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Effect of Micronutrients and Nanoparticles on Vegetative Growth of Anthurium *Anthurium andraeanum* cv. Xavia

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ABSTRACT: Anthurium is the latest sensation of Indian floriculture scene and the genus *Anthurium*, with 700 species is largest genus of the family *Araceae*. Anthurium is an important tropical ornamental plant grown for its colourful spathe & attractive foliage. The study was plotted according to a Completely Randomized Design (CRD) with Duncan's Multiple Range Test (DMRT). The experiment was conducted during the year 2018-2019 and 2021-2022 throughout the year under agroshadenet structure of RKVY Project on Anthurium, Department of Floriculture and Landscaping, Biotechnology-cum-Tissue Culture Centre, Orissa University of Agriculture and Technology (OUAT), Odisha. It has been concluded that the vegetative parameters of *Anthurium andraeanum* cv. Xavia, treatment T_7 (ZnONPs@75ppm) significantly enhanced the Plant height (43.43 cm), Plant spread (46.13 cm), No. of suckers (3.56 nos.) and leaf petiole length (34.06 cm) in compare to other treatments.

Keywords: Leaf Petiole length, Plant spread, Plant height and number of suckers.

INTRODUCTION

Anthurium is the latest sensation of Indian floriculture scene and the genus *Anthurium*, with 700 species is largest genus of the family *Araceae*. Anthurium is an important tropical ornamental plant grown for its colourful spathe & attractive foliage. Although, Anthurium is sold both as cut flower and potted plant, the trade in cut flower is much larger than the potted plant. They are very popular as cut flowers for their beauty, bold and long-lasting qualities which are essential pre- requisites for any floral arrangement. *Anthurium andraeanuam* Linden, the best-known species was discovered by Eduard Andre in 1870.Anthurium was brought to Europe in 1876 and later it spreads to Brazil and Hawaii. The Hawaiian Anthurium is one of the primary ornamentals produced on the island and exported to the United States and Canada, Germany, Italy, Japan, and other nations. Anthurium ranks seventh in the global flower trade and commands a respectable price both for its cut flower and whole plant.

Life cycle of Anthurium consist of two phases. First is juvenile phase in which vegetative buds emerge in the axils of the leaves. Second is generative phase in which inflorescence buds can be found in the leaf axils (Christensen, 1971). Once the juvenile phase has passed, flowers are produced in an alternating cycle with leaves throughout the year (Kamemoto and Nakasone 1963).

The agroclimatic conditions of Odisha along with abundant water availability offer a natural advantage for the commercialization of several unexploited floras in various parts of the state. The climate of Odisha is represented by tropical monsoon weather. Searing hot summers with considerably high monsoon downpours and cool pleasant winters mark the Odisha climate. Rainfall is the main source of water that varies from 1200 millimeters to 1700 millimeters across the state. It is a great opportunity for a state like Odisha to promote flower production especially cut flower production in coming years. Malkangiri, ports of Koraput, Rayagada in north eastern ghats, Ganjam, Kandhamal, Kendrapada, Jagatsinghpur, Khurda, Puri, Nayagarh are suitable for anthurium cultivation in Odisha (Beura *et al*., 2017).

Micronutrients can be provided through foliar application for obtaining high crop yield and for the efficient use of other essential nutrients like N, P and K and also has beneficial role in recovery of physiological disorders of flowers. Foliar application of nutrients has advantage of uniform distribution of fertilizer materials, low application rates and quick response to applied nutrients (Umer *et al*., 1999). Simultaneously, Nanotechnology is an emerging field in science, whose potentiality seen in almost every field, starting from

drug delivery to waste water clean-up, soil remediation and controlled fertilizer application. These nanotechnology uses various engineered nanoparticles (NPs) & encompasses various field of science under one umbrella; including biology, physics, chemistry & engineering. The use of variety of NPs is increasing day by day in agricultural field, where nano particles have found uses as fertilizer & stress-counteractive agents.

