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RESEARCH PAPER

Effect of zinc and iron application on yield and acquisition of nutrient on mustard crop (*Brassica juncea* L.)

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Abstract : The field experiment was conducted on Pusa Bold variety of mustard with 10 treatments in RBD in *Rabi* season- 2009-10 at Crop Research Centre of, Sardar Vallabhbhai Patel University of Agriculture and Technology; Meerut (U.P). Maximum primary branches (11.05), secondary branches (31.33), siliqua per plant (545.35), number of seed per siliqua (13.55), seed weight per plant 30.38 g and test weight (1000 seed weight, 6.50 g) were recorded, the biological yield was observed highest (114.80 q ha^{-1}) and the grain yield was also (23.40 q ha^{-1}) in T_9 {100 % NPK (RDF) + Zn @ 25 Kg ha^{-1} (B) + Fe @ 25 Kg ha^{-1} (B)}. The maximum stover yield noticed 91.40 q ha^{-1} as compared to T_1 (control) (40.82 q ha^{-1}.), highest total nitrogen uptake by mustard crop, recorded 97.87 kg/ha, in case of phosphorus and potassium uptake by mustard crop was also observed 21.82 kg/ha and 152.82 kg/ha, respectively. The all over present investigation shows that the maximum yield attributes was found when zinc and iron was applied basal with recommended dose of fertilizers.

Key Words : Mustard, Micronutrient and Uptake, Kg ha^{-1}

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INTRODUCTION

India is one of the leading oil seed producing country in the world. Rapeseed and mustard are the main oil seed crops grown in *Rabi* season in India. Oil seeds the second largest agricultural commodity after cereals in India. Its production was 7.20 tonnes from 6.3 m ha mainly confined with the states *viz.*, Rajasthan, Uttar Pradesh, Haryana, Madhya Pradesh, Gujarat, West Bengal, Assam, Bihar, and Punjab. Among the states, Uttar Pradesh alone produces about 13.78 per cent of total mustard production from 14.03 per cent area, whereas, Rajasthan on top with 48.64 per cent production from 45.06 per cent area in India during 2008-09.

Iron is critical for chlorophyll formation and photosynthesis. Chlorophyll is the small "sun-panels" which the plants use to harvest energy from the sun and gives plants green pigment. Photosynthesis is the process during which the actual sun- rays are harvested. Iron is also used by enzymes to regulate transpiration in plants. This transpiration process allows nutrients to reach all parts of the plants. Without iron the above functions would not work.

Since these functions are essential for plant growth, iron is an essential element, so there is a need to focus on these nutrients, especially zinc, as it is one of the most important micronutrient, while, applying with iron and NPK. Zinc deficient soil can be found throughout the world and are normally associated with low soil organic matter and alkaline soil. Zinc deficiencies are corrected in most cases by applying a granular zinc ($ZnSO_4.7H_2O$) fertilizer. Growth of winter crops in the soils is adversely affected due to reduction in zinc availability at

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low temperatures.

Although zinc can be applied as foliar application in emergency measure, greatest yields are obtained when it is applied to the soil. Soil application of zinc is normally made at the seeding of crop. Sometimes, Zn deficiency appears due to the low amount of Zn as recommended and low temperature as required during the crop growth. Deficiency of zinc can also appear after seeding of the crop in soils with high phosphorus contents. Zinc sulphate improves phosphorus utilization and regulates plant growth and increase leaf size, promotes silking, hastens maturity and increase to test weight.

MATERIAL AND METHODS

A field experiment was conducted during the *Rabi* season of 2008-09 at the Crop Research Center of Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut. The soil was sandy loam with pH 8.36 and low in organic carbon 0.36per cent, available N (79.80), available K (165.30) and medium in available P (14.80) kg ha^{-1} and sufficient amount of Zn and Fe (0.49 and 12.25 ppm). The treatments T_1-Control (without fertilizers), T_2-100 per cent NPK @ 80,60,40 kg ha^{-1} (RDF), T_3- 100 per cent NPK (RDF) + Zn @ 25 kg ha^{-1} (B), T_4- 100 per cent NPK (RDF) + Zn (F), T_5- 100 per cent NPK (RDF) + Fe @ 25 kg ha^{-1} (B), T_6- 100 per cent NPK (RDF) + Fe (F), T_7- 100 per cent NPK (RDF) + Zn @ 25 kg/ha (B) + Fe (F), T_8- 100 per cent NPK (RDF) + Zn (F) + Fe @ 25 kg ha^{-1} (B), T_9- 100 per cent NPK (RDF) + Zn @ 25 kg ha^{-1} (B) + Fe @ 25 kg ha^{-1} (B) and T_{10} - 100 per cent NPK (RDF) + Zn (F) + Fe (F)were laid out in RBD in the three replications. The calculated quantity of Zn and Fe was applied as based as well as foliar at first and second irrigation as per treatment 30 and 60 DAS, respectively. Indian mustard variety Pusa Bold was sown at 30 cm row spacing using 4 kg seed ha^{-1}.

