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Interaction on effect of different doses zinc and sulphur to seed yield parameters on mustard

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Abstract
An experiment was designed to find out the influence of different doses of zinc and sulphur on yield and seed quality of Indian mustard variety Urvashi. The field experiment and laboratory experiment was conducted in Split Plot Design with three replications during 2011-12 & 2012-13 on Indian mustard variety Urvashi at New Dairy Farm, Kalyanpur, Kanpur and Seed Testing Laboratory of Department of Seed Science and Technology, respectively. Six doses of zinc and sulphur viz. 0.0, 2.5, 5.0, 7.5, 10.0, 12.5 Kg ha^{-1} and 0, 10, 20, 30, 40, 50 Kg ha^{-1}, respectively were applied as basal dose. Observations were recorded on interaction effect of seed yield and seed quality parameters. Results showed that the application of zinc and sulphur affected significantly to all parameters. The interaction zinc and sulphur did not show significant effect on days to 50% flowering, number of siliquae $plant^{-1}$, number of seeds $siliqua^{-1}$, days taken to maturity, raw seed yield Kg $plot^{-1}$, graded seed yield Kg $plot^{-1}$, raw seed yield Kg ha^{-1}, graded seed yield Kg ha^{-1}, 1000-seed weight. However, rest of the characters was affected by the application of zinc and sulphur.

Keywords: Mustard, zinc, sulphur, effect, seed yield, interaction

Introduction
Mustard (*Brassica juncea* (L.) Czern and Coss) is important *Rabi* oilseed crop which belongs to family "Cruciferae. In India, first rank in area and third in production after China and Canada. On the world map, Indian rapeseed and mustard occupies about 6.18 million hectare area with a production of 7.36 mt and average productivity of 1190 kg/ha. In India Rajasthan ranks first both in area in production. Gujarat state has the highest productivity of rapessed and mustard, Whereas in UP repressed and mustard is grown on 6.58 lakh. ha area with production of 0.76 mt and productivity of 1155kg/ha (Anonymous 2015) [1].
In India consumption of oil and fats is continuously increasing due to increase in population at an annual growth rate of 2.1 per cent and improved standards of living due to accelerated economic development in the base scenario of per capita growing by 4.0 per cent annually, an average Indian's yearly edible oil requirement in fated to rise from 9. 81 kg in 1999-2000 to 16 kg by 2015 (Hegde, 2004) [10].
For oil seeds sulphur and zinc are vital nutrients for growth and development. Sulphur in considered to be the fourth important essential nutrient after nitrogen, phosphorus and potassium for the plant growth. Sulphur performs many physiological functions like synthesis of cysteine, methionine, chlorophyll and oil content of oil seed crops. It is also responsible for synthesis of certain vitamins (B, Biotin and Thiamine), metabolism of carbohydrates, proteins and oil formation of flavor compounds in crucifers.
Keeping this in view, the present investigation was carried out to study the effect of sulphur, zinc and FYM on growth, yield attributes, seed yield, gross income, net profit and B:C ratio in irrigated Indian mustard.
In recent years, sulphur deficiency has been aggravated in the due to continuous removal by crops and use of high analysis sulphur devoid fertilizers coupled with intensive cropping with high yielding varieties and reduction in use of organic manure and sulphur containing fungicides and insecticides resulted in sulphur deficiency in soils (Pasricha *et al.,* 1972)
Sulphur deficiency is as high as 81 per cent in the light textured soils of North and North West zone of Gujarat (Sadasania, 1992) [13]. They reported that sulphur deficiency tends to affect adversely on growth and which reduces the crop yield to the extent of 10-30 per cent.