MATERIAL AND METHODS

The present investigation was carried out in 2018-19 and 2022-2023 throughout the year. The study was plotted according to a Completely Randomized Design (CRD) with Duncan's Multiple Range Test (DMRT). The experiment was conducted during the year 2018-2019 under agroshadenet structure of RKVY Project on Anthurium, Dept. of Floriculture and Landscaping, Biotechnology-cum-Tissue Culture Centre, Orissa University of Agriculture and Technology (OUAT), Odisha. The 7 elements known as micronutrients—chlorine, zinc, copper, molybdenum, iron, manganese, boron—are crucial for crop development in extremely small amounts. The micronutrients that fertilisation used in my experiment include manganese, copper, zinc, and molybdenum. Enhancing plants' ability to withstand drought stress (DS) requires the use of nanoparticles (NPs). NPs trigger the production of stress-related proteins, boost photosynthesis, promote water absorption, nutrition, preserve membrane integrity, increase harvest index and grain yield. After 10 days of planting, the plants were sprayed with the required solutions of $MnSO_4$, $CuSO_4$, ZnO NPs, MgO NPs was applied at different concentration as per treatments for 3 times at 4 months interval in a year as foliar application. Spraying was done during early morning and late afternoon hours on non-windy days to ensure maximum absorption by the plants. The height of the plant was measured from its primary growth tip to the base of its stem at ground level. This was noted using a metre scale at 30-, 60-, and 90-days following planting. The readings were taken from five plants and mean was worked out and expressed in centimeters. At the bud initiation stage, the plant spread was measured in the E-W and N-S directions, and the mean values were computed and expressed in centimeters. At intervals of four months (120 days) after planting, the total number of suckers generated per plant was counted. The average was then calculated and represented as the number of suckers per plant. The total length of the leaf petiole, which connects the top of the whole leaf to the base of the lowest leaflet where it meets the leaf stem, was measured in centimeters.

Fig. 1. Vegetative growth (Plant height, Plant spread) of *Anthurium andraeanum*.

Micronutrients and nanoparticles measured in laboratory before foliar application on different treatments.

The treatments are as follows.

Treatments	Groups	Concentration
T_1	Control	-
T_2	Foliar spray of $MnSO_4$	@0.2%
T_3	Foliar spray of $MnSO_4$	@0.4%
T_4	Foliar spray of $CuSO_4$	@0.5%
T_5	Foliar spray of $CuSO_4$	@0.75%
T_6	Foliar spray of ZnO nanoparticles	@50 ppm
T_7	Foliar spray of ZnO nanoparticles	@75 ppm
T_8	Foliar spray of ZnO nanoparticles	@100 ppm
T_9	Foliar spray of MgO nanoparticles	@50 ppm
T_{10}	Foliar spray of MgO nanoparticles	@75 ppm
T_{11}	Foliar spray of MgO nanoparticles	@100 ppm

RESULTS AND DISCUSSION

The observations on vegetative growth parameters like plant height, plant spread, Nos. of suckers & leaf petiole length etc. as influenced by the foliar application of different micro nutrients and nano particles, either alone or in combinations were recorded and the data was statistically analysed and presented in and Fig. 1 and Table 1.

The results revealed that in case of *Anthurium andraeanum* cv. Xavia, the plant height in the 1st year was significantly higher (42.80 cm) with the foliar application of Zinc Oxide nanoparticles (ZnO NPs) @ 75ppm (T_7). In the 2nd year also the treatment T_7 (ZnO NPs) @ 75ppm) showed the best result with respect to plant height (44.07 cm). The pooled result for the character plant height for both the years was also found to be highest (43.43 cm) with the application of Zinc oxide nanoparticles @ 75ppm (T_7) while the treatments T_8 (ZnO NPs @ 100ppm) and T_6 (ZnO NPs@ 50ppm) with the values 43.06 cm and 42.66 cm, respectively remained at par. However, minimum plant height of 33.03 cm, 33.53 cm, and 33.28 cm for 1st year, 2nd year and pooled mean, respectively was recorded in T_1 (control).

