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Effect of Biofertilizers and Levels and Sources of Sulphur on Growth and Yield of Sunflower (*Helianthus annus* L.)

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ABSTRACT: A trial was executed during *Zaid season of 2021*, at crop research farm of Department of Agronomy at Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj with the objective to study effect of biofertilizers and levels and sources of sulphur on growth, yield and oil content of sunflower (*Helianthus annuus* L.) under Randomized block design comprising of 9 treatments, with 2 different levels of sulphur from 2 different sources along with 2 different biofertilizers. The treatment T_6 has recorded maximum plant height (134.90 cm) at 80 DAS, RGR of 0.24 g/g/day, highest number of seeds in capitulum 375.33, test weight (39.20), grain yield (1495.67 kg/ha), stover yield (3255.33 kg/ha). While highest leaves (23.40) were reported by treatment T_7 and oil content (42.26%). Treatment T_8 has recorded maximum Crop growth rate (3.43) at 20-40 DAS and Harvest index (35.83). Treatment T_5 has recorded maximum dry weight of 13.02g at harvest. Treatment T_5 has recorded maximum gross and net return of 160233.33 and 111752.3 INR/ha respectively, while highest B: C ratio (1.4645) was obtained by T_8.

Keywords: Sulphur, Biofertilizers, Gypsum, FYM, Growth, Yield, Economics.

INTRODUCTION

Sunflower is one of the most important oilseeds considered as premium because of its high polyunsaturated fatty acid (PUFA) content with a high level of linoleic acid (64%) and absence of linolenic acid which helps in washing out cholesterol deposition in the coronary arteries of the heart and thus good for cardio vascular disease. Contributing for "***Yellow revolution***" in oil seeds for self-support in the country is noteworthy (Mangala 2002). great promise because after sunflower crop soybean contribute more due to short lived, high seed multiplication ratio, wider adaptability, photo-insensitivity, higher water use efficiency and drought tolerance. In our country this crop is in an area of 0.48 million hectares. Sunflower competes in the world oilseed complex, which consists of soybean, rapeseed, sunflower, palm oil and cottonseed (Klein Gartner, 1997). In spite of the cultivation of a number of oilseed crops, the country meets 50% of its domestic requirements through import. Low productivity and stock still or decline in area of production of these oil seeds like groundnut, rapeseed, and mustard are the key reason which has caused insufficient carrying capacity. As increase in the number of the people oil of vegetables is increasing at the rate of about 4–6% (Agarwal, 2007). To cope up with the present demand-supply deficit there is imperative necessitate perking up the productivity. Only sunflower and rapeseed derive about 75% of their value from oil.

Sulphur is the fourth most important nutrient after Nitrogen, phosphorus and potassium deficiency is widespread in India (Yadav *et al*. 2000; Sakal *et al*. 2001). Sulphur deficiency is observed primarily due to high crop yield and therefore remove of sulphur highly in crops and low recommendation of fertilizers containing sulphur. (Messick, 2003). The uptake of sulphur by oilseed crops is much like that of phosphorous. Oil crops require about the same amount as S as, or more than, phosphorus for high yield and product quality (Jamal *et al*. 2010). Sulphur is best known for its role in the synthesis of cysteine, methionine, chlorophyll and oil content of oilseed crops. It is also responsible for the synthesis of certain oil formation of flavoured compounds. Sulphur fertilization improves both the quality and quantity of oilseeds.

An intensive cropping system has depleted the inherent soil fertility, leading to deficiency of important plant nutrients which finally causes poor nutrition. Proficient use of inputs along with ample and impartial fertilizer use is mandatory for sustainable production. Global agriculture is facing serious upshot of population pressure, climatic variations and detrimental environmental impacts. To subsist on the earth, enlarged population needs more food. To warrant food security new-fangled method should be initiated by sustainable crop production that contribute plenty nourishment, devoid of harming the agroecosystem (Panwar and Vijayaluxmi, 2005).

