The Pharma Innovation Journal 2021; 10(11): 1822-1825

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; 10(11): 1822-1825

www.thepharmajournal.com
Received: 06-09-2021
Accepted: 13-10-2021

Godehalu Sandhya
M.Sc. Scholar, Department of Agronomy, SHUATS, Prayagraj, Uttar Pradesh, India

Rajesh Singh
Assistant Professor, Department of Agronomy, SHUATS, Prayagraj, Uttar Pradesh, India

Ekta Singh
Ph.D., Agronomy Student, Department of Agronomy, SHUATS, Prayagraj, Uttar Pradesh, India

Corresponding Author:
Godehalu Sandhya
M.Sc. Scholar, Department of Agronomy, SHUATS, Prayagraj, Uttar Pradesh, India

Original Research Article

Effect of biofertilizers and levels and sources of sulphur on yield and economics of sunflower (*Helianthus annuus* L.)

Godehalu Sandhya, Rajesh Singh and Ekta Singh

Abstract
A field experiment was conducted 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 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 grain yield (1495.67 kg/ha), stover yield (3255.33 kg/ha). 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 (*Helianthus annuus* L.) belongs to the family Compositae originated in Mexico and Peru, introduced into India in the 16th century. 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 heart patients. But its contribution towards attaining self-sufficiency in edible oil as well as to the "*Yellow revolution*" in the country is noteworthy (Mangala Rai, 2002) [22]. next to soybean, holds great promise because of its short duration (90-100 days), high seed multiplication ratio, wider adaptability, photo-insensitivity, higher water use efficiency and drought tolerance. In India sunflower is cultivated in an area of 0.48 million hectares, with a total annual production of 0.32 million tonnes and productivity of 720 kg/ha, (Ministry of Agriculture, Govt. of India, 2019-20). 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. With a rapidly increasing population, the demand for vegetable oil in the country is increasing at the rate of about 4–6% (Agarwal, 2007) [1]. 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) [38, 30]. Sulphur deficiency is observed primarily due to high crop yield and therefore higher rate of sulphur removal by crops and lesser use of sulphur-containing fertilizers (Messick, 2003) [23]. The uptake of sulphur by oilseed crops is much like that of phosphorus. Oil crops require about the same amount as S as, or more than, phosphorus for high yield and product quality (Jamal *et al.* 2010) [15]. 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) [25]. 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 (Amutha *et al*., 2014) [2].

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) [36]. 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) [8]. *Azotobacter*, and *Azospirillum*, can fix atmospheric nitrogen into the soil and make it available to plant. To a little degree synthesis of growth-promoting substances *viz.*, auxins, gibberellins, cytokinin's, vitamins and that play an significant function in the nitrogen cycle in nature, binding atmospheric nitrogen, which is out-of-the-way to plants, and releasing it in the form of ammonium ions into the soil. 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) [2]. 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. In the view of above consideration, the present investigation entitled **"**Effect of biofertilizers and levels of sulphur from different sources on economics of sunflower (*Helianthus annuus. L)*" was carried out.

Materials and Methods

The experiment was carried out during the *Zaid season of* 2021 at the CRF (Crop Research Farm) SHUATS, Department of Agronomy, Naini Agricultural Institute, 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 laid out in Randomized Block Design comprising of 9 treatments which are replicated thrice. 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 factors are combined to frame the 9 treatment combinations that are depicted 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 protection measures were followed as per recommendations for the region. 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 crop was harvested from the net plot area (1 m^2) and manual threshing was carried out after proper 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) [11]. After thorough field preparation, initial soil samples were taken to analyse for available major nutrients. Nitrogen (N), phosphorous (P), potassium (K), Organic Carbon (OC), pH and soluble salts. The type of soil in the experimental field is sandy loam. 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

Result and Discussion

Table 2: Effect of biofertilizers and levels and sources of sulphur on yield and economics of sunflower

S. no	T. no	Grain yield (kg/ha)	Straw yield (kg/ha)	Cost of cultivation (INR/ha)	Gross returns (INR/ha)	Net returns (INR/ha)	Benefit cost ratio
1	T_1	1411.33	2890	46106	155246.7	109140.7	1.4183
2	T_2	1404.33	2935.5	46256	155430	109174	1.4201
3	T_3	1398.67	2960.60	47728	154916.7	107188.7	1.4400
4	T_4	1429.33	3008.67	47878	156713.3	108835.3	1.4401
5	T_5	1457	3052	48481	160233.3	111752.3	1.4453
6	T_6	1495.67	3255.33	48631	160196.7	111565.7	1.4472
7	T_7	1443	3186.67	49632	158876.7	109244.7	1.4617
8	T_8	1407.33	3106.67	49782	157886.7	108104.7	1.4645
9	T_9	1313.33	2613.33	43456	146446.7	102990.7	1.3939

Grain yield
The treatment T_6 has recorded 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) [31] also observed that sulphur is known to play vital role in formation of amino acids. Higher dry matter accumulation and better translocation of photo- synthates led to increase in yield components, which in turn resulted in increase in seed yield. Similar findings were reported Patel *et al.* (2011) [26].

