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Influence of gibberellic acid on growth performance of mint (*Mentha arvensis* L.) Cv. CIM-Unnati

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Abstract

The present investigation entitled "influence of gibberellic acid on growth performance of mint (*Mentha arvensis* L.) Cv. CIM-Unnati" was conducted at Nursery No.4, College of Horticulture, Dapoli. Dist. Ratnagiri (MS) during the academic year 2023-24. The study was conducted using a Randomized Block Design with eleven treatments and each replicated three times. The treatments included T_1 – Control (no dipping and no spraying), T_2 - Dipping and spraying with GA_3 50 ppm, T_3 - Spraying with GA_3 50 ppm, T_4 - Dipping and spraying with GA_3 100 ppm, T_5 - Spraying with GA_3 100 ppm, T_6 - Dipping and spraying with GA_3 150 ppm, T_7 - Spraying with GA_3 150 ppm, T_8 - Dipping and spraying with GA_3 200 ppm, T_9 - Spraying with GA_3 200 ppm, T_{10} - Dipping and spraying with GA_3 250 ppm and T_{11} - Spraying with GA_3 250 ppm. Among all the treatments studied the highest plant height (64.63 cm), plant spread (N-S) (44.79 cm) and (E-W) (38.89 cm), number of leaves (334.02), number of branches (78.73), leaf length (6.05 cm), leaf width (4.56 cm) and stem girth (13.26 mm) were recorded in the treatment T_4 - Dipping and spraying with GA_3 100 ppm.

Keywords: Gibberellic acid (GA_3), Mint, CIM-Unnati

1. Introduction

Mentha well known as Mint with scientific name *Mentha spp.* also identified by colloquial names such as podina and pudina. Comprises about 25 species belongs to the family Lamiaceae. It is widely cultivated around the world, with India, China, Vietnam and Brazil being the leading mint producers. India leads globaly, with Uttar Pradesh alone contributing nearly 90 percent of the India's mint production. Japanese mint (*Mentha arvensis* L.) rich in menthol content ranging from 80-85 percent [1]. Major cultivated species includes Japanese mint, Peppermint, Spear mint and Bergamot mint [2]. Mentha species widely cultivated as a industrial crop due to essential oil, which are rich in certain monoterpenes and extensively used in cosmetics and pharmaceutical industries. Japanese mint alone cultivated on about 60,000 ha. of land and annually producing over 12,000 tonnes of oil [3]. Menthol mint is a perennial aromatic herb that can be typically grows up to the height of 60 to 80 cm. Generally propagated by using stolons, stem cuttings and terminal cuttings also used. The flower of mint are small, with corolla of 4 to 5 mm and calyx of about 2 to 3 mm. Leaves are opposite to each other forming a pairs and are twisted-edged [4]. Menthol is a key component of mint, is used for its cooling properties, common ingredient in medicinal and cosmetic products. Also found in toothpaste, lotions, lipsticks, face and shaving creams, inhalers, cough syrups, ointments and aerosols because of their antimicrobial and stimulating effect. As the plant hormone gibberellic acid (GA_3) plays a vital role in enhancing plant growth and development by promoting cell division and elongation leading to increase in overall plant growth and boosts crop productivity. As the foliar application of plant growth regulators is an effective method for providing nutrients during plant's growth stages by promoting faster nutrient uptake. Despite it's potential, limited research work has been conducted on mint crop, especially under the Konkan region of Maharashtra. The aims objective of this study is to enhance large-scale mint production by evaluating the optimal concentration of Gibberellic acid.

2. Materials and Methodology

The present study was conducted at Nursery No.4, College of Horticulture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri, (415 712) during the period 2023-24, India. The experiment was conducted in Randomised Block Design with eleven treatments and three replications. Treatments includes, application of different concentration GA_3 sprays *Viz*., T_1 – Control (no dipping and no spraying), T_2 - Dipping and spraying with GA_3 50 ppm, T_3 - Spraying with GA_3 50 ppm, T_4 - Dipping and spraying with GA_3 100 ppm, T_5 - Spraying with GA_3 100 ppm, T_6 - Dipping and spraying with GA_3 150 ppm, T_7 - Spraying with GA_3 150 ppm, T_8 - Dipping and spraying with GA_3 200 ppm, T_9 - Spraying with GA_3 200 ppm, T_{10} - Dipping and spraying with GA_3 250 ppm and T_{11} - Spraying with GA_3 250 ppm. Experimental plot of gross plot area 341.25 m^2 and net plot area 120 m^2 was bring to the fine tilth by ploughing and harrowing, and 33 raised bed plots each of having measurement of 3 x 1 m was prepared. The planting material (stolons) were brought from the Central Institute of Medicinal and Aromatic Plants (CIMAP), Lucknow. Stolons was cut into small pieces of 3 to 4 cm length having 2 to 3 nodes were planted in portrays after treating with 1% carbendazim 50% WP to prevent fungal disease incidence. Recommended dose of NPK were applied @ 150:60:60 kg/ha. At the time of transplanting full dose of phosphorus and potash along with 1/3rd dose of nitrogen was applied, remaining nitrogen were applied in two split doses first at 45 DAT and second at 90 DAT. 21 days after planting of sprouted stolons was transplanted in the main field at the spacing of 45 x 30 cm. Dipping treatment for treatment (T_2, T_4, T_6, T_8 and T_{10}) was given before planting by means of uniform dipping stolons in the respective concentration of GA_3 solution for 5 minutes. All the foliar sprays of GA_3 were applied at 30, 60 and 90 days after transplanting. Each replication consists of 30 plants, for recording the observations five plants from each treatment per replication were selected. The collected data were statistically analysed by using the process described by Panse and Sukhatme [5].

