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Research Article

Effect of plant growth regulators on growth and yield of spinach beat (*Beta valgaris var. Begalensis*)

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Abstract

A field experiment was conducted at Horticulture Research farm, AKS University, Satna (M.P.) during *Rabi* season of 2023-24 to assess the influence of plant growth regulators on growth and yield of spinach beat. There were three PGRviz. GA_3, IAA and NAAwhich were applied in three concentrations each as GA_3 25 ppm, GA_3 50 ppm, GA_3 100 ppm, IAA 25 ppm, IAA 50 ppm, IAA 100 ppm, NAA 25 ppm, NAA 50 ppm, NAA 100 ppm and control. These were tested in randomized block design with three replications. Application of combine dose of NAA @ 100 ppm was significantly altered the, plant spread (9.26 cm), No. of leaves per plant (7.23) Leaf length (9.68cm), Leaf area (15.27cm^2) as compared to control. However, application of NAA @ 100 ppm resulted in maximum fresh green yield 128.25 q/ha as compared to other plant growth regulators control.

Key Words: NAA, Leaf area, spinach beet, fresh green yield, Plant growth regulators

Introduction:

Spinach beet (*Beta vulgaris varr. bengalensis*.) is the most important leafy vegetable grown in the Indian subcontinent, USA, Canada and Europe. It is rich in nutrients such as minerals, carbohydrates, vitamins A and C, riboflavin, nicotinic acid, and thiamine. Andhra Pradesh, Telangana, Kerala, Tamil Nadu, Uttar Pradesh, Karnataka, Maharashtra, West Bengal and Gujarat are leading producing states of spinach beat in India. In 2021, world production of spinach was 32 million tonnes, with China alone accounting for 92% of the total. In MP Spinach Production in 2021was in an area of 3902 ha, 60195 MT, (Anonymous 2021-22). Foliar application of essential nutrients is valuable to minimize nutrient deficiencies in plants. However, plants usually respond to foliar application to a different extent, depending

upon the nature of the crop and agroclimatic and biochemical factors. A number of positive effects on the growth and productivity of some PGR through foliar supplementation have been registered by earlier research workers (Wahba and Ezz El-Din, 2002; Ezz El-Din and Khalil, 2003). In some previous study, in which the concentration of PGRs was optimized for improved antioxidant attributes in spinach (Aslam *et al.* 2013), the current study aimed to evaluate whether or not the foliar application of selected PGRs contributes towards improving the biochemical and antioxidant attributes of spinach in a field experiment, so as to explore their practical and sustainable agricultural applications. Pre-treatment of explants with auxin for different time periods before transfer to PGR-free medium is a factor affecting the efficiency of plant regeneration via organogenesis (Mii *et al.* 1992). Neither is the effect of the culture period on plant regeneration via somatic embryogenesis. Hence, the present experiment was carried out to evaluate the influence of plant growth regulators on growth and yield of spinach beet.

Material & Method:

The present study was conducted in the winter (*Rabi*) seasons of 2023-24 at the Horticulture Research Farm, AKS University, Satna (M.P.) The experiment was designed using a randomized block design with 10 treatments. The treatment details of the different plant gowth regulators application of T_2: GA_3 25 ppm, T_3: GA_3 50 ppm, T_4: GA_3 100 ppm, T_5: IAA 25 ppm, T_6: IAA 50 ppm, T_7: IAA 100 ppm, T_8: NAA 25 ppm, T_9: NAA 50 ppm, T_{10}: NAA 100 ppm and control T_1: weedy check. The soil of the research field was silty in texture pH of 7.5, medium in organic carbon (0.43%), available N (176 kg/ha), medium in available P (12.5 kg/ha) and high available K (200 kg/ha). Spinach variety (All green) was sown on 28th November 2023 and by using seed rate of 20 kg/ ha at 2-3 cm depth with rows 25 cm apart. The recommended dose of fertilizer was applied at the rate of 25-50-25kg N, P, K, in the form of urea, di-ammonium phosphate, muriate of potash, respectively. At the time of sowing, half dose of nitrogen, full dose of phosphorous, potassium, zinc and sulphur were applied as basal dose. Basal application was done in lines 5 cm below the seed rows. The remaining 50 percent of nitrogen was top dressed onto the crop at 30 days after sowing. All the Plant growth regulators (PGRs) were sprayed uniformly as per the treatment. The determined

quantity of Plant growth regulators (PGRs) was applied to each treatment using a knapsack sprayer, with a spray volume of 750 litres of water per hectare**.**

The statistical analysis was carried out using Analysis of Variance (Gomez and Gomez 1984) and mean comparisons were based on the least significant difference (LSD) at 0.05 probability.

