-insensitive has vast potential to produce oil in the present day of scarcity of edible oil. Generally, oilseed corp responds to phosphorus and sulphur in marginally deficient soils. Of late, zinc deficiency has become widespread and crop yield could be enhanced further by supplying zinc to such soil. A relative change in the levels of these nutrients would bring about a positive influence on the growth and yield of this crop. With this in view, the present investigation was taken up in Alfisol to study the effect of P, S and Zn on the growth and yield of sunflower under irrigated condition.

MATERIALS AND METHODS

A field experiment was conducted in Alfisol which was sandy loam, alkaline (pH 8.5), electrical conductivity (0.18 dS/m), organic carbon (0.30%) with exchangeable calcium and mangesium (4.8 meq/100 g). The soil was low in available P (10.38 kg P/ ha), 7.8 ppm sulphur and 0.65 ppm DTPA-extractable zinc. The soils was well-drained. The treatments consisted of 3 levels of P (0, 75 and 112.5 kg P_2O_5/ha), 2 levels of S (0 and 10 ppm) and 2 levels of of Zn (0 and 5 ppm) and were replicated thrice. Uniform recommended dose of N and K (K_2O) @ 62.5 kg/ha each were applied as urea and muriate of potash respectively. The P, S and Zn were applied in the form of diammonium phosphate, factamphsos (20 : 20 : 0 : 15) and zinc sulphate as it is cheap and readily available. Sunflower ('KBSH 1') was grown as test crop. Soils were analysed before the commencement of the study by following standard procedures. The oil content of sunflower was determined by nuclear magnetic resonance.

RESULTS AND DISCUSSION

Crop growth

The growth of sunflower crop at 45 days after seeding was significant due to treatment effects. The height of the crop increased from 73.7 cm at P_0 Zn_0 S_0 to 110.3

Table 1. Plant height (cm) and head diameter (cm) of sunflower at 45 days after seeding as influenced by levels of phosphorus, sulphur and zinc

	S_0				S_{10}			
	Zn_0		Zn_5		Zn_0		Zn_{10}	
	Plant height	Head diameter	Plant height	Head diameter	Plant height	Head diameter	Plant height	Head diameter
P_0	73.7	8.9	77.9	9.7	80.1	10.5	86.9	11.9
P_{75}	91.3	10.4	96.4	11.3	102.3	11.4	109.1	12.5
$P_{112.5}$	103.7	11.9	110.3	12.6	118.7	13.0	126.7	14.3
Mean	89.6	10.4	94.9	11.2	100.4	11.6	107.6	12.9

	Plant height	*Head diameter*
CD (P = 0.05)		
P	2.69	0.35
S	2.20	0.29
Zn	2.20	0.29
P × S	3.81	0.50
P × Zn	3.81	0.50
S × Zn	3.11	0.41
P × S × Zn	5.39	0.71

cm at $P_{112.5}$ S_0 Zn_5. Similar trend of higher magnitude was seen by the application of sulphur at 10 ppm. The highest height recorded was 126.7 cm at $P_{112.5}$ S_{10} Zn_5 treatment (Table 1).

Head diameter of sunflower crop increased from 8.9 cm at $P_0Zn_0S_0$ to 12.6 cm at $P_{112.5}S_0Zn_5$. Further, it enhanced to 14.3 cm at $P_{112.5}$ S_{10} Zn_5 (Table 1).

The 1,000-seed weight increased steadily by graded levels of P_2O_5 with Zn. There was concommittent increase in weight of 1,000-seed by application of S at 10 ppm with phosphorus and zinc (Table 2).

It was observed that level of P and S were in effective. However, interactions of P × Zn, S × Zn, P × S × Zn were significant.

The soils were low in P, S and Zn and the application of these nutrients promoted the growth of crop which favourably reflected on the head diameter of sunflower formation and setting of seeds for good corp. The effect of sulphur and zice was significant. Tripathi and Kalra (1981) reported favourable impact of phosphorus. Gangwar and Parameswaran (1976) attributed their positive impact on head diameter and also on 1,000-seed weight.

