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Influence of Potassium and Sulphur on Yield, Economics and Quality of Summer Sunflower (*Helianthus annuus*. L)

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

The experiment was carried out during summer season of 2022 at crop research farm (CRF), Department of Agronomy, SHAUTS, Prayagraj (U.P), to evaluate the influence of potassium and sulphur rates on growth and yield of summer sunflower. The treatments consisted of 3 levels of Potassium (30,40,50 kg/ha) and Sulphur (10,20,30 Kg/ha) and a control. The experiment used a Randomized Complete Block Design (RCBD) with ten treatments that were replicated three times. The findings revealed that application of 50 kg potassium with combination of 30 kg sulphur as soil application recorded highest yield attributes namely seeds per capitulum (332.4) Test weight (33.7 g), seed yield (1,463.44 kg/ha), stover yield (3,211.6 kg/ha), harvest index (31.3%) and oil content(41.8 %). Maximum gross returns (98,050.48 (Indian rupee) INR/ha), net returns (64,665.51 (Indian rupee) INR/ha) and highest benefit - cost ratio (1.94) was found in treatment (T_9) with the application of 50 kg potassium soil application with combination of 30 kg sulphur as soil application.

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1. INTRODUCTION

Sunflower (*Helianthus annuus* L.) the most important oilseed crops of the world because of the adequate concentration of unsaturated fatty acids in its oil (Burton et al., 2004) and occupies second place next to soybean as a source of vegetable edible oil. Sunflower has gained popularity of all the oilseed crops, because of its excellent quality oil due to its richness with high degree polyunsaturated fatty acids, anti-cholesterol properties, short duration, wide adaptability to soil and climatic conditions, photo and thermo-insensitiveness, drought tolerance and higher oil yield per unit area [1]. Sulphur (S) helps in the synthesis of cysteine, methionine, chlorophyll, vitamins (B, biotin, and thiamine), metabolism of carbohydrates, especially by its effect on the protolytic enzymes [2]. Sulphur helps in increasing the content of oil seeds and improves the quality, colour and uniformity of crop. Application of sulphur stimulates the photosynthetic activity and synthesis of protein. Sarkar and Mallick [3] reported Sulphur had favourable effect on yield attributes due to proper partitioning of photosynthates from source to sink. Potassium (K) is one of the most essential elements for plant growth, Potassium is used as a tool for maintaining internal salt meditation within cells and balance of water in the plant and operating in closing and opening of stomata [4]. Potassium is also very important for activation of enzymes for photosynthesis, protein synthesis and starch formation [5].

2. MATERIALS AND METHODS

The experiment was conducted during *Zaid* season of 2022 at crop research farm (CRF), Department of Agronomy, SHAUTS, Prayagraj (U.P). The Soil in the experimental plot was sandy-loamy in texture, nearly neutral in soil response (P^H 7.8) The experiment was conducted in Randomized Complete Block Design (RCBD) consisting of ten treatment combinations with three replications and was laid out with the different treatments allocated randomly in each replication. The soil of the experimental field was sandy loam in texture, slightly alkaline reaction (pH 7.1) with low level of organic carbon (0.28%), available N (225 Kg/ha), P (19.50 kg/ha) and higher level of K (92.00 kg/ha). The treatment combinations are T_1 – 30 kg/ha Potassium + 10 kg/ha Sulphur, T_2 - 30 kg/ha Potassium + 20 kg/ha Sulphur, T_3 - 30 kg/ha Potassium + 30 kg/ha Sulphur, T_4 - 40 kg/ha Potassium + 10 kg/ha Sulphur, T_5 - 40 kg/ha Potassium + 20 kg/ha Sulphur, T_6 - 40 kg/ha Potassium + 30 kg/ha Sulphur, T_7 - 50 kg/ha Potassium + 10 kg/ha Sulphur, T_8 - 50 kg/ha Potassium + 20 kg/ha Sulphur, T_9 - 50 kg/ha Potassium + 30 kg/ha Sulphur,T_{10} – N:P:K – 80:60:40 kg/ha (Control). The observations were recorded on different growth parameters at harvest viz. Number of seeds per capitulum, test weight, seed yield, stover yield and harvest index and oil content. Maximum net returns, gross returns, and benefit cost ratio.

