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Effect of Ethrel and Cycocel on Vegetative and Flowering Characters of Pansy (*Viola tricolor* var. hortensis)

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

The present study was conducted to evaluate the effect of ethrel and cycocel on vegetative and flowering characters of pansy (Viola tricolor var. hortensis)" in Horticulture Research Field, Faculty of Agriculture, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India, during October 2023 to March 2024. The objective was to identify the most suitable dose of ethrel and cycocel on the vegetative and flowering characters of pansy plant. The experiment was laid out in Randomized Block Design (RBD), with eleven treatments and three replications. The statistical analysis revealed significant differences among the various treatments of pansies for all observed parameters. From the present investigation, it was observed that among the different treatments, the treatment T7 (Ethrel @ 100 ppm) was found superior in terms of chlorophyll content (56.34), plant spread (12.47 cm), leaf area (37.11 cm2) and self-life (5.07 days), whereas, the treatment T10 (Ethrel @ 250 ppm) showed superiority in terms of number of leaves (62.40) and number of branches (6.47).

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Among the different treatments, the highest gross return ₹9000 per 100 pots, net return ₹2942.65 per 100 pots and benefit cost ratio 1.48, was recorded in treatment T7 (Ethrel @ 100 ppm). Hence, T7 (Ethrel @ 100 ppm) can be recommended for plant growth and flowering of Pansy (Viola tricolor var. hortensis) and treatment T10 (Ethrel @ 250 ppm) can be recommended for the delayed flower producing and compact plant production.

Keywords: Cycocel; ethrel; flowering; pansy; vegetative.

1. INTRODUCTION

Pansies, scientifically known as *Viola tricolor* var. hortensis, are charming and popular flowering plants that belong to the Violaceae family. These dainty flowers are known for their distinctive "face" or "smiling" appearance, with two upper petals overlapping two lower petals, resembling a face with a dark central blotch that often looks like a nose. Pansies are widely cultivated for their vibrant and varied colors, making them a favorite choice for gardeners, florists, and horticultural enthusiasts. In warmer climate zones, pansies can bloom over the winter and may re-seed themselves. However, they are not very heat-tolerant as high temperatures and warm air inhibit their blooming and, in some cases, can even cause wilting [1].

A plant growth regulator (PGR) plays crucial role in controlling various aspects of a plant's life cycle, including germination, root and shoot development, flowering, fruiting, and responses to environmental stress [2-5]. The present study on the effect of plant growth regulator on Pansy plant can help to determine the optimum dosages of ethrel and cycocel to obtain desirable vegetative and flowering growth of Pansy plant. The application of growth regulators like ethrel and cycocel on Pansies can result in more compact, sturdy and visually appealing plants with enhanced flowering characteristics. Ethrel can be used to stimulate and synchronize flowering in pansies. This is especially valuable if you want pansies to bloom at specific times of the year, such as for a particular season, holiday, or event. Cycocel helps reduce stem elongation and maintain a more compact growth habit, resulting in shorter, sturdier pansy plants. These effects can be particularly advantageous for commercial cultivation, landscaping, and for gardeners looking to achieve specific aesthetic and timing goals with their Pansy plants.

2. MATERIALS AND METHODS

The experiment was conducted at Horticulture Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, (U.P.) during year 2022-24. Prayagraj is situated at an elevation of 98 meters above sea level at 25.45 °N altitude and 81.84 °E longitudes. This region has a subtropical climate prevailing in the south-east part of Uttar Pradesh. The area of Prayagraj district comes under subtropical belt in the South East of Uttar Pradesh, which experience extremely hot summer and fairly cold winter, the maximum temperature of the location reaches up to 46°C - 48°C. The relative humidity ranged between 20- 94 %. The average rainfall in this area is around 850- 1100 mm annually. The experiment was laid out in Randomized Block Design (RBD), with eleven treatments and three replications. Hortensis variety of pansy was selected and propagated using seeds. Seeds were procured from Vinz Seeds, Nagpur and Maharashtra. Two different plant growth retardants were used *viz.,* cycocel and ethrel and they were sprayed twice at the interval of 15 days. Chemicals were procured from local market of Allopi Bagh, Prayagraj.

