***Original Research Article***

Effect of Row spacing and Zinc on growth and yield of Mustard (*Brassica juncea* L.)


## Abstract

A field experiment was conducted during Rabi season of 2021 at experimental field of the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj and Uttar Pradesh, India to determine the "Effect of row spacing and zinc on growth and yield of Mustard (*Brassica juncea* L.)". The experiment consisted of 3 row spacings 20 cm, 30 cm, 40 cm and 3 levels of zinc fertilizer of 5 kg/ha, 10 kg/ha and 15 kg/ha. The experiment was carried out through a statistical design of Randomized Block Design (RBD) with three replications. Full doses of Nitrogen, Phosphorus and Potassium fertilizers were applied as basal. Variety used was varuna T59. Report of the study indicate that, among different row spacings and zinc the treatment with row spacing 40 cm and zinc at 15 kg/ha produced significantly highest plant height (202.36 cm), higher number of branches(11.18), dry weight/plant(32.96g). The treatment combination with row spacing 30 cm and zinc 15 kg/ha produces the highest number of siliqua per plant (295.65), number of seeds per siliqua (15.47), test weight (3.87 g), seed yield (2.10 t/ha), stover yield (4.53 t/ha), and Harvest index (31.66%). However, the treatment with row spacing 30 cm and zinc at 15 kg/ha was found to be effective in highest gross returns (126420 INR/ha), net returns (89638.4 INR/ha) and benefit cost ratio (2.43) when compared to the other treatments.



**Key words:** Mustard, Row spacing, Zinc, Yield.


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## 1.INTRODUCTION

Oil seed crops constitute the second largest agriculture production in India after food grains. Oilseeds play an important role in Indian agriculture and industries. Plant based edible oils are indispensable in the human diet and also an important ingredient of several industrial uses. Under the names rapeseed and mustard, several oilseeds are belonging to the *cruciferae* are grown in India. They are generally divided into four groups: Brown mustard, Sarson, Toria and Taramira. In trade sarson, toria and taramira are known as rapeseed, and rai as mustard. The oilseed sector constitutes an important determinant of agricultural economy in the country. The increasing population couples with rise in income led to higher demand of edible oils. Rapeseed-mustard after China and Canada, accounting for 16% of the global production. Quality breeding of rapeseed has been oriented largely by nutritional concerns of consumers and food industries.

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Mustard (*Brassica spp.*) is the third important oilseed crop in the world after soybean and groundnut, respectively. In India, mustard is the second important edible oil seed after groundnut. Rapeseed and mustard are the major oilseed crops. The production of rape seed in India is around 16.2 million tonnes which accounts for about 18 percent of the total oilseed

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production of the country. The oil obtained from the different types show slight variation in percentage of oil. The oil content varies from 37 to 49 per cent. The seed and oil are used in the preparation of pickles and for flavouring curries and vegetables**.** The oil is utilized for human consumption throughout northern India in cooking and frying purposes. Also it is used in the preparation of hair oils, medicines, soap making. It is used in soap making, in mixtures with mineral oils for lubrication. Oil cake is used as a cattle feed and manure. Green stems and leaves are used as good fodder for cattle. The leaves of young plants are used as green vegetables as they supply enough sulphur and minerals in the diet. **(Singh *et al.*, 2012).**

Mustard seed in general, contains 30-33 % oil, 17-25 % proteins, 8-10 % fibers, 6-10 % moisture, and 10-12 % extractable substances (Pandey *et al*.,2013). The seed and oil of mustard are used as a condiment in the preparation of pickles, flavouring curries and vegetables as well as for cooking and frying purposes. Its oil is used in many industrial products, cake as cattle feed and manure and green leaves for vegetable and green fodder.

Plant density is an important cultural practice that determines number of pods, number of siliquae and other growth attributes of mustard. Improved varieties of mustard or hybrids are capable of higher yields when grown under optimum row spacing and fertility level. The seed yield and maturity of mustard plants are greatly influenced by environmental conditions regardless of proper row spacing. Mustard seeds when planted at higher densities are susceptible to lodging and show heavy incidence of Downey mildew without the benefit of any yield increase.

