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EFFECT OF SPACING AND SEED SOAKING WITH GA_3 ON GROWTH, YIELD AND QUALITY OF RADISH (*Raphanus sativus* L.)

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ABSTRACT

An the experiment was conducted during Rabi 2009-10 at Akola to study the effect of spacing and seed soaking with GA_3 on growth, yield and quality of radish (*Raphanus sativus* L.). The results revealed that, the significantly the highest plant height (38.20 cm), length of root (25. 53 cm), root yield plot^{-1} (11.30 kg), hectare^{-1} (261.54 q), ascorbic acid content (16.11 mg/ 100 g) and minimum pithiness (9.60 %) was recorded in closer spacing of 45 cm x 10 cm (S_1). The wider spacing has significantly superior performance in number of leaves (13.86), Leaf area (161.56 cm^2), Fresh weight of leaves (115.20 g), Fresh weight of roots (133.10 g), diameter of the root (3.88 cm) and chlorophyll content (0.61 mg/100 g). The effect of seed soaking with GA_3 was statistically significant at all stages but the treatment G_5 i.e. GA_3 at 40 ppm showed superior performance in all growth, yield and quality parameters in radish.

KEYWORDS: Radish, GA_3, Spacing, Seed soaking

INTRODUCTION

Radish (*Raphanus sativus* L.) belongs to the genus Raphanus of the family Cruciferae, it is grown for its young tuberous roots which are eaten raw as a salad or cooked as a vegetable and an appetizer. In India, with increase in population and improvement in dietary habits, the consumption of vegetables has improved. People realize the importance of vegetables in their diet as vegetables have high nutritive value, which are vital for the body. In present scenario, the cultivable land is decreasing continuously due to rapid urbanization, industrialization and shrinking land holdings. In order to fulfil the demand of the people for the improved quality radish, it is essential to increase the production of radish considerably. This can be achieved by bringing more area under cultivation and increasing the productivity. Among the cultural practices plant population had a profound influence on the yield and quality of radish. Plant population also affect the plant growth, development and yield. So, there is every need to find out the optimum plant population Treatment of seed with plant growth regulators is one of the most popular and cheapest methods and has been claimed as an effective tool for improving yield in many crops. Among these plant growth regulators GA is known to have root elongation and enhancement of quality on root crops. Hence, the present investigation was helpful to know the effect of spacing and seed soaking with GA_3 on growth, yield and quality of radish.

MATERIAL AND METHODS

The present investigation entitled, "Effect of spacing and seed soaking with GA_3 on growth, yield and quality of radish" was carried out during *Rabi* 2009-10. The experiment was laid out with cv. Pusa chetki in Factorial Randomized Block Design with three different spacings i.e. S_1 - 45 cm × 10 cm, S_2 - 45 cm × 15 cm and S_3 - 45 cm × 20 cm and five different concentrations of GA_3 seed soaking i.e. G_1 - control, G_2 - GA_3 at 10 ppm, G_3 - GA_3 at 20 ppm, G_4 - GA_3 at 30 ppm, G_5 - GA_3 at 40 ppm and replicated thrice with fifteen treatment.

Ascorbic acid content in root was estimated by titrating the sample with 2, 6 dichlorophenol indophenol and calculated as per the formula given below.

$$\text{Ascorbic acid (mg/ 100 g juice)} = \frac{\text{Titre} \times \text{Dye factor} \times \text{Volume made up}}{\text{Aliquot of extract taken for estimation} \times \text{Volume of sample taken for estimation}} \times 100$$

The chlorophyll content of the leaves was estimated in percentage by the following procedure.

i) 0.0375 g of leaf sample was accurately weighed on electronic mono pan balance and about 10 ml of DMSO (Dimethyl sulphoxide solution) was added to the leaf sample.

ii) The samples were kept within the solution for two hours in autoclaves at 60°C.

iii) After two hours, all the chlorophyll was extracted in the solution.

iv) The optical density was calibrated at 645 nm for chlorophyll 'a' and 663 nm for chlorophyll 'b' and at 652 nm for total chlorophyll.

