

International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2026): 5.29
IJABR 2026; SP-10(1): 1252-1254
www.biochemjournal.com
Received: 15-11-2025
Accepted: 18-12-2025

Poornima Malviya
Department of Agronomy,
College of Agriculture,
Jawaharlal Nehru Krishi
Vishwa Vidyalaya, Jabalpur,
Madhya Pradesh, India

SB Agrawal
Department of Forestry,
College of Agriculture,
Jawaharlal Nehru Krishi
Vishwa Vidyalaya, Jabalpur,
Madhya Pradesh, India

Vijay Singh Suryawanshi
Krishi Vigyan Kendra,
Narsinghpur, Jawaharlal
Nehru Krishi Vishwa
Vidyalaya, Jabalpur, Madhya
Pradesh, India

Komal Bhatt
Department of Forestry,
College of Agriculture,
Jawaharlal Nehru Krishi
Vishwa Vidyalaya, Jabalpur,
Madhya Pradesh, India

Deeksha Gupta
Department of Forestry,
College of Agriculture,
Jawaharlal Nehru Krishi
Vishwa Vidyalaya, Jabalpur,
Madhya Pradesh, India

Corresponding Author:
Poornima Malviya
Department of Agronomy,
College of Agriculture,
Jawaharlal Nehru Krishi
Vishwa Vidyalaya, Jabalpur,
Madhya Pradesh, India

Changes in soil fertility status due to micronutrients under different methods of mustard establishment in black soils of Madhya Pradesh

Poornima Malviya, SB Agrawal, Vijay Singh Suryawanshi, Komal Bhatt and Deeksha Gupta

DOI: <https://www.doi.org/10.33545/26174693.2026.v10.i1So.7273>

Abstract

A field experiment was conducted over two consecutive *rabi* seasons of 2022-23 and 2023-24 at Research Farm, Department of Agronomy, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh to study the “Changes in soil fertility status due to micronutrients under different methods of mustard establishment in black soils of Madhya Pradesh”. These treatments consisted of two crop establishment methods (direct seeding and transplanting) were taken in main plots and four levels of sulphur (control, 20 kg S ha⁻¹, 30 kg S ha⁻¹ and 40 kg S ha⁻¹) in sub plots and three levels of boron (control, 1 kg B ha⁻¹ and 2 kg B ha⁻¹) in sub-sub plots. These treatments were arranged in a split-split plot design with three replications. The soil bulk density, pH, EC and organic carbon of soil of experimental field did not influenced due to various levels of sulphur and boron in crop establishment methods. But available nitrogen, sulphur and boron was significantly influenced by levels of sulphur and boron in post-harvest soils. Thus it is concluded that crop establishment methods direct seeding and transplanting proved equally good for soil physiochemical properties. The sulphur and boron both the nutrients are necessary for maintaining nutrient status in soil under mustard cultivation.

Keywords: Mustard, physical chemical properties, sulphur, boron, soil

Introduction

Indian mustard (*Brassica juncea* L.) is a major oilseed crop of India, which contributing edible oil and strengthening rural economy. Despite of its significance, mustard yield is constrained due to nutrient imbalance and inadequate crop management practices. Various mustard growing areas, deficiency of secondary and micronutrients, particularly sulphur and boron have been proliferated due to continuous cropping and imbalance use of nutrients. Sulphur and boron deficiency are widely recognized as a yield-limiting factor in Indian soils, which adversely affecting protein synthesis, oil content as well as seed quality in mustard.

The physical and chemical properties of soil play an important role in nutrition uptake and subsequently in growth and yield of crop. Sulphur is an essential component of amino acids, vitamins, enzymes, and is vital for oil synthesis and seed protein content in mustard. (Sharma *et al.*, 2008) [7]. Boron, although needed in less amounts, is crucial for cell wall synthesis, pollen viability, and reproductive development; its lack frequently leads to inadequate blooming and decreased siliqua production, ultimately reducing seed yield.

Evaluating soil chemical characteristics under different fertiliser levels and establishment procedures is crucial for formulating sustainable and site-specific nutrient management strategies. A comprehensive study of mustard response to varying levels of sulphur and boron with different establishing methods would yield insights for optimising nutrient use efficiency while maintaining soil health and productivity.