3. Results and Discussion

3.1 Plant Height (cm)

Plant height is a key indicator of overall growth performance of plant. The highest plant height (64.63 cm) was noticed in treatment (T_4) Dipping and spraying with GA_3 100 ppm which was statistically at par with the treatment T_5 – Spraying with GA_3 100 ppm (61.28 cm). However, the lowest plant height was found in treatment T_1 – Control (43.17 cm). The increase in plant height by application of GA_3 is may be due to the increase in meristematic activity of apical tissues, increase in rate of cell division and cell elongation which helps to enhance photosynthetic activity and facilitates rapid plant growth. The present findings are in accordance with the findings of Singha *et al.* [6] in mint, Chiranjeevi *et al.* [7] in aonla seedlings, Surve [8] in kokum and Khan *et al.* [9] in palmrosa.

3.2 Plant Spread (N-S) (E-W) (cm)

The maximum plant spread (44.79 cm) North-South was recorded in the treatment T_4 - Dipping and spraying with GA_3 100 ppm which was statistically at par with treatment T_5 – Spraying with GA_3 100 ppm (37.75 cm). In contrast, the minimum plant spread (28.50 cm) North-South was observed in treatment T_1 – Control. The highest plant spread (38.89 cm) East-West was noticed in T_4 - Dipping and spraying with GA_3 100 ppm which was on par with T_5 – Spraying with GA_3 100 ppm (36.86 cm). On the other hand, the lowest plant spread (30.87 cm) was found in treatment T_1 – Control. It might be due to the GA_3 which enhances the cell division and promotes protein synthesis which stimulates the profuse branching ultimately increase in overall plant growth and increase in plant spread occurs. The present findings are in line with the findings of Singha *et al.* [6] in mint, Sharifuzzaman *et al.* [10] in chrysanthemum and Patel *et al.* [11] in chrysanthemum.

Table 1: Effect of gibberellic acid on plant height (cm), plant spread (North-South and East-West) (cm) and number of leaves of mint.

Treatments	Plant height (cm)	Plant spread (N-S) (cm)	Plant spread (E-W) (cm)	Number of leaves
	120 Days after transplanting			
T_1 - Control	43.17	28.50	30.87	180.10
T_2 - Dipping + spraying with GA_3 50 ppm	52.45	32.67	34.85	258.13
T_3 - Spraying with GA_3 50 ppm	52.41	31.71	34.23	245.11
T_4 - Dipping + spraying with GA_3 100 ppm	64.63	44.79	38.89	334.02
T_5 - Spraying with GA_3 100 ppm	61.28	37.75	36.86	316.50
T_6 - Dipping + spraying with GA_3 150 ppm	57.06	34.74	35.58	281.67
T_7 - Spraying with GA_3 150 ppm	54.30	32.89	34.97	270.05
T_8 - Dipping + spraying with GA_3 200 ppm	49.23	31.17	32.81	231.14
T_9 - Spraying with GA_3 200 ppm	47.92	30.96	32.05	218.27
T_{10} - Dipping + spraying with GA_3 250 ppm	46.67	29.61	32.02	207.98
T_{11} - Spraying with GA_3 250 ppm	44.23	28.55	31.59	198.53
Range	43.17-64.63	28.50-44.79	30.87-38.89	180.10-334.02
Mean	52.12	33.03	34.07	249.23
F test	SIG	SIG	SIG	SIG
S.E m ±	1.29	3.04	0.75	8.77
CD at 5%	3.82	8.96	2.20	25.87

3.3 Number of Leaves

Leaves play a vital role in plant growth as it is the plant organ which mainly responsible for photosynthesis. The highest number of leaves (334.02) were recorded in treatment T_4 - Dipping and spraying with GA_3 100 ppm which was found statistically on par with T_5 – Spraying with GA_3 100 ppm (316.50), on the other hand the lowest number of leaves (180.10) were observed in treatment T_1 - control. This might be due to gibberellic acid which promotes both cell division and elongation of plant tissue and by increasing the meristematic activity and by boosting the growth and leaf development. The results are confirmative with the findings of Patil *et al.* [12] in jamun, Surve [8] in kokum, Rahman *et al.* [13] in jamun and kadhim *et al.* [14] in sweet basil.

