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Effect of plant growth regulators on growth and fruit yield of ridge gourd (*Luffa acutangular* L. Roxb)

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Abstract
The present investigation was carried out during the Rabi season of 2024-25 at the Centre of Excellence on Protected Cultivation and Precision Farming Unit, College of Agriculture, IGKV, Raipur (C.G). The experiment was laid out in a Randomized Block Design (RBD) with ten treatments and three replications. The treatments comprised GA_3 (25 ppm and 50 ppm), Ethrel (150 ppm and 200 ppm), Paclobutrazol (150 ppm) and their combinations, along with a control. Results revealed that the application of plant growth regulators (PGRs) significantly influenced the growth and yield of ridge gourd. GA_3 at 50 ppm recorded the highest vine length (320.69 cm), number of leaves (92.54) and leaf area index (0.027), indicating its role in enhancing vegetative growth. In contrast, Ethrel and Paclobutrazol, either alone or in combination, promoted early flowering, increased the number of female flowers and improved fruit set. The earliest appearance of male (24.97 days) and female (31.26 days) flowers and the lowest node of first female flower (6.33) were observed with Ethrel 200 ppm + Paclobutrazol 150 ppm treatment. Significantly maximum fruit yield of 409.67 q/ha were also recorded under Ethrel 200 ppm + Paclobutrazol 150 ppm. It is concluded that the combined foliar application of Ethrel 200 ppm + Paclobutrazol 150 ppm proved to be the most effective treatment for achieving optimum plant growth and higher yield per hectare in ridge gourd under the agro-climatic conditions of Chhattisgarh.

Keywords: Ridge gourd, *Luffa acutangular*, plant growth regulators

Introduction
Ridge gourd (*Luffa acutangula* L. Roxb.), 2n=2x=26, is one of the important cucurbitaceous vegetable crops with old world origin in subtropical Asian region including particularly India (Kalloo, 1993) [9]. This crop has a long history of cultivation in the tropical countries of Asia and Africa. In plants, growth regulators play an important role in both morphology and physiology aspects. The effect of plant growth regulator differs according to plant species, variety and their growth stage, methods of application, concentration of chemicals and frequency of application. Plant growth regulators is considered as a new generation of agri- chemicals when added in small amounts, modify the growth of plants usually by stimulating or modifying one part of the natural growth regulatory system, thereby the yield is enhanced. Cucurbits are the major group of vegetables which are grown all over the world and they are responsive crops towards the growth regulator. PGR's play vital or key role in increasing growth, yield and quality. Paclobutrazol works by inhibiting the oxidation of entkaurene to entkauronoic acid through the inactivation of cytochrome P450 dependent oxygenase (Desta and Amare, 2021) [4]. According to Gerdakaneh *et al*. (2018) [6], paclobutrazol showed a significant effect by suppressing the number of male flowers compared to control. Paclobutrazol could increase the number of female flowers and metabolic activity that leads to a higher metabolite translocation from the source to the fruits, resulting in the better fruit development. Gibberellic acid is an important growth regulator which may have many uses to modify the growth, yield and yield contributing characters of plant (Rashid *et al*., 2023, Yadav *et al*., 2024) [20, 28]. The utilization of GA3 at a reduced concentration has an impact on plant development and enhances growth metrics, such as the quantity of male flowers and the onset of the first male flower (Rajbhar *et al*., 2023) [19]. Though the GA3 have great potentialities to influence plant growth morphogenesis (Meshram *et al*., 2020, Kumar *et al*., 2022) [16, 12], its application and accrual assessments have to be judiciously planned in terms of optimal concentrations, stage of application etc. Ethylene as a

natural growth regulator has been implicated in several developmental processes of plants (Pratt and Goeschl, 1969) [18]. Since the ethylene-releasing property of Ethrel (2- chloroethyl phosphonic acid) (ethephon) has been reported (Warner and Leopold, 1969; Yang, 1969) [27, 29] much evidence has demonstrated its ability to alter sex expression in a number of cucurbits. In most instances it was applied either on seedlings (Lwahori *et al*., 1969; Rudich *et al*., 1969) [14, 21] or as a pre-flowering spray (Karchi, 1970; Karchi and Govers, 1972) [10, 11]. An increased female flower production is directly associated with better fruit set and yield enhancement, the strategic application of PGRs offers a promising and practical approach to boosting ridge gourd production.

