Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; 7(3): 3434-3437
Received: 05-03-2018
Accepted: 10-04-2018

Shweta
School of Agriculture, Lovely Professional University, Phagwara, Punjab, India

D Mal
School of Agriculture, Lovely Professional University, Phagwara, Punjab, India

V Thakur
School of Agriculture, Lovely Professional University, Phagwara, Punjab, India

S Datta
School of Agriculture, Lovely Professional University, Phagwara, Punjab, India

Correspondence
Shweta
School of Agriculture, Lovely Professional University, Phagwara, Punjab, India

Effect of different plant growth regulators (GA3 and NAA) on growth and yield parameters of radish (*Raphanus sativus* L.) Var. Pusa Reshmi

Shweta, D Mal, V Thakur and S Datta

Abstract
The present experiment was conducted at School of Agriculture, Department of Vegetable Science at Lovely Professional University, Jalandhar during the winter season from October 2017 - December 2017 to study the effect of different plant growth regulators (GA_3 and NAA) on growth and yield parameters of radish (*Raphanus sativus* L.) var. Pusa Reshmi. The experiment was laid out in randomized block design (RBD) with three replications. The treatments used were i.e. three different concentrations of GA_3 (5, 10, 15 ppm) and three different dose of NAA (10, 20, 30 ppm) and control to improve various growth and yield contributing parameters of Radish. Among all the treatments, it was concluded that higher dose of GA_3 at 15 ppm results in increasing maximum leaf length, plant height and it also increases the yield attributing characters such as root length, fresh weight of roots, root yield kg/plot and as well as highest over control. From this experiment, it was concluded that the application of GA_3 15 ppm can be recommended in radish for higher root yield.

Keywords: growth, root, GA_3, NAA, yield

Introduction
Radish (*Raphanus sativus* L.) commonly known as 'Mooli' came from latin word "radix" which means root belongs to family Brassicaceae, the most popular root vegetable cultivated in India. It is grown in many tropical and subtropical parts of the world for its fleshy roots and leaves. West Bengal is the leading state in the production of radish. Radish was considered as medicinal plant in Puranas. Radish seeds are used for making soap and for edible purpose because its seeds contain oil (George, 1999). Its roots have anti-diabetic properties so radish is used by diabetic patients (Banihani, 2017) [4] and it is also useful in urinary complaints, spleen and problem of piles (Brintha and Seran, 2009 [8] and Dhananjaya, 2007 [9]. Leaves are used to cure Jaundice through home remedies by using radish leaves (Gohil *et al.*, 2010) [10]. The juice of fresh leaves is used as laxative and diuretic. Radish is a good source of Vitamin-C i.e.15-40 mg per 100 g, also contains many nutrients and wide varieties of minerals and vitamins such as 0.7% protein, 3.4-6.8% carbohydrates, 0.2% fat, 0.8 g fiber per 100 g of fresh edible portion.
Radish is fast- growing, annual and cool season crop. As compared to European type varieties of radish, Asiatic type varieties can tolerate higher temperature e.g. Pusa Reshmi, Pusa Chetki, Punjab Safed etc. Optimum temperature for its proper size, texture and better flavour is 15^0 C - 18^0 C (Angell and Hillyer, 1962) [3]. Radish seeds germinate best at a temperature of 5^0 C and optimum temperate is 15^0 C for maximum germination percentage in radish (Abdel *et al.*, 2016) [1]. Pungency in radish is due to the presence of volatile compound isothiocynate which fights against colon cancer, oral cancer, intestinal cancer, kidney cancer. As the temperature start rising, spiciness and toughness of radish also starts increasing and as the temperature goes down, spiciness decreases means spiciness is more in radish grown in summer season. In India it is grown widely in West Bengal, Uttar Pradesh, Bihar, Himachal Pradesh, Gujarat, Punjab and Haryana. According to World Scenario, radish occupies an area of about 40.70 thousand ha with production of 508.75 thousand MT in West Bengal as it is the major radish producing state particularly Nadia and Murshidabad districts followed by Haryana and Punjab. In Punjab, it is cultivated at an area of 13.60 thousand ha with a production of 294.65 MT (NHB 2016-2017) [12].
Use of Plant Growth Regulators is one of the most recent trends in the field of agriculture science. These are the chemicals that produce naturally in plants (IAA, natural auxin) and when applied in low dose, then it stimulates many physiological reactions (Bhatia and Parashar, 1988) [6]. These are used to increase or stimulate the growth of the plant, popularly known as Phytohormones such as Auxin, Cytokinin, Ethylene, Abscisic acid. These chemicals can be used in mostly two different ways- foliar application or seed treatment but generally