Biofertilizers have attracted greater attention as a substitute for costly chemical fertilizers. Biofertilizers contain living microorganisms that provide eco-friendly organic agro-input and are more cost-effective than chemical fertilizers (Amrutha *et al*., 2014). When applied to soil or used as seed treatment, they colonize the rhizosphere i.e., the root zone or the interior part of the plant which promotes by enhancing the availability of essential nutrients to the host plant. Through natural processes like nitrogen fixation and invigorating plant growth by the amalgamation of growth-promoting substances to append nutrients (Vessey, 2003). Biofertilizers are generally applied to the soil, seeds, or seedlings, with or without some carrier for the microorganisms, for example, FYM, peat, composts, or coal (Chand *et al.,* 2006). *Azotobacter,* and *Azospirillum,* can fix atmospheric nitrogen into the soil and make it available to plant. To a low degree combination of development support substances *viz.,* auxins, gibberellins, cytokinin's, and vitamins that play a significant function in the nitrogen cycle in nature, binding atmospheric nitrogen. Azotobacter has a jam-packed array of enzymes essential to execute the nitrogen fixation: ferredoxin, hydrogenase, and a chief enzyme nitrogenase (Amutha *et al.,* 2014). Azospirillum being an associative symbiotic, this bacterium brings many benefits to many non-leguminous crops like cereals, millets, forage crops, and vegetable crops. When associate with roots N_2 -fixing capacity is very high. It also increases germination, vigour in young plants leading to improved crop stands, root proliferation and this bacterium secretes a vast group of plant hormones.

MATERIALS AND METHODS

The experiment was carried out during the *Zaid season of 2021* at the CRF of Agronomy department, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh. To assess the effect of different levels of Sulphur from and biofertilizers on Growth, Yield and Economics of Sunflower (*Helianthus annus* L.). The experiment was conducted in Randomized complete block design with treatments containing 9 and with 3 replications. Treatment combination consisted of two factors, one with two different biofertilizers i.e., *Azotobacter* and *Azospirillum* and the other with two levels of sulphur i.e., Sulphur $S_{1:}$ 20 kg/ha, Sulphur $S_{2:}$ 30 kg/ha, Sulphur from different sources viz., Single super phosphate (SSP) and Gypsum. The related factors are given in Table-1. The nutrient sources were Urea, DAP, SSP, MOP and Gypsum to fulfil the requirement of Nitrogen, Phosphorus, Potassium and Sulphur. Each treatment was given nitrogen, phosphorus and potassium (80:60:400 kg/ha) respectively as per calculation based on sulphur in SSP. Plant. The recommendations were followed according to region for protection of crop without infestation of pests and diseases. Five random plants were selected and tagged properly in each plot for recording plant height, number of leaves/plant at an interval of 20, 40, 60 DAS and at harvest stages of the crop. To record plant dry weight three random plants were selected from border rows of each plot. The harvested crop of plot area (1 m^2) was taken and threshing was carried out by manually for drying. Later winnowed, cleaned and weighed the grain per net plot value, the grain yield per ha was computed and expressed in tonnes per hectare. The data were computed and analysed by following the statistical method of Gomez and Gomez (1984). After plots were prepared. To analyse the various major nutrients the soil sample was collected from the plots. Nitrogen (N), phosphorous (P), potassium (K), Organic Carbon (OC), pH and soluble salts. Sandy loam is the type of soil in trial field. The pH of the experimental field was 7.4, EC of 0.30 d/Sm, organic carbon was 0.47%. The N status of the experimental field was 210 kg/ha, available P was 11 kg/ha, while available K status was 233 kg/ha. Yield parameters grain yield kg/ha, straw yield kg/ha, were recorded as per the standard method. The monetary parameters like cost of cultivation, gross returns, net returns, and Benefit: Cost ratios were worked out as per the standard method.

Table 1: Details of treatment combination.

