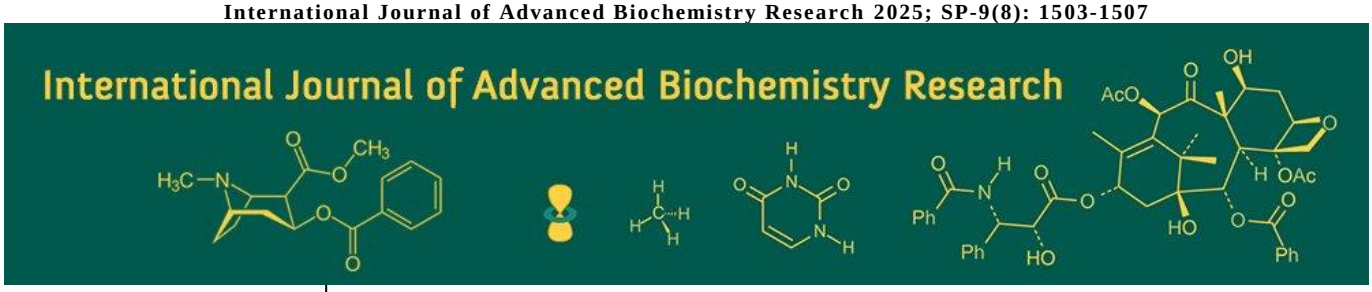

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Effect of plant growth regulators on growth and yield of round gourd

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Abstract
The present investigation entitled "Effect of plant growth regulators on growth and yield of round gourd" was carried out during the summer season of 2024-2025 at the Experimental Unit, Betelvine Research Station, Ramtek, Nagpur. The primary objective was to study the effect of plant growth regulators on growth and yield of round gourd. Significant differences were recorded among treatments for key growth attributes, including length of main vine, number of sub vines, number of leaves vine^{-1}, length of internode and leaf area at 30, 45, and 60 days after sowing (DAS). Application of GA_3 at 90 ppm resulted in the highest main vine length (176.7 cm), number of leaves vine^{-1} (69.9), internodal length (11.87 cm) and leaf area (92.90 cm²) at 60 DAS. In contrast, Ethrel at 150 ppm produced the maximum number of sub vines (7.2). With respect to yield, Ethrel at 150 ppm recorded the maximum fruits vine^{-1} (13.50), fruit weight (60.30 g), fruit yield vine^{-1} (0.813 kg), fruit yield plot^{-1} (12.45 kg) and fruit yield hectare^{-1} (103.75 q), whereas Ethrel at 200 ppm promoted the days to first fruit harvest (39.57 days). Overall, Ethrel at 150 ppm proved most effective for enhancing yield attributes, while GA_3 at 90 ppm significantly improved vegetative growth parameters.

Keywords: *Praecitrullus fistulosus*, GA_3, ethrel, DAS, cucurbits

Introduction
Olericulture, the branch of horticulture dealing with vegetable production, is central to global food and nutritional security. Vegetables are indispensable in daily diets as they supply essential vitamins, minerals, dietary fiber and bioactive compounds that help maintain health and reduce the risk of chronic diseases (Yawalkar, 2018) [15]. Within the vegetable sector, cucurbits occupy a prominent position due to their diversity, adaptability and economic value. They are cultivated widely across tropical and subtropical regions and contribute significantly to human nutrition and rural livelihoods (More *et al.*, 2015) [4].

Round gourd (*Praecitrullus fistulosus*), commonly known as "tinda" is an important cucurbitaceous vegetable grown extensively in arid and semi-arid regions of India and adjoining countries. The crop is well suited to hot climates, short in duration, and bears prolifically, which makes it suitable for both subsistence and commercial farming (Singh *et al.*, 2002) [10]. Nutritionally, its fruits are rich in carbohydrates, proteins, fiber and minerals such as calcium and iron, while being low in calories and fats, making them a wholesome component of balanced diets (Sultana e*t al.*, 2016) [12]. Beyond its dietary value, round gourd also holds medicinal significance. Traditional knowledge and scientific studies indicate that extracts of its fruits and seeds possess diuretic, hepatoprotective, cardioprotective and antioxidant properties due to the presence of bioactive compounds like flavonoids, tannins, alkaloids and phenolic acids (Gupta *et al.*, 2011; Sultana *et al.*, 2016) [1, 12]. Thus, the crop is important not only as a vegetable but also as a functional food resource.