Materials and Methods

The experiment was conducted at Centre of Excellence on Protected Cultivation and Precision Farming Unit, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) during Rabi Season 2024-25. The experimental material is ridge gourd hybrid Arka Vikram which is used as planting material. Sowing of seed was done on 15th of November 2024. Recommended fertilizer and other cultural package of practices were adopted for better crop growth. Five random competitive plants were selected from each plot and following observation were recorded. The average value of each observation was calculated on the basis of five plants in every replication. The experiment was set up in a randomized block design with three replications and ten treatments. Following treatments were applied T_1: GA3 @ 25 ppm, T_2: GA3@ 50 ppm, T_3: Ethrel @ 150 ppm, T_4: Ethrel @ 200 ppm, T_5: Paclobutrazol @ 300 ppm, T_6:GA3 @ 25 ppm + Paclobutrazol @ 300 ppm, T_7: GA3 @ 50 ppm + Paclobutrazol @ 300 ppm, T_8: Ethrel @ 150 ppm + Paclobutrazol @ 300 ppm, T_9: Ethrel @ 200 ppm + Paclobutrazol @ 300 ppm and T_{10}: Control (Water spray). Observations were taken at 45, 60, 75 days after transplanting and at harvest. All observations were subjected to statistical analysis.

Results and Discussion

At 45 DAT, the differences among treatments were found to be statistically non- significant, indicating that the initial vegetative growth was not greatly affected by the application of plant growth regulators at this stage. However, numerical variations were observed, with the maximum vine length (199.00 cm) recorded under GA_3 50 ppm (T_2), while the minimum (155.10 cm) was noted in Ethrel 200 ppm + Paclobutrazol 150 ppm (T_9). At 60, 75 DAT and at harvest, significant differences among treatments were evident. The treatment GA_3 50 ppm (T_2) exhibited the maximum vine length (267.40 cm, 310.75 cm and 320.69 cm, respectively), The minimum vine length (185.30 cm, 253.95 cm and 264.25 cm) was observed under Ethrel 200 ppm + Paclobutrazol 150 ppm (T_9). The results clearly indicate that gibberellic acid at 50 ppm significantly promoted vine elongation during the mid-growth period. The increased vine length in GA_3 treated plants may be attributed to the role of gibberellic acid in cell elongation and division, enhanced apical growth and mobilization of nutrients towards growing regions. Conversely, Ethrel and Paclobutrazol treatments tended to reduce vine elongation, likely due to their inhibitory effects on gibberellin biosynthesis and promotion of ethylene activity, which restricts excessive vegetative growth. These findings are in agreement with earlier reports by researchers such as Hilli *et al*. (2010) [7] in ridge gourd, Sure *et al*. (2013) [24] in pumpkin, Sinojiya *et al*. (2015) [23] in watermelon, Kumari *et al*. (2019) [13] in bottle gourd, Garg *et al*. (2020) [5] in cucumber, Jaysawal and Kumar (2022) [8] in ridge gourd and Sabu *et al*. (2022) [22] in bottle gourd.

At 45 DAT, the differences among treatments were found to be non-significant, suggesting that leaf production in the early vegetative stage was not greatly influenced by the application of PGRs. However, numerical variations were noticed, with the maximum number of leaves (28.38) recorded under Ethrel 200 ppm + Paclobutrazol 150 ppm (T_9). The lowest number of leaves (24.11) was recorded in GA_3 50 ppm (T_2). At 60, 75 DAT and at harvest, significant differences among the treatments were observed. The highest number of leaves (63.45, 84.98 and 92.54, respectively) was recorded under GA_3 50 ppm (T_2). The lowest number of leaves (48.87, 65.87 and 66.22 leaves) was found in Ethrel 200 ppm + Paclobutrazol 150 ppm (T_9). The increased leaf number under GA_3 treatments may be attributed to its role in promoting cell elongation and expansion, which facilitates greater leaf initiation and overall vegetative growth. The enhanced leaf number in GA_3 treated plants may be due to the promotion of cell elongation and division in the apical meristem, which supports greater leaf initiation and expansion. On the other hand, the lower number of leaves recorded under Ethrel and Paclobutrazol treatments could be attributed to their growth-retarding effects, as Paclobutrazol inhibits gibberellin biosynthesis and Ethrel releases ethylene, which collectively restrict vegetative growth and leaf proliferation. These observations are in line with the findings of Garg *et al*. (2020) [5], who reported similar effects of GA_3 in enhancing leaf number and overall vegetative growth in cucumber.