Material and Method
The experiment was conducted at the New Dairy Research Farm, Chandra Shekhar Azad University of Agriculture and Technology, Kalyanpur,

Kanpur UP during 2011-12 and 2012-13 Indian mustard variety Urvashi under Split Plot Design with three replications having plant distance 45 cm and 5 cm respectively. Five rows were sown in each plot of 4 × 2.25 $m^{2.}$ The recommended fertilizer was applied at the rate of 120 Kg N, 60 Kg P_2O_5 and 40 Kg K_2O ha^{-1} uniformly in all plots as feeder dose and plant protection measure were Spraying of Malathion 50 EC @ 1 liter dissolved in 1000 liters of water ha^{-1} for the control of hairy caterpillar. Spraying of Imidachloroprid 17.8 EC @ 375 ml in 1000 liters of water ha^{-1} was applied as per requirement for the control of aphids. The study was consisted of two factors *viz*. zinc and sulphur with Six doses of zinc and sulphur viz. 0.0, 2.5, 5.0, 7.5, 10.0, 12.5 Kg ha^{-1} and 0, 10, 20, 30, 40, 50 Kg ha^{-1}, respectively were applied as basal dose. The composition of soil of the experimental plot is alluvial in nature. The soil samples were drawn and analyzed in the Soil Testing Laboratory Chandra Shekhar Azad University of Agriculture and Technology, Kanpur for different physical and chemical composition following the standard procedure.
Observations were Recorded: Plant Height (cm), Number of Primary and Secondary Branches $Plant^{-1,}$ Days to 50% Flowering, Number of Siliquae $Plant^{-1,}$ Length of Siliqua (cm), Number of Seeds $Siliqua^{-1}$, Days to Maturity, Raw Seed Yield (Kg $plot^{-1}$), Raw Seed Yield (Kg ha^{-1}), Graded Seed Yield (Kg $plot^{-1}$), Graded Seed Yield (Kg ha^{-1}) and 1000 Seed Weight.

Results

Interaction Effect of Zinc and Sulphur

Plant Height

The significantly influence the interaction of sulphur and zinc on plant height of Indian mustard. Most of the treatment combination differed significantly to each other. Table (1) reveals that interaction of S_5 × Zn_5 recorded significantly highest plant height (185.98 cm) and statistically at par Zn_4 × S_4, Zn_5 × S_4, Zn_3 × S_5 and Zn_4 × S_5, while treatment combination of S_0 and Zn_0 recorded minimum plant height (173.49 cm) of Indian mustard.

Number of Primary Branches

The interaction effect on number of primary branches $plant^{-1}$ of Indian mustard. Most of the treatment combination differed significantly to each other. Table 4.14 reveals that interaction of Zn_5 × S_5 recorded significantly highest number of primary branches $plant^{-1}$ (8.93) which is at par with Zn_4 × S_5 while treatment combination of S_0 and Zn_0 recorded minimum number of primary branches (1) of Indian mustard.

Number of Secondary Branches $Plant^{-1}$

The interaction effect on number of secondary branches $plant^{-1}$ of Indian mustard was significantly influenced by different levels of zinc and sulphur. The interaction of Zn_5 × S_5 produced significantly more number of secondary branches $plant^{-1}$ (13.98) and found to be statistically at par to Zn_4 × S_5. The minimum number of secondary branches $plant^{-1}$ (8.50) was obtained in Zn_0 × S_0 (Table 1).

Days to 50% Flowering

The interaction of zinc and sulphur application did not show significant effect on number of days taken to 50% flowering of Indian mustard (Table 2). However, numerically maximum and minimum number of days taken to 50% flowering (62.50) and (55.70) was obtained with the combined application of Zn_5 × S_5 and Zn_0 × S_0, respectively.

Number of Siliquae $Plant^{-1}$

The interaction of zinc and sulphur did not show significant effect on number of siliquae $plant^{-1}$ of Indian mustard. Table 2 reveals that the application of Zn_5 × S_5 recorded maximum number of siliquae $plant^{-1}$ (315.50) while treatment combination of Zn_0 and S_0 scored minimum number of siliquae $plant^{-1}$ (191.10) of Indian mustard.

Length of Siliqua

The interaction effect of different levels of zinc and sulphur was significantly influenced on length of siliqua of Indian mustard. However, numerically minimum length of siliqua (3.93 cm) was observed in the combination of Zn_0 × S_0 and significantly maximum length of siliqua (5.38 cm) was observed in the treatment combination of Zn_5 × S_5 of Indian mustard (Table 2).

Number of Seeds $Siliqua^{-1}$

that interaction of sulphur and zinc did not show significant difference on number of seeds $siliqua^{-1}$, however, numerically minimum number of seeds $siliqua^{-1}$ (11.33) was obtained in the combination of absolute control (Zn_0 × S_0) and maximum (15.19) was observed in the treatment combination of Zn_5 × S_5 (Table 3).

