International Journal of Bioresource Science
Citation: IJBS: **10**(02): 159-163, December 2023
DOI: 10.30954/2347-9655.02.2023.2

ASSOCIATION FOR AGRICULTURE ENVIRONMENT AND BIOTECHNOLOGY

Research Paper

Effect of Sulphur Fertilization and Dates of Sowing on the Growth, Yield Attributes and Yield of Sunflower under Coastal Saline Soil of West Bengal

Tanuj Kumar Mandal[1*], Pijush Das[1], Bishal Mukherjee[1] and Tadiboina Gopala Krishna[2]

[1]Department of Agronomy, School of Agriculture and Allied Sciences, The Neotia University, Sarisha, West Bengal, India
[2]Department of Agronomy and Agroforestry, MS Swaminathan School of Agriculture, Centurion University of Technology and Management, Odisha, India

*Corresponding author: tanujkumar.mandal@tnu.in (**ORCID ID:** 0000-0003-4599-7548)

Received: 17-08-2023 **Revised:** 22-11-2023 **Accepted:** 01-12-2023

ABSTRACT

The field experiment was carried out at Instructional Farm, The Neotia University, West Bengal to study the effect of sulphur fertilization and dates of sowing on the growth, yield attributes and yield of sunflower during two consecutive winters of 2021-22 and 2022-23. The soil of the experimental field was fine in texture and clayey in nature, having 213.6 kg/ha available N, 11.08 kg/ha available P, 234.08 kg/ha exchangeable K and 0.46 % organic carbon. The experiment was laid out in a split plot design, replicated thrice, having four levels of Sulphur fertilization viz. S_0, Control, S_1, 20 kg S/ha, S_2, 40 kg S/ha, S_3, 60 kg S/ha, respectively considered as main-plot, while, 4 levels of date of sowing, viz., D_1,sowing at 1st fortnight of November, D_2, 2nd fortnight of November, D_3, 1st fortnight of December and D_4, 2nd fortnight of December, respectively were considered as sub-plot treatment of the experiment. The variety of sunflower was Divakar. The recommended dose of fertilizer was 80 kg N: 60 kg P_2O_5: 40 kg K_2O ha^{-1}. The results showed that application of 60 kg S ha^{-1},*i.e.*, S_3, recorded highest values of all the growth, yield attributes, seed yield (26.35 q ha^{-1}) and oil yield (11.38 q ha^{-1}) than all other treatments. D_1 *i.e.*, sowing at 1st fortnight of November recorded highest values of seed yield (25.94 q ha^{-1}), oil content (43.03 %) and oil yield (11.38 q ha^{-1}) of sunflower.

HIGHLIGHTS

- Sulphur fertilization in sunflower at the rate of 60 kg S ha^{-1} enhanced seed and oil yield of sunflower.
- Sowing of sunflower during first week of November was beneficial in the coastal saline soil of West Bengal.

Keywords: Sulphur fertilization, Dates of sowing, Seed yield, Oil content

India is the fourth largest oilseed producer in the world and it occupies 20.8% of the area under cultivation globally, accounting for 10% of world production. Nearly 72% of the oilseed area is restricted to rainfed farming adopted by smallholders with lower level of input management leading to poor productivity (https://www.indiantradeportal.in). The oilseeds production can be enhanced by adoption of proper agronomic management under appropriate cropping system (Sarkar *et al.* 2000; Sahoo *et al.* 2023a). The present-day agriculture is facing a huge problem because of the continuously

How to cite this article: Mandal, T.K., Das, P., Mukherjee, B. and Krishna, T.G. (2023). Effect of Sulphur Fertilization and Dates of Sowing on the Growth, Yield Attributes and Yield of Sunflower under Coastal Saline Soil of West Bengal. *Int. J. Bioresource Sci.*, **10**(02): 159-163.

Source of Support: IUCEA; **Conflict of Interest:** None

increasing demand for enhanced production of crop output to fulfill the requirements of the ever-growing human population in the consequences of degradation of natural resources and climate change scenario (Manasa *et al.* 2020; Sahoo *et al.* 2023b; Sairam *et al.* 2023). Under this context, it is necessary to adopt suitable agro-techniques for enhancement of crop productivity. The yield enhancement of the oilseeds also greatly depends on the extent of adoption of suitable agronomic practices (Supriya *et al.* 2020; Chappa *et al.* 2022; Mirriam *et al.* 2022).

