

# **Studies on Growth and Yield of Mustard (*Brassica juncea* L.) var. as influenced by Potassium and Zinc**

## **ABSTRACT**

A field experiment was conducted during *Rabi season* of 2022, at crop research farm, Department of Agronomy at Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj in North Eastern plains of Eastern Uttar Pradesh with the objective to study the effect of potassium and zinc on growth and yield of Mustard (*Brassica juncea* L.) Var. under Randomized block design comprising of 10 treatments of which treatments (T<sub>1</sub>-T<sub>9</sub>) with different combination of nitrogen and phosphorus along with potassium and zinc which are replicated thrice. The exploratory plot's soil had a sandy loam texture, a (pH 7.2) that was natural with EC - 0.26 (dS/m), a low in organic carbon (0.48 %), available N (225 kg/ha), available P (13.60 kg/ha) and available K (215.4 kg/ha). The experimental results revealed that 25 kg N/ha + 50 kg P/ha recorded Maximum plant height (193.45 cm), Highest plant dry weight (35.25 gm), number of siliqua/plant (302.20), number of seeds/siliqua (17.60), Seed yield (2685 kg/ha), Stover yield (6143 kg/ha).

**Key words-** Mustard, Potassium, Zinc, Growth, Yield

## **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 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 oil is used primarily for cooking and valued for vegetable, fodder, condiments and medicinal purposes. Mustard is nutritionally very rich and its oil content varies from 37 – 49 per cent. Indian mustard oil being rich source of the unsaturated fatty acids is primarily used for human consumption as desirable edible oil. The oil obtained from rapeseed-mustard is rich in unsaturated and low in saturated fatty acids. The seed and oil of mustard have peculiar pungency due to glycoside "Sinigrin" (C<sub>10</sub>H<sub>16</sub>O<sub>9</sub>NS<sub>2</sub>K) thus making it suitable for condiments and can be used for the preparation of pickles, curries. Oil in mustard seed was extracted by the soxhlet method. Grain and straw K contents were estimated by flame photometry following nitric and perchloric acid digestion of the samples (Jackson, 1973).

Potassium is one of the major nutrients in soil, amongst the mineral cations required by plant. The earth crust contain 2.4% potassium. It is largely present in complex silicate components; some potassium is associated with organic matter and clay fraction of soil. The potassium content

in the soil varies from 0.1% to 3.0 % or even more. Potash is also essential for absorbing water through the root system in conditions of soil moisture deficiency (**Umar, 2006**).

Micronutrients are as important to plant nutrition as primary and secondary nutrients, though plant don't require as much of them. Lack of any one of the micronutrients in the soil can limit growth, even when all other nutrients are present in adequate amounts. High yielding mustard crop removes more micronutrients from the soil which cannot be replenished from the use of high analysis NPK fertilizers contain lower quantities of micronutrient contaminants. So, there is need for micronutrients application in order to achieve balanced nutrition. Thus, there is an urgent need for stepping up the use of micronutrient in growing field crops. To enhance the productivity of crop, micronutrients like Fe, Mn, Cu and Zn need to be supplemented along with NPK fertilizers (**Kumar et al. 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**).

## MATERIALS AND METHODS

A field experiment was conducted during Rabi season of 2022, at Crop research farm of Department of Agronomy at Sam Higginbottom University of Agriculture, Technology, and Sciences, Prayagraj which is located at 25° 24' 42" N latitude, 81° 50' 56" E longitude and 98 m altitude above the mean sea level (MSL). 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<sub>1</sub>) 30 kg K/ha + 5 kg Zn/ha, (T<sub>2</sub>) 30 kg K/ha + 10 kg Zn/ha, (T<sub>3</sub>) 30 kg K/ha + 15 kg Zn/ha, (T<sub>4</sub>) 40 kg K/ha + 5 kg Zn/ha, (T<sub>5</sub>) 40 kg K/ha + 10 kg Zn/ha, (T<sub>6</sub>) 40 kg K/ha + 15 kg Zn/ha, (T<sub>7</sub>) 50 kg K/ha + 5 kg Zn/ha, (T<sub>8</sub>) 50 kg K/ha + 10 kg Zn/ha, (T<sub>9</sub>) 50 kg K/ha + 15 kg Zn/ha and (T<sub>10</sub>) Control. The mustard crop was harvested treatment wise at harvesting maturity stage. Growth parameters viz. plant height (cm), dry matter accumulation g/plant were recorded manually on five randomly selected representative plants from each plot of each replication separately and after harvesting, seeds were separated from each net plot and were dried under sun for three days. Later winnowed, cleaned and seed yield per ha was computed and expressed in tonnes per hectare. After complete drying under sun for 10 days stover yield from each net plot was recorded and expressed in tonnes per hectare. The data was computed and analysed 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.

