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Effect of Different Levels of N P K and Zinc Sulphate on Physico-Chemical Properties of Soil in Cultivation of Mustard (*Brassica juncea* L.) Var. Jai Kisan

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ABSTRACT

The experiment was conducted during rabi season of 2013-14.The Soil of experimental area falls under Inceptisols order. The design applied for statistical analysis was carried out with 3^2 Randomized Block Design having three factors with the three levels of NPK was 0, 50 and 100 % and Zinc Sulphate was 0, 50 and 100% each. Doses for three levels of NPK as L_0 (0 kg N ha^{-1}+ 0 kg P ha^{-1} + 0 kg K ha^{-1}), L_1 (40 kg N ha^{-1}+ 30 kg P ha^{-1} + 20 kg K ha^{-1}) and L_2 (80 kg N ha^{-1}+ 60 kg P ha^{-1} + 40 kg K ha^{-1}) and Zinc Sulphate as Z_0 (0.0 kg ha^{-1}), Z_1 (25 kg ha^{-1}) and Z_2 (50 kg ha^{-1}) The treatment T_8- L_2Z_2 [@100% NPK+ 100% $ZnSo_4$] was found to be the best in all parameters. Data were recorded of post-harvest soil in the treatment T_8 as Bulk Density (g cm^{-3}), Particle Density (g cm^{-3}), Pore Space (%), pH, EC(dSm^{-1}), OC (%), available Nitrogen(kg ha^{-1}), available Phosphorous(kg ha^{-1}), available Potassium (kg ha^{-1}), available Zinc (ppm) and available Sulphur (ppm) which were as 1.22, 2.49, 50.99, 7.03, 0.24, 0.72, 308.07, 26.90, 206.53, 0.90 and 13.06 respectively. Soil physical properties such as Particle Density and Pore Space were found non-significant but effect of increasing levels of NPK on Bulk density found significant. Soil chemical properties such as Organic Carbon (%), available Phosphorous and available Potash were found non-significant, but effect of different levels of NPK and Zinc Sulphate on Zinc was significant. Effect of increasing levels of available NPK and Zinc Sulphate on available Nitrogen and available Sulphur were significant but combination of NPK and Zinc Sulphate was found to be non-significant. Adequate plant nutrient supplyhold the key for improving the sustaining soil fertility.

Key word: *Soil properties, Nitrogen, Phosphorus, Potassium, Zinc, Sulphur.*

INTRODUCTION

India is one among the leading oil seed producing countries in the world. Oilseeds form the second largest agricultural commodity after cereals. Mustard is the second important edible oil seed crop after groundnut. It plays an important role in the oil seed economy of the country. Indian mustard (*Brassica juncea* L.) commonly known as raya, rai or lahi is an important oilseed crop among the Brassica group of oilseed in India.

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Rape seed and mustard crops are being cultivated in 53 countries spreading over the six continents across the globe covering an area of 24.2 million hectare. Indians contribution to world and production is 28.3 and 19.8 percent respectively. In India, Toria is cultivated on 6.86 million hectares in Rabi season[3]. Rapeseed-mustard is an important group of edible oil seed crops and contributes around 26.1% of the total oil seed production. Out of 57856 thousand tonnes of rapeseed–mustard seed produced over 30308 thousand ha in the world, India produce 5833 thousand tonnes from 5750 thousand ha^{-1}. Indian mustard [*Brassica juncea* (L.)] contributes about 85% of the total rapeseed–mustard produced in India[11]. Nitrogen is the most important nutrient, which determines the growth of the Toria crop and increases the amount of protein, methionine dry matter and the yield. Phosphorus and Potash are known to be efficiently utilized in the presence of Nitrogen. It promotes flowering, setting of siliqua and in increase the size of siliqua and yield[15]. Phosphorus is an element for Toria and mustard. Phosphorus is generally deficient in majority of our Indian soils and need much attention for maintenance of soil fertility. When Phosphorus was applied in conjunction with Nitrogen and Potash, there was significant increase in the yield of Toria and mustard[15]. Potassium is one of the seventeen elements which are essential for growth and development of plants. Mustard is an important oil seed crop of arid and semi-arid region. Potassium is required for improving the yield and quality of different crops becouse of its effect on photosynthesis, water use efficiency and plant tolerance to diseases, drought and cold as well for making the balance between protein and carbohydrates[15]. One of the most important micronutrient is Zinc (Zn). Zinc deficient soil can be found throughout the world and are normally associated with low soil organic matter and a soil pH higher than 7.0, Zinc deficiencies are corrected in most cases by applying a granular Zn fertilizer. In this research, the material and method used to achieve the general objectives, which are to evaluate the growth promoting, to reduce zinc deficiency effect and to get high yield of fresh weight of mustard using zinc sulphate[10]. Sulphur plays the key role is most important among the secondary nutrient in the production of oilseed crops. It plays significant role in the development of seed. An oilseed crop requires sulphur comparatively higher than other nutrient. Average over a large amount of data the application of sulphur increased crop yield by 17% in rice 25% in soybean 20% in sunflower and mustard 16% in linseed. Various nutrient and micro nutrient as required for oilseed production but the nutrient which plays a multiple role in providing nutrition to oil seed crops, particularly those belonging to cruciferae family is sulphur. Each unit of fertilizer generates 3-5 units of edible oil, commonly needed by every family. Amount of sulphur absorbed by crops is generally 9-15% (one-tenth to one- seventh) of the nitrogen up take, In Toria sulphur uptake is usually one-third of nitrogen uptake[15].

