

Original Research Article

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

Abstract

A research was conducted 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 (30,40,50kg/ha) and Sulphur as (10,20,30 Kg/ha) and a control. The experiment was laid out in Randomized Complete Block Design (RCBD) with 10 treatments and replicated thrice. The results showed that Application of 50 kg potassium soil application 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 (T₉) with the application of 50 kg potassium soil application with combination of 30 kg sulphur as soil application.

Key words: Potassium, Sulphur, Yield, economics, oil, Zaid.

INTRODUCTION

Sunflower (*Helianthus annuus L.*) the most important oilseed crops of the world because of the adequate concentration of unsaturated fatty acids (900 g kg/ha) 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 (Thimmegowda et al., 2007). 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

Comment [VB1]: Although the treatment 10 is a compost NPK fertilizer

Formatted: Justified

Comment [VB2]: Kindly recheck this units

enzymes (Najar et al., 2011). 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 (2009) 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 (Fournier et al. 2005). Potassium is also very important for activation of enzymes for photosynthesis, protein synthesis and starch formation(Asif et al. 2001).

Comment [VB3]: A short summary of the research intention here to close the section so that can inform on what was done below.

MATERIALS AND METHODS:

The experiment was conducted during *Zaid* season of 2022. 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 T₁ 30 kg/ha Potassium + 10 kg/ha Sulphur, T₂ 30 kg/ha Potassium + 20 kg/ha Sulphur, T₃ 30 kg/ha Potassium + 30 kg/ha Sulphur, T₄ 40 kg/ha Potassium + 10 kg/ha Sulphur, T₅ 40 kg/ha Potassium + 20 kg/ha Sulphur, T₆ 40 kg/ha Potassium + 30 kg/ha Sulphur, T₇ 50 kg/ha Potassium + 10 kg/ha Sulphur, T₈ 50 kg/ha Potassium + 20 kg/ha Sulphur, T₉ 50 kg/ha Potassium + 30 kg/ha Sulphur, T₁₀ – 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. (Dipak et al., 2018).

Comment [VB4]: Where was the experiment conducted? Description of the study area can be important and of adding value here.

Comment [VB5]: Present the treatments in a table for clarity

Comment [VB6]: Why is this reference here?

RESULTS AND DISCUSSION

Yield Attributes

Significantly Maximum Number of Seeds/capitulum (332.4) was recorded with the application of treatment T₉- 50Kg/ha Potassium + 30Kg/ha Sulphur over all the treatments. However, number of seeds (331.5) were obtained in T₈- 50Kg/ha Potassium + 20Kg/ha

Sulphur were found to be statistically at par with T₉- 50Kg/ha Potassium + 30Kg/ha Sulphur. Significantly Maximum Test weight (33.7 g) was recorded with the application of treatment T₉- 50Kg/ha Potassium + 30Kg/ha Sulphur over all the treatments. However, the treatment T₈- 50Kg/ha Potassium + 20Kg/ha Sulphur (33.2) which were found to be statistically at par with T₉- 50Kg/ha Potassium + 30Kg/ha Sulphur. Significantly Maximum Seed yield (1463.44 kg/ha) was recorded with the treatment T₉- 50Kg/ha Potassium + 30Kg/ha Sulphur over all the treatments. However, the T₆- 40Kg/ha Potassium + 30Kg/ha Sulphur (1417.10 kg/ha) and T₈- 50Kg/ha Potassium + 20Kg/ha Sulphur (1426.03 kg/ha) which was found to be statistically at par with T₉- 50Kg/ha Potassium + 30Kg/ha Sulphur. Significantly Maximum Stover yield (3211.6 kg/ha) was recorded with the treatment T₉- 50Kg/ha Potassium + 30Kg/ha Sulphur over all the treatments. However, the ~~T₈- 50Kg/ha Potassium + 20Kg/ha Sulphur (3202.9 kg/ha)~~ ~~T₆- 40Kg/ha Potassium + 30Kg/ha Sulphur (3194.8 kg/ha)~~ and ~~T₆- 40Kg/ha Potassium + 30Kg/ha Sulphur (3194.8 kg/ha)~~ ~~T₈- 50Kg/ha Potassium + 20Kg/ha Sulphur (3202.9 kg/ha)~~ which was found to be statistically at par with T₉- 50Kg/ha Potassium + 30Kg/ha Sulphur. Significantly Maximum Harvest index (31.3 %) was recorded with the treatment T₉- 50Kg/ha Potassium + 30Kg/ha Sulphur over all the treatments. However, the treatments T₅- 40Kg/ha Potassium + 20Kg/ha Sulphur (30.5 %) T₆- 40Kg/ha Potassium + 30Kg/ha Sulphur (30.7 %) and T₈- 50Kg/ha Potassium + 20Kg/ha Sulphur (30.8%) which was found to be statistically at par with T₉- 50Kg/ha Potassium + 30Kg/ha Sulphur. (Farhadet *et al.*, 2010).