In modern crop management, plant growth regulators (PGRs) are widely employed to regulate physiological processes and optimize productivity. PGRs are organic substances that influence growth and development even at low concentrations. Among them, gibberellic acid (GA_3) and Ethrel (ethephon) are particularly relevant in cucurbits. GA_3 promotes cell elongation, stem and leaf expansion and seed germination, while Ethrel acts as a source of ethylene, a hormone involved in regulating flowering, sex expression, fruit set and ripening (Taiz & Zeiger, 2010) [13]. Their application can help balance vegetative and reproductive

growth, which is essential for achieving higher yields in crops like round gourd.

Considering the economic and nutritional significance of round gourd and the pivotal role of PGRs in modifying plant growth and development, the present study was undertaken to evaluate the effect of GA_3 and Ethrel on growth and yield of *Praecitrullus fistulosus*.

Materials and Methods

Experimental details

A field experiment was conducted using a Randomized Block Design (RBD) with three replications and seven treatments, namely: T_1 - Control (water spray), T_2 - GA_3 50 ppm, T_3 - GA_3 70 ppm, T_4 - GA_3 90 ppm, T_5 - Ethrel 100 ppm, T_6 - Ethrel 150 ppm and T_7 - Ethrel 200 ppm. The observations recorded on various growth and yield parameters of round gourd under these treatments. The experiment was laid out in ridges and furrows bed with spacing was 1 m x 1 m. Nutrient management in round gourd was applied during land preparation, along with FYM @ 10-15 t/ha and 100:50:50 kg NPK/ha. Phosphorus and Potassium were applied as basal, while Nitrogen was split between sowing and 30 DAS, ensuring balanced nutrition for better growth and yield. The data pertaining to each parameter were subjected to analysis of variance (ANOVA) as outlined by Panse and Sukhatme (1967) [6]. Treatment means were compared using the critical difference (CD) at a 5 per cent level of significance.

Observation recorded

Growth parameters

- **Length of main vine (cm):** Length of main vine was measured from the soil surface to the apical bud on the randomly selected five plants of round gourd at 15 days interval from 30, 45 and 60 DAS of crop and average was worked out.
- **Number of sub vines:** The number of sub vines was recorded at 30, 45 and 60 DAS from five randomly selected plants and mean values were calculated.
- **Number of leaves vine^{-1}**
  The number of fully grown, green and photosynthetically active leaves was recorded at 30, 45 and 60 DAS and average number of leaves were worked out from the five randomly selected vines.
- **Length of internode (cm):** The lengths of internodes on the main vine of each tagged vine were measured by meter scale in centimeter at the 60 DAS and then mean was calculated.
- **Leaf area (cm^2):** Leaf area was measured in cm^2 using a leaf area meter on five leaves per tagged vine and the mean value was calculated.

3.1.2 Yield parameter

- **Days to first fruit harvest:** The observation was recorded as the number of days from sowing to the harvest of the first marketable fruit in each plot. Observations were taken after flowering initiation and fruits were considered harvestable upon reaching marketable maturity and later on mean was calculated.
- **Number of fruits vine^{-1}:** The number of fruits harvested in each picking from each tagged vine was counted and after final harvesting all the values were summed up to get the number of marketable fruits produced per plant and later on mean was calculated.
- **Fruit weight (g):** The weight of fruit was measured from randomly selected five fruits from every treatment with the help of electronic weighing machine and then average was recorded.
- **Fruit yield plant^{-1}:** The fruits harvested in each picking from each tagged plant were weighed with the help of digital weighing balance and after the final harvesting values of all periodical harvestings were summed up and later on fruit yield plant^{-1} was calculated in kilograms.
- **Fruit yield plot^{-1} (kg):** The fruits harvested in each picking from all the plants in each treatment plot were weighed with the help of digital weighing balance and after the final harvesting values of all periodical harvestings were summed up and later on fruit yield plot^{-1} was calculated in kilograms.
- **Fruit yield hectare^{-1} (q):** The weight of fruit hectare^{-1} in quintals was calculated by counting the weight of the fruits from each plot according to treatment and then multiplying that weight by the hectare factor.