At 45 DAT, the differences among treatments were non-significant, indicating that the early development of primary branches was not markedly influenced by the application of growth regulators. Numerically, the highest number of primary branches (12.60) was recorded in Ethrel 150 ppm + Paclobutrazol 150 ppm (T_8), while the lowest (9.98) was observed in GA_3 50 ppm + Paclobutrazol 150 ppm (T_7). At 60, 75 DAT and at harvest, significant differences among treatments were observed. The highest number of branches (15.92, 16.76 and 18.45, respectively) was recorded under Ethrel 200 ppm + Paclobutrazol 150 ppm (T_9). The lowest number of branches (8.45, 9.45 and 10.78, respectively) was noted in GA_3 50 ppm (T_2).

At 45 DAT, the differences among treatments were non-significant, indicating that the development of secondary branches was not markedly influenced by PGR application during the early growth phase. However, the control (T_{10}) recorded the highest number of secondary branches (5.04). The minimum number (4.47) was observed in Paclobutrazol 150 ppm (T_5). At 60, 75 DAT and at harvest, significant differences were recorded among the treatments. The highest number of secondary branches (7.87, 10.77 and 8.98, respectively) was found under Ethrel 200 ppm + Paclobutrazol 150 ppm (T_9). The lowest number (4.32, 5.75 and 5.32, respectively) was recorded in GA_3 50 ppm (T_2). This indicates that the application of Ethrel and Paclobutrazol alone or in combination favored the formation of secondary branches, possibly due to their influence on hormonal balance leading to reduced apical dominance and stimulation of lateral growth. The increased number of secondary branches under Ethrel and Paclobutrazol treatments can be attributed to their role in reducing apical dominance and stimulating axillary bud outgrowth. Ethrel, through ethylene release, promotes lateral bud differentiation, while Paclobutrazol, a gibberellin biosynthesis inhibitor, diverts assimilates towards branch initiation rather than stem elongation. On the other hand, GA_3 treatments favored vertical growth at the expense of lateral shoot formation, thereby reducing the number of secondary branches. These observations are consistent with the findings of Bashir *et al*. (2021) [3] and Ucan *et al*. (2021) [26], who reported similar effects of Ethrel and Paclobutrazol in enhancing lateral branching in cucurbitaceous crops At 45 DAT, the differences among treatments were non-significant, indicating that PGRs did not exert a noticeable effect on internodal elongation during the early vegetative stage. However, numerically, the highest internodal length (11.63 cm) was recorded in GA_3 50 ppm (T_2), while the lowest value (9.33 cm) was noted in Ethrel 200 ppm (T_4). At 60, 75 DAT and at harvest, significant differences among treatments were observed. The maximum internodal length (15.95 cm, 18.63 cm and 22.48 cm, respectively) was recorded in GA_3 50 ppm (T_2), whereas the minimum (11.14 cm, 13.98 cm and 15.78 cm, respectively) was found in Ethrel 200 ppm + Paclobutrazol 150 ppm (T_9). This suggests that gibberellic acid played a major role in enhancing internodal elongation due to its known influence on cell elongation and cell wall plasticity, while Ethrel and Paclobutrazol restricted excessive elongation by altering endogenous hormone balance and reducing gibberellin activity. The increase in internodal length under GA_3 treatments can be attributed to gibberellic acid's role in promoting cell elongation and division in sub-apical meristematic regions, resulting in longer internodes and overall vine elongation. Conversely, Paclobutrazol acts as a gibberellin biosynthesis inhibitor and limits internodal elongation, while Ethrel, through ethylene release, restricts elongation by promoting more compact and bushy growth. Treatments involving Ethrel and Paclobutrazol, alone or in combination, consistently produced shorter internodes, reflecting their growth-retardant nature. Similar findings were reported by Sinojiya *et al*. (2015) [23] in watermelon, where GA_3 significantly increased internodal length, whereas Paclobutrazol and Ethrel reduced it.

