

Original Research Article

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Effect of Different Doses of Sulphur and Zinc with NPK on Physico-Chemical Properties of Soil and Yield Attribute of Yellow Mustard (*Brassica campestris* L.) Cv. Sunanda

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ABSTRACT

Keywords

Sulphur, Zinc,
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The experiment was carried out at Soil Science and agricultural chemistry research farm SHUATS, Allahabad during *rabi* season 2016-17. The experiment was laid out in 3×3 factorial randomized block design with three replications, consisting of nine treatments. Treatment T₈ (@ 30 Sulphur kg ha⁻¹ + 2.75 kg Zinc ha⁻¹) was to be best in pH, EC, OC, available nitrogen (kg ha⁻¹), phosphorus (kg ha⁻¹), potassium (kg ha⁻¹), sulphur (ppm) and zinc (ppm) which were as 6.96, 0.24, 0.69, 380.24, 27.46, 270.72, 28.50, 2.94 respectively. Soil chemical properties as available nitrogen and potassium were found to be significant but pH, EC, OC, available phosphorus, sulphur and zinc were found to be significant. Soil physical properties as bulk density (g cm⁻³), particle density (g cm⁻³), pore space (%) and solid space (%) were found to be non-significant.

Introduction

Oilseeds occupy a prestigious place in Indian agriculture due to their vital role in the sustainable economy of the country. Vegetable oil (edible) plays a significant role in human nutrition. As a high energy component of food, edible oil is important for meeting the calorific requirements of human beings. Indian mustard is one of the most important winter oil seed crops. In oilseeds, sulphur plays a vital role in the development of seed and improving the quality. Sulphur improves the quality of mustard by increasing the oil contents, protein content and several fatty acids. Sulphur helps in chlorophyll

formation and also encourages vegetative growth. It also helps in the reduction-oxidation reactions in the respiration. The importance of micronutrients application in increasing crop production has been recognized in India (Dubey *et al.*, 2013).

India is amongst the largest vegetable oil economic in the world. Mustard is rich in minerals like calcium, manganese, copper, iron, selenium, zinc, vitamin A, B, C and proteins. 100 g mustard seed contains 508 kcal energy, 28.09 g carbohydrates, 26.08 g proteins, 36.24 g total fat and 12.2 g dietary

fiber. The physical properties of soil play an important role in determining its suitability for crop production. The characteristics like support in power and bearing capacity, tillage practices, moisture storage capacity, drainage, ease of penetration by roots, aeration, retention of plant nutrient and its availability to plant. It includes bulk density, particle density, porosity, soil texture and soil colour too. Sulphur plays a significant role in increasing production especially in oilseeds (Upadhyay *et al.*, 2016) (Table 1).

The nutrient elements of major significance for yield and quality of yellow mustard are nitrogen, phosphorus and sulphur. Nitrogen is an important constituent of protein for which the plants take inorganic nitrogen in the form of ammonium or nitrate. Higher the nitrogen greater would be the protein and protoplasm which would increase, in turn greater cell size, leaf area index resulting into greater photosynthetic activity. Thus, the nitrogen help in formation in of a larger frame on which more flowers and eventually more pods can develop. This shows a positive link between larger nitrogen supply and higher seed yield. In case of nitrogen deficiency the leaves and stems become light green in colour. In case of acute shortage the leaves may become chlorotic associated with purple coloration and older leaves may wither. The plants have poor growth with thin and short stems having few or practically no branches (Bharose *et al.*, 2010). The deficiency of Zinc is most widely spread as reported. Zinc deficiency is particularly reported from Punjab, tarai area of U.P. some parts of Haryana, Western U.P. and Delhi. Zinc plays a role in the synthesis of nucleic acid and protein. It also helps in the utilization of phosphorus and nitrogen along with physiology of seed formation. The Zinc also maintains the semi-permeability of the cell membrane. The zinc deficiency is externally observed by development of band of white or

yellow tissue between mid-rib and edge of leaf. Deficiency in rapeseed and mustard can be corrected by adding Zinc sulphate” was undertaken during the *rabi* season of the following objective: (23-35%), Zinc chloride (45%), zinc friate (4-10%), Zinc chelate (2-7%) and zinc oxide (78%) (Thakkar *et al.*, 2005).