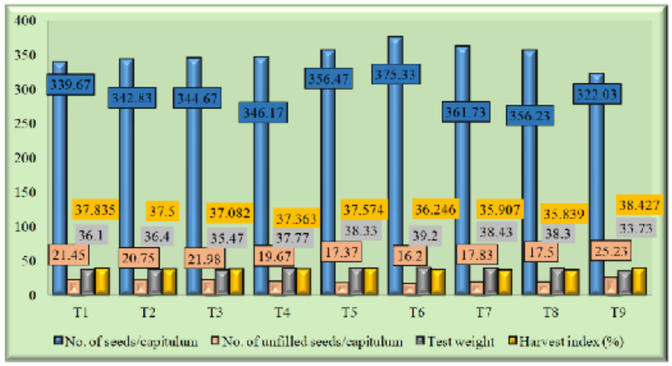
S. No.	Treatment no.	Treatment combination
1.	T_1	20 kg/ha of Sulphur through SSP + Azospirillum
2.	T_2	20 kg/ha of Sulphur through SSP + Azotobacter
3.	T_3	20kg/ha of Sulphur through gypsum + Azospirillum
4.	T_4	20kg/ha of Sulphur through gypsum + Azotobacter
5.	T_5	30kg/ha of Sulphur through SSP + Azospirillum
6.	T_6	30kg/ha of Sulphur through SSP + Azotobacter
7.	T_7	30kg/ha of Sulphur through gypsum + Azospirillum
8.	T_8	30kg/ha of Sulphur through gypsum + Azotobacter
9.	T_9	Control

RESULTS AND DISSCUSIONS

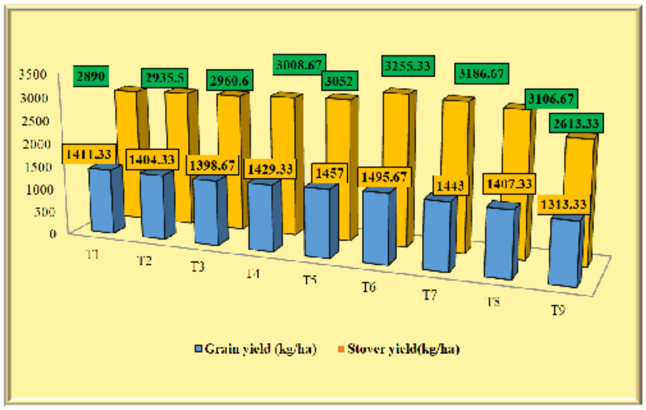
Growth parameters. At harvest, treatment T_6 has recorded a height plant height of 134.90 cm. However, the treatments T_5, T_7, and T_8 were found at par to the maximum. Plant height might have increased with rising sulphur uptake as it boosts cell multiplication, elongation and cell expansion all through the whole period of crop growth, higher levels of sulphur in protein & carbohydrate metabolism, activating many enzymes which persuade shoot length (Kumar *et al.*, 2011). These findings are in agreement with Wu *et al.*, (2005); Gabhiye *et al.*, (2003). At 80 DAS treatment having T_7 has reported the maximal number of leaves/plants 23.40. While the treatments T_5, T_6, and T_8

have shared the parity with the maximum. **Ramakrishnan and Selvakumar (2012)** report suggest that biofertilizers can enhance nitrogen absorption by plants and improves plant mineral concentration through nitrogen fixation which can lead to enhanced no. of leaves. Similar findings were observed by Bhadauria *et al.* (2005); Gopinathan and Prakash, (2014); Ravi *et al*., (2008).

Graph 1: Graph depicting the yield attributes of sunflower



Graph 2: Graph depicting the grain and stover yield of sunflower.