Seed and oil yields

Significant response of sunflower to levels of P, S and Zn was seen on the seed yield. The seed yield of 1,780 obtained at $P_0S_0Zn_0$ increased to 2,829 kg/ha at $P_{112.5}$ S_0Zn_5. The maximum recorded yield of 3,050 kg/ha was under $P_{112.5}$ S_{10} Zn_5 treatment (Table 2). The P and S applications influenced the yield

Table 2. Effect of levels of phosphorus, sulphur and zinc on 1,000-seed weight (g) and seed yield (kg/ha) of sunflower

Treatment	S_0				S_{10}			
	Zn_0		Zn_5		Zn_0		Zn_5	
	1,000-seed weight	Seed yield	1,000-seed weight	Seed yield	1,000-seed weight	Seed yield	1,000-seed weight	Seed yield
P_0	38.1	1,780	41.0	2,084	40.8	2,270	41.0	2,443
P_{75}	41.1	2,263	42.9	2,408	41.4	2,428	41.7	2,677
$P_{112.5}$	38.7	2,567	41.9	2,829	41.0	2,912	42.6	3,056
Mean	39.3	2,203	41.9	2,440	41.1	2,537	41.7	2,725

	1,000-seed weight	*Seed yield*
CD (P = 0.05)		
P	NS	145
S	NS	118
Zn	1.55	118
P × S	NS	205
P × Zn	2.70	205
S × Zn	2.20	167
P × S × Zn	3.81	290

Table 3. Oil yield of sunflower (kg/ha) as influenced by levels of phosphorus, sulphur and zinc

Treatment	S_0			S_{10}		
	Zn_0	Zn_5	Mean	Zn_0	Zn_5	Mean
P_0	635.5	731.6	683.5	832.4	889.7	861.1
P_{75}	859.0	897.1	878.0	934.0	962.8	948.4
$P_{112.5}$	991.1	1,131.9	1,061.5	1,174	1,189.2	1,182.0
Mean	828.5	920.2		980.4	1,013.9	

CD (P = 0.05)			
P	26.26	P × Zn	88.95
S	50.84	S × Zn	71.90
Zn	50.84	P × S × Zn	124.50
P × S	80.05		

components of sunflower as a result of changes in the growth and development pattern of the crop. The importance of phosphorus and sulphur in improving seed yield was demonstrated by Srinivas Raju and Verma (1981) and Rao and Reddy (1982).

Muthuvel *et al.* (1983) reported the significance of zinc nutrition to sunflower along with phosphorus. The effect of Zn on the seed yield was greater than of S. Highly significant enhancement on the oil yield of sunflower due to treatment effects was noticed (Table 3). The lowest oil yield of 635 kg/ha was obtained at $P_0S_0Zn_0$ level and 1,132 kg/ha at $P_{112.5}S_0Zn_5$. Further, enhancement of oil yield was registered by application of S at 10 ppm with P and Zn, recording the maximum economical oil yield of 1,189 kg/ha at $P_{112.5}$ $S_{10}Zn_5$. The reason for significant improvement in oil yield was attributed to the application of P, Zn and S in soils low in these nutrient content. The synergistic effect of P × S × Zn was remarkable for improving the oil yield. Choudhary and Paturde (1981) contended the significant role of P, S and Zn to sunflower.

It was concluded that seed and oil yields of sunflower could be enhanced significantly by the application of P at higher level ($P_{112.5}$ kg P_2O_5/ha) than recommended dose (75 kg P_2O_5/ha) along with S and Zn in deficient soils of Alfisol.

REFERENCES

Chaudhary, C. S. and Paturde, J. T. 1981. Effect of nitrogen and phsphorus on seed and oil yields of sunflower. *Indian Journal of Agricultural Research* **15** (3) : 141–144.

Gangwar, M. S. and Parmaeswaran, P. M. 1976. Phosphorus-sulphur relationship in sunflower. I. Effect of phosphorus and sulphur on yield. *Oilseed Journal* **6** (3) : 28–32.

Muthuvel, R. and Rajukkannu, K. 1983. Effect of magnesium and sulphur on sunflower. *Madras Agricultural Journal* **70** (2) : 130.

Rao, N. N. and Reddy, S. N. 1982. Effect of plant density and time of application of N and P on growth and yield of sunflower. *Indian Journal of Agronomy* **27** (4) : 475–477.

Srinivas Raju, M. and Verma, S. D. 1981. Effect of fertilizer rates and plant spacing on sunflower yield components. *Andhra Agricultural Journal* **28** (1/2) : 47–49.

Tipathi, P. N. and Kalra, G. S. 1981. Effect of NPK on maturity and yield of sunflower. *Indian Journal of Agronomy* **26** (1) : 66–70.