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RESEARCH ARTICLE

Influence of potting media compositions and triacontanol on growth, flowering and pot presentability of potted chrysanthemum

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Abstract

The selection of suitable growing media well-aerated with sufficient water absorption and drainage capability is an important prerequisite to producing potted plants. Another key component that influences the vegetative and flowering attributes of potted plants is the application of plant growth regulators. Several plant growth regulators are now being utilized efficiently for various purposes in floriculture and among them, triacontanol is one of the most important. In J&K there is a huge scope for commercialization of flowering potted plants and among them, *Chrysanthemum* is a potential pot plant. This suggested research to identify the best potting media composition and ideal triacontanol dose to produce quality *Chrysanthemum* flowerpots. Therefore, the effect of three potting mixtures viz., soil + sand + FYM (2:1:1 v/v), soil + perlite + vermicompost (2:1:1 v/v), cocopeat + vermiculite + vermicompost (2:1:1 v/v) and five triacontanol doses (0, 0.5, 1.5, 2.5, 3.5 ppm) were tested on the growth and flowering characteristics of *Chrysanthemum morifolium* Ramat. at SKUAST-J, during 2023-2024. The experiment was carried out in a factorial completely randomized design with fifteen treatments replicated thrice. The result showed that among the various treatments, T_8 i.e., soil + perlite + vermicompost (2:1:1 v/v) plus triacontanol at 1.5 ppm was found superior in terms of plant height (28.27 cm), the number of branches per plant (6.36), plant spread (275.44 cm^2), leaf area (7.92 cm^2), chlorophyll content (53.35 SPAD value), flower diameter (3.98 cm), number of flowers per plant (26.17), dry weight of shoot (59.33 g) and root (23.67 g) and pot presentability score (93) as compared to other treatment combinations.

Keywords

chrysanthemum; pot presentability; potting mixture; triacontanol

Introduction

Chrysanthemum is a valuable commercial flower crop grown for its attractive flowers all over the world and holds significant value within the Asteraceae family (1, 2). Potted chrysanthemums commonly called pot mums are a favoured choice in urban areas for living spaces, balconies and patios (2, 3). The major cities of India like Delhi, Kolkata, Mumbai, Bangalore and Coimbatore have a high projected demand of potted *Chrysanthemum* around the year. With urbanization and increasing interest in indoor and balcony gardening, demand for high-quality potted *Chrysanthemum* is rising. Although greater growth, flowering and overall plant presentability largely depends on the selection of an efficient potting medium and the growth-promoting substances.

The selection of suitable growing media is essential for the production of quality horticultural crops. It directly affects the development and later maintenance of the extensive functional rooting system (4). A good growing medium would provide sufficient anchorage or support to the plant and serve as a reservoir for nutrients and water between the roots and the atmosphere outside the root substrate (5). Different growing media like coco peat, vermiculite, perlite and rock wool are nowadays available and widely used in pot cultures in addition to farmyard manure (FYM) and vermicompost.

Growth regulators play a crucial role in regulating the growth and development of plants and also help them respond to both biotic and abiotic stresses (6). Ornamental plant growers in the commercial sector are integrating plant growth regulators into their cultivation practices as a fundamental component. This is because these regulators exert rapid impacts on both the vegetative growth and flowering yield of ornamental crops (7). Triacontanol regulates various plant metabolic activities leading to better growth and development and is an endogenous plant growth regulator which occurs naturally in epicuticular waxes (8, 9). Its positive role in improving growth, yield, photosynthesis, enzymatic activity and the levels of various crucial components has been reported. Research suggests that triacontanol influences the upregulation of genes involved in photosynthesis and potentially stimulates flowering in plants (10). There is very limited literature available on the role of triacontanol in enhancing the growth and flowering attributes of Chrysanthemum.

Considering the lack of comprehensive studies investigating the beneficial effects of triacontanol on potted *Chrysanthemum*, particularly in conjunction with various potting media under the subtropical conditions of Jammu, the current study was undertaken to evaluate the interactive impact of different potting mixtures and doses of triacontanol on growth, flowering and pot presentability of potted Chrysanthemum.

This research seeks to provide valuable insights into optimizing cultivation techniques for potted Chrysanthemum, benefiting both scientific understanding and practical floricultural applications. The findings of this research can serve as a foundation for studying the combined effects of triacontanol and potting media on other potted ornamental plants. In further research, investigating the reusability of potting media can contribute to sustainable floriculture. Also, future studies can explore the underlying molecular pathways influenced by triacontanol like its role in gene expression related to photosynthesis, flowering etc.