Sunflower (*Helianthus annuus* L.) is considered as one of the important essential oilseed crops in India. It is commonly known as "*Surajmukhi*" in the country. It is the 3rd most important edible oil seed crop in the world preceded by soybean and rapeseed. Total area under sunflower cultivation is estimated 26.2 M ha all over globe with a net production of 47.3 M tonnes in 2016 (FAO, 2017). But, in India it is grown in only 0.29 m ha area with very low production of 0.21 m tones (DAE and FW, 2018). It indicates that there is ample scope to increase the area under sunflower cultivation. There is enormous growing popularity of sunflower oil as cooking oil or vegetable oil because of its so many health benefits. Sunflower oil has high oxidative stability and includes significant levels of vitamin E in the form of alpha tocopherol. It also contains a lot of linoleic acid (64%) which helps to prevent cholesterol buildup in the heart's coronary arteries.

It is mainly cultivated in the temperate region where it can adapt easily and perform well to a variety of climatic and soil condition (Canavar *et al.* 2010; Demir, 2016; Demir and Basalma, 2018; Sandeep Kumar *et al.* 2019). It is a photo insensitive crop and can be grown successively throughout year in different parts of the country under rainfed conditions. Lower productivity of sunflower is mainly due to cultivation in energy starved conditions with low fertility having imbalanced nutrition. Apart from NPK, Sulphur is the fourth major nutrient which is the constituent of the cystin, amino acids, methionine and chlorophyll. Sulphur had significant importance for sunflower as it has pivotal role in its achene yield, oil and protein production, in enzymatic processes and in the chemical composition of seeds (Naser *et al.* 2012; Sial *et al.* 2022). Study conducted by Babu and Hegde (2010) also concluded significant increase in plant height, dry matter and weight of seeds, head diameter, the percentage of oil and biological yields of sunflower also improved by application of sulphur. Thus, ensuring sulphur fertilization at proper dosage can have immense impact on growth and yield attributing characters of sunflower in different parts of our country.

On the other hand, sowing date has a considerable impact on seed production and oil content of sunflower under various climatic conditions. Sunflower seed production is decreased by delayed sowing because fewer and lighter seeds are produced per plant (Siddique *et al.* 2002). Again, in the case of delayed sowing soil water availability is typically limited during flowering and seed development stage, which are critical times for seed filling. Lack of water during these stages reduces the soil's ability to supply nutrients for reproductive growth, which in turn lowers seed production (Ali *et al.* 2012). Additionally, several studies also revealed that delayed sowing in general decreases crop yield during dry months particularly under rainfed conditions (Nihal, 2010; Ahmed *et al.* 2015).

Therefore, in order to meet the demand for vegetable oil and enhance the production of sunflower in dry conditions, it is necessary to determine the effects of sulphur fertilization and sowing date on yield parameters and grain yield of sunflower. Improved management strategies can be established to provide better results in sunflower by providing proper fertilization under varying planting dates. The goal of this study is to investigate how different doses of Sulphur affects various yield components, seed yield, oil content and oil yield of sunflower cultivars with four distinct planting dates during *rabi* (winter) season of 2021-22 and 2022-23.

MATERIALS AND METHODS

The field experiment was carried out at Instructional Farm, The Neotia University, West Bengal in the *rabi* (winter) season of 2021-22 and 2022-23. The farm is geographically located at the south of the tropic of cancer, 22° 262 N latitude and 88° 192 E longitudes. The soil of the experimental field was fine in texture and clayey in nature,having 213.6 kg/ha available N, 11.08 kg/ha available P, 234.08 kg/ha exchangeable K and 0.46 % organic carbon. The experiment was laid out in a split plot design with 3 replications having four levels of Sulphur

fertilization viz. S_0- Control, S_1- 20 kg S/ha, S_2- 40 kg S/ha, S_3- 60 kg S/ha, respectively considered as main-plot, while, 4 levels of date of sowing, viz. D_1- Sowing at 1st fortnight of November, D_2- 2nd fortnight of November, D_3- 1st fortnight of December and D_4- 2nd fortnight of December, respectively were considered as sub-plot treatment of the experiment.