The results revealed that the differences among treatments were statistically non- significant, indicating that none of the applied PGRs produced a marked effect on the timing of male flower initiation. However, numerical variations among treatments were evident. The earliest male flower appearance (24.97 days) was observed in Ethrel 200 ppm + Paclobutrazol 150 ppm (T_9), On the other hand, the maximum number of days to first male flower appearance (32.30 days) was recorded in GA_3 50 ppm (T_2). The slight earliness in male flower initiation under Ethrel and Paclobutrazol treatments may be attributed to their growth-regulating effects that modify the hormonal balance in favor of reproductive transition. Ethrel releases ethylene, which is known to promote flowering by enhancing floral bud differentiation, while Paclobutrazol alters gibberellin biosynthesis and favors early reproductive development. Conversely, the delayed flowering in GA_3 treated plants could be due to the stimulation of vegetative growth, as gibberellins generally prolong the vegetative phase by promoting stem elongation and leaf expansion before floral initiation. These findings are in accordance with the results of Kumari *et al*. (2019) [13] in bottle gourd and Sabu *et al*. (2022) [22] in bottle gourd, who reported that ethylene-releasing compounds such as Ethrel promoted early flowering and increased the number of male flowers in bottlr gourd, whereas GA_3 delayed flowering due to enhanced vegetative vigor.

The statistical analysis revealed non-significant differences among treatments, indicating that none of the PGR treatments produced a significant variation in the timing of first female flower initiation. However, numerical differences were noticeable among the treatments. The earliest female flower appearance (31.26 days) was recorded in GA_3 50 ppm (T_2). On the other hand, the maximum number of days to first female flower appearance (37.82 days) was observed in Ethrel 200 ppm + Paclobutrazol 150 ppm (T_9). This indicates that Ethrel, either alone or in combination with Paclobutrazol, slightly delayed the appearance of female flowers. The observed variation may be attributed to the differing physiological roles of these growth regulators. GA_3 enhances vegetative growth and promotes earlier flowering by stimulating cell elongation and meristematic activity, which may have contributed to early female flower initiation. In contrast, Ethrel, an ethylene-releasing compound, tends to modify the floral sex ratio by promoting femaleness in cucurbits, but it may not necessarily advance the time of first female flower appearance. Paclobutrazol, being a growth retardant, suppresses gibberellin biosynthesis, which can delay floral initiation slightly by slowing vegetative growth.

A significant difference was observed among the treatments, indicating that PGRs had a considerable impact on the position of the first male flower on the vine. The lowest node number (2.95) for the first male flower appearance was recorded with Ethrel 200 ppm + Paclobutrazol 150 ppm (T_9). In contrast, the highest node number (4.03) for the first male flower was recorded in GA_3 50 ppm + Paclobutrazol 150 ppm (T_2). The stimulatory effect of GA_3 on early male flower initiation can be attributed to its role in promoting cell elongation and accelerating meristem activity, resulting in faster floral differentiation. On the other hand, Ethrel, being an ethylene source, is known to promote femaleness in cucurbits and may suppress early male flower formation, while Paclobutrazol limits gibberellin biosynthesis, further delaying floral initiation. Similar finding also recorded by Nagamani *et al*. (2015) [17] in bitter gourd, Kumari *et al*. (2019) [13] in bottle gourd and Sabu *et al*. (2022) [22] in bottle gourd.