Maximum plant spread (46.27cm) and (46.00 cm) for 1st year and 2nd year, respectively was exhibited by the plants sprayed with T_7 (ZnONPs@75ppm). The pooled data of two years revealed that the plants sprayed with ZnONPs@75ppm (T_7) shows maximum plant spread of 46.13 cm followed by the treatment T_8 (ZnONPs@100ppm) with value 45.63 cm. The least plant spread 39.17 cm, 39.00 cm, and 39.08 cm for 1st year, 2nd year and pooled mean, respectively was recorded in T_1 (control).

The sucker numbers were recorded to be highest (3.27 nos. and 3.87 nos. for 1st year and 2nd year, respectively) in the plants sprayed with T_7 (ZnONPs@75ppm). The pooled result for the character number of suckers for both the years was also found to be highest (3.56 nos.) in the treatment T_7 (ZnONPs @75ppm) followed by the treatments T_8 (ZnONPs@100ppm) with the values 3.03 nos. However, minimum number of suckers for 1st year (1.17 nos.), 2nd year (1.40 nos.), and pooled mean of both years (1.28 nos.) was recorded in T_1 (control).

Longest leaf petiole length (34.60cm) and (34.60 cm) for 1st year and 2nd year, respectively was exhibited by the plants sprayed with T_7 (ZnONPs@75ppm). The pooled data of two years revealed that the plants sprayed with ZnONPs@75ppm (T_7) of shows longest leaf petiole length of 34.60 cm followed by the treatment T_8 (ZnONPs@100ppm) with value 33.7 cm. The lowest leaf petiole length 29.07 cm, 30.17 cm, and 29.62 cm for 1st year, 2nd year and pooled mean, respectively was recorded in T_1 (control).

Considering the above-mentioned vegetative parameters of *Anthurium andraeanum* cv. Xavia**,** it has been concluded that the treatment T_7 (ZnONPs@75ppm) significantly enhanced the Plant height (43.43 cm), Plant spread (46.13 cm), No. of suckers (3.56 nos.) and leaf petiole length (34.06 cm) in compare to other treatments.

Table 1: Effect of micronutrients and nano particles on vegetative growth of *Anthurium andraeanum* cv. Xavia.

Characters		Plant Height (cm.)			Plant Spread (cm.)			No. of Suckers (nos.)			Leaf petiole length (cm.)		
Treatments		1st yr (2018-19)	2nd yr. (2021-22)	Pooled analysis	1st yr (2018-19)	2nd yr. (2021-22)	Pooled analysis	1st yr (2018-19)	2nd yr. (2021-22)	Pooled analysis	1st yr (2018-19)	2nd yr. (2021-22)	Pooled analysis
Control	T_1	33.03	33.53	33.28 f	39.17	39.00	39.08 g	1.17	1.40	1.28 g	29.07	30.17	29.62 g
$MnSO_4$@0.2%	T_2	34.93	34.33	34.63 e	41.97	41.30	41.63 f	1.30	1.53	1.42 fg	32.03	33.03	32.5 de
$MnSO_4$ @ 0.4%	T_3	36.90	36.40	36.65 d	41.80	41.77	41.78 f	1.40	1.63	1.52 efg	31.30	31.37	31.33 f
$CuSO_4$ @ 0.5%	T_4	37.13	37.13	37.13 d	42.73	42.73	42.73 e	1.70	1.93	1.82 de	31.97	31.97	31.97 ef
$CuSO_4$ @ 0.75%	T_5	39.10	39.97	39.53 c	43.80	43.83	43.81 d	2.13	2.37	2.25 c	32.43	32.83	32.63 cde
ZnONPs@50 ppm	T_6	42.30	43.03	42.66 a	44.23	44.23	44.23 c	2.03	2.70	2.37 c	33.07	33.53	33.3 bc
ZnONPs@75 ppm	T_7	42.80	44.07	43.43 a	46.27	46.00	46.13 a	3.27	3.87	3.56 a	34.60	34.60	34.6 a
ZnONPs@100ppm	T_8	42.70	43.37	43.03 a	45.90	45.37	45.63 b	2.73	3.33	3.03 b	33.53	33.87	33.7 b
MgONPs@50 ppm	T_9	42.27	43.40	42.53 b	45.50	45.10	45.30 b	1.50	2.27	1.88 de	32.97	32.97	32.97 cd
MgONPs@75 ppm	T_{10}	40.80	42.20	41.50 b	45.50	45.50	45.50 b	1.87	2.40	2.13 cd	32.80	32.80	32.8 cd
MgONPs@100ppm	T_{11}	39.80	40.80	40.30 c	44.70	44.30	44.50 c	1.40	2.07	1.73 ef	31.30	31.30	31.30 f