The treatments were T_0 (Control), T_1 (Cycocel @ 100 ppm), T_2 (Cycocel @ 200 ppm), T_3 (Cycocel @ 300 ppm), T_4 (Cycocel @ 400 ppm), T_5 (Cycocel @ 500 ppm), T_6 (Ethrel @ 50 ppm), T_7 (Ethrel @ 100 ppm), T_8 (Ethrel @ 150 ppm), T_9 (Ethrel @ 200 ppm), T_{10} (Ethrel @ 250 ppm).

3. RESULTS AND DISCUSSION

3.1 Vegetative Characters

The data recorded on various vegetative characters was statistically analyzed to find out most suitable dose of ethrel and cycocel on the vegetative characters of pansy. The results of the investigation, regarding the vegetative characters of pansy have been presented in Table 1.

3.1.1 Plant height (cm)

The maximum plant height (13.50) was observed in T_2 - Cycocel @ 200 ppm, followed

closely by T_0 (Control) at 13.41 cm, and T_8 with Ethrel @ 150 ppm at 13.30 cm. In contrast, the shortest plants, measuring 9.53 cm, were observed in T_{10} with Ethrel @ 250 ppm.

Plants treated with cycocel recorded maximum plant height. It serves as a chemical agent employed to regulate plant growth by either impeding the translocation of gibberellins or facilitating their degradation. However, its impact on plant growth varies depending on the concentration applied. Baevre [6] found that plant quality increased when used in low concentration. Similar finding was reported by Biswas et al., [7].

3.1.2 Number of leaves

The maximum number of leaves was observed in T_{10} - Ethrel @ 250 ppm (62.40) which was at par with T_7 - Ethrel @ 100 ppm (52.67) whereas, minimum number of leaves was reported in T_2- Cycocel @ 200 ppm (31.40).

Plants treated with ethrel recorded maximum number of leaves. At lower concentrations and appropriate application timing, ethrel may stimulate leaf production, leading to an increase in the number of leaves. Similar finding was also recorded by Zeljković et al*.,* [1] and Kumar et al*.,*[8].

3.1.3 Number of branches

The maximum number of branches was observed in T_{10} - Ethrel @ 250 ppm (6.47) which was at par with T_7 - Ethrel @ 100 ppm (6.00) whereas, minimum number of branches was reported in T_5 - Cycocel @ 500 ppm (3.33).

Plants treated with ethrel recorded maximum number of branches. At right concentration, ethrel stimulates the production of auxins, which are plant hormones responsible for cell elongation and branching. By enhancing auxin levels, ethrel encourages the growth of lateral shoots and branches in pansy plants, leading to an increase in the overall number of branches Banon et al., [9] and Panda et al., [10].

3.1.4 Chlorophyll content

The maximum chlorophyll content was observed in T_7 - Ethrel @ 100 ppm (56.34) which was at par with T_3 - Cycocel @ 300 ppm (53.51) whereas, minimum chlorophyll content was reported in T_{10} - Ethrel @ 250 ppm (42.09).

Research indicates that optimal ethrel concentration (100ppm) correlates with higher chlorophyll content in pansies. However, at maximum ethrel levels, chlorophyll content diminishes. This suggests a non-linear relationship between ethrel concentration and chlorophyll levels in pansies, highlighting the need for precise application to optimize plant health. Banon et al., [9] and Manu et al., [11].

3.1.5 Plant spread

The maximum plant spread was observed in T_7 - Ethrel @ 100 ppm (12.47) which was at par with T_1 - Cycocel @ 100 ppm (11.53) whereas, minimum plant spread was reported in T_8 - Ethrel @ 150 ppm (10.80).

Ethrel affects plant spread by promoting stem elongation, influencing fruit setting and development, altering branching patterns, and inducing abscission of plant parts. Its impact depends on factors like concentration, timing, and plant species. Similar finding is recorded by Panda et al., [10], Ghadage et al*.,* [12] and Menaka et al*.,*[13].

3.1.6 Leaf area

The maximum leaf area was observed in T_7 - Ethrel @ 100 ppm (37.11) which was at par with T_8- Ethrel @ 150 ppm (35.79) whereas, minimum leaf area was reported in T_0 - Control (21.41).