Results and discussion

A. Growth Parameters

1. Length of main vine

The vine length was non-significant at 30 DAS, whereas significant differences were recorded at 45 and 60 DAS due to the application of plant growth regulators. At 45 DAS, the maximum vine length (137.7 cm) was observed in treatment GA_3 90 ppm, followed by treatment GA_3 70 ppm (133.1 cm), while the minimum (115.4 cm) was recorded in control. Similarly, at 60 DAS, treatment GA_3 90 ppm (176.7 cm) recorded the highest length of main vine, which was at par with treatment GA_3 70 ppm (171.7 cm) and treatment GA_3 50 ppm (165.7 cm), whereas the lowest (139.1 cm) was noticed under control. The enhanced vine length with GA_3, especially at 90 ppm, may be due to increased cell division and elongation promoting vegetative growth, which corroborates with the findings of Sirohi *et al*. (2005) [11] in bottle gourd.

2. Number of sub vines

The number of sub vines remained non-significant at 30 DAS, but significant variation was observed at 45 and 60 DAS due to the application of plant growth regulators. At 45 DAS, the highest number of sub vines (5.63) was recorded in treatment Ethrel 200 ppm, which was statistically at par with treatment Ethrel 150 ppm (5.50) and treatment Ethrel 100 ppm (5.28). The lowest number (3.07) was observed in the control. Similarly, at 60 DAS, treatment Ethrel 200 ppm (7.20) recorded the maximum number of sub vines, followed by treatment Ethrel 150 ppm (6.90) and treatment Ethrel 100 ppm (6.60), while the minimum (4.90) was observed in the control plot. The increase in branching with Ethrel, particularly at higher concentrations, might be due to the suppression of apical dominance and stimulation of lateral bud growth. These results are supported by the findings of Panse *et al*. (2018) [5] in sponge gourd and Meena *et al.* (2017) [3] in cucumber.

3. Number of leaves vine^{-1}

The number of leaves vine^{-1} was non-significant at 30 DAS, while significant differences were observed at 45 and 60 DAS. At 45 DAS, treatment GA_3 90 ppm recorded the highest number of leaves vine^{-1} (49.9), followed by treatment GA_3 70 ppm (49.1), whereas the minimum (42.5) was noted in the control. At 60 DAS, treatment GA_3 90 ppm

again produced the maximum number of leaves (69.9), which was at par with treatment GA_3 70 ppm (65.7) and the lowest number (54.7) was observed in the control plot. The enhancement in leaf production with GA_3, especially at 90 ppm, may be attributed to its ability to induce rapid cell division and elongation, resulting in increased vegetative vigor. These findings are in accordance with those reported by Sirohi *et al.* (2005) [11] in bottle gourd and Verma *et al.* (2014) [14] in cucumber.

4. Length of internode (cm)

A significant effect of plant growth regulators on internode length was recorded. The highest internode length (11.87 cm) was obtained in treatment GA_3 90 ppm, followed by treatment GA_3 70 ppm (11.27 cm) and treatment GA_3 50 ppm (10.63 cm), while the minimum (8.50 cm) was observed in the control, demonstrating the superior influence of GA_3 over Ethrel and untreated plots. The increase in internode length under treatment GA_3 90 ppm, could be due to its role in enhancing cell elongation through increased enzyme activity and cell wall loosening, which supports the findings of Sirohi *et al.* (2005) [11] in bottle gourd and Rai *et al*. (2006) [7] in cucumber.

5. Leaf area (cm^2)

Leaf area was significantly influenced by various concentrations of plant growth regulators. The highest leaf area (92.90 cm^2) was observed under treatment GA_3 90 ppm, followed by treatment GA_3 70 ppm (91.67 cm^2) and treatment GA_3 50 ppm (89.83 cm^2), while the minimum (76.93 cm^2) was recorded in the control. The enhanced leaf area under GA_3, particularly at 90 ppm, may be attributed to stimulated cell division and expansion, resulting in broader leaf lamina and improved photosynthetic surface. Similar findings have been reported by Sirohi *et al*. (2005) [11] in bottle gourd and Shinde *et al*. (2010) [9] in cucumber.

