Plant Archives Vol. 25, Supplement 1, 2025 pp. 2537-2542 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2025.v25.supplement-1.347

EFFECT OF NANO FERTILIZERS ON GROWTH AND YIELD OF *ASPARAGUS DENSIFLORUS* CV. SPRENGERI

M. Sathya Sri[1*], S. Kumar[2] and K. Sanjeev Kumar[3]
[1]Department of Horticulture, Annamalai University, Chidambaram-608002, Tamil Nadu, India.
[2]Department of Horticulture, Horticultural Research Station, Kodaikanal-623 103, Tamil Nadu, India.
[3]Department of plant pathology, Annamalai University, Chidambaram-608 002, Tamil Nadu, India.
*Corresponding author E-mail: sathyasrim29700@gmail.com
(Date of Receiving : 27-10-2024; Date of Acceptance : 21-12-2024)

ABSTRACT

The experiment was designed to study the effect of nano fertilizers on growth and yield of *Asparagus densiflorus* cv. 'sprengeri'. The experiment comprised of 12 treatments using two nano fertilizers *viz.,* Nano NPK 4:4:4 soil drenches @ 1500 ppm, 3000 ppm, 4500 ppm and nano urea foliar spray @ 0.05 %, 0.1 % along with control (water spray). The experiment was laid out in completely randomized design (CRD) with three replications. The treatment with nano NPK 4:4:4 soil drenches @ 4500 ppm + nano urea foliar spray @ 0.1 % (T_{11}) recorded maximum cladophyll height (57.95 cm), plant spread (East to West and North to South) (74.66 cm and 52.14 cm respectively), number of cladophylls (46.86), number of primary branches (49.92), number of cladodes primary branch^{-1} (39.57), number of cladodes cladophyll^{-1} (1182.06), fresh weight of cladophylls plant^{-1} (156.40 g), dry weight of cladophylls plant^{-1} (18.90 g), number of tubers plant^{1} (69.41), fresh weight of roots and tubers plant^{-1} (270.71 g), dry weight of roots and tubers plant^{-1} (56.10 g) and dry matter production (104.7 g) followed by Nano NPK 4:4:4 soil drenches @ 4500 ppm + nano urea foliar spray @ 0.05 % (T_8).The least values were recorded with control (T_{12}).

Keywords **:** Asparagus, sprengeri fern, nano fertilizer, nano NPK and nano urea.

Introduction

Cut greens also known as ornamental filler crops which occupy an important position in floral industry as cut foliages. These are very popular because of its production throughout the year, low investment and lesser market risk (Patil *et al.,* 2020). They are preferred by the customers for their attractive form, colour, freshness of leaves, and they are not prone to rapid wilting and last long when compared to flowers. The perishable decorative greens, which were used earlier at about five per cent as fillers in bouquet making have increased substantially to 20-25 per cent (Bhattacharjee, 2006). *Asparagus densiflorus* cv. 'Sprengeri' is one of the important ornamental filler plants grown for its attractive foliage throughout the world. Its feathery, emerald-green foliage is also used in preparing bouquets, garlands, swags or wreaths and it also used as cascading filler. In the present scenario of increasing demand for asparagus, growing them in partial greenhouse and shade net house are the best alternative way for utilizing land and other resources more effectively.

Nutrients derived from nano encapsulation might have properties that are effective for crop growth due to release of the nutrients on demand and slow release of chemical fertilizers that regulate plant growth and enhance target activity (De Rosa *et al.,* 2010 and Nair *et al.,* 2010). Nano fertilizers are alternative to conventional fertilizer for its gradual and controlled supply of nutrients in the soil. They could release their active ingredients in response to environmental triggers and biological demands more precisely and play a beneficial role in soil health by building up carbon uptake, improving soil aggregation and water holding capacity (Tarafdar *et al.*, 2012). A very small particle size of nano fertilizer less than the pore size of roots and leaves allows the ease of more nutrient penetration into the plant from the applied surface such as soil or

leaves (Singh, 2017). Therefore, it results in increased nutrients uptake and maximizes the yield of the crop (Meena and Yadav, 2015). With the above facts in mind, the present investigation was carried out to study the effect of application of nano NPK 4:4:4 and nano urea on growth and yield of *Asparagus densiflorus* cv. 'Sprengeri'.