Days to Maturity

The interaction effect of zinc and sulphur did not show significant influence on days taken to maturity. However, numerically minimum number of days taken to maturity (131.00) was observed in the combination of Zn_0 × S_0 and maximum (136.33) was observed with the treatment of Zn_5 × S_5 (Table 3).

Raw Seed Yield (Kg $plot^{-1}$)

The interaction effect on raw seed yield of Indian mustard due to different levels of zinc and sulphur did not show significant effect, however, numerically lowest raw seed yield (2.19 Kg $plot^{-1}$) was obtained in the treatment combination of Zn_0 × S_0 and highest (2.58 Kg $plot^{-1}$) was obtained in the treatment combination of Zn_5 × S_5 (Table 3).

Graded Seed Yield (Kg $plot^{-1}$)

The interaction effect of zinc and sulphur did not show significant differences on graded seed yield (Kg $plot^{-1}$) of Indian mustard, however, numerically highest graded seed yield (2.53 Kg $plot^{-1}$) was obtained in the treatment combination of Zn_5 × S_5 while lowest (1.93 Kg $plot^{-1}$) was obtained in the treatment combination of without zinc and Sulphur applied plot (Zn_0 × S_0) (Table 4).

Raw Seed Yield (Kg ha^{-1})

Combined application of various doses of zinc and sulphur did not show significant effect on raw seed yield of Indian mustard. The maximum raw seed yield (2886.77 Kg ha^{-1}) of Indian mustard was produced with the application of highest tested doses of Zn_5 × S_5 while it was lowest (2426.88 Kg ha^{-1}) in Zn_1× S_0 applied plot (Table 4).

Graded Seed Yield (Kg ha^{-1})

The interaction effect of different doses of zinc and sulphur did not show significant effect on graded seed yield (Kg ha^{-1}) of Indian mustard. The numerically maximum graded seed yield (2814.26 Kg ha^{-1}) of Indian mustard was obtained with the treatment combination of Zn_5 × S_5, however, it was

minimum (2143.28 Kg ha^{-1}) in $Zn_1 \times S_0$ applied plot (Table 4).

1000-Seed Weight

Interaction of different levels of zinc and sulphur did not show significant effect on 1000-seed weight of Indian mustard. The maximum 1000-seed weight (5.84 g) was obtained with treatment combinations of $Zn_5 \times S_5$ while minimum (4.79 g) was observed in absolute control plots $Zn_0 \times S_0$ (Table 5).

Discussion

Effect of Zinc, Sulphur and their Interaction on Yield Attributing Characters and Yield of Indian Mustard

An application of zinc and sulphur had affected significantly to yield and yield attributing parameters under study. Various levels of zinc and sulphur applied showed significant effect. The interaction of sulphur and zinc influenced significantly to the number of primary and secondary branches plant^{-1} of Indian mustard. The combination of 10.0 Kg Zn ha^{-1} + 50 Kg S ha^{-1} recorded maximum number of primary and secondary branches plant^{-1}. These results are in close conformity with the findings of Subash and Yadav (2007) [22], Singh and Verma (2007) [18], Tripathi (2011) [23], Verma *et al*. (2012), Baudh and Prasad (2012) [2], Singh *et al*. (2012) [20] and Dubey *et al*. (2013) [5].

The interaction effect of different doses of zinc and sulphur did not influence to days taken of 50 per cent flowering of Indian mustard. The combination of 10.0 Kg Zn ha^{-1} and 50 Kg S ha^{-1} had taken maximum days to 50 per cent flowering while minimum days taken for 50 per cent flowering in absolute control. Maurya (2012) [11] reported that application of 60 Kg S ha^{-1} had taken significantly more time for 50 per cent heading as compared to control in wheat.

The interaction effect of zinc and sulphur did not influence significantly on days taken to maturity of Indian mustard.