The variety of sunflower was Divakar. The recommended dose of fertilizer was applied to the crop N: P_2O_5: K_2O @ 80: 60: 40 kg ha^{-1}. Full dose of P_2O_5, K_2O, Sulphur and 1/2 dose of N was applied as basal and the rest 1/2 dose of N was equally splitted into two, of which 1st was applied 30 days after sowing and 2nd was applied at 50 days after sowing. Two hand weeding at 30 DAS and 45 DAS were done along with 5 number of irrigations uniformly. The observations were recorded form 10 randomly selected plants. The data were subjected to statistical analysis using analysis of variance method (Gomez and Gomez, 1984) and the significance of different sources of variations were tested by error mean square using Fisher and Snedecor's 'F" test at a probability level of 0.05.

RESULTS AND DISCUSSION

Sulphur levels significantly influenced the plant height (cm.) and dry matter (g/plant) of sunflower. Among the sulphur levels, S_3 *i.e.*, application of 60 kg S ha^{-1} recorded highest values of plant height (182.27 cm.) and dry matter (127.37 g/plant) of sunflower. Among the dates of sowing, D_1 *i.e.*, Sowing at 1st fortnight of November recorded highest values of plant height (177.05 cm.) and dry matter (123.72 g/plant) of sunflower (Table 1).

Sulphur levels also influenced most of the yield attributing characters (Head diameter, Head weight, Number of seeds $head^{-1}$, 100 seeds weight and seed yield significantly but. Application of 60 kg S ha^{-1} *i.e.*, S_3 recorded highest values of head diameter (13.41 cm.), head weight (72.86 g), number of seeds $head^{-1}$ (791.77) and 100 seeds weight (51.52). The increased growth and yield attributes is mainly due to the production of amino acids, better cell division and photosynthetic activity, which led to increased plant height and head diameter (Intodia *et al.* 1997; Raja *et al.* 2007).

Table 1: Effect of Sulphur fertilization and dates of sowing on growth, yield attributes and yield of sunflower under coastal saline soil of West Bengal (Pooled data)

Treatments	Plant height at harvest (cm.)	Dry matter at harvest (g/ plant)	Head diameter (cm.)	Head weight (g)	Number of seeds $head^{-1}$	100 seeds weight	Seed yield (q ha^{-1})	Oil content (%)	Oil yield (q ha^{-1})
Sulphur levels									
S0 (Control)	158.025	101.62	11.30	66.12	677.85	47.79	24.24	42.33	10.26
S1(20 kg)	173.4	117.65	12.33	68.62	674.94	48.73	24.92	42.69	10.64
S2 (40 kg)	181.85	125.80	13.29	71.96	722.50	49.95	25.96	43.11	11.19
S3(60 kg)	182.27	127.37	13.41	72.86	791.77	51.52	26.35	43.18	11.38
S. Em. (±)	0.930	1.564	0.068	0.247	6.038	0.272	0.180	0.130	0.095
C.D. *(P=0.05%)*	2.276	3.827	0.168	0.605	14.776	0.666	0.441	**NS**	0.234
Dates of sowing									
D1	177.05	123.72	12.71	70.35	739.15	50.28	25.94	43.03	11.17
D2	174.95	120.22	12.64	70.15	721.18	49.76	25.61	42.97	11.01
D3	172.57	116.30	12.53	69.70	707.50	49.30	25.04	42.75	10.71
D4	170.97	112.20	12.45	69.38	699.23	48.64	24.88	42.56	10.59
S. Em. (±)	0.246	0.298	0.027	0.099	1.145	0.065	0.037	0.049	0.015
C.D. *(P=0.05%)*	0.508	0.616	0.056	0.206	2.364	0.134	0.076	0.101	0.030

S_0- Control, S_1- 20 kg S/ha, S_2- 40 kg S/ha, S_3- 60 kg S/ha and D_1- Sowing at 1st fortnight of November, D_2- 2nd fortnight of November, D_3- 1st fortnight of December and D_4- 2nd fortnight of December.