3. RESULTS AND DISCUSSION

3.1 Yield Attributes

Significantly Maximum Number of Seeds/capitulum (332.4) was recorded with the application of treatment T_9- 50Kg/ha Potassium + 30Kg/ha Sulphur over all the treatments. However, number of seeds (331.5) were obtained in T_8- 50Kg/ha Potassium + 20Kg/ha Sulphur were found to be statistically at par with T_9- 50Kg/ha Potassium + 30Kg/ha Sulphur. Significantly Maximum Test weight (33.7 g) was recorded with the application of treatment T_9- 50Kg/ha Potassium + 30Kg/ha Sulphur over all the treatments. However, the treatment T_8- 50Kg/ha Potassium + 20Kg/ha Sulphur (33.2) which were found to be statistically at par with T_9- 50Kg/ha Potassium + 30Kg/ha Sulphur. Significantly Maximum Seed yield (1463.44 kg/ha) was recorded with the treatment T_9- 50Kg/ha Potassium + 30Kg/ha Sulphur. over all the treatments. However, the T_6- 40Kg/ha Potassium + 30Kg/ha Sulphur (1417.10 kg/ha) and T_8- 50Kg/ha Potassium + 20Kg/ha Sulphur (1426.03 kg/ha) which was found to be statistically at par with T_9- 50Kg/ha Potassium + 30Kg/ha Sulphur. Significantly Maximum Stover yield (3211.6 kg/ha) was recorded with the treatment T_9- 50Kg/ha Potassium + 30Kg/ha Sulphur over all the treatments. However, the T_6- 40Kg/ha Potassium + 30Kg/ha Sulphur (3194.8 kg/ha) and T_8- 50Kg/ha Potassium + 20Kg/ha Sulphur (3202.9 kg/ha) which was found to be statistically at par with T_9- 50Kg/ha Potassium + 30Kg/ha Sulphur. Significantly Maximum Harvest index (31.3 %) was recorded with the treatment T_9- 50Kg/ha Potassium + 30Kg/ha Sulphur over all the treatments. However, the treatments T_5- 40Kg/ha Potassium + 20Kg/ha Sulphur (30.5%) T_6- 40Kg/ha Potassium + 30Kg/ha Sulphur

(30.7%) and T_8- 50Kg/ha Potassium + 20Kg/ha Sulphur (30.8%) which was found to be statistically at par with T_9- 50Kg/ha Potassium + 30Kg/ha Sulphur.

3.2 Oil Content

Significantly Maximum Oil Content (41.23%) was recorded with the treatment T_9- 50Kg/ha Potassium + 30Kg/ha Sulphur over all the treatments. However, the treatments T_6- 40Kg/ha Potassium + 30Kg/ha Sulphur (41.2%) and T_8- 50Kg/ha Potassium + 20Kg/ha Sulphur (41.3%) was found to be statistically at par with T_9- 50Kg/ha Potassium + 30Kg/ha Sulphur. Faisal et al. [6].

3.3 Economics

Higher cost of cultivation was observed with the application of treatment T_9(33,384.97) Higher Gross (Rs. 98050.48/ha) Higher Net returns (Rs. 64665.51/ha) Higher Benefit cost Sulphur (1.94) have been recorded with the treatment T_9- 50Kg/ha Potassium + 30Kg/ha Sulphur over rest of the treatments [7-17].