The interaction effect of various levels of zinc and sulphur did not show significant differences on number of siliquae plant^{-1}. Significant increase in number of siliquae plant^{-1} due to sulphur application had been reported by Sharma (1994), Kachroo (1995) [7], Kachroo and Kumar (1997) [8], Chauhan *et al.* (2002) [3], Sharawat *et al.* (2002) [15], Rout *et al.* (2004) [14], Singh and Meena (2004), Sharma *et al.* (2005) [17], Singh *et al.* (2007) [18], Sharifi (2012) [16], Singh *et al.* (2012) [20], Verma *et al.* (2012) and Dubey *et al.* (2013) [5]. The increase in number of siliquae plant^{-1} with zinc application have also been reported by Subbaiah and Mittra (1996) [21], Mina *et al.* (2003) [12], Kumar *et al.* (2005) [9], Husain and Kumar (2006) [6], Singh *et al.* (2007) [18], Verma *et al.* (2012) and Dubey *et al.* (2013) [5].

The interaction of different levels of zinc and sulphur showed significant effect on length of siliqua. Application of 12.5 Kg Zn ha^{-1} + 50 Kg S ha^{-1} recorded maximum length of siliqua while minimum length of siliqua was recorded in absolute control plot.

The interaction effect of different doses of zinc and sulphur did not show any significant effect on number of seeds siliqua^{-1}. Number of seeds siliqua^{-1} was numerically maximum with the application 12.5 Kg Zn ha^{-1} + 50 Kg S ha^{-1} while minimum number of seeds siliqua^{-1} was recorded in absolute control plot.

The interaction effect of various levels of zinc and sulphur did not influence significantly on raw seed yield and graded seed yield of Indian mustard. Numerically highest raw seed yield and graded seed yield (Kg plot^{-1} and Kg ha^{-1}) was recorded with the combination of 12.5 Kg Zn ha^{-1} + 50 Kg S ha^{-1} ($Zn_5 \times S_5$) while it was minimum in absolute control plot. Jat *et al.* (2008) reported that combined application of 2.5 Kg Zn ha^{-1} + 40 Kg S ha^{-1} significantly increased seed yield and yield attributes of mustard. Similar results were obtained by Tripathi *et al.* (2011) [23], Baudh and Prasad (2012) [2], Singh *et al.* (2012) [20], Verma *et al.* (2012), Dubey *et al.* (2013) [5] and Chaudhary *et al.* (2014).

Table 1: Interaction Effect of Zinc and Sulphur on Plant Height (cm), Primary Branches Plant^{-1} Secondary Branches Plant^{-1}in Indian Mustard Variety Urvashi (Pooled).

Sulphur	Plant Height (cm)						Primary Branches Plant^{-1}						Secondary Branches Plant^{-1}					
Zinc	0 Kg S ha^{-1} (S_0)	10 Kg S ha^{-1} (S_1)	20 Kg S ha^{-1} (S_2)	30 Kg S ha^{-1} (S_3)	40 kg S ha^{-1} (S_4)	50 kg S ha^{-1} (S_5)	0 Kg S ha^{-1} (S_0)	10 Kg S ha^{-1} (S_1)	20 Kg S ha^{-1} (S_2)	30 Kg S ha^{-1} (S_3)	40 kg S ha^{-1} (S_4)	50 kg S ha^{-1} (S_5)	0 Kg S ha^{-1} (S_0)	10 Kg S ha^{-1} (S_1)	20 Kg S ha^{-1} (S_2)	30 Kg S ha^{-1} (S_3)	40 kg S ha^{-1} (S_4)	50 kg S ha^{-1} (S_5)
0.0 Kg Zn ha^{-1}(Zn_0)	173.49	174.42	175.88	176.47	178.11	179.62	4.18	5.02	5.55	6.05	6.38	6.83	8.50	8.63	9.15	9.78	10.82	11.28
2.5 Kg Zn ha^{-1}(Zn_1)	173.89	175.47	177.25	178.44	180.99	182.01	4.28	5.20	5.70	6.18	6.85	7.23	8.58	8.78	9.35	10.08	10.97	11.63
5.0 kg Zn ha^{-1} (Zn_2)	174.44	176.01	177.96	179.62	183.44	184.06	4.37	5.37	5.83	6.25	7.05	7.98	8.72	9.05	9.68	10.30	11.36	11.95
7.5 Kg Zn ha^{-1}(Zn_3)	174.87	176.92	178.60	180.68	184.04	184.90	4.43	5.43	5.98	6.47	7.42	8.20	8.77	9.27	9.90	10.67	12.53	12.87
10.0 kg Zn ha^{-1}(Zn_4)	175.35	177.38	179.09	181.56	184.65	185.48	4.67	5.65	6.35	6.65	8.22	8.90	8.85	9.43	10.25	11.52	13.46	13.89
12.5 kg Zn ha^{-1}(Zn_5)	175.97	178.05	180.08	182.78	185.17	185.98	4.83	5.70	6.40	6.70	8.32	8.93	8.88	9.58	10.55	11.72	13.56	13.98
SE (d)	0.86						0.24						018					
CD (p = 0.05)	1.69						0.48						0.36					