The seed yield and oil yield of sunflower were influenced significantly by sulphur levels. Application of 60 kg S ha^{-1} *i.e.*, S_3 recorded highest seed yield (26.35 q ha^{-1}) which was statistically at par with S_2 *i.e.*, application of 40 kg S ha^{-1} (25.96 q ha^{-1}) and oil yield (11.38 q ha^{-1}) statistically at par with S_2 *i.e.*, application of 40 kg S ha^{-1} (11.19 q ha^{-1}) of sunflower. Sulphur is helpful in the conversion of carbohydrates into oil and also in the synthesis of fatty acid-containing enzyme thiokinase (Sreemannarayana *et al.* 1998). But Sulphur levels did not show any significant effect on the oil content (%) of sunflower. Sulphur is very much essential for the nutrition of oilseeds and it is the main constituent of cystine, cysteine and methionine, which are sulphur containing amino acids (Gangadhara, 1990; Parmar *et al.* 2018).

Among the dates of sowing, D_1 *i.e.*, Sowing at 1st fortnight of November recorded highest values of head diameter (12.71 cm.), head weight (70.35 g), number of seeds $head^{-1}$ (739.15) and 100 seeds weight (50.28). Sowing at 1st fortnight of November *i.e.*, D_1 also recorded highest seed yield (25.94 q ha^{-1}), oil content (43.03 %) and oil yield (11.38 q ha^{-1}) of sunflower. Better productivity of sunflower is mainly determined by providing best weather conditions throughout its life cycle (Kaleem *et al.* 2011). This can be achieved by sowing the seeds on proper time. Delayed sowing reduced the yield attributed, seed yield, oil content and oil yield of sunflower. Decreased seed yield in delayed sowing treatments is might be due to a decrease in yield components by producing light weight seeds (Siddique *et al.* 2002).

AKNOWLEDGEMENTS

The authors are thankful to the staff members of university farm and departmental laboratory for providing incessant facilities in conducting field trial as well as for laboratory analysis.

REFERENCES

Ahmed, B., Sultana, M., Zaman, J., Paul, S., Rahman, M., Islam, R and Majumdar, F. 2015. Effect of sowing dates on the yield of sunflower. *Bangladesh J. Agric. Res.*, **18**(1): 1-5.

Ali, A., Ahmad, A., Khaliq, T. and Akhtar, J. 2012. Planting density and nitrogen rates optimization from growth and yield of sunflower (*Helianthus annuus* L). *J. Anim. Plant Sci.*, **22**: 1070–1075.

Babu, S.N.S and Hegde, D.M. 2010. Delineation of sulphur deficient soil and evaluation of oilseed crops responses to sulphur. *Fert. Market News,* **33**: 9–17.

Canavar, Ö., Ellmer, F. and Chmielewski, F. 2010. Investigation of yield and yield components of sunflower (*Helianthus annuus* L.) cultivars in the ecological conditions of Berlin (Germany). *Helia.*, **33**: 117-130.

Chappa, L.R., Mugwe, J., Maitra, S. and Gitari, H.I. 2022. Current status, and prospects of improving sunflower production in Tanzania through intercropping with Sunnhemp. *Int. J. Bioresour. Environ. Agric. Sci.*, **9**: 1 - 8.

Demir, I. 2016. Determination of the yield and yield components performance of some sunflowers (*Helianthus annuus* L.) under rainfed conditions. 19th International Sunflower Conference. *Edirne, Turkey*, 985-992.

Demir, I. and Basalma, D. 2018. Response of Different Level of Nitrogen and Sulphur Doses on Oil Yield and Seed Nutrients Content of Sunflower (*Helianthus annuus* L.). *Fresenius Environ. Bulletin.*, **27**: 6337-6342.

Directorate of Economics and Statistics 2018. Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture and Farmers Welfare, Government of India.

FAO. 2017. Food and Agriculture Organization of the United Nations Available online: httpfaoorg/faostat/en/#data/QC.

Gangadhara, G.A. 1990. Effect of S on yield, oil content of sunflower and uptake of micronutrients by plants. *J. Ind. Soc. Soil Sci.*, **38**: 692-695.

Gomez, K.A. and Gomez, A.A. 1984. Statistical procedures for Agricultural Research (2nd Ed.), An International Rice Research Institute Book. A Willey Inter-Science Publication (John Willey and Sons), *New York*, pp. 258 – 259.

Intodia, S.K. and Tomar, O.P. 1997. Effect of sulphur application on growth and yield of sunflower (*Helianthus annuus*). *Ind. J. Agric. Sci.*, **67**: 46-47.

Kaleem, S., Hassan, F., Ahmad, M., Mahmood, I., Wasaya, A., Randhawa, M. and Khaliq, P. 2011. Effect of growing degree days on autumn planted sunflower. *Afr. J. Biotechnol.*, **10**: 8840- 8846.