Materials and Methods

A field experiment was conducted at Research Farm, Department of Agronomy, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (MP) during *rabi* seasons of 2022-23 and 2023-24 in order to determine the changes in soil fertility status due to micronutrients under different methods of mustard establishment in black soils of Madhya Pradesh.

A total of 24 treatment combinations were laid out in a split-split plot design with three replications. Treatment consisted of two crop establishment methods (M_1 : Direct seeding and M_2 : transplanting) in main plots and four levels of sulphur (S_1 : control, S_2 : 20 kg S ha⁻¹, S_3 : 30 kg S ha⁻¹ and S_4 : 40 kg S ha⁻¹) in sub plots and three levels of boron (B_0 : control, B_1 : 1 kg B ha⁻¹ and B_2 : 2 kg B ha⁻¹) in sub-sub plots. Mustard variety RH-725 were used for sowing. The recommended dose of fertilizer 80:40:40 kg NPK ha⁻¹ were

given to the crop. Sulphur and boron was applied in soil as basal as per the treatments. In order to study the physical chemical properties, soil sample were collected from different places randomly from experimental plot with the help of wooden spade to a depth of 0-15 cm prior to start of experiment. The soil sample representing the main plot, sub plot and sub-sub plot were taken and analysed in laboratory for physical and chemical properties.

Table 1: Procedure employed for physical and chemical analysis of soil samples

S. No.	Parameters	Method applied	Initial Value
1	Bulk density (g cm ⁻³)	Core sample (Black <i>et al.</i> , 1965) ^[1]	1.30
2	Soil pH 1:2.5 (Soil water ratio)	Glass electric pH meter (Piper, 1966) ^[6]	7.06
3	Electrical conductivity (dSm ⁻¹)	Solu-bridge method (Black, 1965) ^[11]	0.26
4	Organic Carbon (%)	Chromic acid rapid titration method (Walkley and Black, 1934) ^[9]	0.68%
5	Available Nitrogen (kg ha ⁻¹)	Alkaline permanganate method (Subbiah and Asija, 1956) ^[8]	262.20
6	Available Phosphorus (kg ha ⁻¹)	Calorimeter method (Olsen <i>et al.</i> , 1954) ^[5]	12.80
7	Available Potassium (kg ha ⁻¹)	Flame photometer Method (Jackson, 1973) ^[3]	286.40
8	Available Sulphur (kg ha ⁻¹)	Turbidimetric procedure (Chesnin and Yien, 1951) ^[2]	9.30
9	Available boron (mg ha ⁻¹)	Azomethine-H method (John <i>et al.</i> 1975) ^[4]	0.57

Results and Discussion

Effect of crop establishment methods

The data presented in Table 2 showed that effect of crop establishment methods on soil physical and chemical properties with respect to soil bulk density, pH, electrical conductivity and organic carbon content was found non-significant in post-harvest soil. However, the higher values of bulk density (1.31 g cm⁻³), pH (7.13), electrical conductivity (0.29 d S m⁻¹) and organic carbon (0.70%) was found in transplanting of crop through the difference were non-significant.

Data in relation to status of available nitrogen, phosphorus, potassium, sulphur and boron were determined in post-harvest soil were present in Table 3. The results of study reveal that the soil status of N, P and K numerically improved over their initial values in the post-harvest soil. The status of available nitrogen, phosphorus and potassium, improved over the years. However, the differences among the treatments were found to be non-significant.

Effect of sulphur

The effect of levels of sulphur on soil bulk density, pH, electrical conductivity and organic carbon content in post-harvest soil was found non-significant. The highest values of soil bulk density (1.28 g cm⁻³), pH (7.14), EC (0.30 dS m⁻¹) was observed in control while 40 kg S ha⁻¹ registered the highest organic carbon (0.69%). However, increasing levels of sulphur from 0 to 40 kg S ha⁻¹ decreased the soil pH, while increased the organic carbon as compared to their initial values.

Further, data showed that higher values of available nitrogen 281.23 kg ha⁻¹ was recorded in 40 kg S ha⁻¹ in post-harvest soil and significantly superior over rest levels of sulphur (Table 3). The 40 kg S ha⁻¹ was also found to be statistically at par with 30 kg S ha⁻¹. The lowest available nitrogen of 260.54 kg ha⁻¹ in post-harvest soil was recorded in control treatment. The available phosphorus and potassium did not

changed significantly due to sulphur level during the study period in post-harvest soil.