Effect of micro nutrient and nano particle effect on vegetative Characteristics of different cultivars of Anthurium

Plant height. Among the 11 treatments maximum plant height was found in treatment with application of ZnO nanoparticles @ 75ppm irrespective of all cultivars i.e. 43.43 cm (Xavia), 34.38 cm. It's clearly show that significant difference was observed amongst different cultivars. The cultivars Xavia was tallest plant height followed by Candy Stripe and then Tropical Red. It might be due to ZnO NPs which stimulate active growth on plant at low concentration. Ghafariyan *et al.* (2013) found the fact that nanoparticles (NPs) have become one of agriculture's most cutting-edge and promising applications. The impacts of NPs on plants may provide fresh insights into ecosystems since it is widely acknowledged that plants are a vital component of all ecosystems.

Plant spread. The Plant spread were found highest in treatment with application of ZnO NPs nanoparticles @ 75ppm in all cultivars i.e. 46.13 cm (Xavia). The cultivars Xavia was height plant spread followed by Candy Stripe and then Tropical Red. ZnO NPs used as fertilizer which protect the plant from biotic and abiotic stress condition.

No. of Suckers. No. of suckerswas found maximum in treatment i.e. ZnO NPs @ 75 ppm. In Xavia, the no. of suckers found that 3.56 nos., 3.12 nos. & 2.87 nos. respectively. The result may be due to major effect of micronutrients-based nanoparticles.

Leaf Petiole length. Leaf Petiole lengthwas found maximum in treatment with the application of ZnO NPs @ 75ppm irrespective of all cultivar i.e. in Xavia (34.6 cm. It might be due to proper availability of zinc which increases synthesis of proteins and consequence of which there is an increased meristematic activity leading to higher plant growth. Similar results were found by Dufour and Guérin (2003) who conducted trial on cultivation of anthurium in soil less media under polyhouse. The best results regarding plant growth and yield was obtained with a solution having lowest calcium (2.25 mg/l) and the highest ammonium (2.43 mg/l) concentrations of the plant and played an important role in fertilization balance.

CONCLUSIONS

The *Anthurium andraeanum* cv. Xavia was significantly influenced on vegetative characteristics by application of various micro nutrients and nano particles. It is concluded that among various treatment, maximum plant height (43.43 cm), plant spread (46.13), no. of suckers (3.56 nos.) & leaf petiole length (34.6 cm.) was observed with i.e. Application of ZnO NPs @ 75 ppm. Whereas minimum plant height (33.28 cm), plant spread (39.08 cm), no. of suckers (1.28 nos.) & leaf petiole length (29.62 cm.) was recorded in T1 (Control). From the present investigation it is concluded that among 11 treatments foliar application of Zinc Oxide nanoparticles (ZnONPs) @ 75ppm was considered to be best for the *Anthurium andraeanum* cultivars Xavia in all aspects like vegetative parameters, Floral characteristics as well as postharvest life. The use of micronutrients and micronutrient-based nanoparticles in the plants reduces the dependency on chemical fertilizers, thereby, improving the soil health in addition to the producing a good crop.

FUTURE SCOPE

We cannot completely rule out the risks associated with using nanotechnologies in agriculture, although there have been successful breakthroughs in this area. Modern research should spend more in assessing the safety of the materials to raise the standards for their processing, characterization, and overall application as a result of the technology's adoption as a means of unmatched development.

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Conflict of Interest. None.

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