Materials and Methods

The experiment was conducted in the research farm of Department of Soil Science, Department of Soil Science and Agricultural Chemistry, Sam Higginbottom University of Agriculture, Technology and Sciences Allahabad which situated six km away from Allahabad city on the right bank of Yamuna river. The experimental site is located in the sub – tropical region with 25^o 22’45.14” N latitude 81^o 54’49.95” E longitudes and 98 meter the sea level *altitudes*. The experiment was laid out in a 3² RBD factorial design with three levels of each sulphur and zinc with nine treatments, each consisting of three replicates. The total number of plots was 27. Yellow Mustard (*Brassica campestris* L.) “Cv. Sunanda” was sown in *rabi* season plots of size 2 x 2 m with row spacing 30 cm and plant to plant distance 10 cm. The Soil of experimental area falls in order of Inception and is alluvial in nature; both the mechanical and chemical analysis of soil was done before starting of the experiment to ascertain the initial fertility status (Table 2). The soil samples were randomly collected from 0-15cm depths prior to tillage operations. The treatment consisted of nine combination of inorganic source of fertilizers T₀ (@ 0 S kg ha⁻¹ + 0 Zn kg ha⁻¹), T₁ (@ 0 S kg ha⁻¹ + 1.35 Zn kg ha⁻¹), T₂ (@ 0 S kg ha⁻¹ + 2.75 Zn kg ha⁻¹), T₃ (@ 15 S kg ha⁻¹ + 0 Zn kg ha⁻¹), T₄ (@ 15 S kg ha⁻¹ + 1.35 Zn kg ha⁻¹), T₅ (@ 30 S kg ha⁻¹ + 2.75 Zn kg ha⁻¹), T₆ (@ 30 S kg ha⁻¹ + 0 Zn kg ha⁻¹), T₇ (@ 30 S kg ha⁻¹ + 1.35 Zn kg ha⁻¹), T₈ (@ 30 S kg ha⁻¹ + 2.75 Zn kg ha⁻¹).

¹), the source of sulphur and zinc as milvet sulphur and zinc sulphate respectively.

Physical and chemical analysis of soil samples (Pre-Sowing)

Response on bulk density, particle density and pore space (%) of soil after crop harvest

The result depicted in table 3 shows that the maximum bulk density of soil (g cm^{-3}), was found in T₁-(@ 0 S kg ha⁻¹ + 1.35 Zn kg ha⁻¹) which was 1.09 and minimum was found in T₈-(@ 30 S kg ha⁻¹ + 2.75 Zn kg ha⁻¹) which was 1.03 (g cm^{-3}). The interaction effect of sulphur and zinc with NPK on bulk density (g cm^{-3}) of soil were found non significant.

The results shows that the maximum particle density of soil (g cm^{-3}), was found in T₂-(@ 0 S kg ha⁻¹ + 2.75 Zn kg ha⁻¹) which was 2.85 and minimum was found in T₈-(@ 30 S kg ha⁻¹ + 2.75 Zn kg ha⁻¹) which was 2 (g cm^{-3}). The interaction effect of sulphur and zinc with NPK on particle density (g m^{-3}) of soil were found non significant. The results shows that the maximum pore space (%) of soil, was found in T₄-(@ 15 S kg ha⁻¹ + 1.35 Zn kg ha⁻¹)

which was 60.37 and minimum was found in T₅-(@ 15 S kg ha⁻¹ + 2.75 Zn kg ha⁻¹) which was 52.63. The interaction effect of sulphur and zinc with NPK on pore space (%) of soil were found non significant.

The results shows that the maximum solid space (%) of soil, was found in T₅-(@ 15 S kg ha⁻¹ + 2.75 Zn kg ha⁻¹) which was 47.37 and minimum was found in T₄-(@ 15 S kg ha⁻¹ + 1.35 Zn kg ha⁻¹) which was 39.63. The interaction effect of sulphur and zinc with NPK on solid space (%) of soil were found non significant.

Chemical properties

Response on pH and EC at 25°C (dSm⁻¹) of soil after crop harvest

The result depicted in table 3 shows that the pH and EC shows that the maximum pH and EC at 25°C (dSm⁻¹) of soil was found in T₄-(@ 15 S kg ha⁻¹ + 1.35 Zn kg ha⁻¹) which were 7.25 and 0.64 and minimum was found in T₅-(@ 15 S kg ha⁻¹ + 2.75 Zn kg ha⁻¹) which were 6.80 and 0.57. The interaction effect of sulphur and zinc with NPK on pH and EC was found non-significant.