At harvest, treatment T_5 has recorded the highest dry weight of 13.02 g, and the treatments T_6, T_7, and T_8 were found at par to the maximum. Sulphur helps in better photosynthesis means more dry matter accumulation as sulphur is a constituent of succinyl Co-A, which is involved in chlorophyll in leaves and their activation at the cellular level accelerates chemosynthesis. Biofertilizers not only provide nitrogen but also produces a variety of growth-promoting substances, among them indole acetic acid, gibberellins, and B-vitamins this might have helped in the hike in no. of leaves Wu *et al.*, (2005). These findings are similar to that of Kavitha (2013); Vaghasia and kahanpara (2008); Rani *et al.* (2009); Hussain *et al.* (2011); Basavaraju (1999). At harvest, all the treatments except T_2, T_4, and T_9 have shared the parity with maximum. The crop fertilized with sulphur increased the CGR considerably up to 40-60 days stage which might be because of improved plant vigour due to efficient photosynthesis, protein, and carbohydrate metabolism (Kumar *et al.* 2011). These are in agreement with the statements of Gashti *et al.* (2009). At harvest the treatments T_1, T_4, T_6, and T_7 have recorded the highest relative growth rate of 0.04 g/g/day. The data was presented in Table 2.

Table 2: Effect of biofertilizers and levels and sources of sulphur on growth parameters of sunflower.

S.No.	Treatment no.	Plant height (cm)	No. of leaves/plant	Dry weight (g/plant)	Crop growth rate g/m^2/day	Relative growth rate (g/g/day)
1.	T_1	125.07	21.23	10.80	1.68	0.04
2.	T_2	126.03	21.08	10.94	1.52	0.03
3.	T_3	125.53	20.87	10.75	1.72	0.03
4.	T_4	126.33	21.73	11.12	1.52	0.04
5.	T_5	131.73	22.23	13.02	1.76	0.03
6.	T_6	134.90	22.77	12.22	1.75	0.04
7.	T_7	134.17	23.40	12.38	1.74	0.04
8.	T_8	133.70	22.53	12.18	1.67	0.03
9.	T_9	121.80	19.57	10.21	1.41	0.02
	F-test	125.07	S	S	S	NS
	CD (P=0.05)	125.53	0.49	0.36	0.06	0.01
	SEm±	126.03	1.46	1.07	0.19	0.02

*S-Significant at $P < 0.05$; NS-Non-significant at $P > 0.05$

Effect on yield and yield attributes of sunflower: Maximum no. of seeds/ capitulum was recorded by the treatment T_6 and the treatments T_5, T_7, and T_8 were found at par to the maximum. The increase in the number of seeds per head might be due to an increase in translocation of assimilates from source to sink Shekavat and shivaay (2009). These findings are similar to that of Mirche *et al.* (2016); Gabhiye *et al*. (2003). The highest no. of unfilled grains was recorded in Treatment T_9, while the treatments T_1 and T_3 have shared the static parity with maximum. Sulphur application might have increased seed yield of sunflower owing to an increase in seed filling and thus decreasing the number of unfilled seeds Shekavat and shivaay (2009). The highest test weight was recorded in the treatment T_6 of 39.20 g. While the lowest was recorded with the treatment T_9. However, treatments T_4, T_5, T_7, and T_8 were found at par to the maximum. Increased translocation of photosynthesis to sink might have increased test weight. These findings are similar to Intodia and tomar (2004); Kumar and singh (2005). The treatment T_6 has recorded a maximum grain yield of 1495.67 kg/ha while the lowest of 1313.33 kg/ha was recorded with the treatment T_9. The treatments T_4, T_5, and T_7 were found statistically at par to the maximum. Sarkar and Mallick (2009) also observed that sulphur is known to play a vital role in the formation of amino acids. Higher dry matter accumulation and better translocation of photosynthates led to increasing in yield components, which in turn resulted in an increase in seed yield. Similar findings were reported by Kacharoo and Kumar (1997); Sharma and Gupta (2003). Patel *et al.* (2011) observed that increased yield may be due to yield is associated with good inorganic nitrogen utilization with the existence of biofertilizers which leads to better biological Nitrogen fixation for improved root development and higher production of plant growth hormones. Ramakrishnan and Selvakumar (2012) reported that biofertilizers can enhance nitrogen absorption by plants and improves plant mineral concentration through nitrogen fixation which alters yield in plants. These are in agreement with the statements of Kloepper *et al.*, (1991); Balasubramani *et al.* (1997). The treatment T_6 has recorded the highest stover yield of 3255.33 kg/ha, while the lowest of 2613.33 kg/ha was recorded by the treatment T_9. The treatment T_7 has shared the parity with the maximum. An increase in stover yield can be ascribed to the overall improvement in plant organs associated with faster and uniform vegetative growth of the crop with sulphur application Solanki & Sharma, (2016). The highest harvest index was recorded with treatment T_9 of 38.427, while the lowest was recorded with the treatment T_8 of 35.839, while all the treatments except T_6, T_7, and T_8 have shared the parity with the maximum.