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Effect on growth and yield and yield attribute of mustard :

The data on growth parameters and yield and yield attribute of mustard are presented in Table 1 and 2. Various plant growth parameter of mustard crop are affected by varying the method of application of micronutrients during the crop season. The plant height was significantly influence by the different method of zinc and iron application at all the growth stages. Plant height is an index of good vegetative growth. The maximum plant height 98.25 cm at 60 DAS and 196.25 cm at harvest was observed in T_9 [100 % NPK (RDF) + Zn @ 25 kg ha^{-1} (B) + Fe @ 25 kg/ha (B)] treatment, *i.e.* 36.45 and 26.20 per cent increase in plant height were observed at 60 and 147 DAS, respectively (Table 2). Primary branches increase with advancement of crop age the maximum branches was observed in T_9 (11.05) at 60 DAS significantly, when zinc and iron applied basal and foliar (Table 1). The similar results were also reported by Meena *et al.* (2006), Chaudhary *et al.* (2007), Yadav *et al.* (2007) and Ravi *et al.* (2008).

Maximum number of secondary branches at 60 DAS (31.33) and at harvest 147 DAS (34.67) were recorded in T_9 [100 % NPK (RDF) + Zn @ 25 kg/ha (B) + Fe @ 25 kg/ha (B)]. (Table 1) significantly increase in number of branches per plant as compared to T_1 attributed to increase in absorption and translocation of assimilation and stimulation graphical and lateral meristems to grow result supported by Husain and Kumar (2006).

The numbers of siliqua per plant at harvesting highest (545.35), number of seed per siliqua was recorded maximum in T_9 (13.55). The highest length of Siliqua found 5.20 cm (Table 2), treatment in which recommended dose of fertilizer were applied along with zinc and iron application as basal. The significant increase in number of Siliqua per plant and number of seed per Siliqua as compared to T_1 (Control). It is evident that zinc and iron element play an important role in plant,

Table 1: Effect of zinc and iron application on number of primary and secondary branches/plant in mustard

Treatments	Primary branches/plant		Secondary branches/plant	
	30 DAS	60 DAS	60 DAS	At harvest
T_1	1.50	4.75	11.33	13.33
T_2	1.58	5.75	23.00	25.33
T_3	1.61	7.97	23.33	25.67
T_4	1.56	6.65	20.00	23.33
T_5	1.46	7.35	22.33	25.00
T_6	1.50	6.15	20.00	22.33
T_7	1.57	10.25	24.67	27.67
T_8	1.74	8.50	22.00	24.33
T_9	1.76	11.05	31.33	34.67
T_{10}	1.72	8.17	23.67	27.00
S.E. ±	0.10	0.30	1.68	1.61
C.D. (P=0.05)	N.S.	0.91	5.04	4.81

similar results were reported by Sudhakar *et al.* (2002) and Husain and Kumar (2006). Significantly result was observed, when zinc and iron was applied basal along with RDF (T_9) in seed weight per plant and 1000 seed weight (6.50g) the result was supported by Sudhakar *et al.* (2002) and Zizala *et al.* (2008).

Yield attributes :

The grain yields of mustard in different treatments were significant; when zinc and iron are applied alone and with combination significantly increased the grain yield. The highest grain yield was recorded in T_9 (23.40 q/ha) followed by T_7 and T_8 gave grain yield 22.14 and 20.45 qha^{-1} *i.e.* 145, 132 and 115 per cent increased in grain yield by T_9, T_7 and T_8, respectively over control (Table 2). Similar observation were also recorded by Saxena *et al.* (2005), Kumar *et al.* (2006), Meena *et al.* (2006), Chaudhary *et al.* (2007), Jat and Mehra (2007), Yadav *et al.* (2007) and Ravi *et al.* (2008). Similarly the Stover yield was recorded significantly maximum in T_9 (91.40 q ha^{-1}) followed by T_7, T_8 and T_{10} gave values 87.74, 79.25 and 75.82 q ha^{-1}, respectively. The stover yield was observed 123, 114, 94 and 86 per cent higher as compared to T_1 (control). These results are supported by the findings of Saxena *et al.* (2005), Chaudhary *et al.* (2007), Jat and Mehra (2007) and Chandra and Khandelwal (2009).