Materials and Methods

Plant material and growing conditions

The study was conducted in factorial CRD (completely randomized design) with three replications at the Division of Floriculture and Landscaping, Experimental Farm, SKUAST-Jammu, which is located 296 m above mean sea level and at a latitude of 33° 55' North and longitude of 74° 58' East. The area corresponds to Zone V of Jammu and Kashmir, agro-climatically. Subtropical weather prevails year-round, with hot, dry summers, hot and humid rainy seasons and freezing winters with an average total rainfall of 1000 to1200 mm; the average annual highest temperature of 45-46°C during summer and lowest temperature of 4-6°C during winter. Maximum and minimum average humidity are 92.0% and 32.0%, respectively. The variety of *Chrysanthemum* used in this experiment was 'Pink Crest'. Three-year-old quality *Chrysanthemum* plants of this variety already growing in the experimental farm of the Division of Floriculture and Landscaping, SKUAST-Jammu were used as the source of cuttings. Terminal cuttings about 6-7 cm long of pencil thickness were taken in August 2023 during the vegetative growth stage of these plants and were grown in sand for rooting. Different potting mixtures viz. soil, sand, FYM, perlite, vermicompost, cocopeat and vermiculite were utilized in the experiment. These media were thoroughly mixed in the desired ratio on a v/v basis as per the different treatment combinations [soil + sand + FYM (2:1:1v/v), soil + perlite + vermicompost (2:1:1v/v), cocopeat + vermiculite + vermicompost (2:1:1v/v)] and filled in plastic pots of 8-inch diameter. The potting media are selected after reviewing the mixture combinations used in the previous studies, like the one conducted to evaluate the effect of growing media on *Chrysanthemum* where soil + sand + FYM (2:1:1v/v) had been used as a control media (11). The current study has used cocopeat in combination with vermiculite and vermicompost as both the cocopeat and vermiculite have shown optimal results on the growth and flowering of *Chrysanthemum* (12). A study observed better response in *Chrysanthemum* cv. 'Haldighati' when perlite was used as medium in combination with soil and FYM (2). Inspired by their work, potting media including a mixture of soil, perlite and vermicompost have been used in the present research. Uniform, healthy and well-developed rooted cuttings of *Chrysanthemum* were taken and planted on 27th September 2023 in the pots. For optimum plant establishment, mild watering was done using a rose can right after planting. Foliar spray of triacontanol at different concentrations i.e., 0, 0.5, 1.5, 2.5 and 3.5 ppm was given to the plants growing in the pots after 2 months of planting before the initiation of flowering. These doses are selected based on previous research (10) on the influence of triacontanol on potted *Bougainvillea* where concentrations of 0, 0.5, 1.0, 2.5 and 5.0 ppm were used, as lower concentrations of triacontanol are biologically functional and plants are responsive to the low doses of triacontanol.

Measurement of growth parameters

The various growth parameters include plant height, plant spread, number of branches, leaf area and chlorophyll content. The plant height was measured from the bottom or foot of the plant to its tip by using a scale and the average of the data was calculated and demonstrated in centimetres (cm). The number of branches was counted per plant based on visual observation at 50% flowering stage. Using a scale, the spread of the crop from the point at which the width was observed maximum on any two sides was recorded from the potted plants. By multiplying the two values, plant spread was worked out and expressed in cm^2. The leaf area was evaluated using graph paper. Three leaves of different sizes (small, medium and large) were taken from each plant and outlined on graph paper to measure their leaf area. The average leaf area of these leaves was taken and expressed in cm^2. The chlorophyll content of 3 leaves selected from different portions (top, bottom and middle) of each plant was measured using SPAD-502 meter and their mean chlorophyll content was calculated.

Measurement of flowering parameters

The number of days taken for first bud appearance, first flower opening and 50% flowering were recorded in every plant from the day of transplanting of rooted cuttings and their mean was evaluated. Flower diameter (cm) was evaluated with the help of a measuring scale. Flower diameter was measured by randomly selecting 6–7 blossoms from a plant and calculating the average diameter. Numbers of flowers were counted on randomly selected 4–5 branches of every plant and their mean value was evaluated to calculate the number of flowers per plant. Total numbers of flowers were counted on every plant in each treatment and average numbers of flowers were enumerated in every treatment. The number of days taken for the flower to remain presentable in the pot after full bloom was recorded and the mean value from each treatment was computed. Plants were uprooted from the pots and roots were separated from the shoots. The roots and shoots were oven-dried separately to obtain their dry weight. Based on dry weight, the root: shoot ratio was calculated. Pot presentability was evaluated based on the point system modified after Conover. The presentability parameters were studied and points were allotted to each parameter out of a maximum of 100 points (13).