Table 3: Effect of biofertilizers and levels and sources of sulphur on yield and yield attributes of sunflower.

Sr. No.	T. No.	No. of seeds/capitulum	No. of unfilled grains/capitulum	Test weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest index (%)
1.	T_1	339.67	21.45	36.10	1411.33	2890	37.835
2.	T_2	342.83	20.75	36.40	1404.33	2935.5	37.50
3.	T_3	344.67	21.98	35.47	1398.67	2960.60	37.082
4.	T_4	346.17	19.67	37.77	1429.33	3008.67	37.363
5.	T_5	356.47	17.37	38.33	1457	3052	37.574
6.	T_6	375.33	16.20	39.20	1495.67	3255.33	36.246
7.	T_7	361.73	17.83	38.43	1443	3186.67	35.907
8.	T_8	356.23	17.50	38.30	1407.33	3106.67	35.839
9.	T_9	322.03	25.23	33.73	1313.33	2613.33	38.427
	F-test	S	S	S	S	S	S
	CD = (0.05)	26.62	3.70	2.07	66.64	118.81	1.59
	SEm±	8.88	1.24	0.69	22.23	39.63	0.53

Fig. 1. Land preparation and sowing operation; Spraying operation in sunflower crop at crop research farm, Department of Agronomy, SHUATS, Prayagraj, during Zaid, 2021.

CONCLUSION

Treatment T_5 which obtained gross return (160233.3 INR/ha) and net return (111752.3 INR//ha), whereas highest benefit: cost ratio (1.4645) was obtained by treatment T_8, which may be more preferable for farmers since it is economically more profitable and hence, can be recommended to the farmers. As the monetary units is the supreme importance in the farmer perspective.

FUTURE SCOPE

Since findings were based on the one season under agro-ecological conditions of Prayagraj. So, for recommendation to the farmers the trail should be repeated for further.

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Conflict of Interest. None.

REFERENCES

Agarwal, A. K. (2007). Biofuels (alcohols and bio diesel) applications as fuels for internal combustion engine, programme of energy combustion sciences, *33*: 233-271.

Amutha, R., Karunakaran, S., & Dhana Sekaran S. (2014). Isolation and mass production of biofertilizer (*Azotobacter* and *Phosphobacter*). *Int. J. Latest Res. Sci. Tech., 3*: 79-81.

Anonymous, Department of Agriculture and Commerce (2018). Ministry of Agriculture, Government of India, Agricultural Statistics at a Glance.

Balasubramani, P., Pappaiah, C. M., & Chezkiyan N. (1997). Effect of Azospirillum and nitrogen on growth, flowering, fruit and quality of bhendi (*Abelmoschus esculentum* L.) var Pusa Sawani. *South Indian Hortic*., *45*(4): 178-180.

Basavaraju M. N. (1999). Effect of Azotobacter inoculation on growth and yield of radish. M.Sc. (Agri) Thesis. University of Agric. Sci., Bangalore, Karnataka, India.

Bhadauria K. K. S., Dwivedi, Y. C., & Kushwah, S. S. (2005). Effect of bio-inoculants and its methods of inoculation in combination with different level of nitrogen on growth, yield and economics of tomato. *JNKVV Research J., 39*(2), 112-115.

