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Effect of Nano Zn compared with $ZnSO_4$ on Growth and yield of Jasmine (Jasminum sambac L.)

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Abstract:
This study was carried out to access the effect of foliar application of Nano foliar spray of Zinc Nanoparticles (Nano Zinc oxide) on Jasmine (*Jasminum sambac*) flower yield and quality. A experiment was conducted based on the Completely randomized design in pot culture to found out the efficacy of Nano Zinc over Zinc Sulphate, with nine treatments and three replications per treatment. Foliar spray of Nano Zinc oxide at six concentration (0.25, 0.5, 0.75, 1.0, 1.5 and 2ppm) and $ZnSO_4$ at two concentration (1% and 2%) were applied at 30, 60 and 90 DAP (Days After Planting). T_7 Nano Zinc Oxide 2% significantly increases the growth and yield that resulted in increased aquaporin genes involved in water uptake, bioavailability, solubility in soil with increased surface area to volume ratio slow and gradual release of nutrients to the plants due to its particle size (<100nm). Which influence the better growth and yield compare to conventional nutrients.

Keywords: Zinc Oxide Nanoparticles, Zinc Sulphate, Foliar application, Jasmine, and Particle size.

Introduction:

Jasmine is one of the important commercial flower crops grown in India. Jasmine occupy a unique position among different flowers because of their exquisite white flowers, sweet scent, numerous visual benefits, significant export demands and ability to produce additional income for flower growers. Jasmine is a member of the family. The term ‘Jasmine’ is believed to come from the Persian word ‘Yasmin,’ associated with the Oleaceae family. Signifying perfume and also derived from the ancient Arabic term ‘Yasmin’. The group Jasminum consists of roughly 200 species that are spread across the warmer regions of Europe and the Pacific area (Bhattachtaerjee, 1974). An in-depth assessment of these species has shown the actual number of true species is merely 89, with 40 residing in the Indian sub-continent. (Veluswamy et al., 1983).Tamil Nadu stands is the leading state in jasmine producer in the nation, achieving yearly output of 1,80,670 MT metric tons from a region of 17,260 ha (Indiastat, 2020-21).This focused on efficacy of Nano Zinc oxide over $ZnSO_4$.

MATERIALS AND METHODS:

3.0.2. Preparation of Nano Zinc Oxide:

Wet chemical method used for preparation of ZnO_2 nanoparticles. To prepare ZnO_2 nanoparticles, take 100 ml of Zinc nitrate and add 100 ml of 0.2 M NaOH drop by drop of continuous stirring. The resulting solution kept at room temperature for 4 hours under constant stirring. After 10 minutes the white

precipitation was obtained. The obtained white precipitate was obtained by centrifuged at 1500 rpm, washed several times with distilled water and then with alcohol and dried at 80℃ in hot air oven for 5 hours. During drying, the conversion of Zn (OH) 2 into zinc oxide takes place.

The nano particles can be produced by two ways Bottom up approach and top down approach the basic component of both approaches is starting material of nano particles preparation. Bulk materials is used as a starting material in the top down approach. In contrastly, tiny atomic particles are used as a starting material in bottom up approach (figure 1.0). Top down approach are used for the preparation of Organic Nano particles and the bottom up approaches are used in Physical, Chemical and mechanical methods for the preparation of nano particles. In this experiment the foliar Spray of Zinc Nano particles are sprayed at 60, 90, and 120 DAP.

The semi hardwood cuttings variety 'Gundumalli' with the characteristics of small, white in colour, star shape with 5 petals. Flowers are produced in cluster with strong scented smell were used in this experiment. The semi hardwood cuttings of jasmine were procured from Sravanan Nursery, Hosur. **T**he jasmine variety Gundumalli was used for all three phases of the experiments. The Synthesised Nano nutrients are employed in the study NZnO were used.

Cuttings after hardening were planted in 8" Polypropylene, U treated brown color pot Diameter of 21 x 15 x 10.5 cm. Twenty days old, healthy and uniform sized rooted cuttings were planted in pots filled with media comprised of sand, red earth and farmyard manure in the ratio 2:1:1. One gram of carbofuran was applied to each pot before planting for the eradication of the soil pathogens and nematodes. Hand weeding was carried out, whenever it was found necessary, depending upon the weed population to keep the field free from weeds.

Irrigation was given at regular interval ranging from every three days depending upon the soil moisture and whether condition**.** Application of nano nutrients such as nano Zinc and nano Iron were used as foliar spray. The nano nutrients are synthesized by the Sol gel method for Zinc Nanoparticles (NZnO) Four dose of Nutrients were applied (0.25ppm, 0.5ppm, 1ppm, 1.5ppm, and 2ppm). Along with that two dose of $ZnSO_4$.

Efficacy of Nano ZnO as foliar spray on growth and yield of jasmine Pot Culture (NZnO)

No. of Replication	3
No. of treatments	9
No. of pot	140
Design	Completely Randomised Design
Date	25 June 2022 – May 2023
No. of Treatment	Treatment details
T_1	Control
T_2	Nano ZnO 0.005%
T_3	Nano ZnO 0.01%
T_4	Nano ZnO 0.015%
T_5	Nano ZnO 0.02%
T_6	Nano ZnO 0.03%
T_7	Nano ZnO 0.05%
T_8	Nano ZnO 0.5%
T_9	$ZnSO_4$ 2%

The parameters are recorded in this experiment to analysis the efficiency of Nano Zinc Oxide Viz., Plant height (cm), Stem girth (cm), Internodal length (cm), Plant spread (cm), Leaf area (cm^2), Chlorophyll content (mg g^{-1}), Days to first flower bud appearance, Days to first flowering, Days to fifty per cent flower, Bud length (cm), Number of buds per /plant, Number of buds per / cluster, Flower diameter (cm), and 50 Flower weight (g) and yield per pot.