Statistical analysis

The design used in the experiment is factorial CRD including 2 factors *viz.,* potting mixtures (3 levels) and triacontanol doses (5 levels) and the statistical test used for this 2-factor CRD analysis or Two-Way Analysis of Variance (ANOVA) is F-test. The data was analysed by using Operational Statistics (OPSTAT) software and critical difference (CD) was calculated at the probability level of 5%. The analysis showed the interactive effects of both factors which helped in drawing conclusions and decision-making.

Results and Discussion

Growth traits

Data presented (Table 1) shows the influence of different potting media compositions and triacontanol doses on plant height (cm), branches/plant, plant spread (cm^2), leaf area (cm^2), chlorophyll content (SPAD value) of *Chrysanthemum*. The findings indicate that maximum plant spread (275.44 cm^2) was recorded with the treatment T_8 (soil + perlite + vermicompost (2:1:1 v/v) plus triacontanol at 1.5 ppm) whereas minimum plant spread of 181.77 cm^2 was recorded with treatment T_{15} (cocopeat + vermiculite + vermicompost (2:1:1 v/v) + triacontanol at 3.5 ppm). Maximum leaf area (7.92 cm^2) was recorded with treatment T_8 (soil + perlite + vermicompost (2:1:1 v/v) plus triacontanol at 1.5 ppm) whereas a minimum of 6.35 cm^2 was recorded with treatment T_4 (soil + sand + FYM (2:1:1 v/v) + triacontanol at 2.5 ppm). Our results conform with a previous study that recorded maximum values for the plant spread and leaf area with potting media containing perlite + FYM + garden soil (2:1:1) in *Chrysanthemum* cv. 'Haldighati' (2). Potting mixtures enhance drainage, aeration, water retention and nutrient absorption by the root system, which might potentially account for vigorous plant growth. The increase in plant spread might be attributed to the proliferation of branches at broader angles from the main stem, indicative of healthy vegetative growth (14). Triacontanol's influence on plant growth could be attributed to its potential to stimulate accelerated cell division and elongation resulting in robust plant growth. The increased plant spread might be linked to the growth-promoting action of triacontanol, through higher photosynthetic activity and an increase in the production and supply of energy-rich food substances to the meristematic cells (15). Triacontanol facilitates the transfer of photosynthates to the sink, which might potentially explain the greater leaf area (16).

However, the effects on plant height, number of branches/plant and chlorophyll content (SPAD value) did not show any significant results.

Flowering traits

An overview of Table 1 shows the influence of different potting mixtures and triacontanol doses on days to first bud appearance, days to first flower opening, flower diameter (cm), no. of flowers/ plant, days to 50% flowering, flowering duration (days) of *Chrysanthemum morifolium* Ramat.. Minimum days to first bud appearance (64.44 days) were recorded with treatment T_{13} (coco peat + vermiculite + vermicompost (2:1:1 v/v) plus triacontanol at 1.5 ppm) whereas maximum (83.44 days) was recorded with T_5 (soil + sand + FYM (2:1:1 v/v) plus triacontanol at 3.5ppm). Minimum days for first flower opening (95.7 days) and 50% flowering (115.67 days) were observed with treatment combination soil + perlite + vermicompost (2:1:1 v/v) plus triacontanol at 0.5 ppm i.e., T_7. Observed results support the previous findings in *Chrysanthemum* cv. 'Haldighati', which recorded early flower production with potting media containing perlite + FYM + garden soil (2:1:1), which might be due to rapid uptake of nutrients by the plant and vigorous growth of the plant growing in the media (2).