Bhosale, N. D., Dabhi, B. M., Gaikwad, V. P., & Chavan, A. B. (2011). Growth, yield and quality parameters of sesamum (*Sesamum indicum* L.) as influenced by different levels of potash and sulphur, *International Journals Forestry Crop Improvement*, *2*(2): 121-123.

Chand, S., Anwar, M., & Patra D. (2006). Influence of long-term application of organic and inorganic fertilizer to build up soil fertility and nutrient uptake in mint-mustard cropping sequence: *Communications Soil Science Plant Analysis, 37*(2): 63-76.

Gabhiye R. P., Sharma R. R., & Tewari R. N. (2003). Effect of biofertilizers on growth and yield parameters of tomato. *Indian J. Hort., 60*(4): 368-371.

Gashti, A. H., Esfahani, M., Asghari, J., Safarzadeh, M. N., & Rabiei, B. (2009). Effect of sulphur application on growth indices and yield of peanut (*Arachis hypogaea* L.). *Journal of Sciences and Technology*. *Agricultural and Natural Research*, *13*(48): 27-39.

Gomez, K. A., & Gomez, A. A. (1984). Statistical Procedures for Agricultural Research. edn 2, John Wiley & Sons, New York.

Gopinathan R., & Prakash M. (2014). Effect of vermicompost enriched with Biofertilizers on the productivity of tomato (*Lycopersicum esculentum* mill.). *Int. J. Curr. Micobiol. App. Sci*., *3*(9): 1238-1245.

Hussain, S. S., Misger, F. A., Kumar, A., & Baba, M. H. (2011). Effect of nitrogen and sulphur on biological and economical yield of sunflower (*Helianthus annuus* L.). *Research Journal Agricultural Sciences*, *2*(2): 308-310.

Intodia, S. K., & Tomar, O. P. (2004). Effect of sulphur application on growth and yield of sunflower (*Helianthus annuus*). *Indian Journal Agriculture Sciences, 67*(1): 46-47.

Jamal, A., Yong-Sun, M., & Malik Zainul, A. (2010). Sulphur –a general overview and interaction with nitrogen. *Australian Journal of Crop Science*, *47*(7): 523-529.

Jat, R. A., & Ahlawat, I. P. S. (2010). Effect of organic manure and sulphur fertilization in pigeon pea +groundnut (*Arachis hypogaea*) intercropping system. *Indian Journal of Agronomy, 55*(4): 276-281.

Kacharoo, D., & Kumar, A. (2006). Nitrogen and sulphur fertilization in relation to yield attributes and seed yield of Indian mustard *(Brassica juncea). Indian Journal of Agronomy*, *42*(1): 145-147.

Kavitha, S. (2013). Individual and combined effect of Biofertilizer, Chemical fertilizer and Vermicompost on Amaranthus tristis. *Int. J. Pharm. Sci. Rev. Res.*, *20*(2): 190-195.

Kloepper, J. W., Rodrguez-kbana R., Mcinroy J. A., & Collins, D. J. (1991). Analysis of populations and physiological characterization of microorganisms in rhizospheres of plants with antagonistic properties to phytopathogenic nematodes. *Plant Soil, 136*: 95–102.

Kumar, S., & Singh, S. S. (2005). Effect of different levels of phosphorus and sulphur on the growth, yield and oil content of sunflower, (*Helianthus annuus* L.) *Journal Oilseeds Research*, *22*(2): 408-409.

Kumar, S., Tewari, S. K., & Singh, S. S. (2011). Effect of sources and levels of sulphur and spacing on the growth, yield and quality of spring sunflower (*Helianthus annuus*). *Indian Journal of Agronomy*, *56*(3): 242-246.

Mangala R. (2002). Oilseeds in India. *Andhra Pradesh Agriculture Regional Research Journal* pp.13-15.