The data pertaining available sulphur and boron were also presented in Table 3. The highest value of available sulphur of 11.52 kg ha⁻¹ was observed under 40 kg S ha⁻¹ while lowest values of available sulphur (10.05 kg ha⁻¹) was observed in control plots. It was also observed that available sulphur gradually increased with an increase in dose of sulphur. These findings are in accordance with the findings of Singh *et al.*, (2017). The available boron did not changed significantly due to sulphur level during the study period in post-harvest soil.

Effect of boron

The result of study reveal that effect of levels of boron on soil bulk density, pH, electrical conductivity and organic carbon content in post-harvest soil were found non-significant (Table 2). The highest value of soil bulk density (1.32 g cm⁻³), pH (7.14) and electrical conductivity (0.29 dS m⁻¹) was recorded in control, while minimum pH (7.06) and electrical conductivity (0.26 dS m⁻¹) was recorded under application of boron @ 2 kg ha⁻¹. Whereas, highest value of organic carbon (0.69%) was recorded in of boron @ 2 kg ha⁻¹. Increasing the levels of boron 0 to 2 kg ha⁻¹ decreased the soil pH, EC but increased the organic carbon content.

The data presented in Table 3 indicated that various boron levels had significant effect on status of available boron in post-harvest soils except available phosphorus potassium and sulphur which were non-significant. The available phosphorus, potassium and sulphur in post-harvest soil did not show any significant variations due to boron levels.

The results of study reveal that the status of boron in post-harvest soils were changed significantly due to change of levels of boron. Application of boron @ 2 kg ha⁻¹ registered significantly highest values of available boron (0.67 mg ha⁻¹) in post-harvest soil. Whereas, lowest values of available boron (0.62 mg ha⁻¹) was found in control.

Table 2: Physical -chemical properties of soil as affected by levels of sulphur and boron under crop establishment methods after two years of experimentation

Treatments	Bulk density (g cm ³)			pH			Electrical Conductivity (dS m ⁻¹)			Organic Carbon (%)		
Initial Value	1.30			7.06			0.26			0.68		
	Y1	Y2	Pooled	Y1	Y2	Pooled	Y1	Y2	Pooled	Y1	Y2	Pooled
Crop Establishment Methods												
Direct seeding	1.29	1.30	1.30	7.09	7.07	7.08	0.27	0.26	0.27	0.68	0.68	0.68
Transplanting	1.31	1.32	1.31	7.14	7.12	7.13	0.29	0.28	0.29	0.69	0.71	0.70
SEm±	0.008	0.008	0.008	0.14	0.11	0.12	0.01	0.01	0.01	0.01	0.01	0.01
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Sulphur Levels (S)												
Control	1.28	1.29	1.28	7.16	7.13	7.14	0.31	0.29	0.30	0.68	0.68	0.68
20 kg ha ⁻¹	1.30	1.31	1.30	7.14	7.11	7.12	0.29	0.28	0.29	0.69	0.69	0.69
30 kg ha ⁻¹	1.31	1.32	1.32	7.12	7.10	7.11	0.28	0.27	0.27	0.68	0.70	0.69
40 kg ha ⁻¹	1.32	1.33	1.32	7.06	7.05	7.06	0.26	0.25	0.25	0.68	0.70	0.69
SEm±	0.004	0.004	0.004	0.14	0.10	0.12	0.02	0.02	0.02	0.01	0.01	0.01
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Boron Levels (B)												
Control	1.29	1.30	1.29	7.15	7.13	7.14	0.29	0.28	0.29	0.66	0.68	0.67
1 kg ha ⁻¹	1.30	1.31	1.31	7.13	7.11	7.12	0.29	0.28	0.28	0.67	0.69	0.68
2 kg ha ⁻¹	1.31	1.32	1.32	7.07	7.05	7.06	0.27	0.26	0.26	0.68	0.71	0.69
SEm±	0.002	0.002	0.002	0.09	0.06	0.07	0.01	0.01	0.01	0.01	0.01	0.01
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Y₁-2022-23, Y₂-2023-24**Table 3:** Effect of different levels of sulphur and boron on soil fertility status after two years of experimentation