Table 1. Influence of different potting mixtures and triacontanol doses on days to 50% flowering, flower diameter (cm), no. of flowers/ stem, no. of flowers/ plant, flowering duration (days), dry weight of shoot (g), dry weight of root (g), root: shoot ratio of *Chrysanthemum morifolium* Ramat

	Growth traits					Flowering traits						Root and shoot biomass		
	Plant height (cm)	Branches/ plant	Plant spread (cm²)	Leaf area (cm²)	SPAD value	First bud appearance (days)	First flower opening (days)	Days to 50% flowering	Flower diameter (cm)	No. of flowers/ plant	Flowering duration (days)	Dry weight of shoot (g)	Dry weight of root (g)	Root: shoot ratio
T_1	21.83	4.87	195.63	6.73	39.37	73.88	103.22	123.88	3.45	15.60	42.68	45.00	21.67	0.48
T_2	22.80	5.10	237.60	6.77	42.23	75.55	100.44	123.55	3.46	22.33	47.50	47.33	21.00	0.44
T_3	25.10	5.37	270.10	7.27	44.90	68.00	98.44	121.00	3.96	24.93	58.17	50.67	22.33	0.44
T_4	21.33	4.73	234.93	6.35	42.77	75.88	100.00	124.88	3.33	20.47	48.50	47.00	20.00	0.43
T_5	21.30	4.70	189.73	6.68	41.47	83.44	103.11	126.44	3.12	21.67	47.30	47.33	21.33	0.45
T_6	25.13	5.70	195.89	7.41	47.93	68.50	98.50	118.50	3.76	17.90	48.22	53.00	21.67	0.41
T_7	26.76	6.10	191.88	7.50	49.44	65.67	95.70	115.67	3.94	23.37	50.11	54.67	22.33	0.41
T_8	28.27	6.36	275.44	7.92	53.35	67.27	97.30	117.27	3.98	26.17	56.44	59.33	23.67	0.40
T_9	25.99	5.55	237.66	7.10	49.08	70.97	101.00	120.97	3.37	22.20	51.44	56.33	22.33	0.40
T_{10}	25.43	5.50	258.66	6.71	48.52	70.97	101.00	120.97	3.64	24.13	50.77	53.67	23.67	0.44
T_{11}	22.07	5.40	199.44	7.62	39.91	73.22	100.88	125.22	3.53	17.47	45.44	51.33	22.00	0.43
T_{12}	22.83	5.30	233.00	6.86	41.21	78.44	100.55	122.44	3.58	22.60	52.66	50.67	20.67	0.41
T_{13}	26.23	6.12	273.00	7.01	44.30	64.44	98.00	120.44	3.97	25.40	59.66	50.33	21.67	0.43
T_{14}	21.87	5.85	184.33	6.70	41.21	82.00	101.88	122.00	3.67	21.03	50.55	49.33	20.33	0.41
T_{15}	21.07	5.28	181.77	7.33	39.71	71.11	103.44	125.11	3.30	23.17	47.22	49.67	19.67	0.40
SE± (m)	0.94	0.24	10.58	0.24	2.06	1.78	1.86	1.27	0.09	0.55	2.17	0.86	0.42	0.02
CD (0.05%)	NS	NS	30.57	0.69	NS	5.17	5.42	3.68	0.25	1.60	NS	2.49	1.22	NS

T_1: Soil + Sand + FYM (2:1:1), T_2: Soil + Sand + FYM (2:1:1) +Triacontanol at 0.5 ppm, T_3: Soil + Sand + FYM (2:1:1) +Triacontanol at 1.5 ppm, T_4: Soil + Sand + FYM (2:1:1) +Triacontanol at 2.5 ppm, T_5: Soil + Sand + FYM (2:1:1) +Triacontanol at 3.5 ppm, T_6: Soil + Perlite + Vermicompost (2:1:1), T_7: Soil + Perlite + Vermicompost (2:1:1) + Triacontanol at 0.5 ppm, T_8: Soil + Perlite + Vermicompost (2:1:1) + Triacontanol at 1.5 ppm, T_9: Soil + Perlite + Vermicompost (2:1:1) + Triacontanol at 2.5 ppm, T_{10}: Soil + Perlite + Vermicompost (2:1:1) + Triacontanol at 3.5 ppm, T_{11}: Cocopeat + Vermiculite + Vermicompost (2:1:1), T_{12}: Cocopeat + Vermiculite + Vermicompost (2:1:1) + Triacontanol at 0.5 ppm, T_{13}: Cocopeat + Vermiculite +Vermicompost (2:1:1) + Triacontanol at 1.5 ppm, T_{14}: Cocopeat + Vermiculite +Vermicompost (2:1:1) + Triacontanol at 2.5 ppm, T_{15}: Cocopeat + Vermiculite +Vermicompost (2:1:1) + Triacontanol at 3.5 ppm.