MATERIAL AND METHODS

A field Experiment was conducted on Crop Research Farm of Department of Soil Science, Allahabad School of Agriculture, Sam Higginbottom Institute of Agriculture**,** Technology & Sciences (Deemed-to-be-University) Allahabad, (U.P.) India. The soil of experimental area falls in Inceptisols order and the experimental field is alluvial in nature. The design applied for statistical analysis was carried out with 3^2 factorial randomized block design having three factors with three levels of NPK and three levels of Zinc Sulphate. Doses for three levels of N P K as 0, 50 and 100 % were L_0 (0 kg N/ha +0 kg P/ha+ 0 kg K/ha), L_1 (40 kg N/ha +30 kg P/ha+ 20 kg K/ha) and L_2 (80 kg N/ha +60 kg P/ha+ 40 kg K/ha) respectively and doses for three levels of $ZnSO_4$ as 0, 50 and 100% were Z_0 (0.0 kg ha^{-1}), Z_1 (25.0 kg ha^{-1}) and Z_2 (50.0 kg ha^{-1}) respectively. Treatments were T_0 – ($L_0 Z_0$) [@ 0 % N P K + 0% $ZnSO_4$], T_1 – (L_0Z_1) [@ 0% N P K+ 50% $ZnSO_4$], T_2 – ($L_0 Z_2$) [@ 0% N P

K+ 100% $ZnSO_4$], T_3 – (L_1Z_0) [@ 50% N P K + 0% $ZnSO_4$], T_4- (L_1 Z_1) [@ 50% N P K+ 50% $ZnSO_4$], T_5- (L_1 Z_2) [@50% N P K+100% $ZnSO_4$], T_6 – (L_2 Z_0) [@ 100% N P K+ 0% $ZnSO_4$], T_7 – (L_2 Z_1) [@100% N P K+ 50% $ZnSO_4$], T_8- (L_2 Z_2) [@100% N P K+ 100% $ZnSO_4$]. Having the treatments was replicated thrice. The source of Nitrogen, Phosphorus, Potassium, Zinc and Sulphur as Urea, SSP, MOP, Zinc Sulphate respectively. Basal dose of fertilizer was applied in respective plots according to treatment allocation in furrows opened by about 5cm depth before sowing of seeds in soil at the same time at the depth of 5cm, row to row distance was maintained at 45 cm and plant to plant distance was 15 cm. During the course of experiment, observations were recorded as mean values of the data.

The soil analysis was done in the laboratory of Soil Science and Agriculture Chemistry, SHIATS.-DU, Allahabad with following standard methods:-

Table 1(a): Mechanical analysis of the Pre-sowing Soil.

S. No.	Soil separates	(%)	Method followed
1.	Sand	60.0	**Bouyoucous hydrometer (1927)**
2.	Silt	20.12	
3.	Clay	11.51	
4.	Texture of soil	Sandy loam	

Table 1 (b): Physical and Chemical analysis of Pre-sowing soil.