Table 2: Interaction Effect of Zinc and Sulphur on Days to 50%, Number of Siliquae Plant^{-1} Length of Siliqua (cm)Flowering in Indian Mustard Variety Urvashi (Pooled).

Sulphur	Days to 50%						Number of Siliquae Plant^{-1}						Length of Siliqua (cm)					
Zinc	0 Kg S ha^{-1} (S_0)	10 Kg S ha^{-1} (S_1)	20 Kg S ha^{-1} (S_2)	30 Kg S ha^{-1} (S_3)	40 kg S ha^{-1} (S_4)	50 kg S ha^{-1} (S_5)	0 Kg S ha^{-1} (S_0)	10 Kg S ha^{-1} (S_1)	20 Kg S ha^{-1} (S_2)	30 Kg S ha^{-1} (S_3)	40 Kg S ha^{-1} (S_4)	50 Kg S ha^{-1} (S_5)	0 Kg S ha^{-1} (S_0)	10 Kg S ha^{-1} (S_1)	20 Kg S ha^{-1} (S_2)	30 Kg S ha^{-1} (S_3)	40 kg S ha^{-1} (S_4)	50 kg S ha^{-1} (S_5)
0.0 Kg Zn ha^{-1}(Zn_0)	55.70	55.80	56.70	57.50	58.30	59.20	191.10	240.99	251.95	262.05	273.81	283.83	3.93	4.08	4.14	4.26	4.37	4.49
2.5 Kg Zn	56.35	56.85	57.50	58.25	59.45	60.35	232.51	249.01	258.16	269.73	281.45	291.28	4.25	4.35	4.43	4.55	4.70	4.83

ha^{-1}(Zn$_1$)																		
5.0 kg Zn ha^{-1} (Zn$_2$)	57.58	57.70	58.15	58.95	59.80	61.20	241.39	251.11	261.26	274.00	285.42	298.05	4.33	4.42	4.51	4.62	4.84	4.97
7.5 Kg Zn ha^{-1}(Zn$_3$)	58.15	58.40	59.25	59.32	60.35	61.43	247.86	253.25	263.86	276.81	288.87	305.11	4.36	4.53	4.59	4.75	4.98	5.16
10.0 kg Zn ha^{-1}(Zn$_4$)	58.35	58.80	59.67	60.10	60.95	62.35	248.54	259.39	268.91	281.17	294.85	313.03	4.39	4.59	4.65	4.84	5.06	5.24
12.5 kg Zn ha^{-1}(Zn$_5$)	58.75	59.10	59.75	60.20	61.10	62.55	251.58	260.77	270.22	282.82	297.65	315.50	4.44	4.65	4.72	4.96	5.19	5.38
SE (d)	0.38						14.44						0.06					
CD (p = 0.05)	N.S.						N.S						0.12					

Table 3: Interaction Effect of Zinc and Sulphur on Number of Seeds Siliqua$^{-1,}$ Days taken to Maturity, Raw Seed Yield (Kg Plot^{-1})in Indian Mustard Variety Urvashi (Pooled).