Treatments	Available nitrogen (kg ha ⁻¹)			Available phosphorous (kg ha ⁻¹)			Available potassium (kg ha ⁻¹)			Available Sulphur (ppm)			Available Boron (mg ha ⁻¹)		
Initial Value	262.20			12.80			286.40			9.30			0.57		
	Y1	Y2	Pooled	Y1	Y2	Pooled	Y1	Y2	Pooled	Y1	Y2	Pooled	Y1	Y2	Pooled
Crop Establishment Methods															
Direct seeding	266.41	270.35	268.38	13.21	13.65	13.43	283.26	285.59	284.43	10.42	10.79	10.61	0.64	0.66	0.65
Transplanting	274.01	276.29	275.15	13.49	13.91	13.70	287.40	290.73	289.07	10.86	11.35	11.10	0.66	0.68	0.67
SEm±	3.60	2.61	3.08	0.21	0.12	0.16	2.96	1.65	2.30	0.14	0.12	0.12	0.01	0.01	0.01
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Sulphur Levels (S)															
Control	258.40	262.68	260.54	13.02	13.21	13.12	280.83	283.66	282.24	9.88	10.22	10.05	0.57	0.59	0.58
20 kg ha ⁻¹	264.51	270.33	267.42	13.27	13.76	13.52	284.32	287.15	285.73	10.47	10.79	10.63	0.63	0.65	0.64
30 kg ha ⁻¹	276.94	278.81	277.87	13.47	13.97	13.72	287.20	290.03	288.61	11.01	11.44	11.23	0.68	0.70	0.69
40 kg ha ⁻¹	280.99	281.46	281.23	13.64	14.17	13.91	288.98	291.81	290.39	11.21	11.83	11.52	0.71	0.73	0.72
SEm±	2.44	1.96	1.65	0.30	0.32	0.30	3.49	2.98	3.04	0.13	0.14	0.13	0.06	0.05	0.06
CD (P=0.05)	7.51	6.04	5.07	NS	NS	NS	NS	NS	NS	0.41	0.44	0.39	NS	NS	NS
Boron Levels (B)															
Control	266.91	268.66	267.79	13.13	13.54	13.34	282.52	285.02	283.77	10.43	10.84	10.63	0.61	0.63	0.62
1 kg ha ⁻¹	270.48	274.07	272.27	13.36	13.82	13.59	285.70	289.20	287.45	10.67	11.11	10.89	0.65	0.67	0.66
2 kg ha ⁻¹	273.24	277.23	275.24	13.56	13.97	13.76	287.78	290.28	289.03	10.83	11.26	11.05	0.66	0.68	0.67
SEm±	2.20	2.70	2.45	0.16	0.17	0.15	2.10	2.05	1.89	0.14	0.16	0.15	0.01	0.01	0.01
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.02	0.02	0.02

Conclusion

Based on two years field study it is concluded that crop establishment methods direct seeding and transplanting proved equally good for soil properties. Whereas, levels of sulphur and boron both had the significant positive effect on status of available sulphur and boron after two years of experimentation. Thus, it may be recommended that sulphur and boron both the nutrients are necessary for maintaining nutrient status in soil under mustard cultivation.

References

- Black CA. Methods of Soil Analysis. Madison (WI): American Society of Agronomy; 1965.
- Chesnin L, Yien CH. Turbidimetric determination of available sulphate. Soil Science Society of America Proceedings. 1951;15:149-151.
- Jackson ML. Soil Chemical Analysis. New Delhi (India): Prentice Hall of India Ltd.; 1973.
- John MK, Chuah HH, Neufeld JH. Application of improved azomethine-H method to the determination of boron in soils and plants. Analytical Letters. 1975;8:559-568.
- Olsen SR. Estimation of available phosphorus in soils by extraction with sodium bicarbonate. Washington, DC: US Department of Agriculture; 1984. (No. 939).
- Piper CS. Soil and Plant Analysis. Bombay (India): Hans Publishers; 1966.
- Sharma DN, Khoddar VK, Sharma RA, Sindh D. Effect of different doses and sources of sulphur on the quality and yield of mustard. J Indian Soc Soil Sci. 2008;39:193-200.
- Subbiah BV, Asija GL. A rapid method for estimation of nitrogen in soil. Current Science. 1956;25:259-260.
- Walkley A, Black CA. An examination of the different methods for determining soil organic matter and a proposed modification of the chromic acid titration method. Soil Science. 1934;37:29-33.