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Effect of plant growth regulators and zinc levels on growth and yield of Toria (*Brassica rapa* L.)

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Abstract

A field experiment was conducted during *Rabi* season (2021-22) at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P.). The soil of experimental plot was sandy loam in texture, nearly natural in soil reaction (pH 7.1), low in organic carbon (0.28%), available N (225 kg/ha), available P (19.50 kg/ha) and available K (213.7 kg/ha). The Treatments consisted of 3 levels of plant growth regulators PGR_1 (GA_3 30 ppm), PGR_2 (GA_3 60 ppm), PGR_3 (GA_3 90 ppm) and 3 levels of zinc (Zn_1-5 kg/ha), (Zn_2-10 kg/ha) and (Zn_3-15 kg/ha). The experiment was laid out in Randomized Block Design with 9 treatments and replicated thrice. The results reported that the application of GA_3 90 ppm + Zn 15 Kg/ha recorded maximum (Treatment-9) Plant height (126.50 cm), Number of branches/plant (11.70), plant dry weight (14.50 g/plant), number of siliqua per plant (299.80), number of seeds per siliqua (23.20), test weight (3.23 g), seed yield (1.78 t/ha), straw yield (5.53 t/ha) and harvest index was found to be non-significant. Maximum Gross returns (95906.66 INR/ha), Net returns (57686.66 INR/ha) and B:C ratio (1.50) was recorded with the treatment (T_9) with the application of GA_3 90 ppm + Zn 15 Kg/ha.

Keywords: Plant growth regulators, growth, yield, zinc, rabi, gibberellic acid

Introduction

In India, rapeseed-mustard occupy 6.23 million, ha area with production and productivity of 9.34 million tonnes and 1499 kg ha respectively (India starts 2019-20). It is a major Rabi crop. Cultivation of mustard is taken up between October-November and February March. Major growing areas are Rajasthan, Uttar Pradesh, and Haryana. Broadly seven varieties of mustard rapeseed are mostly grown in India. Rajasthan and Uttar Pradesh are the major mustard producing states in our country. Together, they contribute to about 50% of the total production. Gibberellic acid (GA_3) is a phytohormone that is needed in small amounts at low concentration to accelerate plant growth and development. So, favourable condition may be induced by applying growth regulators like GA_3 exogenously in proper concentration at a proper time in a specific crop. Gibberellic acid is such a plant growth regulator, which can manipulate a variety of growth and development phenomena in various crops. GA_3 enhances growth activities to plant, stimulates stem elongation, and increases dry weight and yield. Yield quintal ha-1 after harvest. Foliar sprayed of different concentrations of GA_3 increased yield and quality characters of mustard crop. Micronutrients are also essential for plant growth. Zinc influences the formation of growth hormones and it plays a helpful role in reproduction of certain plants (Patel *et al*., 2006) [7]. Zinc is necessary to activate many enzymes like Tryptophan synthetase, superoxide dismutase and dehydrogenases. Lack of zinc causes deficiency in formation of RNA and protein. Therefore, the plant with lack of zinc is poor in amount of protein (Singh *et al*., 2007). Rengel (2001) [8, 9] showed that zinc fertilizer application causes root and shoot growth during the growing season and therefore, lead to increased seed yield. Zinc also has the role in photosynthesis and nitrogen metabolism and it helps in regulating the auxin concentration in plant. It promotes flower setting and help in proper development of fruits. It also helps in carbohydrates transformation and sulphur metabolism. The grain and straw yield were also significantly increased by the application of zinc. The favourable influence of applied zinc on these growth parameters, yield attributes and yield may be ascribed to catalytic or stimulatory effect of zinc on most of the physiological and metabolic processes of the plant. It also helps in chlorophyll formation and plays an important role in nitrogen metabolism. Thus, the application of zinc in a soil deficient in its content, improved the overall growth and development of plant.

Materials and Methods

The experiment was conducted during *Rabi* season of 2021-22. The experiment was conducted in Randomized Block Design consisting of nine treatment combinations with three replications and was laid out with the different treatments allocated randomly in each replication. The soil of the experimental field was sandy loam in texture, slightly alkaline reaction (pH 7.1) with low level of organic carbon (0.28%), available N (225 Kg/ha), P (19.50 kg/ha) and higher level of K (92.00 kg/ha). The treatment combinations are T_1 - GA_3 30 ppm + Zn 5 kg/ha, T_2 - GA_3 30 ppm+ Zn 10 kg/ha, T_3 - GA_3 30 ppm+ Zn 15 kg/ha, T_4 - GA_3 60 ppm + Zn 5 kg/ha, T_5 - GA_3 60 ppm + Zn 10 kg/ha, T_6 - GA_3 60 ppm + Zn 15 kg /ha, T_7 - GA_3 90 ppm + Zn 5 kg/ha, T_8 - GA_3 90 ppm + Zn 10 kg/ha, T_9 - $GA_3$90 ppm + Zn 15 Kg/ha. The observations were recorded on different growth parameters at harvest *viz*. plant height (cm), number of branches per plant, plant dry weight, Number of siliqua per plant, number of seeds per siliqua, test weight, grain yield and stover yield.