Materials and Methods

The present investigation was carried out in Chidambaram, Cuddalore District, Tamil Nadu, India during 2021-2023. An experiment was laid out in completely randomized block design with three replication and 12 treatments. The treatments were: T_1 - Nano NPK 4:4:4 soil drenches @ 1500 ppm, T_2 - Nano NPK 4:4:4 soil drenches @ 3000 ppm, T_3 - Nano NPK 4:4:4 soil drenches @ 4500 ppm, T_4 - Nano urea foliar spray @ 0.05 %, T_5 - Nano urea foliar spray @ 0.1 %, T_6- Nano NPK 4:4:4 soil drenches @ 1500 ppm + Nano urea foliar spray @ 0.05%, T_7- Nano NPK 4:4:4 soil drenches @ 3000 ppm + Nano urea foliar spray @ 0.05%, T_8- Nano NPK 4:4:4 soil drenches @ 4500 ppm + Nano urea foliar spray @ 0.05%, T_9- Nano NPK 4:4:4 soil drenches @ 1500 ppm + Nano urea foliar spray @ 0.1 %, T_{10}- Nano NPK 4:4:4 soil drenches @ 3000 ppm + Nano urea foliar spray @ 0.1 %, T_{11}- Nano NPK 4:4:4 soil drenches @ 4500 ppm + Nano urea foliar spray @ 0.1 %, T_{12} - Control (water spray).

The potted healthy plants of *Asparagus densiflorus* cv. 'Sprengeri' with same size of 10 cm height and 3-month-old plants were brought and multiplied by division method are allowed to grow for 4 months. In which, the uniformly grown plants are selected and transplanted to prepared growing media in poly bags under shade net condition (50% shade level) for this experiment. The required quantities of nano NPK 4:4:4 was prepared as per the treatment schedule and were given as soil drenching at 1st and 3rd week of every month during experimental period. Likewise, the required quantities of nano urea were prepared as per the treatment schedule and were given as foliar spray at 2nd and 4th week of every month during experimental period by using hand sprayer. Observations were recorded on cladophyll height, plant spread (East to West and North to South), number of cladophylls, number of primary branches, number of cladodes primary branch^{-1}, number of cladodes cladophyll^{-1}, fresh weight of cladophylls plant^{-1}, dry weight of cladophylls plant^{-1}, number of tubers plant^{-1}, fresh weight of roots and tubers plant^{-1}, dry weight of roots and tubers plant^{-1} and dry matter production at 210 DAP of plant growth in each replication of treatments. The recorded data of various growth and yield parameters during the crop period were analyzed by adapting statistical procedures as per the procedure of Panse and Sukhatme (1985). Whenever the results were found to be significant, the critical difference was arrived at five percent level to draw statistical conclusion. The statistical analysis of data was performed through WASP software.

Results and Discussion

Growth and yield parameters

The data indicated that there was a significant difference on growth and yield of asparagus due to different treatments. Among the growth attributes**,** gradual increase in cladophyll height was observed in all the treatment at all the stages of plant growth. Maximum cladophyll height of 57.95 cm were recorded in the treatment with nano NPK 4:4:4 soil drenches @ 4500 ppm + nano urea foliar spray @ 0.1% (T_{11}), followed by T_8 (Nano NPK 4:4:4 soil drenches @ 4500 ppm + nano urea foliar spray @ 0.05 %) with the values of 55.39 cm. while the lowest cladophyll height (32.72 cm) was recorded in control (Fig. 1). This favorable effect has occurred due to the main effect of nano-fertilizers in modification of plant gene expression and associated biological pathways which ultimately affect plant height. Further, foliar spray of nano urea increased the cladophyll height due to greater uptake of nitrogen through application of nano urea which was finally involved in the cell division, cell elongation as well as protein synthesis which ultimately enhanced the stem length and vegetative growth (Ghormade *et al.*, 2011 and Sathyan, 2022). The results are in agreement with the findings of Elsadek *et al.* (2020) in *Codiaeum variegatum*.

With regard to plant spread, the maximum plant spread on both the direction with the values of 52.14 cm (North-South) and 74.66 cm (East-West), were registered with application of nano NPK 4:4:4 soil drenches @ 4500 ppm + nano urea foliar spray @ 0.1 % (T_{11}), followed by T_8 (49.98 cm and 71.71 cm). The minimum plant spread on both directions were noticed in T_{12} control (Table 1). The plants irrespective of their treatments had more spread on East- West direction than the North-South direction which may be due to sunlight availability and solar movement in the tropics especially in the coastal ecosystem (Sowmiya and Karuppaiah, 2021). The better establishment of plant spread might be due to nano fertilizers that increase the meristimatic activity and stimulation of cell elongation in plants (Mahil and Kumar, 2019). These results are in conformity with the results of Merghany *et al.* (2019) in cucumber, Abdel-Aziz *et al.* (2021) in *Capsicum annuum.* Also, the effect of nano urea on increasing the

plant spread may be due to stimulating effect of nitrogen on auxin production encourages cell division and elongation in the vegetative growth of the plant (El-Shawa *et al.,* 2022). Similar observation was also made earlier by Vinayaka (2022) in jamun, Rathod *et al.* (2022) in French basil.