seed treatment is most suitable for Radish crop. GA_3 is known to increase the seed germination percentage whereas NAA is basically used for vegetative growth particularly flowering but NAA at higher concentrations enhance the yield of radish (Singh *et al.,* 1989) [15].

Materials and Methods

The investigation was carried out at Lovely Profession University Farm, Phagwara during winter season, 2017. Soil of the field was Alkaline in nature with pH 7.46 with 1.6% Organic carbon. The experiment was laid out in randomized block design (RBD) with three replications having 10 different treatments. The treatment includes various concentrations of GA3 and NAA and Control *viz.* (T1) GA3 5 ppm, (T2) GA3 10 ppm, (T3) GA3 15 ppm, (T4) NAA 10 ppm, (T5) NAA 20 ppm, (T6) NAA 30 ppm, (T7) Control. The variety Pusa Reshmi was used in this investigation and the seeds of variety Pusa Reshmi were soaked in 6 different concentrations and other one is control (with water) for 8 hours and dried in partial shade for 2 hours. Sowing of the seeds was done in mid-October i.e. 12th October with a spacing of 25 X 10cm. Total Area of the experimental field was 118.95 m^2, length 18.3m, width 6.5m, net plot size of 1.7mX 1.1m. Standard dose FYM (10-15t/ha) incorporated with fertilizer i.e. N: P: K (100: 60: 60 kg/ha), irrigation was done at10-15 days interval, while various intercultural operations like weeding followed by hoeing (2-3 times), and thinning was carried out after 25-30 days of sowing to avoid the overcrowding of plants. The observations were recorded on the basis of various growth parameters such as leaf length at various growth stages i.e. 30 days, 45 days and at final harvesting, plant height, root length, fresh weight of roots, yield kg/plot. Data analysis was done on OPSTAT software.

Results and Discussion

Vegetative characters

Leaf length at 30 days (cm)

Leaf length is one of the important growth parameter of radish. It is evident from the data presented in (Table 4.1) that there was significant variation in leaf length by application of different concentrations of both the growth regulators GA_3 and NAA. Among the different treatments used, the maximum leaf length at 30 days of sowing was recorded in higher dose of GA_3 at 15ppm (32.14 cm) over rest of the treatments applied followed by GA_3 at 10 ppm (30.72 cm) and the minimum leaf length was noted in control treatment (22.08 cm).

Leaf Length at 45 days (cm)

The perusal data presented in (Table 4.1) shown that in case of leaf length at 45 days of sowing increased concentration of GA_3 from 5 ppm to 15 ppm affect the length of leaves significantly at all stages of growth. The maximum leaf length was recorded under the highest concentration of GA_3 i.e. under GA_3 at 15 ppm (34.02 cm) followed by GA_3 at 10 ppm (32.17 cm). The lowest leaf length was observed under the control treatment (24.35 cm). It also found to be increased under higher concentration of NAA i.e. NAA 30ppm (30.90 cm). Thus the increasing concentrations of both the growth regulators GA3 and NAA increase the leaf length of radish at 45 days vividly.

Leaf length at final harvesting (cm)

It is obvious from the data given in Table 4.1. revealed that there was significant variation found in leaf length at final harvesting and it was recorded to be maximum under the highest concentration of GA_3 at 15 ppm (37.16 cm) over all the treatments applied and found to be lesser than before when dose reduced to GA_3 at 10ppm (35.11 cm) and found lowest under the control treatment (27.87 cm). Thus decrease in the concentration of GA_3 reduces the length of the leaf at harvesting stage of radish.

The huge variation in leaf length might be due to the reason that GA_3 application leads to rise in cell number, cell division and cell size which increase the metabolic activities in the plant (Bhosale *et al.* 2017) [7].