Stover yield
The treatment T_6 has recorded 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. 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 [34]. Similar findings are observed by Intodia and tomar (2004) [14] Shekavat and shivaay (2009) [33].

Economics
Gross returns
Highest gross return of 1, 60,233.33 INR/ha was recorded with the treatment T_5. While lowest gross return was recorded by the treatment T_9 of 1, 46,446.7 INR/ha. All of the treatments except T_9 have recorded the statistical parity with the maximum. Similar findings were reported by Jat and Ahlaaat (2010) [16] Bhosale *et al.* (2011) [7].

Net returns
Highest net return was recorded with the treatment T_5 of 1, 11,752.3 INR/ha, while the treatment T_9 has recorded the lowest net return of 1, 02,990.7 INR/ha. There was no significant difference among the treatments.

Benefit-Cost ratio
Maximum B: C ratio of 1.464 was recorded by the treatment T_8 while less B: C ratio of 1.3939. There was no significant difference among the treatments.

Reference

1. Agarwal AK. Biofuels (alcohols and bio diesel) applications as fuels for internal combustion engine, programme of energy combustion sciences 2007;33:233-271.
2. Amutha R, Karunakaran S, Dhanasekaran S. Isolation and mass production of biofertilizer (*Azotobacter* and *Phosphobacter*). Int J Latest Res Sci Tech 2014;3:79-81.
3. Anonymous. Department of Agriculture and Commerce, Ministry of Agriculture, Government of India, Agricultural Statistics at a Glance 2018.
4. Balasubramani P, Pappaiah CM, Chezkiyan N. Effect of Azospirillum and nitrogen on growth, flowering, fruit and quality of bhendi *(Abelmoschus esculentum*. L.) var Pusa Sawani. South Indian Hortic 1997;45(4):178-180.
5. Basavaraju MN. Effect of Azotobacter inoculation on growth and yield of radish. M.Sc. (Agri) Thesis. University of Agric. Sci., Bangalore, Karnataka, India 1999.
6. Bhadauria KKS, Dwivedi YC, Kushwah SS. 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 2005;39(2):112-115.
7. Bhosale ND, Dabhi BM, Gaikwad VP, Chavan AB. Growth, yield and quality parameters of sesamum (*Sesamum indicum* L.) as influenced by different levels of potash and sulphur, International Journals Forestry Crop Improvement 2011;2(2):121-123.
8. Chand S, Anwar M, Patra D. 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 2006;37(2):63-76.
9. Gabhiye RP, Sharma RR, Tewari RN. Effect of biofertilizers on growth and yield parameters of tomato. Indian J. Hort 2003;60(4):368-371.
10. Gashti AH, Esfahani M, Asghari J, Safarzadeh MN, Rabiei B. Effect of sulphur application on growth indices and yield of peanut (*Arachis hypogaea* L.). Journal of Sciences and Technology. Agricultural and Natural Research 2009;13(48):27-39.
11. Gomez KA, Gomez AA. Statistical Procedures for Agricultural Research. edn 2, John Wiley & Sons, New York 1984
12. Gopinathan R, Prakash M. Effect of vermicompost enriched with Biofertilizers on the productivity of tomato (*Lycopersicum esculentum* mill.). Int. J. Curr. Micobiol. App. Sci 2014;3(9):1238-1245.
13. Hussain SS, Misger FA, Kumar A, Baba MH. Effect of nitrogen and sulphur on biological and economical yield of sunflower (*Helianthus annuus* L.). Research Journal Agricultural Sciences 2011;2(2):308-310.
14. Intodia SK, Tomar OP. Effect of sulphur application on growth and yield of sunflower (*Helianthus annuus*).

