Original Research Article

Effect of Potassium & Zinc on the Yield attributes and Economics of Mustard (*Brassica juncea* L.)

ABSTRACT

A field experiment was carried out in the North Eastern Plains of Eastern Uttar Pradesh during the rabi season of 2022 at the agricultural research farm of the Department of Agronomy at Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagrajwith the objective of examining the impact of potassium and zinc on mustard (Brassica juncea L.) Var. growth, yield, and economics using a randomised block design with 10 treatments, of which treatments (T1-T9) T1 – 30 kg K/ha + 5 kg Zn/ha, T2 – 30 kg K/ha + 10 kg Zn/ha, T3 – 30 kg K/ha + 15 kg Zn/ha, T4 – 40 kg K/ha + 5 kg Zn/ha, T5 – 40 kg K/ha + 10 kg Zn/ha, T6 – 40 kg K/ha + 15 kg Zn/ha, T7 – 50 kg K/ha + 5 kg Zn/ha, T8- 50 kg K/ha + 10 kg Zn/ha, T9 – 50 kg K/ha + 15 kg Zn/ha and T10 – Controlwith three separate replications of potassium, zinc, and different combinations of nitrogen and phosphorus.The soil in the exploratory plot had a sandy loam texture, a natural pH of 7.2, an EC of 0.26 (dS/m), a low level of organic carbon (0.48%), and available amounts of N (225 kg/ha), P (13.60 kg/ha), and K (215.4 kg/ha).The experimental findings showed that 50 kg K/ha + 15 kg Zn/ha resulted in the maximum plant height (193.45 cm), the highest plant dry weight (35.25 gm), the number of siliqua/plant (302.20), the number of seeds/siliqua (17.60), the seed yield (2685 kg/ha), and the stover yield (6143 kg/ha). The maximum gross return (136910.00 INR/ha), net return (93070.00 INR/ha), and benefit cost ratio (2.11) were recorded for the treatment 50 kg K/ha + 15 kg Zn/ha. Add the background of the research

Keywords: Mustard, Potassium, Zinc, Yield, Economics the keywords should be in alphabetical order

INTRODUCTION

India is an important rapeseed-mustard growing country in the world, occupying largest area and has second position in production after China. The name mustard is derived from the Latin word 'mustum', which mean old wine mixed with crushed seed. In India, rape seed mustard is cultivated in 5.74 million hectare in a wide range of agro-ecological conditions with the production of 6.79 million ~~tonne~~tons of rapeseed mustard has productivity of 1,186 kg /ha**(Anon., 2017).** In the recent past, the area under brown mustard is increased at the cost of other *Brassicas* due to its higher productivity and tolerance to biotic and abiotic stresses.

Mustard cultivation is confined only to northern India because of late maturity and shattering of pods owing to high temperature prevailing during harvest in February-March. Indian mustard (*Brassica juncea*L.) is cultivated in the states of Assam, Bihar, Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Madhya Pradesh, North Eastern states, Orissa, Punjab, Rajasthan, Uttar Pradesh and West Bengal. Its cultivation is also being popularized in some non-traditional areas such as Karnataka, Andhra Pradesh and Tamil Nadu in recent years.

In addition to the oil, most plant parts of rapeseed-mustard such as seed, sprouts, leaves and tender parts are also of great use to human health and consumed as spices and vegetables. These plant parts are rich in dietary fiber (1.08 g per 100 g on fresh weight basis), omega-3 fatty acids (0.20 g per 100 g on fresh weight basis), calcium (38.92 mg per 100 g on fresh weight basis) and protein (1.88 g per 100 g on fresh weight basis) **(Anon., 2014).** The oil and fats serve as important raw materials for manufacture of paints, soaps, varnishes, hair oil, lubricants, textile auxiliaries and pharmaceuticals. The oil cake is used as cattle feed.

Potassium is one of three major essential nutrient elements required by plants. It is involved in nearly all processed needed to sustain the plant life. While K is not used by the plant as a building block for organic compounds, it functions as an activator for many enzymes and metabolic pathways, including those for photosynthesis and protein and starch formation in grain. Potassium plays a role in the flow of water, nutrients and carbohydrates within the plant. It plays a role in the regulation of stomata closing and opening, thus impacting the exchange of water and gases. Additionally, K is key for cell wall strength and cellulose production. Good K fertility is associated with strong cell walls that enhance disease resistance and the ability of the crop to maintain firm, healthy stalks. Potassium is known to help crop to perform better under water stress through the regulation of the rate at which plant stomata open and close. It is also known for its role to provide lodging resistance and insect/disease resistance to plants. Since, potassium is involved in many metabolic pathways that affect crop quality, it is often called as "the quality element" **(Subba Rao and Srinivasarao, 1996).**

Different factors like improper fertilization and weed management (Chaudhary *et al.*, 2008), micronutrient deficiencies, rainfed growing condition and poor plant population are considered as the reasons for low yield of rapeseed. Nutrient management is one of the most important agronomic factors that influence the yield of Indian mustard. The nutrient requirement of oilseed crops in general and micronutrients in particular are high which are to be supplied in adequate quantities. The total nutrients absorbed by a crop producing one tonne of seed per hectare are of the order (in kilograms): N 300-350, P_2O_5 120-140, K_2O 300-400, Zn 100g and B -36 g **(Aulakh, 2012).**