Plant Height (cm)

Plant height is one of the most important character as it showed how healthy, how vigorous the plant is at its all growth stages**.** It is marked from the records embodied in (Table 4.1) that there was wide variation found in plant height recorded at final harvesting stage of radish as affected by different treatments. Under the highest dose of GA_3 i.e. GA_3 at 15 ppm, maximum plant height was recorded (71.21 cm) i.e. tallest plants were produced under treatment GA_3 at 15 ppm followed by GA_3 at 10 ppm (67.04 cm) respectively and recorded to be minimum in untreated plot control (53.30 cm). GA_3 was found more effective than NAA in increasing the plant height.

The plant height increased with higher concentration of GA_3 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) [14]. The overall increase in vegetative growth may be due the reason that gibberellic acid increase the rate of photosynthesis in plants (Alvin, 1960) [2].

Table 4.1: Influence of various growth substances on vegetative characters of radish including leaf length and at different growth stages and plant height.

Treatment	Leaf length at 30 days (cm)	Leaf length at 45 days (cm)	Leal length at final harvesting (cm)	Plant height (cm)
T_1 GA_3 5 ppm	27.71	29.13	32.28	61.78
T_2 GA_3 10 ppm	30.72	32.17	35.11	67.04
T_3 GA_3 15 ppm	32.14	34.02	37.16	71.21
T_4 NAA 10 ppm	25.01	26.83	29.22	56.29
T_5 NAA 20 ppm	26.24	28.03	30.77	59.09
T_6NAA 30 ppm	28.98	30.90	33.97	64.69
T_7 Control	22.08	24.35	27.87	53.30
SE(m)±	0.32	0.33	0.34	0.47
C.D.	1.01	1.04	1.06	1.47
C.V.	2.04	1.97	1.83	1.32

Yield and yield attributing characters

Root length (cm)

The observation recorded on root length has been accessible in Table 4.2. The mean root length as affected by different treatments varied significantly. The data clearly depicted that (on the basis of mean) the maximum root length was recorded under highest dose of GA_3 i.e. GA_3 at 15 ppm (34.05 cm) over rest of the concentrations of growth regulators applied followed by GA_3 at 10 ppm (31.93 cm) respectively. The minimum root length was recorded under control (25.43 cm). The data showed wide variation in root length of the radish from control treatment.

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 (Sarkar *et al.* 2018) [13].

Weight of root (g)

Responses of root weight to different levels of GA_3 and NAA application described in Table 4.2. Weight of roots is important as it is used to calculate the root yield of the plot in kg and total root yield q/ha. The weight of roots affected significantly by different treatment concentrations. Among all the treatments, the maximum weight of roots was recorded by GA_3 higher concentration means GA_3 at 15 ppm (222.93 g). It was followed by lesser concentration i.e. GA_3 at 10 ppm producing root weight of (206.24 g) and the minimum root weight was recorded under untreated plot i.e. under control (144.71 g). The data clearly indicates that there is huge variation in fresh weight of root due to application of both plant growth regulators which significantly differ from control. The fresh weight of root was maximum in highest concentration of GA_3 this might be due to the reason that the three factors dry matter addition, cell division and expansion results in increased fresh weight of roots (Hopkins, 1999) [11].

Root yield kg/ plot

Root yield kg/plot is the most important parameter as it involves final scheming under the different treatments. It was calculated from fresh weight of root/plant**.** It is evident from the data presented in (Table 4.2) that the various treatments caused significant variation in yield of root kg/plot. Among all the treatments, maximum root yield kg/plot was observed in GA_3 highest concentration i.e. GA_3 at 15 ppm (8.92 kg/plot) over all other treatments and it was followed by GA_3 at 10 ppm (8.25 kg/plot). The minimum root yield was found under untreated plot of radish i.e. under control treatment (5.79 kg/plot). The variation in root yield kg/plot is due to the fact that yield is related to number of plant per plot, root length, and root weight which also increases with increased concentration of GA_3 from 5 ppm to 15 ppm (Bawkar *et al.* 2011) [5].