## RESULTS AND DISSCUSIONS

### Effect on growth parameters:

#### Plant height

It is evident from Table 1. that plant height measured increased with advancement in crop growth. At Harvest maximum plant height 193.45 cm was recorded with 50 kg K/ha + 15 kg

Zn/ha, whereas treatment 50 kg K/ha + 5 kg Zn/ha, 50 kg K/ha + 10 kg Zn/ha were found to be statistically at par with treatment 50 kg K/ha + 15 kg Zn/ha. Plant height of mustard was influenced by the application of both potassium and zinc. Plant height was found to be increased with increased levels of Potassium and Zinc. Among potassium levels, application of 50 kg K/ha was recorded significantly higher plant height. The increased plant height was attributed to proper establishment of crop as it gives the strength to the plant tissues besides activation of numerous enzymes in the plant system. Similar results were also reported by Farhad *et al.* (2010). Increase in plant height due to adequate availability of zinc might be attributed to profuse root system which increases the plant growth by the enhancement in cell division because it influenced the formation of several growth hormones like IAA in plants. Similar results were also reported by (Husain and Kumar 2006).

#### **Dry matter accumulation**

At Harvest highest plant dry weight (35.25 g) was recorded with treatment 50 kg K/ha + 15 kg Zn/ha. However, treatment 50 kg K/ha + 5 kg Zn/ha, 50 kg K/ha + 10 kg Zn/ha were found to be statistically at par with 50 kg K/ha + 15 kg Zn/ha. Significantly higher dry matter production was recorded with the application of 50 kg K/ha. This was due to the favorable effect of higher dry matter distribution in leaf and siliqua. Application of potassium recorded higher LAI at all growth stages. It is because of the role of potassium in translocation of photosynthates from source to sink. Similar results were reported by Singh *et al.* (2013) in mustard. Dry matter production was significantly correlated to leaf area and leaf area index of plants. The supplementation of zinc resulted in increase in dry matter production. The addition of zinc to mustard crop led to more leaf, thus more photosynthetic area was available for light interception, this resulted in dry matter accumulation. Similar results were also reported by Kumar (2006).

#### **Yield and Yield Attributes:**

##### **Number of siliqua/plant**

Significant effect was observed by the statistical analysis of number of siliqua per plant. Treatment 50 kg K/ha + 15 kg Zn/ha resulted in significantly higher number of siliqua/plant (302.20). However, 50 kg K/ha + 10 kg Zn/ha were found to be statistically on par with 50 kg K/ha + 15 kg Zn/ha. Number of siliqua/plant have increased due to higher dose of potassium and zinc. Potassium is reported to enhance the absorption of native as well as added major nutrients and there by improves number of siliqua/plant. In addition potassium application may be attributed to its role in various enzymatic reactions, growth process, hormone production and protein synthesis and also translocation of photosynthates to reproductive parts there by leading higher siliqua per plant. Similar findings were also reported by Bhati *et al.*, (2014). This might be due to optimum availability of Zn which might have resulted in balanced nutrition. Similar findings were also reported by Kaur *et al.*, (2017).

##### **Number of seeds/siliqua**

Significant effect was observed by the statistical analysis of number of seeds/siliqua. Treatment 50 kg K/ha + 15 kg Zn/ha recorded significant and highest number of seeds/siliqua (17.60). However, 50 kg K/ha + 5 kg Zn/ha, 50 kg K/ha + 10 kg Zn/ha recorded statistical parity with 50 kg K/ha + 15 kg Zn/ha. Number of seeds/siliqua have increased due to higher dose of potassium and zinc. Potassium is reported to enhance the absorption of native as well as added major nutrient. In addition potassium application may be attributed to its role in various enzymatic reactions, growth process, hormone production and protein synthesis and also translocation of photosynthates to reproductive parts there by leading higher seeds per siliqua. Similar findings were also reported by

**Bhati et al., (2014).** This might be due to optimum availability of Zn which might have resulted in balanced nutrition. Similar findings were also reported by **Kaur et al., (2017).**

### **Seed yield**

Seed yield was significantly influenced with different combinations of Potassium and Zinc with Nitrogen and Phosphorus. The seed yield showed increasing trend with the application of potassium and zinc in mustard. It rose from 2081 kg/ha under control to 2685 kg/ha with the application of 50 kg K/ha + 15 kg Zn/ha. Significant and highest seed yield (2685 kg/ha) was observed under 50 kg K/ha + 15 kg Zn/ha. However, 50 kg K/ha + 10 kg Zn/ha was found to be statistically on par with 50 kg K/ha + 15 kg Zn/ha. Application different levels of potassium influenced the seed yield. The higher seed yield was associated with higher doses of potassium due to better vegetative growth as indicated by more dry matter production. Similar results were also reported by **Yadav et al., (2013), Abha et al., (2015) and Singh et al., (2013).** The increase in seed yield of mustard under higher zinc supply might be ascribed mainly due to combined effect of higher number of siliqua/plant and number of seeds/siliqua, which was the result of better translocation of photosynthesis from source to sink. Similar results were also reported **Chandra and Khandelwal (2009) and Meena et al. (2006).**