3.4 Number of Branches: Branches plays a crucial role in supporting plant growth and vigor ultimately increases the total yield. The maximum number of branches (78.73) were recorded in treatment T_4 - Dipping and spraying with GA_3 100 ppm which was found at par with T_5 – Spraying with GA_3 100 ppm (75.74). On the other hand, the lowest number of branches were noticed in treatment T_1 – Control (48.60). The number branches was increased by the application of GA_3 might be due to the stimulation of cell elongation and particularly the axillary buds are sensitive to gibberellic acid which helps in encouraging them to develop into profussed branches. Similar results were recorded by Patel *et al.* [11] in chrysanthemum, Singha *et al.* [6] in mint, Dadkhah *et al.* [15] in Summer savory, Singh and Singh [16] in chilli and Kadhim *et al.* [14] in sweet basil.

3.5 Leaf Length (cm)

The highest leaf length (6.05 cm) was observed in T_4 - Dipping and spraying with GA_3 100 ppm and it was statistically at par with treatment T_5 – Spraying with GA_3 100 ppm (5.64 cm). However, the lowest leaf length was found in T_1 – Control (4.84 cm). The observed increase in leaf length is might be due to the result of active cell division and cell elongation. Similar results were earlier recorded by Singha *et al.* [6] in mint and Samapika Dalai *et al.* [17] in cucumber.

Table 2: Effect of gibberellic acid on number of branches, leaf length (cm), leaf width (cm) and stem girth (mm) of mint.

Treatments	Number of branches	Leaf length (cm)	Leaf width (cm)	Stem girth (mm)
	120 Days after transplanting			
T_1 - Control	48.60	4.84	4.01	8.44
T_2 - Dipping + spraying with GA_3 50 ppm	55.52	5.51	4.33	9.32
T_3 - Spraying with GA_3 50 ppm	54.17	5.49	4.32	9.27
T_4 - Dipping + spraying with GA_3 100 ppm	78.73	6.05	4.56	11.44
T_5 - Spraying with GA_3 100 ppm	75.74	5.64	4.40	10.37
T_6 - Dipping + spraying with GA_3 150 ppm	58.97	5.53	4.36	10.05
T_7 - Spraying with GA_3 150 ppm	56.38	5.51	4.34	9.52
T_8 - Dipping + spraying with GA_3 200 ppm	53.60	5.45	4.31	8.86
T_9 - Spraying with GA_3 200 ppm	52.48	5.42	4.29	8.63
T_{10} - Dipping + spraying with GA_3 250 ppm	51.20	5.34	4.25	8.62
T_{11} - Spraying with GA_3 250 ppm	50.30	5.15	4.19	8.56
Range	48.60-78.73	4.84-6.05	4.01-4.56	8.44-11.44
Mean	57.79	5.45	4.30	9.37
F test	SIG	SIG	SIG	SIG
S.E m ±	1.33	0.17	0.06	0.45
CD at 5%	3.91	0.49	0.17	1.32

3.6 Leaf Width (cm)

The data highlights that the highest leaf width (4.56 cm) was observed in T_4 - Dipping and spraying with GA_3 100 ppm which was found statistically at par with treatment T_5 – Spraying with GA_3 100 ppm (4.40 cm). Whereas, the lowest leaf width (4.01 cm) was noticed in T_1 – Control. This may be due to the positive effect of GA_3 which helps to enhance the growth rate by increasing rate of active cell elongation and cell division. The present findings are in line with the findings of Singha *et al.* [6] in mint and Samapika Dalai *et al.* [17] in cucumber.

3.7 Stem Girth (mm)

The maximum stem girth (11.44 mm) was observed in treatment T_4 - Dipping and spraying with GA_3 100 ppm and it was found at par with treatment T_5 - Spraying with GA_3 100 ppm (10.37 mm). The minimum stem girth (8.44 mm) was recorded in the treatment T_1 – Control. This effect may be due to attributed to role of GA3 in enhancing cell wall extensibility which ultimately contributes to increase in stem girth. The increase in stem girth by application of GA_3 was also reported by earlier scientists by Patil *et al.* [12] in jamun, Surve [8] in kokum, Vasantha *et al.* [18] in tamarind and Meshram *et al.* [19] in acid lime.

4. Conclusion

Among all the treatments studied, dipping and spraying with GA_3 @ 100 ppm, administered in three foliar sprays at 30, 60 and 90 days after transplanting significantly enhanced the growth of mint. This treatment resulted in plant height (64.63 cm), plant spread (North-South 44.79 cm and East-West 38.89 cm), number of leaves (334.02), number of branches (78.73), leaf length (6.05 cm), leaf width (4.56 cm) and stem girth (11.44 mm). Thus, from the results obtained from present investigation, it can be concluded that the treatment T_4 – dipping and spraying with GA_3 @ 100 ppm recorded the most promising results with respect to growth attributes of mint over the rest of treatment studied in this study.

5. Disclaimer (Artificial Intelligence)

Author(s) hereby declare that no generative AI technologies such as Large Language Models (ChatGPT, COPOLOT, etc.) and text-to-image generators have been used during writing or editing of this manuscript.

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