B. Yield parameter

1. Days to first fruit harvest

The foliar application of plant growth regulators significantly reduced the days required for first fruit harvest. The earliest harvest (39.57 days) was observed in treatment Ethrel 200 ppm, followed by treatment Ethrel 150 ppm (42.57 days) and treatment Ethrel 100 ppm (45.63 days), while the greatest number of days to harvest (51.73 days) was recorded in the control. The reduction in days to harvest under Ethrel treatments may be attributed to earlier induction of female flowers, quicker fruit set and accelerated reproductive development promoted by ethylene. These results are in accordance with the findings of Meena *et al*. (2017) [3] and Rudra *et al*. (2006) [6] in cucumber.

2. Number of fruit $vine^{-1}$

The number of fruits $vine^{-1}$ was significantly influenced by foliar application of plant growth regulators. The maximum number of fruits $vine^{-1}$ (13.50) was recorded under treatment Ethrel 150 ppm, followed by treatment Ethrel 200 ppm (11.87), while the minimum number (8.37) was recorded in the control. The higher fruit count under Ethrel 150 ppm could be due to increased production of female flowers, better fruit set and improved hormonal balance that favors reproductive development. Similar results were observed by Meena *et al*. (2017) [3] and Kachroo *et al*. (2003) [2] in cucumber and sponge gourd.

3. Fruit weight

Fruit weight was significantly influenced by the foliar application of plant growth regulators. The highest fruit weight (60.30 g) was recorded in treatment Ethrel 150 ppm, which was statistically at par with treatment Ethrel 200 ppm (59.67 g), whereas the lowest fruit weight (46.33 g) was observed in the control treatment. The increase in fruit weight under Ethrel, particularly at 150 ppm, may be attributed to better fruit set, efficient nutrient mobilization and improved hormonal regulation that favor fruit development and enlargement. These results agree with the findings of Meena *et al*. (2017) [3] in cucumber and Kachroo et al. (2003) [2] in sponge gourd.

4. Fruit yield $vine^{-1}$

The foliar application of plant growth regulators had a significant impact on fruit yield $vine^{-1}$. The highest yield $vine^{-1}$ (0.813 kg) was obtained under treatment Ethrel 150 ppm, which was significantly superior to all other treatments, while the lowest yield (0.390 kg) was recorded in the treatment control. The increased fruit yield with treatment Ethrel 150 ppm may be attributed to a higher number of fruits, better fruit set and increased fruit weight, likely due to enhanced femaleness and improved conversion of flowers into fruits. Similar results were also reported by Meena *et al*. (2017) [3] and Kachroo *et al*. (2003) [2] in cucumber and sponge gourd.

5. Fruit yield $plot^{-1}$

Foliar application of plant growth regulators significantly influenced fruit yield $plot^{-1}$. The highest fruit yield $plot^{-1}$ (12.45 kg) was recorded under treatment Ethrel 150 ppm, followed by treatment Ethrel 200 ppm (12.04 kg) and treatment Ethrel 100 ppm (11.17 kg), whereas the lowest yield (8.26 kg) was observed in the control. The increased plot yield under treatment Ethrel 150 ppm may be due to a higher proportion of female flowers, more fruits $vine^{-1}$, better fruit set and larger fruit size, resulting in superior productivity. These findings are supported by the reports of Meena *et al.* (2017) [3] and Kachroo *et al.* (2003) [2] in cucumber and sponge gourd.

6. Fruit yield $hectare^{-1}$

Foliar application of plant growth regulators significantly influenced fruit yield $hectare^{-1}$. The highest yield (103.75 q/ha) was recorded in treatment Ethrel 150 ppm, followed by treatment Ethrel 200 ppm (100.36 q/ha) and treatment Ethrel 100 ppm (93.10 q/ha), while the lowest (68.82 q/ha) was obtained in the control. The increase in yield under Ethrel 150 ppm may be attributed to enhanced femaleness, higher fruit set and better fruit size, contributing to superior cumulative yield at field scale. These findings are in agreement with Meena *et al*. (2017) [3] and Kachroo *et al*. (2003) [2], who also reported increased total yield in cucurbits due to Ethrel application.