### **Stover yield**

The stover yield of mustard was also influenced by the application of potassium and zinc, it varied from 5591 kg/ha under control to 6143 kg/ha with the application of 50 kg K/ha + 15 kg Zn/ha. Highest stover yield (6143 kg/ha) was recorded with 50 kg K/ha + 15 kg Zn/ha, however, 50 kg K/ha + 10 kg Zn/ha was found to be statistically on par with 50 kg K/ha + 15 kg Zn/ha. Application different levels of potassium influenced the seed and stover yield. The higher stover yield was associated with higher doses of potassium due to better vegetative growth as indicated by more dry matter production. Similar results were also reported by **Yadav et al., (2013), Abha et al., (2015) and Singh et al., (2013).** The increase stover yield of mustard under higher zinc supply might be ascribed mainly due to combined effect of higher number of siliqua/plant and number of seeds/siliqua, which was the result of better translocation of photosynthesis from source to sink. Similar results were also reported **Chandra and Khandelwal (2009) and Meena et al. (2006).**

## **CONCLUSION**

Based on the above findings it is concluded that with the application of Potassium (50 kg/ha) along with Zinc (15 kg/ha) performs positively and improves the growth parameters, yield attributes of Mustard. Since the findings are based on one season, further trails may be required for further confirmation.

## **REFERENCES**

- Abha, T., Yadav, S. S., Singh, J. P. and Yadav, P. K., 2015. Potassium fertilization in pearl millet, cluster bean and Indian mustard crops of Southern Hararyana. *Environment and Ecology*, 33(3A):1258-1261.

- Anonymous, 2017, Area coverage, production and yield of oil seeds *rabi* and *kharif* season in India. Economic survey of India, New Delhi, www.Indiastatistic.com. p.21.
- Bartaria, A. M., Shukla, A. K., Kaushik, C. D., Kumar, P. R. and Singh, N. B., 2002. Major diseases of rapeseed – mustard and their management. *Proc. Nation. Sem., Biopesticide* Indian Agricultural Research Institute, New Delhi, p.24.
- Bhati, A. S., Sharma, S. K. and Yadav, R. S., 2014. Yield and Yield attributes of mustard as influenced by levels of potassium and its split application. *Indian Research Journal Genetics and Biotechnology*, **6**(3):518-520.
- Chandra, D. and Khandelwal, R.B. (2009). Effect of zinc and phosphorus on yield, nutrient uptake on oil content of mustard grown on the gypsum treated sodic soil. *Journal of Indian Society Soil Scienc*2009: **57** (1):194-197.
- Farhad, I. S. M., Islam, M. N., Hoque, S. and Bhuiyan, M. S. I., 2010. Role of potassium and sulphur on the growth, yield and oil content of soybean (*Glycine max*). *Academic Journal of Plant Science*, **3**(2):99-103.
- Gomez, K.A. and Gomez, A.A. (1984) Statistical Procedure for Agricultural Research. 2nd Edition, Willey, Hoboken, 28-192.
- Hussain, M.F. and Kumar, R. (2006). Influence of sowing dates and application of zinc on the performance of mustard in south-west semi arid zone of Uttar Pradesh. *International Journal of Agricultural Science*, **2**(2):601-604.
- Jackson, M.L. 1973. Soil Chemical Analysis. Printice Hall India Pvt. Ltd, New Delhi, India.
- Kaur, S., M. Gupta, R. Bharat and V. Sharma 2017. Effect of zinc and boron on yield, nutrient uptake and economics of mustard (*Brassica juncea* L.) in mustard-maize cropping sequence. *Bangladesh J. Bot.*, **46**(2):817-821.
- Kumar Vineet, Prem Nath, Rajesh Kumar, Vikas Kumar, Jugal Kishor Verma and R.K. Naresh, 2016. Interactive effect of sulphur and nitrogen on growth, yield and quality of Indian mustard (*Brassica juncea* L.). *I.J.S.N.*, **7**(1): 57-61.
- Kumar, A., Singh, S. and Singh, K. (2012) Effect of micronutrients on yield, quality and nutrient uptake by mustard in alluvial soil. *Annuals of Plant and Soil Research*. **14**: 68-70.