Table 1. Influence of potassium and sulphur on yield attributes and yield of sunflower

Treatments	Seeds/ Capitulum	Test weight(g)	Seed yield (kg/ha)	Stover yield (kg/ha)	Harvest index (%)
30Kg/ha Potassium + 10Kg/ha Sulphur	320.0	28.8	1155.10	3035.4	27.6
30Kg/ha Potassium + 20Kg/ha Sulphur	321.3	29.3	1235.81	3092.2	28.6
30Kg/ha Potassium + 30Kg/ha Sulphur	325.7	30.2	1290.80	3159.0	29.0
40Kg/ha Potassium + 10Kg/ha Sulphur	324.4	29.5	1247.81	3132.5	28.5
40Kg/ha Potassium + 20Kg/ha Sulphur	329.2	31.7	1399.42	3186.9	30.5
40Kg/ha Potassium + 30Kg/ha Sulphur	330.5	32.4	1417.10	3194.8	30.7
50Kg/ha Potassium + 10Kg/ha Sulphur	327.8	30.4	1349.70	3171.7	29.8
50Kg/ha Potassium + 20Kg/ha Sulphur	331.5	33.2	1426.03	3202.9	30.8
50Kg/ha Potassium + 30Kg/ha Sulphur	332.4	33.7	1463.44	3211.6	31.3
Control	318.8	28.3	1071.70	2996.3	26.3
F test	S	S	S	S	S
S. Em (±)	0.51	0.24	17.92	7.57	0.29
CD (P = 0.05)	1.54	0.73	53.25	22.50	0.88

Table 2. Influence of potassium and sulphur on quality of sunflower

Treatments	Oil Content (%)
1. 30Kg/ha Potassium + 10Kg/ha Sulphur	39.2
2. 30Kg/ha Potassium + 20Kg/ha Sulphur	39.6
3. 30Kg/ha Potassium + 30Kg/ha Sulphur	40.1
4. 40Kg/ha Potassium + 10Kg/ha Sulphur	39.8
5. 40Kg/ha Potassium + 20Kg/ha Sulphur	40.9
6. 40Kg/ha Potassium + 30Kg/ha Sulphur	41.2
7. 50Kg/ha Potassium + 10Kg/ha Sulphur	40.3
8. 50Kg/ha Potassium + 20Kg/ha Sulphur	41.3
9. 50Kg/ha Potassium + 30Kg/ha Sulphur	41.8
10. Control	38.7
F test	S
S. Em (±)	0.19
CD (P = 0.05)	0.57

Table 3. Effect of potassium and sulphur on economics of sunflower

Treatments	Cost of Cultivation	Gross returns	Net returns	B:C Ratio
1. 30Kg/ha Potassium + 10Kg/ha Sulphur	32,311.1	77391.48	45080.38	1.40
2. 30Kg/ha Potassium + 20Kg/ha Sulphur	32,581.37	82799.05	50217.68	1.54
3. 30Kg/ha Potassium + 30Kg/ha Sulphur	32,851.64	86483.60	53631.96	1.63
4. 40Kg/ha Potassium + 10Kg/ha Sulphur	32,577.76	83603.27	51025.51	1.57
5. 40Kg/ha Potassium + 20Kg/ha Sulphur	32,848.03	93760.92	60912.89	1.85
6. 40Kg/ha Potassium + 30Kg/ha Sulphur	33,118.3	94945.70	61827.40	1.87
7. 50Kg/ha Potassium + 10Kg/ha Sulphur	32,844.43	90429.68	57585.25	1.75
8. 50Kg/ha Potassium + 20Kg/ha Sulphur	33,114.7	95543.79	62429.09	1.89
9. 50Kg/ha Potassium + 30Kg/ha Sulphur	33,384.97	98050.48	64665.51	1.94
10. Control	32,307.49	71804.12	39496.63	1.22

4. CONCLUSION

Based on one season of study, it is determined that application of Potassium 50 kg/ha and Sulphur 30 kg/ha (Treatment 9) performed better in terms of growth and yield as compared to other treatments. Significantly enhanced number of seeds per capitulum, test weight, seed yield, stover yield and oil content. Maximum net returns, gross returns and benefit cost ratio was also observed in treatment 9. The conclusions drawn are based on one season data only which requires further confirmation for recommendation.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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