Particulars	Rating	Method
1.Soil pH, Soil water Suspension	7.80	Digital pH meter[9]
2. EC (dS m^{-1})	0.43	Digital Conductivity meter[17]
3. Bulk density (gcm^{-3})	1.63	Graduated measuring cylinder[6]
4. Particle density (gcm^{-3})	2.62	Graduated measuring cylinder[6]
5. Pore space (%)	49.22	Graduated measuring cylinder[6]
6. Organic carbon (%)	0.49	Walkley and Black[18]
7. Available N (Kg ha^{-1})	230.70	Alkaline Permanganate Method[14]
8. Available P (Kg ha^{-1})	17.96	Calorimetric Method[12]
9. Available K (Kg ha^{-1})	258.00	Flame photometric Method[16]
10. Available Zn (ppm)	0. 58	**Shaw and Dean Method (1952)**
11.Available S (ppm)	11.05	Turbidemetric method **(Chesnin & Yien 1950)**

RESULT AND DISCUSSION

Physical Properties:

Response on Bulk density, Particle density and Pore Space (%) of soil after crop harvest

The result depicted in table 2(a) shows that the maximum Bulk density of soil (g cm^{-3}) was found in T_6- (L_2Z_0) [@100% NPK +0% $ZnSO_4$] which was 1.50 and minimum was found in T_8-L_2 Z_2 **[**@ NPK 100% + @ $ZnSo_4$ 100%] which was 1.22. The effect of NPK on Bulk density was significant. The interaction effects of NPK and Zinc Sulphate on Bulk density (g cm^{-3}) of soil were found non-significant. The results shows that the maximum Particle density (g cm^{-3}) and Pore space (%) of soil was found in T_8-L_2 Z_2 **[**@ NPK 100% + @ $ZnSo_4$ 100%] which were 2.49 and 50.99 and minimum was found in T_0 (Control) which were 2.38 and 45.59. Table 2(a) depicted that the mean Particle density (g cm^{-3}) and Pore space (%) of soil was found non-significant at different levels of NPK and Zinc Sulphate. The Interaction effects of NPK and Zinc Sulphate on Particle density and Pore space of soil were found non-significant. It was also observed that Particle density (g cm^{-3}) and Pore space (%) of soil were gradually increased with an increase in dose of NPK and Zinc Sulphate. It may be due to the presence of organic carbon in optimum amounts improves Pore space (%). It contains higher amount of organic materials and indicated an enrichment of fine fractions i.e. leading to change in physical properties of soil. The result are corroborated by Bhattachrya *et al*.[5], Verma *et al*., Agarkar *et al*.[4], Khanday *et al*.

Table 2(a): Effect of different levels of N P K and Zinc Sulphate on Physical Properties of Post-Harvest soil in Mustard (*Brassica juncea* L.) Var. Jai Kisan

Treatment Combination	Bulk Density (g cm^{-3})	Particle Density (g cm^{-3})	Pore space (%)
T_0=L_0Z_0	1.29	2.38	45.59
T_1=L_0Z_1	1.28	2.39	46.27
T_2=L_0Z_2	1.27	2.40	46.64
T_3=L_1Z_0	1.24	2.40	47.23
T_4=L_1Z_1	1.26	2.42	47.81
T_5=L_1Z_2	1.23	2.48	50.17
T_6=L_2Z_0	1.50	2.46	49.19
T_7=L_2Z_1	1.24	2.47	49.59
T_8=L_2Z_2	1.22	2.49	50.99
Mean	**1.28**	**2.43**	**48.16**
F- test (LxZ)	**NS**	**NS**	**NS**
S. Em (±)	0.01	0.09	2.24
C. D. at 5%	-	-	-

Chemical Properties of Post-Harvest Soil

Response on pH at 25°C of soil after crop harvest

The result depicted in table 2(b) show that the pH at 25° C of soil was found maximum in T_0 (Control) and minimum in T_8-L_2 Z_2 **[**@ NPK 100% + @ $ZnSo_4$ 100%] which was 7.63 and 7.03. Effect of NPK on soil pH was significant. Interaction effect of NPK and Zinc Sulphate was non-significant. The decrease in pH might be due to higher growth of crops as respiration is more. Respiration evolves carbon dioxide and reacts with water to form carbonic acid in soil.

Response on EC (dS m^{-1}) at 25°C of soil after crop harvest

The result depicted in table 2(b) show that the EC (dS m^{-1}) at 25°C of soil was found minimum in T_0 (Control) and maximum in T_8-L_2 Z_2 **[**@ NPK 100% + @ $ZnSo_4$ 100%] which was 0.14 and 0.24. Effect of NPK and Zinc Sulphate on soil EC was significant. Interaction effect of NPK and Zinc Sulphate was non-significant.