Messick, D. L. (2003). S fertilizers: A Global prospective, proceedings of TSI-FAI-IFA workshop. S in balanced fertilization, pp 1-7.

Mirche, S. H., Suryavanshi, V. P., Bahure, G. K., Mirza, I. A. B., & Padul, A. S. (2016). Effect of sulphur and boron nutrition and it method of application on growth, yield and economics of sunflower. *Asian Journal of Multidisciplinary Studies*, *4*(3): 43-47.

Panwar, J. D. S., & Vijayaluxmi (2005). Biological nitrogen fixation in pulses and cereals. Development in physiology, biochemistry and molecular biology of plants (Editor: Bandana Bose and A. *Hemantaranjan*) Published by New India Publishing Agency, New Delhi, pp. 125-158.

Patel, N. K., Chaudhari, S. R., & Parekh, J. H. (2011). Effect of Biofertilizer and nitrogen on quality of tomato cv. GT-2, *Adv. Res. J. Crop Improv*., *2*(2): 263-264.

Ramakrishnan, K., & Selvakumar, G. (2012). Effect of biofertilizers on enhancement of growth and yield on Tomato (*Lycopersicum esculentum* Mill.). *Int. J. of Research in Botany*, *2*(4): 20-23.

Rani, K. U., Sharma, K. L., Nagasri, K., Srinivas, K., Muthy, T. V., Maruthi, G. R., Korwar, G. R. Sankar, K. S., Madhavi, M., & Grace, J. K. (2009). Response of sunflower to sources and levels of sulphur under rainfed semiarid tropical conditions. *Communication in Soil Sciences and Plant Analysis, 40*: 2926-2944.

Ravi, S., Channal, H. T., Hebsur, N. S., Patil, B. N., & Dharmatti, P. R. (2008). Effect of sulphur, zinc and iron nutrition on growth, yield, nutrient uptake and quality of safflower. *Karnataka Journal Agricultural Sciences*, *21*(3): 382-385.

Sakal, R., Singh, A. P., Choudhary, B. C., & Shahi, B. (2001). Sulphur status of Usifluvents and response of crops sulphur application Fertilizer News, *46*(10): 61-65.

Sarkar, R. K., & Mallik, R. B. (2009). Effect of nitrogen, sulphur and foliar spray of nitrate salts on performance of spring sunflower (*Helianthus annuus* L.). *Indian Journal Agriculture Sciences*, *79*(12): 986-990.

Sharma, H. R., & Gupta, A. K. (2003). Effect of sulphur on growth parameters and yield of some selected crops. *Annals Agriculture Research*, *24*(1): 136-138.

Shekhawat, K., & Shivay, Y. S. (2009). Effect of nitrogen sources, sulphur and boron on growth parameters and productivity of spring sunflower. *Indian Journal Plant Physiology*, *14*(3): 290-298.

Solanki, R. L., & Sharma, M. (2016). Effect of phosphorus, sulphur and PSB on growth and yield of mustard in southern Rajasthan. *Annals of Plant and soil Research*, *18*(1): 66-69.

Vaghasia, P. M., & Khanpara, V. D. (2008). Response of groundnut (*Arachis hypogaea* L.) to moisture conservation practices and sulphur nutrition under rained conditions. *International Journal Agricultural Sciences*, *4*(2): 523-526.

Vessey, J. K. (2003). Plant growth promoting rhizobacteria as biofertilizers. *Plant and Soil*, *255*: 571-586.

Wu, S. C., Cao, Z. H, Li, Z. G., & Cheung, K. C. (2005). Effect of biofertilizer containing N fixer, P & K solubilizer and AM fungi on maize growth: A greenhouse trail. *Geoderma*, *125*: 155-166.

Yadav, R. L., Dwivedi, B. S., Shukla, A. K., & Kumar, V. (2000). S in balanced fertilization in alluvial soil soils of western Uttar Pradesh. S in Balanced Fertilization, New Delhi. Pp.27-41.

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