Triacontanol elevates the expression of genes linked to photosynthesis, which may facilitate greater energy production, enhanced absorption of water and mineral nutrients, improved activity of antioxidant enzymes and the synthesis of various organic compounds (8, 17). This cascade of effects may contribute to earlier bud formation and flowering.

Maximum flower diameter (3.98 cm) was recorded with treatment T_8 i.e., soil + perlite + vermicompost (2:1:1) plus triacontanol at 1.5 ppm, whereas minimum flower diameter of 3.12 cm was recorded with T_5 (soil + sand + FYM (2:1:1) + triacontanol at 3.5 ppm). The growth medium promotes enhanced translocation of photosynthates from the leaves (source) to the flowers (sink). A continuous supply of photosynthates, coupled with rapid cell division and expansion, may result in larger flower diameters. Similar results were also obtained by Kala *et al.* (2020) (14). An increase in flower diameter might also result from improved photosynthetic activity from triacontanol spray ultimately providing more nutrients to the flowers thereby allowing them to grow larger. The beneficial effects of triacontanol spray at blooming in pansy plants could be attributed to its role in enhancing water absorption, cell division, cell elongation and the plant cell membrane permeability facilitating active movement of the products of photosynthesis from the source to the blooming organs, which causes the C/N ratio to narrow and eventually induces more blooms and increase in flower diameter (18).

The maximum number of flowers per plant (26.17) was recorded with treatment T_8 i.e., soil+ perlite+ vermicompost (2:1:1) plus triacontanol at 1.5 ppm, whereas the minimum number of flowers per plant (15.60) was recorded with T_1 (soil + sand + FYM (2:1:1) + triacontanol at 0 ppm). The production of a greater number of flowers in the growing media could be due to the production of more flower buds per plant, more branches as well as a greater number of flowers per branch in the plant. For *Chrysanthemum* plants cultivated in this media, the rise in flower numbers is likely linked to enhanced carbohydrate accumulation through photosynthesis and vegetative growth due to the balanced supply of nutrients and improved availability of essential components during key growth phases (19). These outcomes support previous research on *Chrysanthemum* (20). Increased flower count might also result from overcoming the apical dominance and encouraging the growth of axillary and apical buds on both primary and secondary branches, thus redirecting energy into branches and leading to the production of more flowers. The findings of the current study align with previous research (21, 22).

The combined effect of different potting mixtures and triacontanol doses on the flowering duration of *Chrysanthemum* was found to be non-significant.

Root and shoot biomass

An overview of Table 1 shows the influence of different potting mixtures and triacontanol doses on the dry weight of root (g), dry weight of shoot (g) and root: shoot ratio of *C. morifolium* Ramat.. The characteristics of both roots and shoots dry weights were significantly influenced by the different potting mixtures and triacontanol. The maximum dry weight of the root (23.67 g) was recorded with treatment T_8 i.e., soil + perlite + vermicompost (2:1:1 v/v) plus triacontanol at 1.5 ppm. However, the minimum dry weight of the root (19.67 g) was observed with treatment T_{15} i.e., cocopeat + vermiculite + vermicompost (2:1:1 v/v) plus triacontanol at 3.5 ppm. The increased phosphorous uptake in the triacontanol-treated plants may account for higher root yields. Triacontanol increases photosynthesis, reduces photorespiration and facilitates the translocation of the photosynthates and other metabolites to the sink areas (16).

The maximum dry weight of the shoot (59.33 g) was recorded with soil + perlite + vermicompost (2:1:1 v/v) plus triacontanol at 1.5 ppm (T_8), whereas the minimum dry weight of the shoot (45.00 g) was recorded with treatment T_1 i.e., soil + sand + FYM (2:1:1 v/v) plus triacontanol at 0 ppm. Triacontanol interacts with existing growth hormones such as cytokinin and gibberellic acid to influence plant growth, yield and metabolic activities in plants which could probably be the contributing factor for higher shoot yields (23). Robust root and shoot growth of plants could be ascribed to enhanced water availability, better drainage and optimal aeration in the potting mixture. These conditions ensure adequate access to both water and oxygen (4).

However, the interaction effects of different potting mixtures and triacontanol doses on the dry root-to-shoot ratio were found to be non-significant.

From the above data, it has been found that the Chrysanthemum plants showed better results for growth and flowering at 1.5 ppm concentration of triacontanol as compared to the higher dose of 3.5 ppm. Similar results were also observed in potted *Bougainvillea*, where better results for most of the parameters were reported with triacontanol at 2.5 ppm as compared to the 5 ppm concentration (10). This may be due to the fact that at a certain point, the increasing dose of triacontanol becomes toxic for the growth and development of the plants. The toxicity of the higher concentration of triacontanol could be seen in many ways like overproduction of reactive oxygen species, hormonal imbalance in plants, decrease in nutrient uptake, deficiency of essential elements etc.