v) Chlorophyll 'a', chlorophyll 'b' and total chlorophyll were calculated with the help of the formula suggested by Arnon (1949).

$$\text{Total chlorophyll} = \frac{\text{O.D. at 65 nm} \times 100}{34.5} \times \frac{V}{100 \times W}$$

where,

O.D. = Optical density

V = Final volume i.e. 10 ml of DMSO

W = Weight of fresh leaves (g)

Chlorophyll 'a' (mg g^{-1} fresh weight) = 12.7 (O.D. at 663) - 2.69 (O.D. at 645) $\times \frac{V}{100 \times W}$

Chlorophyll 'b' (mg g^{-1} fresh weight) = 22.9 (O.D. at 645) - 4.68 (O.D. at 663) x $\frac{V}{100 \times W}$

Freshly harvested roots were cut into three to four pieces and observations on pithiness were taken and expressed in percentage. The data obtained on various observations, during the course of investigation were statistically analyzed by Factorial Randomized Block Design as suggested by Gomez and Gomez (1984).

RESULT AND DISCUSSION

Effect of spacing and GA_3 treatment on growth parameters

Effect of spacing

The data presented in the table revealed that there was a significant difference among the growth characters under study. The significantly maximum plant height (38.20 cm), length of the root (25.53 cm) was recorded with less spacing i.e. S_1 - 45 cm x 10 cm. This might be due to the insufficient space for spreading and severe competition of plants for light and aeration resulting in more vertical growth in closer spacing as compared to wider spacing. These findings were in conformity with El-Desuki *et al.* (2005) in radish. Where as the treatment with wider spacing i.e. S_3 - 45 cm × 20 cm showed the significantly maximum no of leaves (13.86), Leaf area (161.56 cm^2), Fresh weight of leaves (115.20 g), Fresh weight of roots (133.10 g) and diameter of the root (3.88 cm) which was significantly superior over the rest of the treatments. The same treatment recorded less days for germination (5.73) which was desirable. The maximum no of leaves per plant, leaf area, diameter of the root, maximum fresh weight of leaves and root was recorded by wider spacing as compared to closer spacing as a fact that the plants grow at wider spacing got the advantage of better resources like sunshine, aeration and optimum area for nutrient uptake as compared to plants grow under narrow spacing and these results were in conformity with the results of Warade *et al.* (2002) and Parvez *et al.* (2004).

Effect of GA_3 treatment

The data presented in the table revealed that the treatment G_5 i.e. 40 ppm shows significantly superior over other treatments and it was recorded higher values of all growth parameters i.e. plant height (38.87 cm), length of the root (29.01 cm), maximum no leaves (14.34), Leaf area (199.71 cm^2), diameter of the root (4.40 cm), Fresh weight of leaves (118.78 g) and Fresh weight of roots (145.08 g) This might be due to the stem elongation caused by application of GA_3. The GA_3 increases auxin production of apex and accelerate the cell division in cambium or other tissues which results in increase in height of plant, length of the root. Similar results were reported by Mahabir Singh and Rajodia (2001) in radish. The treatment G_5 i.e. 40 ppm shows minimum (5.73) days for germination which was desirable. This is might be due to increasing concentrations of GA_3 accelerate the metabolic activity within the embryo of the seed .Similar results were reported Malhotra and Chaudhari (2001) in radish. The interaction between effect of spacing and seed soaking with GA_3 on all growth parameters was not traceable.

Effect of spacing and GA_3 treatment on yield and quality parameters

Effect of spacing

The data presented in the table 2 revealed that the treatment i.e. S_1 - 45 cm × 10 cm shows significantly superior root yield per plot (11.30 kg) and root yield per hectare (261.54 q) and ascorbic acid content in root (16.11