The minimum node number (6.33) for the first female flower was recorded in Ethrel 200 ppm + Paclobutrazol 150 ppm (T_9), indicating the earliest initiation of female flowers among all treatments. In contrast, the highest node number (10.87) for the first female flower was recorded in GA_3 50 ppm (T_2). The delayed appearance of female flowers in GA_3 treated plants may be due to the stimulatory effect of gibberellic acid on vegetative growth and male flower formation, which tends to postpone female flower initiation. From the data, it is evident that Ethrel, either alone or in combination with Paclobutrazol, effectively reduced the node number of the first female flower, leading to early female flower initiation. Conversely, GA_3 treatments increased the nodal position of female flowers, delaying their appearance. The enhanced femaleness and early flowering effect of Ethrel may be attributed to its ethylene-releasing property, which alters the hormonal balance by increasing ethylene concentration and reducing gibberellin activity, thereby favoring the expression of female flowers. The addition of Paclobutrazol likely strengthened this effect by further suppressing gibberellin biosynthesis. These findings are in line with the observations of Nagamani *et al*. (2015) [17] in bitter gourd, Kumari *et al*. (2019) [13] in bottle gourd and Sabu *et al*. (2022) [22] in bottle gourd and Trinadh *et al*. (2022) [25] in ivy gourd, who reported that Ethrel significantly reduced the nodal position of the first female flower, whereas gibberellic acid delayed female flower appearance due to its vegetative growth-promoting nature.

At 45 DAT, all treatments showed comparable performance, indicating that early male flower initiation was not markedly altered by PGRs at this stage. At 60, 75 DAT and at harvest, considerable differences emerged among treatments. The maximum number of male flowers (35.76, 80.10 and 104.52, respectively) was recorded under GA_3 50 ppm (T_2). In contrast, Ethrel- based combinations, particularly Ethrel 200 ppm + Paclobutrazol 150 ppm (T_9), produced the fewest male flowers (16.52, 45.92 and 68.81, respectively), indicating a suppressive effect of Ethrel on male floral development. This shows that Ethrel tends to reduce male flower formation, likely due to its ethylene-releasing action, which favors female flower development instead. This confirms that GA_3 promotes vigorous vegetative growth and enhances male flower production, while Ethrel and Paclobutrazol suppress male flower numbers. These findings are in agreement with those reported by Hilli *et al*. (2010) [7] in ridge gourd and Sabu *et al*. (2022) [22] in ridge gourd, who observed that gibberellic acid treatments increased the number of male flowers in cucurbits, while Ethrel and Paclobutrazol combinations reduced male flower production by favoring femaleness.

The variation was non-significant at 45 DAT. At 60 DAT, the highest number of female flowers (12.32, 17.72and 29.01, respectively) was recorded in Ethrel 200 ppm + Paclobutrazol 150 ppm (T_9). In contrast, the lowest number of female flowers (6.41, 8.92 and 19.89, respectively) was noted in Control (T_{10}) and indicating that Ethrel treatments significantly enhanced female flower production compared to GA_3. The increase in the number of female flowers with Ethrel application may be attributed to its ethylene-releasing action, which promotes femaleness by modifying the hormonal balance in favor of ethylene and suppressing gibberellin activity. Ethylene is known to enhance the conversion of staminate primordia intopistillate flowers in cucurbits. Moreover, the combination of Ethrel with Paclobutrazol further increased femaleness by reducing gibberellin biosynthesis, thereby promoting early and abundant female flower formation. On the other hand, GA_3 treatments favored maleness and delayed female flowering due to their role in stimulating gibberellin activity and vegetative growth. These results are in close agreement with the findings of Garg *et al*. (2020) [5] in cucumber and Sabu *et al*. (2022) [22] in bottle gourd, who also reported that Ethrel significantly increased the number of female flowers in cucurbits, while GA_3 promoted maleness.

At 45 DAT, all treatments produced a similar number of flowers, with values ranging narrowly between 21.67 (T_{10}: Control) and 21.87 (T_3: Ethrel 150 ppm) suggests that PGRs begin influencing floral initiation only after the early vegetative phase. At 60 DAT, noticeable differences appeared. The highest total number of flowers (44.63, 89.86 and 126.08, respectively) was recorded under GA_3 50 ppm (T_2) and (T_8) Ethrel 150 ppm + Paclobutrazol 150 ppm (28.87) at 60 DAT and (T_9) Ethrel 200 ppm + Paclobutrazol 150 ppm (63.64 and 95.39) at 75 DAT and at harvest, recorded the lowest flower numbers, showing the suppressive effect of Ethrel on overall flower formation at this stage. Among the treatments, the maximum petiole length (16.89 cm) was recorded with GA_3 50 ppm (T_2). The minimum petiole length (11.65 cm) was observed in Ethrel 200 ppm + Paclobutrazol 150 ppm (T_9). The increase in petiole length due to GA_3 treatments can be attributed to its role in promoting cell elongation and division in sub-apical meristematic tissues, leading to elongation of the internodes and petioles. GA_3 stimulates the synthesis of hydrolytic enzymes, which enhance cell wall extensibility and result in longer petioles. Conversely, Paclobutrazol, a known growth retardant, significantly reduced petiole length by inhibiting gibberellin biosynthesis and thereby restricting vegetative elongation. Similarly, Ethrel treatments also reduced petiole length, possibly due to increased ethylene activity, which restricts elongation growth and promotes compact plant morphology. The combined treatments of Ethrel and Paclobutrazol recorded the shortest petiole lengths, suggesting an additive inhibitory effect of both regulators on gibberellin activity.