Comment [VB7]: Adopt the sequence at all result presentation. It would show sequence as T8 recorded higher than T6 treatment

Comment [VB8]: What is the citation recognizing? Aren't this neat this author's results?

Formatted: Indent: First line: 0.5"

Oil content

Significantly Maximum Oil Content (41.23 %) was recorded with the treatment T₉- 50Kg/ha Potassium + 30Kg/ha Sulphur over all the treatments. However, the treatments T₆- 40Kg/ha Potassium + 30Kg/ha Sulphur (41.2 %) and T₈- 50Kg/ha Potassium + 20Kg/ha Sulphur (41.3 %) was found to be statistically at par with T₉- 50Kg/ha Potassium + 30Kg/ha Sulphur. Faisal *et al.* (2013).

Economics

Higher cost of cultivation was observed with the application of treatment T₉(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 T₉-50Kg/ha Potassium + 30Kg/ha Sulphur over rest of the treatments.

CONCLUSION

On the basis of one season experimentation, it is concluded 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.

Reference.

- Ayub M, Tanveer A, Amin MZ, Sharar MS & Pervaiz A (2002). Effect of different sources and levels of potassium on yield and oil content of spring sunflower. *Pak J Biol Sci* 2(3): 801-803.
- Ahmad M, Nadeem MA, Ayub R & Javaid F (2001). Response of sunflower to different potassium levels and harvesting times. *Pak J Life Soc Sci* 1(1): 45-47.
- Ahmad, F. (2018). Influence of Sulphur and Potassium Levels on Yield and Yield Attribute of Sesame (*Sesamum indicum*, L.). *International Journal of Research Studies in Agricultural Sciences (IJRSAS)*, 4(5), pp.8-10.
- Ayub. (2009). Experiment conducted on effect of different sources and levels of potash on yield and oil content of spring sunflower. *Pakistan J. of Biological sci.* 2 (3) 801-803.
- Badrul, H., and Intikhab, A. (2013). Effect of nitrogen, sulphur and farmyard manure on growth dynamics and yield of sunflower (*Helianthus annuus* L.) under temperate conditions. *Scientific Research and Essays*, 8(43), 2144-2147.
- Brar, M. S., P. Sharma, A. Singh, N. S. Dhillon and S. S. Sandhu, 2010. Effect of potassium nutrition on the yield, quality and nutrient uptake by sunflower. *J. of the Indian Soc. of Soil Sci.* 58 (3):344-346
- Dipak Salve, Monika S. Bhavsar, Rajanikant B. Ghagare and Sugandh N. Shinde. 2018. Effect of Potassium and Sulphur on Nutrient Uptake, Yield and Quality of Safflower in Vertisol. *International Journal of Current Microbiology and Applied Sciences*, 7(01): 1116-1123.

Comment [VB9]: This needs to be clearly presented and maybe following the previous format.

In all results presentation I propose the author to present the first higher results for each parameter and the one least, all against the control.

Comment [VB10]: The paper lacks the discussion sections where different results should be discussed and possible explanations for the found results and confronted with other researchers findings.