Result and Discussion:

Effect on growth

Number of leaves per plant at 45 DAS, the treatments NAA 100 ppm and IAA 100 ppm exhibited significantly maximum 7.23 and 7.09 and both were at par with each other. While, treatment Control plot was recorded minimum 6.17. Number of leaves per plant. The Leaf length increased significantly with the increased crop growth period. At 45 days after sowing, the significantly maximum 9.68 cm leaf length was recorded in NAA 100 ppm followed by 9.47 cm in IAA 100 ppm. While the minimum 5.43 cm leaf length was observed in Control plot. The leaf area Index increased significantly with the increased crop growth period as epoted by Andrabi *et al*. (2019), Kusuma *et al*. (2019). At 45 days after sowing, the significantly maximum 15.57 cm^2 leaf area Index was recorded in NAA 100 ppm followed by 15.25 cm^2, IAA 100 ppm. While the minimum 12.67 cm^2 leaf area Index was observed in treatment Control plot. The Plant spread increased significantly with the increased crop growth period. At 45 days after sowing, the significantly maximum 9.26 cm. Plant spread was recorded in NAA 100 ppm followed by 8.85 cm IAA 100 ppm. While the minimum 5.12 cm Plant spread was observed in treatment Control plot.

Root length was influenced significant at maturity. The Root length was significantly maximum 9.26 cm was recorded in NAA 100 ppm followed by 8.85 cm, IAA 100 ppm. While the minimum 5.12 cm root length was observed in treatment Control plot .Among different plant growth regulators, AUXIN is primarily a single naturally occurring substance to be identified as Indole Acetic Acid (IAA). It is involved in cell wall synthesis, xylem differentiation, cell division, cell elongation, photosynthesis, apical dominance, root and shoots growth, prevention of abscission layer, respiration and also increase the certain enzymes. Similarly, Gibberellins are involved in seed germination, mobilization of foods in seed storage cell, cell elongation and permeability of cell membrane, apical bud dormancy, role in sub- apical meristem,

flowering and fruit growth. Beside these, Gibberellins induce synthesis of hydrolytic enzymes. (Prakash *et al.*2017)

Effect on Fresh & Dry weight and Yield

The Fresh weight of leaves increased significantly with the increased crop growth period. At 45 days after sowing, the significantly maximum 16.74 g Fresh weight of leaves was recorded in NAA 100 ppm followed by 15.62 g, IAA 100 ppm. While the minimum 10.68 g Fresh weight of leaves was observed in treatment Control plot. The Dry weight of leaves increased significantly with the increased crop growth period. At 45 days after sowing, the significantly maximum 13.89 g Dry weight of leaves was recorded in NAA 100 ppm followed by 13.02 g IAA 100 ppm. While the minimum 8.90 g dry weight of leaves was observed in treatment Control plot. The significantly maximum 21.57 q/ha Yield per ha was recorded in NAA 100 ppm followed by 21.17 q/ha, IAA 100 ppm. While the minimum 9.13 q/ha, yield per ha was observed in treatment Control ha. Similar findings were also reported by Krishnaveni *et al*. (2016), Yugandhar *et al*. (2016). Plant growth regulators viz. GA3, IAA, TIBA, play an important role in seed germination, seedling growth, vegetative growth and yield in most of crops. The application of growth regulators like Gibberellins, IAA, and TIBA etc. may prove helpful in increasing production of vegetables. Soaking of seed with these growth regulators accelerated the metabolic process involved during seed germination, seedlings growth and also improves growth and yield (Thapa *et al.,* 2013 and Vijendra Kumar *et al.,* 2014).

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Table: 1.0 Effect of PGRs on Plant spread, number of leaves, leaf length and leaf area index of spinach beet.

Treatments	Plant spread (cm)	Number of leaves per plant45 DAS	Leaf length at 45 DAS	Leaf area Index cm^2 at 60 DAS
Control	5.12	6.17	5.43	12.67
GA_3 25 ppm	5.63	6.27	6.14	12.95
GA_3 50 ppm	7.22	6.63	7.55	13.75
GA_3 100 ppm	8.55	7	9.06	14.97
IAA 25 ppm	6.17	6.4	6.71	13.11
IAA 50 ppm	7.8	6.78	8.04	13.99
IAA 100 ppm	8.85	7.09	9.47	15.25
NAA 25 ppm	6.96	6.43	7.32	13.25
NAA 50 ppm	8.28	6.86	8.81	14.32
NAA 100 ppm	9.26	7.23	9.68	15.57
S.Em ±	**0.53**	**0.21**	**0.42**	**0.55**
CD (P=0.05)	**1.56**	**0.60**	**1.24**	**1.61**

Table: 1.0 Effect of PGRs on root length, fresh weight, dry weight of leaves and yield of spinach beat.

Treatments	Root length (cm)	Fresh weight of leaves (g)/plant	Dry weight of leaves (g)/plant	Yield (q/ha)
Control	5.12	10.68	8.9	99.13
GA_3 25 ppm	5.63	11.51	9.59	110.79
GA_3 50 ppm	7.22	13.54	11.29	116.05
GA_3 100 ppm	8.55	14.75	12.29	120.85
IAA 25 ppm	6.17	12.29	10.24	113.18
IAA 50 ppm	7.8	13.83	11.52	118.06
IAA 100 ppm	8.85	15.62	13.02	121.17
NAA 25 ppm	6.96	13.21	11.01	115.12
NAA 50 ppm	8.28	14.18	11.82	119.87
NAA 100 ppm	9.26	16.74	13.89	128.25
S.Em ±	**0.53**	**0.51**	**0.42**	**0.93**
CD (P=0.05)	**1.56**	**1.49**	**1.24**	**2.71**