Hence, nutrient management plays a important role in enhancing the production of mustard. Zinc is one of the essential micronutrient elements required by plants. Zinc has pivotal role in auxin and protein synthesis, seed production, rate of maturity and membrane integrity. It promotes RNA synthesis in absence of it, carbohydrate metabolism is greatly hampered. Apart from this, it helps in cell development, respiration, photosynthesis, chlorophyll formation and enzyme activity. Zinc application also influences the oil content in oil seed crops. Zinc is vital for vigorous growth and natural resistance to disease, pest and stress. Mustard plants absorb zinc in larger amounts than any other micronutrient **(Bartaria *et al.*, 2002).**

MATERIALSANDMETHODS

A field experiment was conducted during the rabi season of 2022, at Crop research farm of Department of Agronomy at Sam Higginbottom University of Agriculture, Technology, and Sciences, Prayagraj. To assess the effect of potassium and zinc on growth and yield of Mustard (*Brassica juncea*L.). The experiment was laid out in Randomized Block Design comprising of 10 treatments which are replicated thrice. Each treatment net plot size is 3m × 3m. The treatment are categorized as with recommended dose of nitrogen through urea and phosphorus through DAP, in addition with Potassium and zinc when applied in combinations as follows, (T_1) 30 kg K/ha + 5 kg Zn/ha, (T_2) 30 kg K/ha + 10 kg Zn/ha, (T_3) 30 kg K/ha + 15 kg Zn/ha, (T_4) 40 kg K/ha + 5 kg Zn/ha, (T_5) 40 kg K/ha + 10 kg Zn/ha, (T_6) 40 kg K/ha + 15 kg Zn/ha, (T_7) 50 kg K/ha + 5 kg Zn/ha, (T_8) 50 kg K/ha + 10 kg Zn/ha, (T_9) 50 kg K/ha + 15 kg Zn/ha and (T_{10}) Control. The mustard crop was harvested treatment wise at harvesting maturity stage.Growth parameters viz. plant height (cm), dry matter accumulation g/plantwere recorded manually on five randomly selected representative plants from each plot of each replication separately andafter harvesting, seeds were separated from each net plot and were dried under sun for five days. Later winnowed, cleaned and seed yield per ha was computed and expressed in kilogram per hectare. After complete drying under sun for 10 days stover yield from each net plot was recorded and expressed in kilogram per hectare. The data was computed and ~~analysed~~analyzed by following statistical method of Gomez and Gomez (1984). The benefit cost ratio was worked out after price value of seed with straw and total cost included in crop cultivation.

RESULTSANDDISSCUSIONS

Yield and Yield Attributes:

Number of siliqua/plant

The statistical examination of the number of siliqua per plant revealed a significant influence.The 50 kg K/ha + 15 kg Zn/ha treatment produced a considerably larger quantity of siliqua/plant (302.20).However, it was discovered that 50 kg K/ha + 10 kg Zn/ha was statistically equivalent to 50 kg K/ha + 15 kg Zn/ha.The number of siliqua/plant has grown due to increasing potassium and zinc doses. Potassium has been shown to boost the absorption of both native and supplemented main nutrients, resulting in an increase in the number of siliqua/plant. Furthermore, potassium application can be linked to its function in numerous enzymatic reactions, growth processes, hormone generation, and protein synthesis, as well as the transport of photosynthates to reproductive regions, resulting in increased siliqua per plant. **Bhati et al. (2014)** reported comparable findings. This could be due to optimal Zn availability, which could have resulted in balanced nutrition. **Kaur et al. (2017)** reported comparable findings.

Number of seeds/siliqua

The statistical examination of number of seeds/siliqua revealed a significant influence. The maximum number of seeds/siliqua (17.60) was recorded in the treatment of 50 kg K/ha + 15 kg Zn/ha. However, 50 kg K/ha + 5 kg Zn/ha, 50 kg K/ha + 10 kg Zn/ha, and 50 kg K/ha + 15 kg Zn/ha both achieved statistical parity.Increased potassium and zinc dosage has led to an increase in the number of seeds/siliqua. According to several reports, potassium improves the absorption of both natural and additional key nutrients. In addition, potassium's use can be explained by its function in a number of enzymatic processes, growth, hormone production, protein synthesis, and the transport of photosynthates to reproductive organs, which increases the number of seeds produced per siliqua. **Bhati et al. (2014)** showed similar results as well. This could be attributed to optimal Zn availability, which may have led to balanced nutrition. **Kaur et al., (2017)** also observed similar findings.