Response on Organic Carbon, available Nitrogen, Phosphorous, Potassium, Zinc and Sulphur of soil after crop harvest

The result depicted in table 2(b) show that the maximum OC (%), available Nitrogen(kg ha^{-1}), Phosphorous (kg ha^{-1}), Potash (kg ha^{-1}), Zinc (ppm) and Sulphur (ppm) of soil was found in T_8-L_2 Z_2 **[**@NPK 100%+ @$ZnSo_4$ 100%] which was 0.72, 308.07, 26.90, 206.53, 0.90 and 13.06 and minimum was found in T_0 (Control) which was 0.58, 287.10, 25.19, 152.64, 0.55 and 10.56. Table 2(b) depicted that the mean of OC (%), available Phosphorous (kg ha^{-1}) and Potash (kg ha^{-1}) of soil was found non-significant at different levels of NPK and Zinc Sulphate. The interaction effects of different levels of NPK and Zinc Sulphate on OC (%), available Phosphorous (kg ha^{-1}) and Potash (kg ha^{-1}) of soil found also non-significant. The effect of different levels of NPK and Zinc Sulphate on available Nitrogen and Sulphur was significant but interaction effect of NPK and Zinc Sulphate was non-significant. The effect of different levels of NPK and Zinc Sulphate on available Zinc was significant and interaction effect of NPK and Zinc Sulphate was also significant. Combined application of NPK and Zinc Sulphate brings significant increase in available N, P, K, Zn and S of post-harvest soil of Mustard. The result are conformity with the finding of Bansal *et al*., Khatkar *et al*., Parmar *et al*., Patwardhan *et al*., Khanday *et al*., Iqbal *et al*.

Table 2(b): Effect of different levels of N P K and Zinc Sulphate on Chemical Properties of Post-Harvest soil in Mustard (*Brassica juncea* L.) Var. Jai Kisan

Treatment Combination	pH (1:2 w/v)	EC (dSm^{-1})	O.C. (%)	N (kg ha^{-1})	P_2O_5 (kg ha^{-1})	K_2O (kg ha^{-1})	Zn (ppm)	S (ppm)
T_0=L_0Z_0	7.63	0.14	0.58	287.10	25.19	152.64	0.55	10.56
T_1=L_0Z_1	7.50	0.15	0.62	288.15	25.69	161.64	0.87	10.80
T_2=L_0Z_2	7.46	0.17	0.61	291.30	25.70	170.60	0.62	11.03
T_3=L_1Z_0	7.30	0.17	0.65	288.15	25.87	179.56	0.65	11.46
T_4=L_1Z_1	7.33	0.19	0.66	293.40	25.88	170.64	0.72	11.53
T_5=L_1Z_2	7.23	0.23	0.69	302.83	26.39	197.60	0.85	12.63
T_6=L_2Z_0	7.26	0.19	0.61	294.45	26.05	179.64	0.77	12.10
T_7=L_2Z_1	7.13	0.21	0.68	296.54	26.22	197.53	0.82	12.40
T_8=L_2Z_2	7.03	0.24	0.72	308.07	26.90	206.53	0.90	13.06
Mean	**7.31**	**0.18**	**0.64**	**294.44**	**25.98**	**179.59**	**0.75**	**11.73**
F- test(LxZ)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**S**	**NS**
S. Em (±)	0.8	0.012	0.05	3.47	0.55	15.87	0.014	0.17
C. D. at 5%	-	-	-	-	-	-	0.04	-

CONCLUSION

It is concluded that the post-harvest soil properties such as EC (dSm^{-1}), available Nitrogen, available Zinc and available Sulphur were found to be significant with increasing levels of NPK and Zinc Sulphate. The treatment combination T_8-L_2 Z_2 **[**@ NPK 100% + @ $ZnSo_4$ 100%] was found to best in terms of Bulk density (g cm^{-3}), pore space (%), Organic Carbon (%), available Nitrogen (kg ha^{-1}), available Phosphorous (kg ha^{-1}), available Potash (kg ha^{-1}), available Zinc (ppm) and available Sulphur (ppm) as 1.22, 50.99, 0.72, 308.07, 26.90, 206.53, 0.90 and 13.06 respectively.

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