Sulphur	**Number of Seeds Siliqua^{-1}**						**Days taken to Maturity**						**Raw Seed Yield (Kg Plot^{-1})**					
Zinc	**0 Kg S ha^{-1} (S$_0$)**	**10 Kg S ha^{-1} (S$_1$)**	**20 Kg S ha^{-1} (S$_2$)**	**30 Kg S ha^{-1} (S$_3$)**	**40 kg S ha^{-1} (S$_4$)**	**50 kg S ha^{-1} (S$_5$)**	**0 Kg S ha^{-1} (S$_0$)**	**10 Kg S ha^{-1} (S$_1$)**	**20 Kg S ha^{-1} (S$_2$)**	**30 Kg S ha^{-1} (S$_3$)**	**40 kg S ha^{-1} (S$_4$)**	**50 kg S ha^{-1} (S$_5$)**	**0 Kg S ha^{-1} (S$_0$)**	**10 Kg S ha^{-1} (S$_1$)**	**20 Kg S ha^{-1} (S$_2$)**	**30 Kg S ha^{-1} (S$_3$)**	**40 kg S ha^{-1} (S$_4$)**	**50 kg S ha^{-1} (S$_5$)**
0.0 Kg Zn ha^{-1}(Zn$_0$)	11.33	11.62	11.94	12.34	12.93	13.35	131.00	131.67	132.83	133.17	133.50	134.00	2.19	2.21	2.25	2.32	2.39	2.45
2.5 Kg Zn ha^{-1}(Zn$_1$)	11.67	11.94	12.15	12.53	13.29	14.01	131.33	132.83	133.00	133.83	134.50	134.67	2.18	2.23	2.27	2.33	2.44	2.51
5.0 kg Zn ha^{-1} (Zn$_2$)	11.90	12.16	12.31	12.80	13.53	14.25	132.17	133.33	133.67	134.17	134.67	135.17	2.21	2.26	2.30	2.35	2.47	2.54
7.5 Kg Zn ha^{-1}(Zn$_3$)	11.98	12.26	12.46	12.97	13.92	14.45	132.33	133.67	133.67	134.83	135.83	135.67	2.23	2.29	2.32	2.38	2.50	2.55
10.0 kg Zn ha^{-1}(Zn$_4$)	12.01	12.34	12.64	13.28	14.16	14.91	132.83	133.83	134.17	135.00	135.83	136.17	2.24	2.33	2.37	2.43	2.55	2.59
12.5 kg Zn ha^{-1}(Zn$_5$)	12.04	12.38	12.82	13.46	14.21	15.19	133.00	134.00	134.33	135.17	136.17	136.33	2.26	2.36	2.41	2.48	2.57	2.58
SE (d)	0.18						0.57						0.03					
CD (p = 0.05)	N.S.						N.S.						N.S					

Table 4: Interaction Effect of Zinc and Sulphur on Graded Seed Yield (Kg Plot^{-1}), Raw Seed Yield (Kg ha^{-1}), Graded Seed Yield (Kg ha^{-1}) in Indian Mustard Variety Urvashi.