Seed yield

Different combinations of potassium and zinc with nitrogen and phosphorus greatly altered seed production. With the administration of potassium and zinc to mustard, seed yield increased. It increased from 2081 kg/ha under control to 2685 kg/ha when 50 kg K/ha + 15 kg Zn/ha were applied. Under 50 kg K/ha + 15 kg Zn/ha, the maximum seed yield (2685 kg/ha) was reported.However, it was discovered that 50 kg K/ha + 10 kg Zn/ha was statistically equivalent to 50 kg K/ha + 15 kg Zn/ha. The seed yield was affected by the potassium application levels.Higher potassium dosages were related with higher seed yield due to improved vegetative growth as demonstrated by increased dry matter production.Yadav et al. (2013), **Abha et al. (2015)**, and **Singh et al. (2013)** all found similar findings. The increase in mustard seed yield under higher zinc supply may be attributed mostly to the combined effect of a higher number of siliqua/plant and number of seeds/siliqua, which was the result of improved photosynthesis translocation from source to sink. Similarly, **Chandra and Khandelwal (2009)** and **Meena et al. (2006)** reported similar findings.

Stover yield

The treatment of potassium and zinc had an impact on the mustard stover yield as well; it changed from 5591 kg/ha under control to 6143 kg/ha with the application of 50 kg K/ha + 15 kg Zn/ha. Although 50 kg K/ha + 15 kg Zn/ha produced the highest stover production (6143 kg/ha), 50 kg K/ha + 10 kg Zn/ha was discovered to be statistically equivalent to 50 kg K/ha + 15 kg Zn/ha. The seed and stover output was impacted by the potassium application at various amounts. Due to improved vegetative development as seen by more dry matter production, the higher stover yield was linked to higher potassium doses.**Yadav et al. (2013), Abha et al. (2015), and Singh et al. (2013)** all found similar findings. The combined effect of a higher number of siliqua/plant and number of seeds/siliqua, which was the result of better translocation of photosynthesis from source to sink, may be attributed primarily to the rise in stover output of mustard under higher zinc supply. Both **Chandra and Khandelwal (2009)** and **Meena et al. (2006)** observed similar findings.

Effectoneconomicsonmustard

The 50 kg K/ha + 15 kg Zn/ha produced the maximum grain production (2685 kg/ha), gross return

(136910.00 INR/ha), net return (93070.00 INR/ha), and benefit cost ratio (2.11), among the various combinations of nutrient sources. Indicate from which table the discussion is made for every sub sections

CONCLUSION

It is concluded that the treatment T9 with the combination of Potassium (50 kg/ha) + Zinc (15 kg/ha) in the Mustard crop was found significantly more productive. It is also recorded that maximum Benefit cost ratio (2.11) as compared to other treatment combinations. Since the findings are based on one season, further trails may be required for further confirmation

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Table1.Effect of Potassium and Zinc on yield attributing characters of mustard.

S.No.	Treatments	No. of siliqua/plant	No. of seeds/siliqua	Seed Yield (Kg/ha)	Stover Yield (Kg/ha)
1	30 kg K/ha + 5 kg Zn/ha	274.27	14.30	2175	5653
2	30 kg K/ha + 10 kg Zn/ha	277.53	14.43	2226	5622
3	30 kg K/ha + 15 kg Zn/ha	279.27	14.67	2268	5701
4	40 kg K/ha + 5 kg Zn/ha	283.47	15.33	2335	5765
5	40 kg K/ha + 10 kg Zn/ha	287.47	15.67	2387	5710
6	40 kg K/ha + 15 kg Zn/ha	290.93	16.33	2466	5816
7	50 kg K/ha + 5 kg Zn/ha	291.60	16.73	2523	5845
8	50 kg K/ha + 10 kg Zn/ha	297.20	17.00	2611	6001
9	50 kg K/ha + 15 kg Zn/ha	302.20	17.60	2685	6143
10	Control (RDF)	266.53	13.87	2081	5591
	Sem (±)	2.63	0.40	26.73	75.62
	CD (5%)	7.82	1.20	79.41	224.67

Table2.Effect of Potassium and Zinc on economics of mustard.

S.No.	Treatments	Cost of cultivation(INR/ha)	Gross return (INR/ha)	Net return (INR/ha)	Benefit Cost ratio
1	30 kg K/ha + 5 kg Zn/ha	42500.00	110930.00	68430.00	1.61
2	30 kg K/ha + 10 kg Zn/ha	43000.00	113500.00	70500.00	1.64
3	30 kg K/ha + 15 kg Zn/ha	43500.00	115670.00	72170.00	1.66
4	40 kg K/ha + 5 kg Zn/ha	42840.00	119090.00	76250.00	1.78
5	40 kg K/ha + 10 kg Zn/ha	43340.00	121740.00	78400.00	1.81
6	40 kg K/ha + 15 kg Zn/ha	43840.00	125740.00	81900.00	1.87
7	50 kg K/ha + 5 kg Zn/ha	43170.00	128670.00	85500.00	1.98
8	50 kg K/ha + 10 kg Zn/ha	43670.00	133160.00	89490.00	2.05
9	50 kg K/ha + 15 kg Zn/ha	44170.00	136910.00	93070.00	2.11
10	Control (RDF)	42340.00	106110.00	63770.00	1.51