The notable increase in leaf area observed with ethrel treatment could stem from its mode of action or from inherent plant physiological processes. These findings align with ElSallami et al*.*, [14] and Ghadage et al*.,* [12], which demonstrated a correlation between escalating ethrel concentrations and heightened carbohydrate content in pansy leaves, consequently leading to expanded leaf area.

3.2 Floral Characters

The data recorded on various floral characters was statistically analyzed to find out most

suitable dose of ethrel and cycocel on the floral characters of pansy. The results of the investigation, regarding the floral characters of pansy have been presented in Table 2.

3.2.1 Number of days to first bud initiation

The minimum days to first bud initiation was observed in T_3 - Cycocel @ 300 ppm (32.20) which was at par with T_0 - Control (33.53) whereas, maximum days to first bud initiation was reported in T_1 - Ethrel @ 250 ppm (46.20).

Cycocel works by inhibiting gibberellin biosynthesis, a plant hormone that promotes stem elongation. By reducing gibberellin levels, cycocel can help regulate plant height and promote more compact growth, which can indirectly affect flowering by altering the balance between vegetative and reproductive growth. Similar finding is recorded by Kumar et al., [8], Ghatas et al., [15] and Priyanka et al., (2023).

3.2.2 Number of days to full bloom from visible bud initiation

The minimum days taken to full bloom from visible bud initiation was observed in T_9 - Ethrel @ 200 ppm (6.33) which was at par with T_4 - Cycocel @ 400 ppm (6.40) whereas, maximum days taken to full bloom from visible bud initiation was reported in T_7 - Ethrel @ 100 ppm (6.80).

Cycocel aids in decreasing the number of days required for bud opening through its regulatory effect on plant growth. By inhibiting gibberellin biosynthesis, cycocel slows down stem elongation and redirects the plant's energy towards reproductive processes like bud development and flowering. This redirection of resources towards floral development can accelerate the opening of buds, leading to a shorter duration between bud initiation and flowering. Variation in number of days to full bloom from visible bud initiation among the treatments was also reported Paleli et al., [16] and Sethy et al., [17].

3.2.3 Flower diameter

The maximum flower diameter was observed in T_8 - Ethrel @ 150 ppm (5.93) which was at par with T_4 - Cycocel @ 400 ppm (5.79) whereas, minimum flower diameter was reported in T_0 - Control (5.39).

Plants treated with ethrel were observed with little big as compare to other. This may be because ethylene, can increase flower diameter in pansies by stimulating cell expansion and division, particularly in the petals. Ethylene promotes cell elongation and enlargement, leading to larger flower size. Additionally, ethylene can enhance flower opening by influencing the balance of hormones involved in flower development. By applying ethrel at the appropriate stage of flower development, growers can encourage the pansy flowers to reach their maximum size potential. Similar finding is recorded by Kumar et al., [18] and Sethy et al., [17].

3.2.4 Self-life

The maximum self-life was observed in T_7 - Ethrel @ 100 ppm (5.07) which was at par with T_4 - Cycocel @ 400 ppm (4.80) whereas, minimum self-life was reported in T_6 - Ethrel @ 50 ppm (4.20).

The maximum shelf life was observed in plants treated with ethrel. This may have been because ethrel increased the shelf life of pansy flowers by delaying senescence and enhancing stress resistance. However, its application needed to be carefully managed to achieve the best results.

These findings align with ElSallami et al., [14] and Kumar et al.,[19].

3.2.5 Number of flowers per plant

The maximum number of flowers was observed in T_1 - Cycocel @ 100 ppm (5.33) which was at par with T_3 - Cycocel @ 300 ppm (4.73) whereas, minimum number of flowers was reported in T_{10} - Ethrel @ 250 ppm (1.00).

Chen et al., [20] noted that the highest flower count occurred in plants treated with cycocel due to its inhibition of gibberellin biosynthesis, resulting in shorter stems and denser growth [21-23]. This observation aligns with our findings, highlighting cycocel's role in enhancing flower production through its impact on plant growth dynamics [24,25]. These findings align with Kumar et al., [8] and Ghatas et al., [15].