Sulphur	**Graded Seed Yield (Kg Plot^{-1})**						**Raw Seed Yield (Kg ha^{-1})**						**Graded Seed Yield (Kg ha^{-1})**					
Zinc	**0 Kg S ha^{-1} (S$_0$)**	**10 Kg S ha^{-1} (S$_1$)**	**20 Kg S ha^{-1} (S$_2$)**	**30 Kg S ha^{-1} (S$_3$)**	**40 kg S ha^{-1} (S$_4$)**	**50 kg S ha^{-1} (S$_5$)**	**0 Kg S ha^{-1} (S$_0$)**	**10 Kg S ha^{-1} (S$_1$)**	**20 Kg S ha^{-1} (S$_2$)**	**30 Kg S ha^{-1} (S$_3$)**	**40 kg S ha^{-1} (S$_4$)**	**50 kg S ha^{-1} (S$_5$)**	**0 Kg S ha^{-1} (S$_0$)**	**10 Kg S ha^{-1} (S$_1$)**	**20 Kg S ha^{-1} (S$_2$)**	**30 Kg S ha^{-1} (S$_3$)**	**40 kg S ha^{-1} (S$_4$)**	**50 kg S ha^{-1} (S$_5$)**
0.0 Kg Zn ha^{-1}(Zn$_0$)	1.93	1.98	2.06	2.16	2.28	2.39	2431.26	2458.11	2504.57	2576.77	2649.84	2728.38	2145.48	2200.01	2284.88	2395.08	2537.17	2655.46
2.5 Kg Zn ha^{-1}(Zn$_1$)	1.93	1.99	2.07	2.17	2.33	2.45	2426.88	2474.41	2525.11	2588.24	2705.26	2785.10	2143.28	2214.60	2304.12	2405.74	2590.17	2720.87
5.0 kg Zn ha^{-1} (Zn$_2$)	1.95	2.02	2.09	2.19	2.36	2.48	2457.79	2512.86	2548.50	2611.66	2741.30	2815.49	2168.95	2249.15	2325.43	2427.48	2621.72	2750.55
7.5 Kg Zn ha^{-1}(Zn$_3$)	1.97	2.05	2.12	2.22	2.39	2.49	2476.10	2544.13	2594.85	2648.39	2777.29	2830.97	2185.11	2277.00	2358.57	2461.59	2659.08	2765.64
10.0 kg Zn ha^{-1}(Zn$_4$)	1.98	2.08	2.16	2.26	2.43	2.52	2492.44	2578.51	2630.27	2700.99	2819.75	2860.45	2199.51	2307.77	2400.00	2510.37	2699.78	2794.45
12.5 kg Zn ha^{-1}(Zn$_5$)	1.99	2.23	2.17	2.28	2.45	2.53	2499.85	2594.95	2660.60	2728.54	2847.80	2886.77	2206.03	2322.98	2410.10	2535.78	2726.57	2814.26
SE (d)	0.07						17.13						13.39					
CD (p = 0.05)	N.S						N.S.						N.S.					

Table 5: Interaction Effect of Zinc and Sulphur on 1000-Seed Weight (g), Seed Germination (%) Seedling Length (cm) in Indian Mustard Variety Urvashi.

Sulphur	**1000-Seed Weight (g)**					
Zinc	**0 Kg S ha^{-1} (S$_0$)**	**10 Kg S ha^{-1} (S$_1$)**	**20 Kg S ha^{-1} (S$_2$)**	**30 Kg S ha^{-1} (S$_3$)**	**40 kg S ha^{-1} (S$_4$)**	**50 kg S ha^{-1} (S$_5$)**
0.0 Kg Zn ha^{-1}(Zn$_0$)	4.79	4.87	4.94	5.02	5.30	5.54
2.5 Kg Zn ha^{-1}(Zn$_1$)	4.82	4.94	5.02	5.24	5.54	5.66
5.0 kg Zn ha^{-1} (Zn$_2$)	4.84	4.97	5.06	5.29	5.58	5.72
7.5 Kg Zn ha^{-1}(Zn$_3$)	4.88	5.08	5.15	5.33	5.63	5.75
10.0 kg Zn ha^{-1}(Zn$_4$)	4.90	5.03	5.12	5.38	5.65	5.79
12.5 kg Zn ha^{-1}(Zn$_5$)	4.94	5.04	5.15	5.40	5.69	5.84
SE (d)	0.04					
CD (p = 0.05)	N. S					