Zinc is one of the first micronutrients recognized as essential for plants that transported to plant root surface through diffusion. The grain yield can be improved by addition of Zn fertilization. Zinc is a micronutrient and in case of its severe deficiency the symptoms may lasts throughout the entire crop season. Zn deficient plant also appears to be stunted as a result approximately 2 billion people suffer from Zn deficiency all over the world. Application of Zn along with other micronutrients improved soil organic matter and resulted in increasing mustard yields **Chen and Aviad 1990.**

## 3. MATERIALS AND METHODS

The experiment was conducted during the *rabi* season of 2021-2022 at the Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj. The Crop Research Farm is situated at 250 57’ N latitude, 870 19’ E longitude and 98 m altitude from the sea level. This area is situated on the right side of the river *Yamuna* and by the opposite side of Prayagraj city. All

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the facilities required for crop cultivation are available. the experiment was laid out in Randomized Block Design consist of different row spacing 3 level of zinc The treatment combination is $T_1$ ( row spacing 20 cm + zinc 5 kg/ha), $T_2$ ( row spacing 30 cm + zinc 5 kg/ha), $T_3$( row spacing 40 cm + zinc 5 kg/ha), $T_4$ ( row spacing 20 cm + zinc 10 kg/ha), $T_5$ ( row spacing 30 cm + zinc 10 kg/ha), $T_6$ ( row spacing 40 cm + zinc 10 kg/ha), $T_7$ ( row spacing 20 cm + zinc 15 kg/ha), $T_8$ ( row spacing 30 cm + zinc 15 kg/ha), $T_9$ ( row spacing 40 cm + zinc 15 kg/ha). the experiment was laid out in Randomized Block Design there are 9 treatments and replicated thrice to fulfill the nutrient sources nutrients used in this experiment are urea, SSP and MOP recommended dosage of fertilizer (RDF) 80 kg N, 40 kg P, 40 kg K. the growth and yield parameter and economics were recorded in equal interval of crop duration like plant height (cm), number of branches (No.), plant dry weight (g), crop growth rate (g/g/day),number of siliquae/plant, number of seeds/siliquae, test weight (g), seed yield (t/ha), stover yield (t/ha), harvest index(%). The data was analyzed statistically by using ANOVA and it is applicable for Randomized Block Design.

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## Results and Discussion

### Effect on growth attributes

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Plant height: It is noticed from table:1 The plant height was progressively increased with the increase in crop age during the experimentation. At 60 DAS, highest plant height (152.40cm) was recorded with application of row spacing 40cm + zinc 15 kg/ha which was significantly superior over all the treatments. Where, the application of row spacing 40 cm + zinc 10 kg/ha had recorded (151.46 cm) which was statistically at par with the application of row spacing 40 cm + zinc 15 kg/ha.

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The increase in plant growth might be due to the better activation of enzymes such as triphosphatage, dehydrogenase, tryptophan synthetase, proteinage and peptidase etc. and better photosynthetic activity. The results are closely related with **Singh and Yadav (1997).**

**Number of branches per plant:** It is noticed from table:1 That the number of branches per plant was progressively increased with the increase in crop age during the experimentation. At 60 DAS, maximum number of branches/plant (8.47) was recorded with application of row spacing 40 cm + zinc 15 kg/ha which was significantly superior over all the treatments. Where, the application of row spacing 40 cm + zinc 10 kg/ha had recorded (8.29) which was statistically at par with application of row spacing 40 cm + zinc 15 kg/ha. Better zinc nutrition of crop helped it in branching both primary and secondary branches in present investigation resulting in higher stover yield at harvest, which in turn has affected the seed yield, which has direct bearings on the dependent characters **(Sipal *et al.*, 2015).**

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**Dry weight per plant:** It is noticed from table:1 That the dry weight per plant was progressively increased with the increase in crop age during the experimentation. At 60 DAS, maximum dry weight (10.66g) was recorded with application of row spacing 40cm + zinc 15 kg/ha which was significantly superior over all the treatments. Where, the application of row

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spacing 40 cm + zinc 10 kg/ha had recorded (10.48g) which was statistically at par with application of row spacing 40 cm + zinc 15 kg/ha.

The probable reasons for better growth might be due to relatively competition free environments prevail, hence more availability of nutrients, greater light interception, efficient utilization of soil moisture and space under lower degree of inter-plant competition ultimately leads to increased synthesis of carbonate and production of more dry matter per plant. The present result is close conformation with **Singh *et al.*, (2006)** at Ludhiana.