Table 1. Effect of different concentrations of ethrel and cycocel on vegetative characters of pansy

Treatments	Plant Height (cm)	Number of Leaves	Number of Branches	Chlorophyll Content	Plant Spread	Leaf Area (cm^2)
T (Control) 0	13.41	34.93	4.60	50.11	11.13	21.41
T (Cycocel @ 100 ppm) 1	11.13	42.27	5.60	48.59	11.53	24.87
T (Cycocel @ 200 ppm) 2	13.50	31.40	3.67	51.32	10.87	24.06
T (Cycocel @ 300 ppm) 3	12.67	41.87	3.53	53.51	11.20	28.95
T (Cycocel @ 400 ppm) 4	13.07	36.27	3.93	51.82	11.47	24.87
T (Cycocel @ 500 ppm) 5	13.25	39.00	3.33	51.42	11.20	25.42
T (Ethrel @ 50 ppm) 6	11.65	46.80	4.20	51.89	11.20	36.35
T (Ethrel @ 100 ppm) 7	11.64	52.67	6.00	56.34	12.47	37.11
T (Ethrel @ 150 ppm) 8	13.30	47.53	3.80	50.36	10.80	35.79
T (Ethrel @ 200 ppm) 9	10.09	51.67	5.00	49.19	11.13	30.31
T (Ethrel @ 250 ppm) 10	9.53	62.40	6.47	42.09	11.00	31.90
F-test	**S**	**S**	**S**	**S**	**S**	**S**
S.Ed	**0.514**	**2.779**	**0.349**	**1.662**	**0.234**	**3.93**
CD at 5%	**1.527**	**10.877**	**13.271**	**4.936**	**0.492**	**8.256**
CV	**11.308**	**8.256**	**1.037**	**5.687**	**2.543**	**10.877**

Table 2. Effect of different concentrations of ethrel and cycocel on floral characters of pansy

Treatments	Number of Days to First Bud Initiation	Number of Days to Full Bloom from Visible Bud Initiation	Flower Diameter (cm)	Self-Life	Number of Flowers Per Plant
T (Control) 0	33.53	6.47	5.39	4.53	4.33
T (Cycocel @ 100 ppm) 1	33.73	6.53	5.48	4.60	5.33
T (Cycocel @ 200 ppm) 2	35.27	6.67	5.75	4.27	3.73
T (Cycocel @ 300 ppm) 3	32.20	6.53	5.70	4.67	4.73
T (Cycocel @ 400 ppm) 4	34.13	6.40	5.79	4.80	4.47
T (Cycocel @ 500 ppm) 5	33.93	6.73	5.73	4.47	4.53
T (Ethrel @ 50 ppm) 6	36.60	6.53	5.59	4.20	4.20
T (Ethrel @ 100 ppm) 7	36.47	6.80	5.70	5.07	2.27
T (Ethrel @ 150 ppm) 8	36.60	6.47	5.93	4.33	2.00
T (Ethrel @ 200 ppm) 9	40.93	6.33	5.75	4.40	1.20
T (Ethrel @ 250 ppm) 10	46.20	6.60	5.76	4.73	1.00
F-test	**S**	**S**	**S**	**S**	**S**
S.Ed	**0.701**	**0.079**	**0.062**	**0.157**	**0.464**
CD at 5%	**2.081**	**0.236**	**0.185**	**0.467**	**1.379**
CV	**3.34**	**2.099**	**1.885**	**5.988**	**23.404**

4. CONCLUSION

From the present investigation, it is concluded that among the different treatments, the treatment T_7 - Ethrel @ 100 ppm was found superior in terms of chlorophyll content (56.34), plant spread (12.47 cm), leaf area (37.11 cm^2) and self-life (5.07 days) whereas, the treatment T_{10} - Ethrel @ 250 ppm showed superiority in terms of number of leaves (62.40) and number of branches (6.47). Among the different treatments, the highest gross return ₹9000/100 pots, net return ₹2942.65/100 pots and benefit cost ratio is 1.48, was recorded in treatment T_7 - Ethrel @ 100 ppm. Hence, Ethrel @ 100 ppm can be recommended for plant growth and flowering of Pansy (*Viola tricolor* var. hortensis) and Ethrel @ 250 ppm can be recommended for the delayed flower producing and compact plant production.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that generative AI technologies such as Large Language Models, etc have been used during writing or editing of manuscripts. This explanation will include the name, version, model, and source of the generative AI technology and as well as all input prompts provided to the generative AI technology.

Details of the AI usage are given below:

1. ChatGPT version 3.0

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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