Indian Journal Agriculture Sciences 2004;67(1):46-47.
15. Jamal A, Yong-Sun M, Malik Zainul A. Sulphur –a general overview and interaction with nitrogen. Australian Journal of Crop Science 2010;47(7):523-529.
16. Jat RA, Ahlawat IPS. Effect of organic manure and sulphur fertilization in pigeon pea +groundnut *(Arachis hypogaea*) intercropping system. Indian Journal of Agronomy 2010;55(4):276-281.
17. Kacharoo D, Kumar A. Nitrogen and sulphur fertilization in relation to yield attributes and seed yield of Indian mustard (*Brassica juncea)*. Indian Journal of Agronomy 2006;42(1):145-147.
18. Kavitha S. Individual and combined effect of Biofertilizer, Chemical fertilizer and Vermicompost on Amaranthus tristis. Int. J. Pharm. Sci. Rev. Res 2013;20(2):190-195.
19. Kloepper JW, Rodrguez-kbana R, Mcinroy JA, Collins DJ. Analysis of populations and physiological characterization of microorganisms in rhizospheres of plants with antagonistic properties to phytopathogenic nematodes. Plant Soil. 1991;136:95-102.
20. Kumar S, Singh SS. Effect of different levels of phosphorus and sulphur on the growth, yield and oil content of sunflower, Helianthus annuus L. Journal Oilseeds Research 2005;22(2):408-409.
21. Kumar S, Tewari SK, Singh SS. Effect of sources and levels of sulphur and spacing on the growth, yield and quality of spring sunflower (*Helianthus annuus*). Indian Journal of Agronomy 2011;56(3):242-246.
22. Mangala Rai. Oilseeds in India. Andhra Pradesh Agriculture Regional Research Journal 2002, 13-15.
23. Messick DL. S fertilizers: A Global prospective, proceedings of TSI-FAI-IFA workshop. S in balanced fertilization 2003, 1-7.
24. Mirche SH, Suryavanshi VP, Bahure GK, Mirza IAB, Padul AS. Effect of sulphur and boron nutrition and its method of application on growth, yield and economics of sunflower. Asian Journal of Multidisciplinary Studies. 2016;4(3):43-47.
25. Panwar JDS, Vijayaluxmi. 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 2005, 125-158.
26. Patel NK, Chaudhari SR, Parekh JH. Effect of Biofertilizer and nitrogen on quality of tomato cv. GT-2, Adv. Res. J. Crop Improv 2011;2(2):263-264.
27. Ramakrishnan K, Selvakumar G. Effect of biofertilizers on enhancement of growth and yield on Tomato *(Lycopersicum esculentum* Mill.). Int. J. of Research in Botany 2012;2(4):20-23.
28. Rani KU, Sharma KL, Nagasri K, Srinivas K, Muthy TV, Maruthi GR *et al*. Response of sunflower to sources and levels of sulphur under rainfed semiarid tropical conditions. Communication in Soil Sciences and Plant Analysis 2009;40:2926-2944.
29. Ravi S, Channal HT, Hebsur NS, Patil BN, Dharmatti PR. Effect of sulphur, zinc and iron nutrition on growth, yield, nutrient uptake and quality of safflower. Karnataka Journal Agricultural Sciences 2008;21(3):382-385.
30. Sakal R, Singh AP, Choudhary BC, Shahi B. Sulphur status of Usifluvents and response of crops sulphur application Fertilizer News 2001;46(10):61-65.
31. Sarkar RK, Mallik RB. Effect of nitrogen, sulphur and foliar spray of nitrate salts on performance of spring sunflower (*Helianthus annuus* L.). Indian Journal Agriculture Sciences 2009;79(12):986-990.
32. Sharma HR, Gupta AK. Effect of sulphur on growth parameters and yield of some selected crops. Annals Agriculture Research 2003;24(1):136-138.
33. Shekhawat K, Shivay YS. Effect of nitrogen sources, sulphur and boron on growth parameters and productivity of spring sunflower. Indian Journal Plant Physiology, 2009;14(3):290-298.
34. Solanki RL, Sharma M. Effect of phosphorus, sulphur and PSB on growth and yield of mustard in southern Rajasthan. Annals of Plant and soil Research 2016;18(1):66-69.
35. Vaghasia PM, Khanpara VD. Response of groundnut (Arachis hypogaea L.) to moisture conservation practices and sulphur nutrition under rained conditions. International Journal Agricultural Sciences 2008;4(2):523-526.
36. Vessey JK. Plant growth promoting rhizobacteria as biofertilizers. Plant and Soil 2003;255:571-86.
37. Wu SC, Cao ZH, Li ZG, Cheung KC. Effect of biofertilizer containing N fixer, P&K solubilizer and AM fungi on maize growth: A greenhouse trail. Geoderma. 2005;125:155-166.
38. Yadav RL, Dwivedi BS, Shukla AK, Kumar V. S in balanced fertilization in alluvial soil soils of western Uttar Pradesh. S in Balanced Fertilization, New Delhi. 2000, 27-41.