Table.1 Physical analysis of soil

Sand (%)	Bouyoucous Hydrometer method Bouyoucous (1927)	62.71
Silt (%)		23.10
Clay (%)		14.19
Textural class		Sandy loam
Bulk density (g cm^{-3})	Graduated measuring cylinder Muthuval (1992)	1.22
Particle density (g cm^{-3})	Graduated measuring cylinder Muthuval (1992)	2.21
Pore Space (%)	Graduated measuring cylinder Muthuval (1992)	53.17
Solid space (%)	Graduated measuring cylinder Muthuval (1992)	46.83

Table.2 Chemical analysis of soil particulars method employed results

pH (1:2)	Digital pH meter (Jackson, 1958)	7.18
EC (dSm ⁻¹)	EC meter (Digital Conductivity Meter) (Wilcox, 1950)	0.53
Organic Carbon (%)	Rapid titration method (Walkley and Black's method 1947)	0.5
Available Nitrogen (kg ha ⁻¹)	Alkaline potassium permanganate method (Subbaih and Asija 1956)	251.63
Available Phosphorus (kg ha ⁻¹)	Colorimetric method (Olsen <i>et al.</i> 1954)	20.41
Available Potassium (kg ha ⁻¹)	Flame photometric method (Toth and Prince, 1949)	130.64
Available Sulphur (ppm)	Turbidometric (Bardsley and Lancaster 1960)	9.82
Available Zinc (ppm)	Spectrophotometer (Shaw & Dean 1952)	0.72

Table.3 Soil properties

Treatment	pH (w/v)	EC (dSm ⁻¹)	Bulk density (g cm ⁻³)	Particle density (g cm ⁻³)	Pore space (%)	Solid space (%)	Organic carbon (%)	Nitrogen (Kg ha ⁻¹)	Phosphorus (Kg ha ⁻¹)	Potassium (Kg ha ⁻¹)	Sulphur (ppm)	Zinc (ppm)
T ₀	7.02	0.57	1.04	2.35	53.62	46.38	0.37	289.13	19.10	183.97	10.43	0.94
T ₁	6.95	0.63	1.09	2.52	56.33	43.67	0.40	297.46	22.90	192.43	10.73	1.21
T ₂	7.09	0.60	1.05	2.45	56.16	42.08	0.47	298.83	23.93	193.07	10.97	1.31
T ₃	7.03	0.62	1.07	2.45	55.45	44.55	0.51	299.46	23.95	196.63	11.40	1.20
T ₄	7.25	0.64	1.04	2.62	60.37	39.63	0.54	300.52	24.11	197.07	12.30	1.29
T ₅	6.80	0.57	1.05	2.24	52.63	47.37	0.55	301.16	24.70	198.20	12.87	1.34
T ₆	6.94	0.62	1.09	2.73	60.04	39.96	0.62	302.51	25.03	202.50	13.40	1.21
T ₇	6.83	0.60	1.05	2.36	54.58	45.42	0.83	303.86	25.75	203.47	13.47	1.32
T ₈	7.20	0.63	1.03	2.24	53.51	46.49	0.88	305.82	26.90	205.07	14.23	1.40
F-test	NS	NS	NS	NS	S	S	S	S	S	S	S	S
S.Ed. (±)	0.209	0.036	0.044	0.296	0.293	0.116	0.050	1.697	0.540	0.745	0.103	0.050
C.D. (at 5%)	0.443	0.076	0.093	0.628	0.622	0.246	0.106	3.599	1.144	1.580	0.220	0.106

Response of organic carbon (%), available nitrogen, phosphorus, potassium, sulphur and zinc (kg ha⁻¹) of soil after crop harvest

The result depicted in table 3 shows that the Maximum OC (%), available nitrogen, phosphorus, potassium, sulphur and zinc (kg ha⁻¹) in soil were found in T₈-(@ 30 S kg ha⁻¹ + 2.75 Zn kg ha⁻¹) which were 0.88, 305.82, 26.90, 205.07, 14.20, 1.40 kg ha⁻¹ respectively

and minimum was found in T₀-(@ 0 S kg ha⁻¹ + 0 Zn kg ha⁻¹) which were 0.37, 289.13, 19.10, 183.97, 10.43, 0.94 kg ha⁻¹ respectively. The interaction effect of sulphur and zinc with NPK on available nitrogen and potassium was found significant and the interaction effect of sulphur and zinc with NPK on OC (%), available phosphorus, sulphur and zinc was found significant. Combined application of sulphur and zinc

NPK brings significantly increase in available nitrogen and available potassium. The results are conformity with the finding of (Baudh *et al.*, 2012; Upadhyay *et al.*, 2016).

It is concluded that Treatment combination T₈ (@ 30 Sulphur kg ha⁻¹ + 2.75 kg Zinc ha⁻¹) was to be best in pH, EC (dSm⁻¹), O.C(%), available nitrogen (kg ha⁻¹), phosphorus (kg ha⁻¹), potassium (kg ha⁻¹), sulphur (ppm) and zinc (ppm) which were as 0.88, 305.82, 26.90, 205.07, 14.20, 1.40 respectively. Soil chemical properties as available N and K were found to be significant but pH, EC, were found to be non-significant. Soil physical properties as bulk density (g cm⁻³), particle density (g cm⁻³), percent pore space (%), solid space (%) were found to be non-significant.

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