- Meena, M.C. Patel, K.P. and Rathod, D.D. (2006). Effect of Zn and Fe enriched FYM on mustard yield and micronutrient availability in loamy sand soil of Anand. *J. Indian Soc. Sci.*,54(4):495-499.
- Singh, P. Panotra, N., Singh, P., Singh, K. N. and Raihana, H. K., 2013. Interaction effect of sulphur and potassium on nutritional quality and profitability of brown sarson (*Brassica rapa var. brown sarson*) in temperate Kashmir. *Indian J. Agron.*, 58(1): 91-95.
- Umar, S. 2006. Alleviating adverse effects of water stress on yield of Sorghum, mustard and groundnut by potassium application. *Pakistan Journal of Botany*. 38: 1373-1380.
- Yadav, S. S., Tikoo, A. and Singh, J. P., 2013. Potassium response in Indian mustard (*Brassica juncea*) as influenced by irrigation and nutrient levels. *Indian J. Agron.*, 55(1): 56-59.

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**Table 1. Effect of Potassium and Zinc on growth parameters of mustard var. ‘at harvest**

| <b>T.No.</b>    | <b>Treatments</b>        | <b>Plant height (cm)</b> | <b>Dry matter accumulation (g/plant)</b> |
|-----------------|--------------------------|--------------------------|--|
| T <sub>1</sub>  | 30 kg K/ha + 5 kg Zn/ha  | 164.74                   | 32.00                                    |
| T <sub>2</sub>  | 30 kg K/ha + 10 kg Zn/ha | 171.07                   | 32.32                                    |
| T <sub>3</sub>  | 30 kg K/ha + 15 kg Zn/ha | 175.77                   | 32.71                                    |
| T <sub>4</sub>  | 40 kg K/ha + 5 kg Zn/ha  | 170.29                   | 33.25                                    |
| T <sub>5</sub>  | 40 kg K/ha + 10 kg Zn/ha | 181.33                   | 33.75                                    |
| T <sub>6</sub>  | 40 kg K/ha + 15 kg Zn/ha | 184.43                   | 34.13                                    |
| T <sub>7</sub>  | 50 kg K/ha + 5 kg Zn/ha  | 188.01                   | 34.29                                    |
| T <sub>8</sub>  | 50 kg K/ha + 10 kg Zn/ha | 190.13                   | 34.80                                    |
| T <sub>9</sub>  | 50 kg K/ha + 15 kg Zn/ha | 193.45                   | 35.25                                    |
| T <sub>10</sub> | Control (RDF)            | 162.89                   | 31.87                                    |
|                 | SEm (±)                  | 1.33                     | 0.33                                     |
|                 | CD (P 0.05)              | 3.94                     | 0.97                                     |

**Table 2. Effect of Potassium and Zinc on yield and yield attributing characters of mustard var. ‘**

| <b>T. No</b>    | <b>Treatments</b>        | <b>No. of siliqua/plant</b> | <b>No. of seeds/siliqua</b> | <b>Seed Yield (Kg/ha)</b> | <b>Stover Yield (Kg/ha)</b> |
|-----------------|--------------------------|-----------------------------|-----------------------------|---------------------------|-----------------------------|
| T <sub>1</sub>  | 30 kg K/ha + 5 kg Zn/ha  | 274.27                      | 14.30                       | 2175                      | 5653                        |
| T <sub>2</sub>  | 30 kg K/ha + 10 kg Zn/ha | 277.53                      | 14.43                       | 2226                      | 5622                        |
| T <sub>3</sub>  | 30 kg K/ha + 15 kg Zn/ha | 279.27                      | 14.67                       | 2268                      | 5701                        |
| T <sub>4</sub>  | 40 kg K/ha + 5 kg Zn/ha  | 283.47                      | 15.33                       | 2335                      | 5765                        |
| T <sub>5</sub>  | 40 kg K/ha + 10 kg Zn/ha | 287.47                      | 15.67                       | 2387                      | 5710                        |
| T <sub>6</sub>  | 40 kg K/ha + 15 kg Zn/ha | 290.93                      | 16.33                       | 2466                      | 5816                        |
| T <sub>7</sub>  | 50 kg K/ha + 5 kg Zn/ha  | 291.60                      | 16.73                       | 2523                      | 5845                        |
| T <sub>8</sub>  | 50 kg K/ha + 10 kg Zn/ha | 297.20                      | 17.00                       | 2611                      | 6001                        |
| T <sub>9</sub>  | 50 kg K/ha + 15 kg Zn/ha | 302.20                      | 17.60                       | 2685                      | 6143                        |
| T <sub>10</sub> | Control (RDF)            | 266.53                      | 13.87                       | 2081                      | 5591                        |
|                 | SEm (±)                  | 2.63                        | 0.40                        | 26.73                     | 75.62                       |
|                 | CD (P 0.05)              | 7.82                        | 1.20                        | 79.41                     | 224.67                      |