**Crop Growth Rate:** It is noticed from table:1 That the crop growth rate was progressively increased with the increase in crop age during the experimentation. At 40-60 DAS, maximum crop growth rate (15.13) was recorded with application of row spacing 20 cm + zinc 10 kg/ha which was significantly superior over all the treatments. Where, the application of row spacing 20 cm + zinc 5 kg/ha had recorded (14.82) which was stastically at par with application of row spacing 20 cm + zinc 10 kg/ha.

**Effect of yield and yield attributes**

**Number of siliquae per plant:** It is noticed from table:2 That the number of siliquae per plant was progressively increased with the increase in crop age during the experimentation. The maximum number of siliquae per plant was recorded highest (295.65) with application of row spacing 30cm + zinc 15 kg/ha which was significantly superior over all the treatments. Where as application of row spacing 30cm + zinc 10 kg/ha has recorded (294.83) which was statistically at par with application of row spacing 30cm + zinc 15 kg/ha. The minimum number of siliquae per plant was recorded (269.31) with application of row spacing 40cm + zinc 5 kg/ha.

**Number of seeds per siliqua:** It is noticed from table:2 That the number of seeds per siliqua was progressively increased with the increase in crop age during the experimentation. The maximum number of seeds per siliqua was recorded highest (15.47) with application of (row spacing 30cm + zinc 15 kg/ha) which was significantly superior over all the treatments. Where as application of row spacing 30cm + zinc 10 kg/ha has recorded (15.37) which was statistically at par with application of row spacing 30cm + zinc 15 kg/ha. The minimum number of seeds per siliqua was recorded (13.52) with application of row spacing 40 cm + zinc 5 kg/ha.

**Test weight:** It is noticed from table:2 That test weight was progressively increased with the increase in crop age during the experimentation. The maximum test weight was recorded highest (3.87g) by application of row spacing 30cm + zinc 15 kg/ha which was significantly superior over all the treatments. Where as, application of row spacing 30cm + zinc 10 kg/ha has recorded (3.82g) which was statistically at par with application of row spacing 30cm +zinc 15 kg/ha. The minimum test weight was recorded (3.08) with application of row spacing 40cm + zinc 5 kg/ha.

The increase in yield attributes is due to the increased supply of available zinc to plants resulting in proper growth and development of plant system. The increase in yield attributes

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resulted in increase in seed, stover and biological yield of mustard. These results are close conformity with the findings of **Singh *et al.*, (1996) and sharma *et al.*, (2000).**

**Seed yield (t/ha):** It is noticed from table:2 That seed yield was progressively increased with the increase in crop age during the experimentation. The maximum seed yield was recorded highest (2.10) with application of row spacing 30cm + zinc 15 kg/ha which was significantly superior over all the treatments. Where as the application of row spacing 30cm + zinc 10 kg/ha has recorded (2.07) which was statistically at par with application of row spacing 30cm +zinc 15 kg/ha. The minimum seed yield was recorded (1.57) with application of row spacing 40cm + zinc 5 kg/ha.

Similar findings were reported by **Jat and Mehra (2007)** The increase in yield might be due to role of zinc in biosynthesis of indole acetic acid (IAA) and especially due to its role in initiation of primordial for reproductive parts and partitioning of photosynthates towards them, which resulted in better flowering and fruiting.

**Stover yield (t/ha):** It is noticed from table:2 That stover yield was progressively increased with the increase in crop age during the experimentation. The maximum stover yield was recorded highest (4.53) with application of row spacing 30cm + zinc 15 kg/ha which was significantly superior over all the treatments. Where application of row spacing 30cm + zinc 10 kg/ha has recorded (4.50) which was statistically at par with application of row spacing 30cm +zinc 15 kg/ha. The minimum stover yield was recorded (3.56) with application of row spacing 40cm + zinc 5 kg/ha.