References

1. Anonymous. Agriculture Statistics at glance, Directorate of Ministry of Agriculture (GOI), New Delhi, 2013. 2015.
2. Baudh AK, Prasad G. Interaction on Effect of Different dose of Sulphur and Zinc with Nitrogen, Phosphorus and Organic Manure on Growth and Productivity of Mustard (*Brassica Compestris*). Indian J Sci. Res 2012;3(1):141-144.
3. Chauhan DR, Ram M, Singh I. Response of Indian Mustard (*Brassica juncea* L.) to Irrigation and Fertilization with Various Sources and Levels of Sulphur. Indian J Agron 2002;47(3):422-426.
4. Choudhary P, Jhajharia A, Kumar R. Influence of Sulphur and Zinc Fertilization on Yield, Yield Components and Quality Traits of Soybean (*Glycine Max* L.). The Bioscan 2014;9(1):137-142.
5. Dubey SK, Tripathi SK, Singh B. Effect of Sulphur and Zinc Levels on Growth, Yield and Quality of Mustard (*Brassica Juncea* L. Czern & Coss). J Crop Sci. and Tech 2013;2(1):1-11.
6. Husain MF, Kumar R. Influence of Sowing Dates and Application of Zinc on the Performance of Mustard in South-west Semi arid Zone of U.P. International J. Agril. Sci 2006;2(2):601-604.
7. Kachroo D. Influence of Nitrogen and Sulphur Fertilization on Growth, Yield and Quality of Mustard (*Brassica Juncea* L.). Thesis Ph.D. G.B. Pant Univ. of Agri. And Tech., Pantnagar, Uttarakhand, 1995.
8. Kachroo D, Kumar A. Nitrogen and Sulphur Fertilization in Relation to Yield Attributes and Seed Yield of Indian Mustard (*Brassica Juncea* L.). Indian J. Agron 1997;42(1):145-147.
9. Kumar M. Effect of Nutrients on Yield and Seed Quality of Indian Mustard [*Brassica Juncea* (L.) Czern & Coss.]. Thesis Ph.D. C.S.A. Univ. of Agri. And Tech., Kanpur, Uttar Pradesh 2005, 105-113.
10. Hedge DM. The Hindu Survey of Indian Agriculture, 2004.
11. Maurya M. Management of Zinc and Sulphur for Maximizing Seed Yield and Seed Quality of Wheat (*Triticum Aestivum L.*). Thesis, CSAUA & T, Kanpur 2012, 77-80.
12. Mina BL, Manoher RS, Chaudhary DR. Yield Attributes, Yield and Quality of Mustard (*Brassica Juncea* L.) as Influenced by Phosphorous and Zinc Nutrition. Ann. of Agri. Res 2003;24(1):87-90.
13. Sadasania RM. Studies on sulpher avibilty in soil of North West Gujrat. M. Sc. Thesis GAU, Sardrkrushinagar, 1992.
14. Raut RF, Hamid A, Ganvir MM. Effect of Irrigation and Sulphur on Growth and Yield of Mustard. Annals Plant Physiol 2004;17(1):12-16.
15. Sharawat S, Singh TP, Singh JP, Sharawat S. Effect of Nitrogen and Sulphur on the Yield and Oil Content of Varuna Mustard (*Brassica Juncea* L.). Progr. Agri 2002;2(2):177.
16. Sharifi RS. Study of Yield & Yield Attribute and Dry Matter Accumulation of Canola (*B. Napus* L.) in Relation to Sulphur Fertilizers. International J Agric. & Crop Sci 2012;4(7):409-415.
17. Sharma R, Dahiya SS, Yadav HD, Singh M. Effect of Sulphur Application on Yield Attributes, Yield, S Uptake and Oil Content of Indian Mustard (*Brassica Juncea* L.). Har. Agric. Uni. J Res 2005;35(2):135-138.
18. Singh D, Verma BS. Effect of Different Sources of Sulphur on the Yield of Indian Mustard (*Brassica Juncea* L.) in Pearl Millet-mustard Cropping System. Annals of Biology 2007;23(1):17-18.
19. Singh M, Kumar M. Effect of Nitrogen and Sulphur Levels on Seed Yield and Some Others Characters in Mustard [*Brassica Juncea* (L.) Czern and Coss]. Indian J of Agric. Sci 2014;10(1):449-452.
20. Singh R, Singh SB, Manahas SS, Kumar A. Effect of Different Levels of Sulphur and Varieties on Growth, Yield and Quality of Indian Mustard. International J Plant Sci 2012;7(2):290-294.
21. Subbaiah G, Mittra BN. Effect of Foliar Spray of Micronutrients on Yield and Oil Content of Indian Mustard (*Brassica Juncea* L.). Indian J Agro 1996; 41(1):95-97.
22. Subhash A, Yadav KK. Effect of Sulphur and Zinc on Growth, Yield, Quality and Net Returns of Mustard [*Brassica Juncea* (L.) Czern and Coss.]. Current Agric 2007;31(1-2):127-129.
23. Tripathi MK, Chaturvedi S, Shukla DK, Saini SK. Influence of Integrated Nutrient Management on Growth, Yield and Quality of Indian Mustard (*Brassica Juncea* L.) in Tarai Region of Northern India. J of Crop & Weed 2011;7(2):104-107.