RESULTS AND DISCUSSION:

Table 1: Effect of Nano Zinc Oxide compared with $ZnSO_4$ on growth and yield parameter of jasmine (*Jasminum Sambac* L.).

Treatment details	No. of leaves	Internodal length (cm)	Plant spread (cm)	Leaf area (cm^2)	Days to first flower bud appearance	Days to first flowering	Bud length (cm)	Flower diameter (cm)	50 flower weight (g)
T_1- Control	145.32	6.72	96.76	10.78	119.66	120.68	3.14	2.15	84.62
T_2 - Nano ZnO 0.005%	154.29	8.33	102.76	12.11	114.87	115.85	4.00	2.82	84.97
T_3 - Nano ZnO 0.01%	155.43	8.39	103.52	12.20	112.48	113.44	4.03	2.88	85.60
T_4 - Nano ZnO 0.015%	161.78	8.73	107.75	12.70	110.52	111.46	4.19	3.62	89.10
T_5 - Nano ZnO 0.02%	165.55	8.93	110.26	13.00	110.29	111.23	4.29	3.89	91.17
T_6 - Nano ZnO 0.03%	171.29	9.24	114.08	13.45	110.09	111.03	4.44	4.16	94.33
T_7 - Nano ZnO 0.05%	179.36	9.68	119.46	14.08	98.26	101.22	4.65	4.56	98.78
T_8 - Nano ZnO 0.5%	161.07	8.69	107.28	12.64	112.00	112.96	4.18	3.55	88.70
T_9 - $ZnSO_4$ 2%	154.21	8.32	102.71	12.11	117.27	118.27	3.98	2.62	84.93
C.D. 5%	3.92	0.29	3.62	0.43	3.75	3.78	0.14	0.12	2.71
SE(m)	1.32	0.09	1.21	0.14	1.26	1.27	0.04	0.04	0.91
SE(d)	1.87	0.14	1.72	0.20	1.79	1.80	0.07	0.06	1.29

The recorded data pertaining to plant height was significantly influenced by different treatments at 45, 90, and 120 DAT. The plant height was significant in T_7 at 45, 90 and 120 DAT (64.25, 80.77, and 92.45) followed by T_6 (61.36, 77.14 and 88.29) and T_5 (59.30, 74.55 and 85.33).No. of Leaf T_7 (178.54), T_6 (170.51) and T_5 (164.79), Internode length, T_7 (9.58), T6 (9.15) and T_5 (8.84), Plant spread T_7 (118.22), T_6 (112.90), and T_5 (109.12), Leaf area (cm^2) T_7 (14.12), T_6 (13.48), T_5 (13.30) Chlorophyll content (mg g-1) T_7 (1.65), T_6 (1.57), T_5 (1.52) Days to first flower bud appearance, Days to first flowering T_7 (99.64) ,T_6 (108.78), and T_5 (108.98) Days to fifty percent flowering T_7 (111.14), T_6 (118.37),and T_5 (118.59) Bud length (cm) T_7 (4.68), T_6 (4.47), and T_5 (4.32) and Yield per pot T_7(3.4),T_6 (3.22), and T_5(2.98). The reason for the enhancement in growth characteristics of Jasmine plants treated with above treatments may be attributed to the physiological role of foliar application of Nano nutrients.

Foliar applications of these nutrients might have augmented rapid and efficient translocation and utilization of nutrients that permits the correction of observed deficiencies in less time than that of the control treatment were only soil application was done. As indicated by Bahmaniar and sooaee Mashaec. (2010) nano nutrients positively affects the plant height. The rise might be due to cell growth under nitrogen. Several studies indicated that foliar application of some nano particles can significantly improve plant growth (Mandeh et al., 2012; Song et al., 2013). Moreover, plant height was more magnified when nano fertilizer was mixed with the conventional ones, even at a lower application rate (Benzon et al., 2015).

The nano nutrients can easily enter through the stomata and other openings and might have assimilated by the plant cells. It could easily be distributed through phloem from source to sink inside the plant. Unutilized nitrogen could be stored in vacuoles and slowly released for further growth and development (Prem Baboo, 2021). Zinc has an effect on synthesizing of natural auxins (IAA) and also can activate many enzymes involved in the biochemical pathways such as carbohydrate metabolism and protein.

The present results are in close agreement with the findings of Khospeyak et al., (2016) who reported significantly higher growth with nano fertilizer treatment over conventional fertilizers. These results agree with those documented by Islam, R., (2020). The application of Nano Zn, enhanced significantly the plant height and the number of secondary branches in safflower (*Carthanthus tinctorius* L.). In addition, the application of nano particles could enhance the morphological traits by increasing the availability of nutrients because of the small size and large surface of nanoparticles (Naderi and Danesh-Shahraki, 2013).

Conclusion:

In conclusion, foliar application of Zinc nano nutrients 0.05% was optimum treatment for growth, yield, nutrient uptake and fertilizer productivity, the results in this study showed that there was generally a positive effect of Zinc nano nutrient spray supply on growth and yield parameters of jasmine in North costal region (Tindivanam) of Tamilnadu conditions compared with conventional fertilizer ZnSO4.

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