Considering that the treatment number 10 was a compost NPK (80:60:40) what does the author has to say about it taking into consideration the crop management or fertilizer management was not clearly explained in the methodology? The T10 has Nitrogen and Phosphorus in its composition while others don't. Interesting that the T10, the only containing NP performed worst. I believe a good discussion would tell something

Formatted: Justified

Formatted: Justified, Indent: Left: 0"

Formatted: Font: (Default) Times New Roman, 12 pt

Formatted: Normal, Justified, Indent: Left: 0", Right: 0", Space Before: 0 pt, Line spacing: single

Formatted: Font: (Default) Times New Roman, 12 pt, Not Italic

Formatted: Font: (Default) Times New Roman, 12 pt

Formatted: Font: Not Italic

Formatted: Font: Not Bold

Formatted: Font color: Auto, Pattern: Clear

Formatted: Font: (Default) Times New Roman, 12 pt

Formatted: Font: (Default) Times New Roman, 12 pt, Not Italic

Formatted: Font: (Default) Times New Roman, 12 pt

Ebrahimian, A. and A. Soleymani, 2013. Growth length and dry matter yield in different stages of safflower as affected by nitrogen, phosphorus and potassium fertilizers, *International Journal of Agronomy and Plant Production* 4 (5): 963-969.

Formatted: Font: Not Italic

Faisal, M. T., Yahya, K. J. and Saad, A. M. (2013). Effect of date and quantity of potassium fertilizer application on growth, yield and oil quality of sunflower *Helianthus annuus*. *J. of Agric. and Vet. Sci.* Volume 4, PP 33-40.

Formatted: Font: Not Bold

Formatted: Indent: Left: 0", Space Before: 0 pt, Line spacing: Multiple 1.08 li

Formatted: Font: Not Italic

Farhad, I. S. M., Islam, M. N., Hoque, S., & Bhuiyan, M. S. I. (2010). Role of potassium and sulphur on the growth, yield and oil content of soybean (*Glycine max* L.). *An Academic Journal of Plant Sciences*, 3(2), 99-103.

Formatted: Font: Not Bold

Formatted: Font color: Auto, Pattern: Clear

Gujar A, Buriro M, Kubar MS, Kubar KA, Kamran M, et al. (2018) Agronomic performance of sunflower *Helianthus annuus* L.) against different sources and levels of potassium fertilization. *Journal of environmental and Agricultural Sciences* 15:18-57.

Formatted: Font: (Default) Times New Roman, 12 pt

Formatted: Normal, Justified, Indent: Left: 0", Right: 0", Space Before: 0 pt, Line spacing: single

Pavani, S., Rekha, K. B., Babu, S. N., and Moguloju, M. (2013). Effect of nitrogen and Sulphur on growth, yield and quality of sunflower (*Helianthus annuus* L.). *Crop Research*, 45(1 to 3), 152-154.

Formatted: Font: (Default) Times New Roman, 12 pt, Not Italic

Formatted: Font: (Default) Times New Roman, 12 pt

Formatted: Font: (Default) Times New Roman, 12 pt

Sarkar, R.K., and R.B. Mallick. 2009. Effect of nitrogen, Sulphur and foliar spray of nitrate salts on performance of spring sunflower (*Helianthus annuus*). *Indian J. Agric.Sci.*, 79(12): 986-90.

Formatted: Normal, Justified, Indent: Left: 0", Space Before: 0 pt

Formatted: Font: (Default) Times New Roman, 12 pt, Not Italic

Thimmegowda MN, Nanjapa HV, Ramachandrappa BK (2007). Effect of soil solarization and farmyard manure application on weed control and productivity of sunflower (*Helianthus annuus*)-bell pepper (*Capsicum annum*) sequence. *Indian J. Agron.* 52(3):204-207.

Formatted: Font: (Default) Times New Roman, 12 pt

Formatted: Font: (Default) Times New Roman, 12 pt, Not Italic

Najar GR, Singh SR, Akthar F, Hakeem SA (2011). Influence of sulphur levels on yield, uptake and quality of soyabean (*Glycine max*) under temperate conditions of Kashmir valley. *Indian J. Agric. Sci.* 81(4):340-343.

Formatted: Font: (Default) Times New Roman, 12 pt, Not Bold

Formatted: Font: (Default) Times New Roman, 12 pt

Fournier JM, Roldan AM, Sanchez C, Alexandre G & Benlloch M (2005). K⁺ starvation increases water uptake in whole sunflower plants. *Plant Sci* 168: 823-829.

Formatted: Font: (Default) Times New Roman, 12 pt

Formatted: Justified, Indent: Left: 0", Hanging: 0.5"

Asif M, Hussain N & Khan MB (2001). Effect of K on the growth and seed yield of spring sunflower (*Helianthus annuus* L.). *Pak J Biol Sci* 4(1): 100-101.

Formatted: Justified, Line spacing: Multiple 1.08 li

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 (\pm)	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