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Study of Plant Growth Regulators on Growth and Yield Parameters of Radish (*Raphanussativus*L.)

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ABSTRACT: *The field experiment to study the Study of plant growth regulators on growth and yield parameters of radish (RaphanussativusL.) was conducted during the year 2020-2021 at Horticulture Research farm, Department of Horticulture, CCR (PG) College Muzaffarnagar251001 (U.P) India. There were nine treatments i.e. T_1(GA_3@ 50 ppm), T_2 (GA_3 @ 100 ppm), T_3 (IAA @ 50 ppm), T_4 (IAA @ 100 ppm), T_5 (NAA @ 50 ppm), T_6 (NAA@100ppm), T_7 (MH@100ppm), T_8 (MH@200ppm) andT_9 (control). The findings of the present investigation clearly indicated that the foliar application of GA_3 @ 100 ppm gave significant effect to improve growth and yield parameters of radishviz., plant height (36.86cm), number of leaves (25.31), leaf length (33.71cm), rootdiameter (5.27cm),weight of root (250.12g) and yield (380.86q/ha) ascomparedtoothertreatments.Hence, foliar application of GA_3 @ 100ppm may be suggested for getting maximum vegetative growth and yield of radish under Western Uttar Pradesh conditions.*

KEYWORDS: *Radish, Growth,GA_3 , NAA, IAA, MH, Yield.*

Radish (Raphanussativus L.), often known as 'Mooli,' is a root vegetable that belongs to the Brassicaceae family and is India's most popular. Radish (Raphanussativus L.; 2n =18) is a popular vegetable that originated in Europe or Asia and is now grown all over the world. Radish is one of the most popular Rabi root crops, and it is widely grown for its high nutritional and therapeutic value. It's a widely consumed vegetable in both tropical and temperate climates. It is planted both as an annual and a biennial crop for root and seed production. West Bengal, Uttar Pradesh, Bihar, Himachal Pradesh, Gujarat, Punjab, and Haryana are among the states in India where it is grown extensively.According to World Scenario, the main radish producing state, West Bengal, has an area of roughly 40.70 thousand ha and produces 508.75 thousand MT of radish, with Nadia and Murshidabad districts leading the way, followed by Haryana and Punjab. It is grown on a total of 13.60 thousand hectares in Punjab, with a production of 294.65 MT (NHB 2016- 2017).

Radish is grown for its young, sensitive tuberous roots, which can be eaten raw or cooked. It contains a lot of vitamins and minerals. 100 gm of edible radish root includes 94.4 percent moisture, 3.4 grams of carbs, 0.7 gm of protein, 0.06 milligrams of thiamine, 0.02 milligrams of riboflavin, 15 milligrams of vitamin C, 35 milligrams of calcium, and 0.04 milligrams of iron (Dhariwal, 6). It has diuretic and invigorating qualities. Radish leaves are a good source of protein that may be extracted commercially. Radish seeds are a wonderful source of non-drying fatty oil that can be used in soap manufacturing, lighting, and cooking. It is eaten as an appetizer and is known for its strong flavor.

Plant bio regulators have been shown to be an effective approach to boost vegetable yield without sacrificing quality or soil health. Plant growth regulators are known to regulate the physiological and biochemical processes of the plant. Controlling dormancy, organ size, crop development, blooming and fruit set, and regulating nutrient input from the soil are among them (Ganpathiet al.,(8).Plant growth and development are influenced by growth regulators at low concentrations, whereas they are inhibited at high doses. The involvement of endogenous gibberellins in the regulation of stem elongation and flower development in radish has received little attention. GA3 is known to improve seed germination, but NAA is primarily utilized for vegetative growth, especially blooming, but NAA at greater concentrations improves radish yield (Singh et al., 1989).(20)

I. MATERIALS AND METHODS

The field experiment was conducted at the Horticultural Research Farm, Department of Horticulture, Chaudhary ChhotuRam(PG) college,Muzaffarnagar251001(U.P).The average annual temperature in Muzaffarnagar is 24.2 °C. The highest and lowest temperatures ever recorded in Muzaffarnagar are 45 °C (113 °F) on 29 May 1994 and −0.9 °C (30.4 °F) respectively. The rainfall averages 929 mm. The driest month is November, with 8 mm of rain. Highest precipitation falls in July, with an average of 261.4 mm

. Gibberellic acid regulates stem elongation, germination, and senescence of leaves and fruit (Daviere