Table 1: Effect of plant growth regulators on length of main vine, number of sub vines, number of leaves vine^{-1}, length of internode and leaf area

Treatments	Length of main vine (cm)			Number of sub vines			Number of leaves vine^{-1}			Length of internode (cm)	Leaf area (cm^2)
	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS		
T_1 - Control (Water spray)	45.2	115.4	139.1	1.75	3.07	4.9	22.00	42.5	54.7	8.50	76.93
T_2 - Gibberellic Acid (GA_3) 50 ppm	56.9	127.8	165.7	2.30	4.38	5.8	22.10	48.5	63.7	10.63	89.83
T_3 - Gibberellic Acid (GA_3) 70 ppm	58.2	133.1	171.7	2.37	4.53	6.0	23.07	49.1	65.7	11.27	91.67
T_4 - Gibberellic Acid (GA_3) 90 ppm	60.1	137.7	176.7	2.43	4.77	6.1	23.50	49.9	69.9	11.87	92.90
T_5 - Ethrel 100 ppm	52.9	124.7	155.5	2.50	5.28	6.6	22.17	45.7	58.3	9.97	81.60
T_6 - Ethrel 150 ppm	53.8	126.8	159.2	2.57	5.50	6.9	22.37	47.3	61.4	10.20	83.17
T_7 - Ethrel 200 ppm	55.1	127.6	162.7	2.65	5.63	7.2	22.40	47.8	63.5	10.43	86.33
F test	NS	Sig.	Sig.	NS	Sig.	Sig.	NS	Sig.	Sig.	Sig.	Sig.
SE (m) ±	3.81	3.09	1.75	0.23	0.19	0.20	0.34	1.41	1.59	0.42	1.53
CD at 5%	11.76	9.54	5.40	0.73	0.60	0.62	1.07	4.36	4.91	1.29	4.71

Table 2: Effect of plant growth regulators on days to first fruit harvest, number of fruit vine^{-1}, fruit weight, fruit yield vine^{-1}, fruit yield plot^{-1} and fruit yield hectare^{-1}

Treatments	Days to first fruit harvest	Number of fruit vine-1	Fruit weight (g)	Fruit yield plant-1 (kg)	Fruit yield plot-1 (kg)	Fruit yield hectare-1 (q)
T_1 - Control (Water spray)	51.73	8.37	46.33	0.390	8.26	68.82
T_2 - Gibberellic Acid (GA3) 50 ppm	48.55	8.70	51.87	0.455	9.02	75.18
T_3 - Gibberellic Acid (GA3) 70 ppm	47.73	9.33	53.67	0.502	9.77	81.42
T_4 - Gibberellic Acid (GA3) 90 ppm	46.50	9.80	54.77	0.539	10.19	84.90
T_5 - Ethrel 100 ppm	45.63	11.20	56.97	0.638	11.17	93.10
T_6 - Ethrel 150 ppm	42.57	13.50	60.30	0.816	12.45	103.75
T_7 - Ethrel 200 ppm	39.57	11.87	59.67	0.710	12.04	100.36
F test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE (m) ±	1.84	0.58	1.05	0.03	0.55	4.63
CD at 5%	5.66	1.78	3.23	0.10	1.71	14.26

Conclusion

The present study entitled "Effect of plant growth regulators on growth and yield of round gourd" showed significant variations in both vegetative and yield related traits due to different foliar applications of GA_3 and Ethrel. Among all treatments, GA_3 at 90 ppm consistently exhibited superior performance in vegetative growth characteristics such as length of main vine (176.7 cm), number of leaves vine^{-1} (69.9), length of internode (11.87 cm) and leaf area (92.90 cm²). However, the highest number of sub vines (7.2) was recorded under Ethrel 200 ppm.

With regard to yield parameters, the earliest first fruit harvest (39.57 days) was observed in Ethrel 200 ppm, whereas Ethrel 150 ppm resulted in the highest number of fruits vine^{-1} (13.50), fruit weight (60.30 g), fruit yield plant^{-1} (0.816 kg), fruit yield plot^{-1} (12.45 kg) and fruit yield hectare^{-1} (103.75 q/ha). On the other hand, the control treatment consistently exhibited the lowest values across most parameters.

Ethrel at 150 ppm showed remarkable effectiveness by significantly enhancing yield traits in round gourd. It produced the highest number of fruits, fruit yield plant^{-1} and fruit yield hectare^{-1}, proving highly profitable. GA_3 at 90 ppm mainly promoted vegetative growth but was less influential on yield. Hence, Ethrel 150 ppm emerged as the most superior and economical treatment among all.

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