Nutrient uptake :

The data on N, P and K uptake by grain of mustard are presented in Table 3. Total uptake of NPK by mustard crop was maximum recorded with RDF along with zinc and iron applied as basal. The total nitrogen uptake was recorded significantly highest in T_9. Total phosphorus uptake was found maximum in T_9 followed by T_7 over control, and the total potassium uptake by mustard crop was also in highest in T_9 over the maximum per cent in increase of nutrient was recorded 191, 236 and 222 per cent NPK, respectively over control. The result are supported by Malewar *et al.* (2001), Giri *et al.* (2003), Kumar *et al.* (2006), Meena *et al.* (2006), Chaudhary *et al.*

Table 2 : Effect of zinc and iron application on yield and yield attributes of mustard crop

Treatments	Grain yield (q ha^{-1})	Stover yield (q ha^{-1})	Biological yield (q ha^{-1})	Plant height (cm)	No. of siliqua/ plant	No. seed/ siliqua	Length of siliqua (cm)	Seed weight/ plant (g)	1000-seed weight (g)
T_1	9.53	40.82	50.35	155.50	295.25	7.95	3.50	9.45	5.20
T_2	11.90	56.52	68.42	160.67	390.60	8.40	4.02	12.10	5.40
T_3	17.94	74.14	92.08	177.25	485.40	10.15	4.62	17.10	5.65
T_4	13.90	71.43	85.33	169.25	460.45	9.45	4.40	14.11	5.55
T_5	14.00	74.14	88.14	170.25	478.75	9.65	4.55	15.20	5.80
T_6	12.20	66.91	79.11	165.00	415.15	8.90	4.36	13.50	5.85
T_7	22.14	87.74	109.88	188.25	522.50	12.20	4.90	28.78	6.35
T_8	20.45	79.25	99.70	182.00	505.75	11.95	4.85	25.32	6.20
T_9	23.40	91.40	114.80	196.25	545.35	13.55	5.20	30.38	6.50
T_{10}	19.28	75.82	95.10	180.25	490.65	10.75	4.75	20.51	6.00
S.E. ±	0.40	0.51	0.59	2.34	4.00	0.16	0.16	0.29	0.14
C.D. (P=0.05)	1.19	1.52	1.77	7.01	11.97	0.48	0.48	0.87	0.40

Table 3 : Effect of zinc and iron application on total NPK uptake (kg/ha) by mustard crop

Treatments	Nitrogen uptake (kg/ha)	Phosphorus uptake (kg/ha)	Potassium uptake (kg/ha)
T_1	23.53	6.47	47.25
T_2	34.71	11.21	90.21
T_3	47.69	17.10	92.95
T_4	44.03	18.65	116.00
T_5	43.39	15.62	119.01
T_6	38.86	13.58	105.94
T_7	60.46	19.89	148.83
T_8	55.93	17.88	134.34
T_9	67.19	21.82	152.82
T_{10}	54.28	17.69	124.09
S.E. ±	6.43	0.26	10.55
C.D. (P=0.05)	19.25	0.78	31.59

(2007), Jat and Mehra (2007), Ravi *et al.* (2008), Zizala *et al.* (2008) and Chandra and Khandelwal (2009).

Conclusion :

It is concluded from that investigation the application of recommended dose of fertilizer (100% NPK) @ 80: 40: 40 recorded better grain yield (11.90 q ha^{-1}) of mustard crop. The highest grain yield (23.40 q ha^{-1}) was obtained in the treatment consisting the basal application of zinc and iron along with 100per cent nitrogen, phosphorus and potash (Recommended dose of fertilizer) (T_9). The addition of Zn and Fe as basal @ 25 Kg/ha along with 100 per cent NPK (RDF) prone super ion to foliar application of Zn and Fe along with 100 per cent NPK (RDF) in terms of yield and other parameters of mustard crop. On an average highest total uptake of NPK recorded 97.54, 21.82, and 152.82 kg ha^{-1}, respectively in treatment T_9 followed by T_7. Similarly maximum total uptake of zinc and iron were recorded 251.76 and 2314.53 g ha^{-1}, respectively in T_9 followed by T_7.

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