and Achard, (3), The mechanism of cell growth mediated through auxins entails its interaction with receptors, membranes and other binding surfaces that could lead to the rapid growth of cells (Krishna,(11). The maximum number of leaves per plant (25.31) was man ifested with the foliar application of GA_3 @100 ppm followed by treatment GA_3 @ 50 ppm (24.41). The minimum number of leaves per plant (19.40) was recorded with control treatment. Similarly, among different treatments of the plant growth regulators, maximum leaf length (33.71 cm) was recorded under the treatment T_2 (GA_3 @100ppm) followed by GA 3 @ 50 ppm. The minimum leaflength (33.43cm) was recorded with the foliar application of double-distilled water (control). The findings of the present investigation are in agreement with the findings of Parvez*etal.* (15),SinghandRajodia(19),Patel*et al.*(14) and Dev*etal.* (5) in case of okra .The seresults are also in the line with the findings of Mishra and Nagaich (13),whoreportedthatfoliar application of GA 3 significantly increased number of leaves perplant andleaflengthincaseofradish.Theprobablereasons forenhancedmorenumberofleavesmightbedueto effectofdifferentplantgrowthregulatorstreatmentson vegetative growth and new vegetative bud initiation by increasing cell division and controlling of the precise patternoftheepidermalcellsofthedevelopingleaf. Little and Mac-Donald (12) reported the GA 3 help to stimulate the activity of sub-apical meristem during new-formed growth and the apical meristemduring vegetative bud development. Dawuda*et al.* (4) reported that the foliar application of GA 3 enhances rapidcellelongationinactivelygrowingregionofthe plant leading to stimulation of new growth.The plant height increased with higher concentration of GA3

this might be due to the reason that when germination starts there is faster elongation and rapid proliferation of cells in growing portion of the plant results in encouragement of new growth leads to an absolute increase in plant height (Shruthi et al. 2016) (17).

It is cleared from the data pertaining to yield parameters that all the yield parameters were significantly influenced by foliar application of plant growth regulators (Table 1). Among different treatments of plant growth regulators, maximum root diameter (5.27 cm) was recorded under thetreatmentsT_2(GA_3@100ppm)followedbyGA_3@50ppm(5.12 cm) as compared to other treatments. Similarly, maximum root weight (250.12 gm) was recorded inthe treatment T_2 (GA 3 @ 100 ppm) followed by GA 3 @50 ppm(240.gm).ButincaseofMH,themorelengthof root(24.60cm)wasrecordedwiththefoliarapplication of lower concentration (MH @ 100 ppm) as compared to the higher one (MH @ 200 ppm) i.e(24.41cm).These findingsare closely confirmatory with the findings of Karuppaiah*et al.*(10),Sadana*etal.*(18)andPatel*etal.*(14).Thestimulating effect of GA 3 and NAA on root weight and root length might be due to fact that bioregulators particularlygibberellinsareknowntoinfluenceoncelldivision and cell enlargement (Kamijima, (9) and photosynthetic activity. Ganpathi*et al.* (8) reportedthat the radish yield component *viz.*, root length, root diameter and fresh weight of root significantly increase due to application of plant growth regulators. Maleic hydrazide is well-known growth inhibitor so the higher concentration of MH could be less effective in respect to the root length as compared to the lower concentration.Root length found to be increase with increased concentration of GA_3 this might be due to the cell growth and cell elongation which results in elongation of root system.[13]

Among all the bio regulators, the maximum weight ofrootperplant(250.12gm)wasrecordedwiththe foliar application of GA 3 @ 100 ppm, which wasfound statistically higher than all other treatments. Similarly, the significantly maximum root yield (380.86 q/ha) was found under the treatments T_2(GA 3 @ 100 ppm) followedbyGA_3@50ppm(370.11q/ha).Thefindings of the study further confirmed by the findings of Singh and Rajodia (19), Parvez*et al.* (15) and Sadana*et al.* (18). Similarly, another researcher also observed significant improvement in root yield of radish when50 ppm GA 3 was used as foliar application (Mishra and Nagaich (13). Patel *et al.,* (14) also reported thatfoliar application of GA 3 @ 20 ppm significantly increased root diameter (5.96 cm) and yield (536.66 q/ha)of radish.TheGrowthregulatorsnamely,$GA_3$and auxins have been found to enhance photosynthetic and enzymatic activity and also help in chlorophyllbiosynthetic which could be the possible reason for higher root yield of radish.

Gibberellic acid and IAA have an ability to reduce the chlorophyll loss from lettuce leaves as suggested by Aharoni (1). reported that gibberellic acid stimulate rates of photosynthesis or enhances ultra-structuralmorphogenesisofplastids anditalsohelpstoenhancetheinvitro activity of RUBP-carboxylase.

Table 1: Study of plant growth regulators on growth and yield parameters of radish (RaphanussativusL.)

Treatments		Plant height (cm)	Number of leaves per plant	Leaf length (cm)	Root length (cm)	Root diameter (cm)	Root weight (g)	Yield (q/ha)
T1	GA_3@50ppm	36.80	24.41	33.43	20.39	5.12	240.72	370.11
T2	GA_3@100ppm	36.86	25.31	33.71	22.01	5.27	250.12	380.86
T3	IAA@50ppm	34.07	24.07	32.85	22.94	4.62	222.17	340.40
T4	IAA@100ppm	34.77	23.31	32.53	22.43	4.55	229.65	346.16
T5	NAA@50ppm	35.03	23.72	32.77	22.50	4.95	232.45	350.51
T6	NAA@100ppm	35.08	23.43	32.02	24.39	5.10	239.14	366.74
T7	MH@100ppm	32.85	23.83	31.77	24.60	4.30	217.21	331.03
T8	MH@200ppm	32.33	24.10	31.10	24.41	4.53	222.04	329.41
T9	Control	27.07	19.63	26.76	18.08	3.95	189.55	286.54
C.D. (P=0.05)		0.17	0.63	0.49	0.84	0.13	2.66	1.01

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