Original Research Article

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

Abstract

The field Study 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.)". This experiment embodied 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 layed out in statistical design of Randomized Block Design (RBD) with three replications. Full doses of Nitrogen, Phosphorus and Potassium fertilizers were applied as basal. The used variety was Varuna T-59. Report of the study indicates 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 siliquae 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.

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. The oilseed crops have a massive importance in the economy of the country as well as for balanced nutrition in the life of the human. Along with the different oilseed crops, the mustard has a crucial place in Indian agriculture. The global production of oilseed is ~ 68 million metric tonnes. In India the total oilseed production is 224.07 lakh tonnes, and the mustard crop contributed 79.60 lakh tonnes **(DES, 2018)**.

"Mustrad (Brasica juncea L.) is important Rabi oilseed crop in the world. India is first position in area and second position in production after China. India is the fourth largest oilseed economy in the world. Oilseed crops hold a sizeable share of the country's gross cropped area (13%) and contribute around 3% of gross national product and 10% of the value of all agricultural commodities" **(Anonymous, 2014)**. "The area, production and productivity of rapeseed-mustard is 6.70 and 34.19 million ha, 7.96 and 63.09 million tonnes and 1188 and 1850 kg/ha, respectively in India and world during 2013-2014" **(Anonymous, 2014)**. "The seed and oil are used in the making of pickles and for flavouring curries and vegetables**.**

The oil is used for human utilization throughout northern India in cooking and frying purposes. Also, it is employed 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 applied 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 usually, contains 30-33 % oil, 17-25 % proteins, 8-10 % fibers, 6-10 % moisture, and 10-12 % extractable substances. The seed and oil of mustard are applied as a condiment in the preparation of pickles, flavouring curries and vegetables as well as for cooking and frying purposes. The oil is utilized for human consumption throughout the northern India for cocking purpose. This is a potential crop in winter (Rabi) season due to its wider adaptability and suitability to exploit residual moisture" **(Mukherjee, 2010).**

One of the most significant strategies in mustard cultivation is row spacing. When planted with the proper row spacing and fertility, improved mustard types or hybrids can produce higher yields. McDonald et al., 1983 discovered that inappropriate spacing reduces crop output. Mustard seed yield is reduced by synchronizing the siliquae filling cycle with high temperatures, resulting in a reduction in assimilates production.

"Zinc is one of the first micronutrients identified as essential for plants that transported to plant root surface through diffusion. The grain yield can be enhanced by the 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 plants 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 better soil organic matter and resulted in increasing mustard yields" **Chen and Aviad 1990.**

2. MATERIALS AND METHODS

This experiment was done during the Rabi season in 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 the facilities required for crop cultivation are available. the experiment was laid out in Randomized complete Block Design consist of 3 different row spacing with 3 levels 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 complete Block Design. There are 9 treatments and three replications 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 were analyzed statistically by using ANOVA and it is applicable for Randomized Block Design.

Results and Discussion

Effect on plant height:

The results in table (1) showed that the plant height was progressively increased with the increase in crop age during the experiment. At 60 DAS, highest plant height (152.40cm) was reported 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.

"The raise 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 the 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 reported 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. In the current study, better zinc nutrition of the crop aided it in branching both primary and secondary branches, resulting in increased stover yield at harvest, which in turn influenced seed yield, which has direct implications for the dependent characters (Sipai et al., 2015).

Dry weight per plant: It is noticed from the 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 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 use 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)**.

Crop Growth Rate: It is noticed from the 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 statistically 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 the 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 reported highest (295.65) with application of row spacing 30cm + zinc 15 kg/ha which was significantly superior over all the treatments, whereas 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 the 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, whereas 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 the 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, whereas 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 raise in yield attributes is due to the increased supply of available zinc to plants resulting in proper growth and increase of plant system. The development in yield attributes 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 the 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, whereas 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 the 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 degree of increase in seed yield t/ha in treatment row spacing 30 cm is probably due to better increase 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 the table(2)tThat 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, whereas 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

It is concluded that application of row spacing 30 cm + zinc 15 kg/ha was found to be more productive and economically viable.

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Table 1: 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: 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