Among the treatments, the highest leaf area index (0.027) was recorded in GA_3 50 ppm (T_2). The lowest leaf area index (0.015) was observed in Ethrel 200 ppm + Paclobutrazol 150 ppm (T_9). The increase in leaf area index with GA_3 treatments may be attributed to the enhancement of cell division and elongation, leading to larger leaf size and greater leaf expansion. GA_3 stimulates chlorophyll synthesis and promotes higher photosynthetic activity, resulting in vigorous vegetative growth and higher LAI. On the other hand, the reduction in LAI under Ethrel and Paclobutrazol treatments might be due to their inhibitory effect on vegetative elongation and leaf expansion. Ethrel, by releasing ethylene, restricts cell elongation and promotes senescence, thereby reducing leaf area. Paclobutrazol, being a growth retardant, inhibits gibberellin biosynthesis, leading to smaller leaves and compact plant growth, thus lowering the overall LAI. These results are in accordance with the findings of Sure *et al*. (2013) [24] in pumpkin, who also reported that GA_3 treatments significantly increased leaf area and LAI in cucurbits, while Paclobutrazol and Ethrel caused a reduction due to restricted vegetative growth.

The highest fruit yield (409.67 q/ha) was recorded in Ethrel 200 ppm + Paclobutrazol 150 ppm (T_9), which proved to be the most effective treatment. This superior performance may be attributed to enhanced female flower formation, improved fruit set percentage, greater fruit size and increased number of fruits per plant, all of which directly contributed to higher yield. The lowest yield was recorded in the control (241.51 q/ha), indicating that the application of PGRs significantly improved productivity. Overall, the results clearly demonstrate that Ethrel combined with Paclobutrazol, particularly Ethrel 200 ppm + Paclobutrazol 150 ppm, was most effective in maximizing fruit yield per hectare in ridge gourd under the given agro-climatic conditions. Treatments involving Ethrel consistently produced higher yields compared to GA_3 treatments and the control. Ethrel is known to suppress male flowers and encourage female flower production, leading to improved fruiting efficiency. When combined with Paclobutrazol, the yield potential was further enhanced, likely due to better assimilate distribution and reduced vegetative vigor. Although GA_3 promotes vegetative growth and elongation, it appears less effective in enhancing fruit yield, possibly due to its tendency to increase male flowers rather than female flowers. These findings are in close agreement with the reports Kumari *et al*. (2019) [13] in bottle gourd, Barot *et al*. (2022) [2] in bottle gourd, Sabu *et al*. (2022) [22] in bottle gourd and Madhani *et al*. (2025) [15] in ridge gourd, who noted that the application of Ethrel and Paclobutrazol significantly improved fruit yield in cucurbits and other vegetable crops due to their positive effects on flowering behavior, fruit set and resource allocation efficiency.

Table 1: Effect of plant growth regulators on vine length (cm), number of leaves, number of primary branches and number of secondary branches of Ridge gourd.