This could be the reason for poor performance and lesser efficiency in the growth promotion of *Chrysanthemum* plants in response to the higher concentration (3.5 ppm) of triacontanol.

Pot presentability

An overview of Table 2 shows the influence of different potting mixtures and triacontanol doses on the pot presentability of *C. morifolium* Ramat.. It was observed that the treatment T_8 [soil + perlite + vermicompost (2:1:1 v/v) + triacontanol at 1.5 ppm] revealed the highest pot presentability score (93 out of 100) which was closely followed by the treatment T_7 [soil + perlite + vermicompost (2:1:1 v/v) + triacontanol at 0.5 ppm] recording pot presentability score 88 out of 100 whereas, minimum pot presentability score (63 out of 100) was recorded with treatment T_5 (soil + sand + FYM (2:1:1) + triacontanol at 3.5 ppm).

Conclusion

It can be concluded from this research that the treatment combination of soil + perlite + vermicompost (2:1:1 v/v) and triacontanol at 1.5 ppm i.e., T_8 showed the most favourable outcomes in promoting growth, flowering and pot presentability in *Chrysanthemum*. This treatment led to the highest plant spread, leaf area, flower diameter, number of flowers per plant, root and shoot biomass and pot presentability score highlighting the positive impact of both the potting media and triacontanol on plant development. The growth-promoting properties of triacontanol, coupled with an optimal potting medium, significantly contributed to improved plant health and overall productivity, establishing it as the most effective treatment in the study.

Table 2. Influence of different potting mixtures and triacontanol doses on pot presentability score of *Chrysanthemum morifolium* Ramat. (Adopted from Conover, 1986 (13))

		Pot presentability score					
		Condition	**Cultural perfection**	**Form**	**Color**	**Stems and foliage**	**Total**
T_1	Soil+Sand+FYM (2:1:1)	12	13	14	12	13	**64**
T_2	Soil+Sand+FYM (2:1:1) +Triacontanol at 0.5 ppm	13	14	13	12	14	**66**
T_3	Soil+Sand+FYM (2:1:1) +Triacontanol at 1.5 ppm	14	13	13	14	15	**69**
T_4	Soil+Sand+FYM (2:1:1) +Triacontanol at 2.5 ppm	12	12	14	13	13	**64**
T_5	Soil+Sand+FYM (2:1:1) +Triacontanol at 3.5 ppm	12	13	13	12	13	**63**
T_6	Soil+Perlite+Vermicompost (2:1:1)	16	15	17	16	17	**81**
T_7	Soil+Perlite+Vermicompost (2:1:1) +Triacontanol at 0.5 ppm	18	17	17	18	18	**88**
T_8	Soil+Perlite+Vermicompost (2:1:1) +Triacontanol at 1.5 ppm	19	18	18	19	19	**93**
T_9	Soil+Perlite+Vermicompost (2:1:1) +Triacontanol at 2.5 ppm	16	17	17	16	18	**84**
T_{10}	Soil+Perlite+Vermicompost (2:1:1) +Triacontanol at 3.5 ppm	15	16	15	17	16	**79**
T_{11}	Cocopeat+Vermiculite+Vermicompost (2:1:1)	14	15	13	13	15	**70**
T_{12}	Cocopeat+Vermiculite+Vermicompost (2:1:1) +Triacontanol at 0.5 ppm	13	15	14	14	15	**71**
T_{13}	Cocopeat+Vermiculite+Vermicompost (2:1:1) +Triacontanol at 1.5 ppm	18	16	18	17	18	**87**
T_{14}	Cocopeat+Vermiculite+Vermicompost (2:1:1) +Triacontanol at 2.5 ppm	17	16	17	16	17	**83**
T_{15}	Cocopeat+Vermiculite+Vermicompost (2:1:1) +Triacontanol at 3.5 ppm	14	14	15	16	15	**74**

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Authors' contributions

SK carried out the investigation, wrote original draft and analysed data. AS and NL participated in the conceptualization, supervision, validation, review and editing. GC helped in supervision, validation and review. All authors read and approved the final manuscript.

Compliance with ethical standards

Conflict of interest: Authors do not have any conflict of interest to declare.

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