The magnitude of increase in seed yield t/ha in treatment row spacing 30 cm is probably due to better development of various growth parameters such as plant height, number of branches per plant and dry weight under optimum plant population per unit area which gave optimum yield per plant and lower plant competition. The wider row spacing improved individual plant yield and yield per unit area is the resultant of cumulative yield from individual plants per unit area. These results are in agreement with those of **Pyare *et al.*, (2008).**

**Harvest Index (%):** It is noticed from table:2 That harvest index was progressively increased with the increase in crop age during the experimentation. The maximum harvest index was recorded highest (31.66) with application of row spacing 30cm + zinc 15 kg/ha which was significantly superior over all the treatments. Where as, application of row spacing 30cm + zinc 10 kg/ha has recorded (31.56) which was statistically at par with application of row spacing 30cm +zinc 15 kg/ha. The minimum harvest index was recorded (29.29) with application of row spacing 20cm + zinc 10 kg/ha.

## Conclusion

On basis of one season of experiment, it is concluded that application of rowspacing 30 cm + zinc 15 kg/ha was found to be more productive and economically viable.

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**Reference**


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Table 1: Various treatments process

Comment [K63]: Effect of row spacing and levels of zinc on the growth characteristics of Mustard

| | | At 60 DAS | | | |
|---|---|---|---|---|---|
| S.No. | Treatments | Plant height (cm) | No. of branches | Dry weight/plant | CGR ($g/m^2/day$) |
| 1 | 20 cm row spacing + 5 kg zinc | 141.95 | 4.20 | 8.91 | 14.82 |
| 2 | 30 cm row spacing + 5 kg zinc | 143.65 | 5.27 | 9.33 | 9.70 |
| 3 | 40 cm row spacing + 5 kg zinc | 145.39 | 6.46 | 9.31 | 7.07 |
| 4 | 20 cm row spacing + 10 kg zinc | 142.99 | 5.82 | 9.00 | 15.13 |
| 5 | 30 cm row spacing + 10 kg zinc | 149.15 | 7.73 | 9.56 | 9.36 |
| 6 | 40 cm row spacing + 10 kg zinc | 151.46 | 8.29 | 10.48 | 8.00 |
| 7 | 20 cm row spacing + 15 kg zinc | 143.84 | 5.83 | 9.12 | 14.46 |
| 8 | 30 cm row spacing + 15 kg zinc | 148.08 | 7.79 | 9.54 | 9.47 |
| 9 | 40 cm row spacing + 15 kg zinc | 152.40 | 8.47 | 10.66 | 8.13 |
| | F test | S | S | S | S |
| | SEm (±) | 0.44 | 0.09 | 0.07 | 0.13 |
| | CD (P=0.05) | 1.32 | 0.28 | 0.21 | 0.39 |

Table 2: Treatments during harvest

Comment [K64]: Effect of row spacing and levels of zinc on the growth characteristics of Mustard during harvest

| At Harvest | | | | | | |
|---|---|---|---|---|---|---|
| Treatments | Siliquae/plant | Seeds/siliqua | Test weight (g) | Seed yield (t/ha) | Stover yield (t/ha) | Harvest index (%) |
| 20 cm row spacing + 5 kg zinc | 279.12 | 14.23 | 3.41 | 279.12 | 14.23 | 3.41 |
| 30 cm row spacing + 5 kg zinc | 282.02 | 14.87 | 3.52 | 282.02 | 14.87 | 3.52 |
| 40 cm row spacing + 5 kg zinc | 269.31 | 13.52 | 3.08 | 269.31 | 13.52 | 3.08 |
| 20 cm row spacing + 10 kg zinc | 286.82 | 14.98 | 3.59 | 286.82 | 14.98 | 3.59 |
| 30 cm row spacing + 10 kg zinc | 294.83 | 15.37 | 3.82 | 294.83 | 15.37 | 3.82 |
| 40 cm row spacing + 10 kg zinc | 270.64 | 13.60 | 3.15 | 270.64 | 13.60 | 3.15 |
| 20 cm row spacing + 15 kg zinc | 291.60 | 15.21 | 3.74 | 291.60 | 15.21 | 3.74 |
| 30 cm row spacing + 15 kg zinc | 295.65 | 15.47 | 3.87 | 295.65 | 15.47 | 3.87 |
| 40 cm row spacing + 15 kg zinc | 274.35 | 13.94 | 3.24 | 274.35 | 13.94 | 3.24 |
| F test | S | S | S | S | S | S |
| SEm (±) | 0.63 | 0.07 | 0.02 | 0.63 | 0.07 | 0.02 |
| CD (P=0.05) | 1.89 | 0.22 | 0.05 | 1.89 | 0.22 | 0.05 |