Naser, A., Anjum, S. Sarvajeet, Gill, S. Umar, I. Ahmed, C. Armando, Duarte and Pereira, E. 2012. Improving growth and productivity of *Oliferous brassica* under changing environment. Significance of nitrogen and sulphur nutrient and underlying mechanisms. *Sci. World J.*, **12**.

Nihal, K. 2010. Response of Lentil (*Lens culinaris* Medik.) to sowing date and timing of nitrogen application. *J. Food Agric. Environ.*, **8**(2): 422-426.

Parmar, N.N., Patel, A.P. and Choudhary, M. 2018. Effect of sources and levels of sulphur on growth, yield and quality of summer sesame under south Gujarat condition (*Sesamum indicum* L.). *Int. J. Curr. Microbiol. Appl. Sci.*, **7**(2): 2600-2605.

Mirriam, A., Mugwe, J., and Raza, M.A., Seleiman, M.F., Maitra, S. and Gitari, Harun H. 2022. Aggrandizing soybean yield, phosphorus use efficiency and economic

returns under phosphatic fertilizer application and inoculation with *Bradyrhizobium*, *J. Soil Sci. Plant Nutri.*, https://doi.org/10.1007/s42729-022-00985-8

Raja, A., Hattab, K.O., Gurusamy, L., Vembu, G. and Suganya, S. 2007. Sulphur application on growth and yield and quality of sesame varieties. *Int. J. Agric. Sci. Res.*, **2**(1): 599-606.

Sahoo, U., Maitra, S., Dey, S., Vishnupriya, K.K., Sairam, M. and Sagar, L. 2023a. Unveiling the potential of maize-legume intercropping system for agricultural sustainability: A review. *Farm. Manage.*, **8**(1): 1 - 13.

Sahoo, U., Maitra, S., Sairam, M. and Sagar, L. 2023b. Potential and advantage of pearl millet- legume intercropping system: A Review. *Int. J. Bioresour. Sci.*, **10**(01): 99-106.

Sairam, M., Maitra, S., Praharaj, S., Nath, S., Shankar, T., Sahoo, U. and Aftab, T. 2023. An insight into the consequences of emerging contaminants in soil and water and plant responses. In: *Emerging contaminants and plants: Interactions, adaptations and remediation technologies*, Aftab, T. (eds.), Cham, Springer International Publishing, pp. 1–27.

Sandeep Kumar, E., Mandal, T.K., Mishra, G.C. Barman, S. and Maitra, S. 2019. Effect of intercropping summer sunflower (*Helianthus annuus* L.) with legumes on yield attributes and productivity of crops. *Int. J. Environ. Agric. Biotech.*, **12**(3): 281—285.

Sarkar, R.K., Shit, D. and Maitra, S. 2000. Competition functions, productivity and economics of chickpea (*Cicer arietinum*)-based intercropping system under rainfed conditions of Bihar plateau. *Indian J. Agron.*, **45**(4): 681-686.

Manasa, P., Maitra, S. and Barman S. 2020. Yield attributes, yield, competitive ability and economics of summer maize-legume intercropping system. *Int. J. Agric. Environ. Biotechnol.*, **13**(1): 33 - 38.

Sial, A.K., Shankar, T., Maitra, S., Sairam, M., Sagar, L., Kumar, P.P., Thandra, B. and Rout, R.K. 2022. Effect of nutrient optimization on growth, yield and quality of sunflower under southern Odisha conditions. *Crop Res.*, **57**(3): 195 - 201.

Siddique, A.B., Wright, D and Ali, S.M.M. 2002. Effect of sowing dates on the phenology, the phenology, seed yield and yield components of peas. *J. Biol. Sci.*, **2**(5): 300-303.

Sreemannarayana, B., Srinivasa Raju, A. and Mrinalini, G. 1998. Effect of N and S application on yield and quality of sunflower. *Madras. Agric. J.*, **85**: 204-205.

Supriya, B., Mishra, G.C., Maitra, S., Chakrapani, B. and Sarath Kumar D. 2020. Influence of fertility levels and cytokinin on yield attributes and yields of sunflower (*Helianthus annuus* L.). *J. Pharmacogn. Phytochem.*, **9**(4): 378 - 382.