Table 1. Effect of spacing and GA_3 treatment on growth parameters

Treatments	Days required for germination	Height of plant (cm)	Number of leaves plant^{-1}	Leaf area (cm^2)	fresh weight of leaves (g)	Fresh weight of root (g)	Length of root (cm)
Spacing							
S_1	7.33	38.20	12.32	150.88	96.99	117.74	25.53
S_2	6.87	35.71	13.21	155.91	99.86	124.73	24.10
S_3	5.73	34.32	13.86	161.56	115.20	133.10	22.35
'F' test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
CD at 5%	0.52	0.73	0.79	5.96	4.58	4.93	1.17
Seed soaking with GA_3							
G_1	8.33	33.00	11.88	107.28	88.48	108.62	17.19
G_2	7.00	34.94	12.88	136.93	96.17	115.77	22.58
G_3	6.89	36.01	13.20	157.70	103.63	123.60	24.16
G_4	6.33	37.58	13.34	178.97	112.73	132.89	27.00
G_5	4.67	38.87	14.34	199.71	118.78	145.08	29.01
'F' test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
CD at 5%	0.68	0.94	1.02	7.69	5.92	6.37	1.51
Interaction (S x G) spacing x seed soaking with GA_3							
'F' test	NS	NS	NS	NS	NS	NS	NS
CD at 5%	-	-	-	-	-	-	-

Table 2. Effect of spacing and GA_3 treatment on yield and quality parameters

Treatments	Diameter of root (cm)	Root yield per plot (kg)	Root yield per hectare (q)	Ascorbic acid content in root (mg/100 g)	Chlorophyll content in leaves (mg/100g)	Pithiness (%)
Spacing						
S_1	3.25	11.30	261.54	16.11	0.40	9.60
S_2	3.46	7.48	173.26	14.86	0.50	12.20
S_3	3.88	6.39	147.84	13.74	0.61	15.40
'F' test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
CD at 5%	0.41	0.36	8.30	0.95	0.08	0.72
Seed soaking with GA_3						
G_1	2.59	7.25	167.79	12.30	0.17	19.67
G_2	3.32	7.77	179.82	13.62	0.40	11.67
G_3	3.53	8.29	191.79	15.19	0.51	11.33
G_4	3.81	8.91	206.24	16.16	0.63	10.33
G_5	4.40	9.74	225.43	17.24	0.81	9.00
'F' test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
CD at 5%	0.53	0.46	10.72	1.23	0.10	0.92
Interaction (S x G) spacing x seed soaking with GA_3						
'F' test	NS	NS	NS	NS	NS	NS
CD at 5%	-	-	-	-	-	-

mg/100 g) over other treatments. This is due to higher plant population maintained per unit area leads to maximum root yield. Higher yield at closer spacing was also reported by El-Desuki *et al.* (2005) in radish, Da Silva *et al.* (2008) in carrot. The pithiness percent was less in close spacing (9.60 %) which was desirable. The wider spaced plants showed maximum diameter of roots by availing more resources, the roots went over growth, due to which there was more development of pithiness in wider spaced roots. The wider spacing treatment S_3 i.e. 45 cm × 20 cm was found significantly superior over all other treatments and recorded maximum chlorophyll content (0.61 mg/ 100 g) in leaves.

Effect of GA_3 treatment

The data presented in the Table 2 revealed that the treatment G_5 i.e. 40 ppm shows significantly superior over other treatments and it was recorded maximum for all yield and quality parameters i.e. root yield per plot (9.74 kg), root yield per hectare (225.43 q) ascorbic acid content in root (17.24 mg/100 g) and chlorophyll content (0.81 mg/ 100 g) in leaves. Application of GA_3 was responsible for increased growth, root length, root diameter, fresh weight of root and resulted in total root yield. It increases the photosynthetic activities within the plant which resulted in more production of carbohydrates and other photosynthetic product. Increase in carbohydrates directly influenced root diameter, length and weight and ultimately the good yield.

The greater accumulation of CHO in the plant is necessary in order to facilitate the development of root and increase in yield. These results are supported by the findings of Mahabir Singh and Rajodia (2001) in radish, Mondal and Shukla (2005) in onion.

Significantly minimum pithiness (9.00%) was recorded in treatment G_5 i.e. GA_3 at 40 ppm. Under the influence of higher concentration of GA_3, there was more elongation of growth, more root length and there was less pithiness in higher concentration of GA_3. These results are supported by Parvez *et al.* (2004).**:** The data in respect of interaction effect of spacing and seed soaking with GA_3 on all yield and quality parameters were non significant.

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