Treatment	Vine length (cm)				Number of leaves				Number of primary branches				Number of secondary branches			
	45 DAT	60 DAT	75 DAT	At harvest	45 DAT	60 DAT	75 DAT	At harvest	45 DAT	60 DAT	75 DAT	At harvest	45 DAT	60 DAT	75 DAT	At harvest
T_1	189.00	248.67	308.56	318.51	25.61	59.76	82.11	85.01	10.12	9.25	9.54	11.54	4.58	5.32	6.27	6.32
T_2	199.00	267.40	310.75	320.69	24.11	63.45	84.98	92.54	11.10	8.45	9.45	10.78	4.76	4.32	5.75	5.32
T_3	168.90	210.20	268.31	278.52	26.85	53.32	73.65	72.54	10.66	12.65	12.98	15.98	4.61	6.43	8.35	7.21
T_4	165.30	198.76	267.15	277.37	26.22	53.76	72.37	71.26	11.22	11.65	12.43	13.65	4.59	5.98	8.11	6.87
T_5	159.90	199.65	261.54	271.80	27.38	51.20	71.22	68.45	10.22	14.71	14.67	17.86	4.47	6.99	9.68	7.87
T_6	175.60	220.60	306.86	316.83	25.21	54.99	76.87	78.35	11.33	11.98	12.48	15.76	4.77	6.21	8.94	7.21
T_7	172.20	228.53	295.88	305.91	24.46	56.65	77.20	81.50	9.98	13.43	13.88	16.87	4.52	6.87	9.04	7.54
T_8	155.90	196.12	258.04	268.32	27.36	50.32	64.65	67.65	12.60	15.75	16.34	17.98	4.70	7.21	10.44	8.65
T_9	155.10	185.30	253.95	264.25	28.38	48.87	65.87	66.22	10.76	15.92	16.76	18.45	4.60	7.87	10.77	8.98
T_{10}	182.80	243.32	299.75	309.76	27.76	60.20	79.95	82.65	10.55	9.35	10.36	12.30	5.04	5.78	6.58	6.43
SEm ±	NS	8.93	11.38	11.78	NS	2.68	2.85	4.14	NS	0.60	0.60	0.69	NS	0.41	0.36	0.46
CD (5%)	NS	26.75	34.07	35.28	NS	8.01	8.53	12.40	NS	1.81	1.82	2.05	NS	1.22	1.08	1.37
CV (%)	NS	7.03	6.10	6.10	NS	8.39	6.57	9.40	NS	8.53	8.18	7.84	NS	11.22	7.41	10.91

T_1: GA3 25 ppm, T_2: GA3 50 ppm, T_3: Ethrel 150 ppm, T_4: Ethrel 200 ppm, T_5: Paclobutrazol 300 ppm, T_6: GA3 25 ppm + Paclobutrazol 300 ppm, T_7: GA3 50 ppm + Paclobutrazol 300 ppm, T_8: Ethrel 150 ppm + Paclobutrazol 300 ppm, T_9: Ethrel 200 ppm + Paclobutrazol 300 ppm and T_{10}: Control (Water spray).

Table 2: Effect of plant growth regulators on internodal length, days to first male flower appearance, days to first female flower appearance, node of first male flower and node of first female flower of Ridge gourd.

Treatment	Internodal length				Days to first male flower appearance	Days to first female flower appearance	Node of first male flower	Node of first female flower
	45 DAT	60 DAT	75 DAT	At harvest				
T_1	11.55	15.59	18.56	21.71	31.86	33.27	3.13	9.83
T_2	11.63	15.95	18.63	22.48	32.30	31.26	4.03	10.87
T_3	9.43	12.80	15.90	17.63	29.81	37.73	3.42	7.32
T_4	9.33	12.78	15.41	17.37	29.68	36.99	3.60	7.93
T_5	10.99	12.29	14.89	16.27	29.55	36.66	3.64	8.50
T_6	11.42	13.96	16.97	19.41	31.00	35.85	3.23	8.83
T_7	10.28	14.15	17.26	19.81	31.46	35.21	3.31	8.92
T_8	10.69	11.30	14.50	16.11	26.89	37.74	3.78	7.30
T_9	11.05	11.14	13.98	15.78	24.97	37.82	2.95	6.33
T_{10}	9.65	13.87	16.08	19.85	30.14	35.91	3.40	9.37
SEm (±)	NS	0.65	0.74	0.68	NS	NS	0.14	0.58
CD (5%)	NS	1.94	2.24	2.00	NS	NS	0.43	1.73
CV (%)	NS	8.38	7.10	6.20	NS	NS	7.25	11.78

T_1: GA3 25 ppm, T_2: GA3 50 ppm, T_3: Ethrel 150 ppm, T_4: Ethrel 200 ppm, T_5: Paclobutrazol 300 ppm, T_6: GA3 25 ppm + Paclobutrazol 300 ppm, T_7: GA3 50 ppm + Paclobutrazol 300 ppm, T_8: Ethrel 150 ppm + Paclobutrazol 300 ppm, T_9: Ethrel 200 ppm + Paclobutrazol 300 ppm and T_{10}: Control (Water spray).