Table 4.2: Influence of growth regulators on yield and yield attributing traits of Radish.

Treatment	Root length (cm)	Weight of root (g)	Root yield (kg/plot)
T_1 GA_3 5 ppm	29.50	186.46	7.46
T_2 GA_3 10 ppm	31.93	206.24	8.25
T_3 GA_3 15 ppm	34.05	222.93	8.92
T_4 NAA 10 ppm	27.07	165.24	6.61
T_5 NAA 20 ppm	28.32	179.52	7.18
T_6NAA 30 ppm	30.72	199.34	7.97
T_7Control	25.43	144.71	5.79
SE(m)±	0.37	1.18	0.05
C.D.	1.16	3.68	0.15
C.V.	2.18	1.10	1.10

Conclusion

On the basis of the results obtained from the present investigation, it can be concluded that among all the growth regulators, GA_3 at 15 ppm accomplished best results followed by GA3 10 ppm which improves the vegetative characters such as leaf length at various growth stages (at 30 days, 45 days and at final harvesting), plant height, yield and yield attributing characters of radish *viz.* root length, fresh weight of roots and root yield kg/plot. Hence GA3 at 15 ppm can be used for radish grown in winter season to increase yield and yield attributing characters and also recommended to farmers for increasing their productivity.

References

1. Abdel CG, Asaad SS and Mohammad DS. Minimum, optimum and maximum temperatures required for germination of Onion, Radish, Tomato and Pepper. International Journal of Farming and Allied Sciences. 2016; 5(1):26-45.
2. Alvin P. Net assimilation rate and growth behaviour of leaves as affected by gibberellic acid, urea and sugar. Plant physiology.1960; 35:285.
3. Angell FF, Hillyer IG. Cultural and environment conditions affecting radish root hypocotyls development. Proceedings of the American Society for Horticultural Science. 1962; 81:402-407.
4. Banihani SA. Radish (*Raphanus sativus*) and Diabetes. Nutrients. 2017; 2:2-5.
5. Bawkar SO, Wagh AP, Dod VN, Nagre PK, Das B. Effect of spacing and seed soaking with GA_3 on growth, yield and quality of carrot. The Asian Journal of Horticulture. 2011; 6(2):373-375.
6. Bhatia KN, Parashar KN. Plant physiology Trueman Book Company, Jalandhar, 1988.
7. Bhosale KS, Limaye AS, Shinde BP. Role of gibberellic acid, leaf extract of Azadirachtaindica and Pongamiapinnata on growth and productivity of Garlic. International Journal of Scientific Research in Science and Technology. 2017; 3(9):138-143.
8. Brintha I, Seran TH. Effect of paired row planting of radish (*Raphanus sativus* L.) intercropped with vegetable amaranthus (*Amaranthus tricolor* L.) on yield components of radish in sandy soil. Journal of Agricultural Science. 2009; 4:19-28.
9. Dhananjaya Organic studies in radish (*Raphanus sativus* L.) varieties. M.Sc. thesis, Department of Horticulture, College of Agriculture, Dharwad, University of Agricutlure Science, 2007.

10. Gohil TG, Shah B, Thakur A. Study of the status of ethnomedicine to cure jaundice through home remedies in Valsad district, Gujrat. International Journal of Plant Sciences. 2010; 5(1):340-343.
11. Hopkins WG. Introduction to plant physiology. John Wiley and Sons, IMC New York. 1999; 2:310-365.
12. National Horticulture Database (NHB), 2016-2017.
13. Sarkar MD, Shahjahan M, Kabir K, Shihab AY, Sayem ANM. Morphological Performance of Onion under Exogenous Treatments of GA_3. Notulae Scientia Biologicae. 2018; 10(1):33-37.
14. Shruthi HT, Srinivasa V, Ibaad MH. Influence of spacing and growth regulators on growth, flowering, seed yield and quality of radish (*Raphanus sativus* L.) Cv. Pusa Chetki. Research in Environment and Life Sciences. 2016; 9(3):288-291.
15. Singh M, Singh RP, Yadav HS. Response of growth regulators and their method of application on yield of radish. Bhartiya Krishi Anusandhan Patrika.1989; 4(2):84-88.