ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 3.4
IJAR 2014; 1(1): 447-449
www.allresearchjournal.com
Received: 07-10-2014
Accepted: 15-11-2014

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Response of foliar spray of GA_3 and stage of application on the performance of seed crop of Radish (*Raphanus sativus* L.) cv. Pusa reshami

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Abstract
The field experiment was conducted at the farm of Brahamanand Mahavidhalya Rath, Hamirpur, Uttar Pradesh during 2013-2014 laid out in Factorial Randomized Block Design. The four concentration of GA_3 i.e, G_0(0 ppm), G_1(20 ppm),G_2(40 ppm),G_3(60 ppm) and three stages of spray after transplanting D_1 (20 days), D_2 (40 days), D_3 (60 days) of growth stage. The combination of 40 ppm of GA_3 and spray after 40 days transplanting was effective in maximum plant height (109.25 cm),plant spread (N-S)(95.58 cm),plant spread (E-W)(95.19 ce m)and minimum days to maturity (94.94days) at growth stage, length of siliqua (6.86cm),weigh of siliqua (29.53 g),weight of 100 seeds (21.02 g), yield of seed per plant (21.05 g), yield of seed per hac. (14.05 qntl.), respectively.

Keywords: Radish (*Raphanus sativus* L.), cv. Pusa reshami and GA_3

Introduction
Radish is one of the important root vegetable extensively grown in almost all parts of the country. It can be considered an annual as well as a biennial crop. It is cool season vegetable. Radish plays a vital role in the health and nutritional security of human beings in addition to improve the economy of the people of the country. Good quality seed is also one of the important means to increase productivity in any crop. A lot of emphases have been given by government of India to improve the quality of seed and planting materials which has not only opened new vistas in increasing production and productivity but also provided ample opportunities for export of quality seed. Radish is a cross-pollinated crop due to saprophytic system of self-incompatibility. The seed production of radish is done by seed to seed and root to seed method. Root to seed method is better than seed to seed method in term of quality of seed. Role of gibberellins in regulating various physiological processes, including seed germination, mobilization of endosperm storage reserves, shoot growth, flowering, floral development and fruit set. The Asiatic variety of radish has its importance, as they fit well in round the year production cycle. Due to specific climatic requirements for seed setting, the seed production of Asiatic type of radish is confined to specific areas in plains. To meet out the ever increasing seed demand of such varieties there is need to find out effective methods for increasing the seed yield and also for spraying gibberllic acid (GA_3) to obtain high seed yield of tropical type of radish under south Indian conditions. A number of studies have been carried out in past to analyze the physiological and biochemical changes associated with accelerated aged seeds.

Materials and Methods
The experiment was conducted during rabi season of at the farm of Brahamanand Mahavidhalya Rath, Hamirpur, Uttar Pradesh during 2013-2014. The four levels of GA_3 G_0: 0 ppm, G_1: 20 ppm,G_2: 40 ppm, G_3: 60 ppm and three stages of spray after transplanting D_1: 20 days, D_2: 40 days, D_3: 60 days of growth stage were tested in Factorial Randomized Block Design replicated thrice, spacing of radish row to row 60cm and plant to plant 30cm.

Radish steckling were raised on ridges and 40-45days old and uniform stecklings were selected. One-third part of root and shoot was cut to the original root and shoot formed without giving any injury to central growing point. The growth, seed yield and quality parameters viz., Plant height(cm) and plant spread (n-s)(cm), plant spread (E-W)(cm) and days to maturity (days) at growth stage, length of siliqua (cm), weight of siliqua (g), weight of 100 seeds (g), yield of seed per plant(g), yield of seed per hac. (QNTL) and data were analyzed as suggested by Sundaraju *et al*. (1972) [7].

Results and Discussion

The results obtained from the present investigation have been discussed in the following sub heads.

Growth attributes

Growth parameters like maximum plant height (109.25 cm),plant spread (N-S)(95.58 cm), plant spread (E-W)(95.19 cm)and minimum days to maturity (94.94days) at growth stage were significantly affected by G_2D_2 treatment combination of 40 ppm of GA_3 and spray at 40 days transplanting at growth stage (Table 1) over other treatments. The increase in plant height and plant spread may be attributed to the action of gibberellins which promote vegetative growth by way of cell division and cell elongation and this may have resulted in the increase of plant height. Another probable reason of significant increase in plant height might be due to the effect of gibberellins on photosynthetic activity in efficiently utilizing photosynthetic products by plants. Yet another possible reason of increase in the plant height might be due to increased osmotic uptake of water and nutrients, by maintaining constant swelling force against the softening of cell walls, resulting in an increased uptake. These results are in close conformity with the findings of Joshi and Singh (2001) [3] and Nitesh *et al*. (2005) [6] and days to maturity (94.90days) Induction of early flowering due to application of micronutrients was mainly ascribed to the process of plant regulators which have an influence on early flower initiation. The results are in agreement with findings of Geetharani *et al*. (2008) [2] in onion, Masuthi *et al.* (2009) [1] in cowpea.