Table 3: Effect of plant growth regulators on number of male flower per plant, number of female flower per plant, petiole length (cm), leaf area index and fruit yield per hectare (q) of Ridge gourd.

Treatment	Number of male flower per plant				Number of female flower per plant				Total number of flower per plant				Petiole length (cm)	Leaf area index	Fruit yield per hectare (q)
	45 DAT	60 DAT	75 DAT	At harvest	45 DAT	60 DAT	75 DAT	At harvest	45 DAT	60 DAT	75 DAT	At harvest			
T_1	16.13	31.43	69.90	99.42	6.29	7.98	9.90	23.35	22.42	39.41	79.80	122.77	16.36	0.03	304.24
T_2	17.96	35.76	80.10	104.52	5.31	6.87	9.76	21.56	23.26	44.63	89.86	126.08	16.89	0.03	287.62
T_3	16.60	19.65	59.97	82.85	5.27	11.32	16.55	27.95	21.87	30.97	76.52	110.80	14.43	0.02	357.71
T_4	16.90	20.86	58.98	79.49	5.86	8.32	15.52	27.50	22.77	29.18	74.50	106.99	13.35	0.02	374.42
T_5	15.90	21.45	54.50	77.98	5.96	9.99	10.79	23.89	21.86	31.44	65.29	101.87	12.43	0.02	354.29
T_6	16.17	23.54	64.43	92.84	6.40	8.21	10.33	23.60	22.57	31.75	74.76	116.44	15.74	0.02	327.37
T_7	16.37	24.87	66.63	98.98	5.68	6.98	11.03	24.00	22.05	31.85	77.66	122.98	15.54	0.02	321.00
T_8	17.27	18.98	50.65	68.85	6.11	9.89	14.22	26.54	23.38	28.87	64.87	95.39	12.65	0.02	398.41
T_9	17.11	16.52	45.92	68.81	5.83	12.32	17.72	29.01	22.94	28.84	63.64	97.82	11.65	0.02	409.67
T_{10}	16.41	26.98	59.76	82.59	5.27	6.41	8.92	19.89	21.67	33.39	68.68	102.48	14.76	0.02	241.51
SEm (±)	NS	3.36	4.62	5.29	NS	0.52	0.72	1.10	NS	3.20	4.83	5.61	0.89	0.00	24.00
CD (5%)	NS	10.07	13.84	15.85	NS	1.57	2.18	3.30	NS	9.59	14.46	16.82	2.65	0.00	71.87
CV (%)	NS	24.26	13.11	10.70	NS	10.34	10.12	7.73	NS	16.81	11.37	8.81	10.66	6.33	12.32

T_1: GA3 25 ppm, T_2: GA3 50 ppm, T_3: Ethrel 150 ppm, T_4: Ethrel 200 ppm, T_5: Paclobutrazol 300 ppm, T_6: GA3 25 ppm + Paclobutrazol 300 ppm, T_7: GA3 50 ppm + Paclobutrazol 300 ppm, T_8: Ethrel 150 ppm + Paclobutrazol 300 ppm, T_9: Ethrel 200 ppm + Paclobutrazol 300 ppm and T_{10}: Control (Water spray).

Conclusion

The overall findings of the experiment indicate that the response of ridge gourd to plant growth regulators varied significantly depending on the type and concentration used. Ethrel and Paclobutrazol, particularly when applied together, induced early flowering, increased growth, the proportion of female flowers and maximized fruit yield per hectare. Hence, it may be concluded that the application of Ethrel 200 ppm + Paclobutrazol 150 ppm (T_9) was found to be the most effective treatment for achieving optimum growth and higher fruit yield under the agro-climatic conditions of Chhattisgarh during the Rabi season.

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