Results and Discussion

A. Growth Attributes

At 80 DAS, maximum plant height (126.50 cm) was recorded in treatment No.9 with application of GA_3 90 ppm + Zn 15 Kg/ha which was significantly superior over all other treatments and treatment with application of GA_3 90 ppm + Zn 10 kg/ha (123.50 cm) is statistically at par with treatment application of GA_3 90 ppm + Zn 15 kg/ha. At 80 DAS, the highest branches per plant was observed in the with GA_3 90 ppm + Zn 15 kg/ha (11.70) which was significantly higher over rest of the treatments and treatment with application of GA_3 90 ppm + Zn 15 kg/ha (10.20) which were statistically at par with application of with GA_3 90 ppm + Zn 15 kg/ha. At 80 DAS, maximum plant dry weight (14.50 g) was recorded with application GA_3 90 ppm+ Zn 15 kg/ha which was significantly superior over all other treatments and treatment with application of GA_3 90 ppm+ Zn 10 kg/ha. (14.30 g) is statistically at par with treatment (T_9) with the application of GA_3 90 ppm+ Zn 15 kg/ha. (Sharma *et al* (2017) [6].

Yield Attributes

Treatment with application of GA_3 90 ppm + Zn 15 Kg/ha was recorded maximum number of siliquae per plant (299.80) which was significantly superior over all other and treatment with application of GA_3 90 ppm + Zn 10 Kg/ha (251.90) which was statistically at par with the treatment with application of GA_3 90 ppm + Zn 15 Kg/ha.Treatment with application of GA_3 90 ppm + Zn 15 Kg/ha was recorded maximum number of seeds per siliquae (23.20) which was significantly superior over all other and treatment with application of GA_3 90 ppm + Zn 10 Kg/ha (22.70) and GA_3 60 ppm + Zn 15 Kg/ha (22.30) which was statistically at par with the treatment with application of GA_3 90 ppm + Zn 15 Kg/ha. Treatment with application of GA_3 90 ppm + Zn 15 Kg/ha was recorded maximum test weight (3.23 g) which was significantly superior over all other and treatment with application of GA_3 60 ppm + Zn 10 Kg/ha (3.10) which was statistically at par with the treatment with application of GA_3 90 ppm + Zn 15 Kg/ha. Treatment with application of GA_3 90 ppm + Zn 15 Kg/ha was recorded maximum seed yield (1.78 t/ha) which was significantly superior over all other and treatment with application of GA_3 90 ppm + Zn 10 Kg/ha (1.63) which was statistically at par with the treatment with application of GA_3 90 ppm + Zn 15 Kg/ha.Treatment with application of GA_3 90 ppm + Zn 15 Kg/ha was recorded maximum stover yield (5.53 t/ha) which was significantly superior over all other and treatment with application of GA_3 90 ppm + Zn 10 Kg/ha (5.10 t/ha) which was statistically at par with the treatment with application of GA_3 90 ppm + Zn 15 Kg/ha.

Treatment with application of GA_3 30 ppm + Zn 15 Kg/ha was recorded maximum harvest index (26.99%) and minimum with application of GA_3 90 ppm + Zn 10 kg/ha (24.23%). There is no significant difference between treatments. (Ijaz *et al* 2019) [5].

Table 1: Effect of plant growth regulators and zinc levels on growth attributes of Toria

Treatments	Plant height (cm) 80 DAS	Number of branches per plant At 80 DAS	Plant dry weight (g/hill) At 80DAS
GA_3 30 ppm + Zn 5 kg/ha	100.80	6.20	13.10
GA_3 30 ppm+ Zn 10 kg/ha	106.90	6.60	13.50
GA_3 30 ppm+ Zn 15 kg/ha	110.50	7.10	13.80
GA_3 60 ppm + Zn 5 kg/ha	109.30	7.50	13.70
GA_3 60 ppm + Zn 10 kg/ha	117.30	8.50	13.80
GA_3 60 ppm + Zn 15 kg /ha	120.10	8.50	14.20
GA_3 90 ppm + Zn 5 kg/ha	115.80	8.10	14.00
GA_3 90 ppm + Zn 10 kg/ha	123.50	10.20	14.30
$GA_3$90 ppm + Zn 15 Kg/ha	126.50	11.70	14.50
S.Em(±)	1.79	0.63	0.09
CD (p=0.05)	5.37	1.88	0.27

Table 2: Effect of plant growth regulators and zinc levels on yield attributes and yield of Toria

Treatments	No. of Siliquae per plant	No. of seeds per Siliquae	Test weight (g)	Grain yield (t/ha)	Stover yield (t/ha)	Harvest index (%)
GA_3 30 ppm + Zn 5 kg/ha	137.50	17.00	2.53	1.07	2.96	26.35
GA_3 30 ppm+ Zn 10 kg/ha	162.70	18.00	2.47	1.18	3.47	25.15
GA_3 30 ppm+ Zn 15 kg/ha	183.10	20.00	2.53	1.33	3.83	26.99
GA_3 60 ppm + Zn 5 kg/ha	167.40	19.00	2.73	1.23	3.72	24.68
GA_3 60 ppm + Zn 10 kg/ha	209.80	20.70	3.10	1.49	4.44	25.12
GA_3 60 ppm + Zn 15 kg /ha	230.00	22.30	2.73	1.39	4.64	22.98
GA_3 90 ppm + Zn 5 kg/ha	205.50	20.70	2.53	1.45	4.02	26.43

GA_3 90 ppm + Zn 10 kg/ha	251.90	22.70	2.60	1.63	5.10	24.23
GA_3 90 ppm + Zn 15 Kg/ha	299.80	23.20	3.23	1.78	5.53	24.34
S.Em (±)	18.08	0.35	010	0.07	0.16	1.10
CD (5%)	54.21	1.05	0.31	0.20	0.48	----

Conclusion

On the basis of one season experimentation it can be concluded that with the application of GA_3 90 ppm + Zn 15 kg/ha was found more productive (1.78 t/ha) and economically viable (1.50).

The conclusions drawn are based on one season data only which requires further confirmation for recommendation.

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