Table1: Effect of Foliar Spray of GA_3 with different concentrations on growth of radish (*Raphanus sativus* L.) cv. Pusa reshami

Treatments	Plant height (cm)	Plant spread (N-S) (cm)	Plant spread (E-W) (cm)	Days to maturity
G_0D_1	98.47	81.17	75.52	108.28
G_0D_2	99.02	84.25	82.41	106.94
G_0D_3	100.52	85.95	83.1	105.82
G_1D_1	100.48	86.21	84.61	104.86
G_1D_2	106.27	92.58	88.09	98.07
G_1D_3	104.81	85.27	85.23	100.52
G_2D_1	107.14	93.5	93.71	97.71
G_2D_2	109.25	95.58	95.19	94.94
G_2D_3	105.25	91.87	91.95	99.71
G_3D_1	102.48	87.25	85.19	102.92
G_3D_2	108.2	94.05	92.28	96.07
G_3D_3	103.54	89.29	86.21	100.15
SEm±	0.14	0.55	0.46	0.30
CD at 5%	1.24	4.73	3.94	2.56

Seed yield attributes

The spray of 40 ppm of GA_3 and spray sprayed at 40 days transplanting recorded significantly highest seed yield and better quality parameters and produced (Table 2).Length of siliqua (6.86cm), weight of siliqua (29.53 g), weight of 100 seeds (21.02 g), yield of seed per plant (21.05 g), yield of seed per hac. (14.05 qntl.) Over other treatments, respectively. The highest seed yield was also due to higher no. of siliqua per plant, siliqua length and no. of seed per siliqua. This increase in yield may be attributed to the fact that GA_3 treated plants remained physiologically more active to build up sufficient food stocks, which in turn, promoted better plant growth and ultimately more number of flowers, leading to higher yields. Another, probable reason for this increase in yield might be due to direct growth regulating action of GA_3. The presence of GA_3 might have increased the growth promoting enzymes there by synthesizing more nucleic acid etc. in the plants. Since RNA and DNA synthesis are mostly extra nuclear and centralized in chloroplasts which might have accelerated the rate of food assimilation and ultimately might have increased the number of flowers as well as the yield. These findings are in accordance with the result of Kumar *et al*. (2014) [4] and Mehta *et al*. (1997) [5].

Table 2: Effect of Foliar Spray of GA_3 with different concentrations on Seed yield and Seed quality of radish (*Raphanus sativus* L.) cv. Pusa reshami

Treatments	Length of Siliqua (cm)	Weight of Siliqua (cm)	Weight of (100g) seed	Yield of Seed /Plant (g)	Yield of Seed q/ha^{-1}
G_0D_1	0.85	14.84	2.88	10.23	3.51
G_0D_2	1.78	15.7	5.93	11.45	4.74
G_0D_3	2.85	16.82	6.84	13.25	5.29
G_1D_1	5.92	15.3	7.00	17.28	6.27
G_1D_2	5.86	26.16	18.05	17.99	11.62
G_1D_3	3.93	23.03	16.96	20.01	9.24
G_2D_1	6.92	27.66	19.97	19.37	12.84
G_2D_2	8.86	29.93	21.02	21.5	14.05
G_2D_3	4.92	25.16	17.93	18.55	10.54
G_3D_1	3.9	18.96	8.01	16.25	7.95
G_3D_2	7.85	28.82	20.06	20.36	13.85
G_3D_3	6.92	19.93	10.96	15.23	10.05
SEm±	0.17	0.19	0.17	0.21	0.34
CD at 5%	1.46	1.66	1.45	1.80	2.91

Conclusion

On the basis of analyzed data presented it may be concluded that to obtain the maximum yield of better quality seed of radishcv. *Pusa reshami* in Bundelkhand region, sraying of 40 ppm GA_3concentration was more effective than other levels of GA_3 to spray at 45 DAT on seed production of radish.

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