Among the various treatments, the maximum number of cladophyll plant^{-1} (46.86) and number of primary branches cladophyll^{-1} (49.92) were found to be higher in the application of nano NPK 4:4:4 soil drenches @ 4500 ppm + nano urea foliar spray @ 0.1 % (T_{11}) when compare to other treatments (Table 1). This was followed by T_8 (Nano NPK 4:4:4 soil drenches @ 4500 ppm + nano urea foliar spray @ 0.05 %) with the values of 44.89 and 47.91 respectively. The least number of cladophyll plant^{-1} and number of primary branches cladophyll^{-1} were recorded in control (T_{12}). Similar opinions were earlier made by Mahewish *et al.* (2021) in rosemary, Sarhan *et al.* (2022) in gladiolus, Kazem *et al.* (2021) in eggplant. The increase in the number of branches is almost related to the physiological role of the macronutrient NPK which is responsible for improving the shoot growth and probably the accumulation of the carbohydrate substances in the seedlings stimulate the growth of the lateral branches (De Bang, 2021). Further, Subramani *et al.* (2023) in okra, Chauhan and Hu (2023) in chilli found that nano urea increases in number of branches in plant may due to the significant quality of nitrogen supplied which have resulted in stimulation of the production and export of cytokinin to the shoots (Venkatesh *et al*., 2022).

The values of the number of cladodes primary branch^{-1} and number of cladodes cladophyll^{-1} (Table 2) differed significantly in all the treatments. Among the treatments, T_{11} (Nano NPK 4:4:4 soil drenches @ 4500 ppm + nano urea foliar spray @ 0.1 %) recorded the maximum number of cladodes primary branch^{-1} and number of cladodes cladophyll^{-1} with the values of 39.57 and 1182.06. This was followed by T_8 with the values of 37.80 and 1133.41 respectively. The minimum value for cladode primary branch^{-1} (23.26) and number of cladodes cladophyll^{-1} (695.10) were registered with control (T_{12}). Such increase may be due to the fact that nano-fertilizers have large surface area with particle size less than the pore size of leaves thereby increases penetration into the plant and improves uptake and nutrient use efficiency (Sharma *et al.,* 2022). Similar results were obtained by Vidyasree *et al.* (2022) in *Philodendron scandens*, Saikia and Gogoi (2023) in tea, Kamaluddin *et al.* (2022) in *Kalanchoe blossfeldiana*.

The increment of fresh weight of cladophyll plant^{-1}, dry weight of cladophyll plant^{-1} (Table 2) and dry matter production plant^{-1} (Fig. 2) is directly related to the vegetative growth and has been found to significantly increase with the application of nano fertilizers. Maximum fresh weight of cladophyll plant^{-1}(156.40 g), dry weight of cladophyll plant^{-1} (18.90 g) and dry matter production plant^{-1} (104.7 g) were noticed with nano NPK 4:4:4 soil drenches @ 4500 ppm + nano urea foliar spray @ 0.1 % (T_{11}), followed by T_8-Nano NPK 4:4:4 soil drenches @ 4500 ppm + nano urea foliar spray @ 0.05 % (150.88 g, 17.85 g and 103.12 g). The least values were recorded in control (T_{12}). Similar findings were also reported by Abdel-Salam (2018) in lettuce, Hegab *et al.* (2018) in *Salvia officinalis*, Sayah and Jameel (2020) in *Cucurbita pepo.* The Maximum fresh weight of cladophyll, dry weight of cladophyll and dry matter production are mainly due to nano fertilizers increase availability of nutrients to the growing plant which increase the chlorophyll formation, photosynthesis rate, dry matter production and result improve overall growth of the plant (Mahmoodi *et al.,* 2018).

The treatment T_{11} (Nano NPK 4:4:4 soil drenches @ 4500 ppm + nano urea foliar spray @ 0.1 %) was found superior in producing maximum number of tubers (69.41), root fresh weight and root dry weight plant^{-1} (270.71 g and 56.10 g), followed by T_8 (65.59 tubers, 259.70 g and 53.23 g). While minimum value was recorded in control (Table 2). The results obtained are in line with the findings of Hussein *et al*. (2016) in marigold, Alhasan *et al.* (2021) in sweet basil, Chauhan (2023) in potato. The increase in number of tubers, root fresh weight and root dry weight plant^{-1} owes to more activity of roots for nutrient uptake from medium which is drenched with nano fertilizers (Mohamadipoor *et al.,* 2013).

Summary

The application of nano fertilizer has shown significant ameliorative effects on growth and yield of *Asparagus densiflorus* cv. 'Sprengeri'.It may be concluded from the results that, the nano NPK 4:4:4 soil drenches @ 4500 ppm + nano urea foliar spray @ 0.1 % (T_{11}) recorded maximum cladophyll height, plant spread (East to West and North to South), number of cladophylls, number of primary branches, number of cladodes primary branch^{-1}, number of cladodes cladophyll^{-1}, fresh weight of cladophylls plant^{-1}, dry weight of cladophylls plant^{-1}, number of tubers plant^{-1}, fresh weight of roots and tubers plants^{-1}, dry weight of roots and tubers plant^{-1} and dry matter production of *Asparagus densiflorus* cv. 'Sprengeri'.

Table 1: Effect of nano fertilizers on growth and yield of *Asparagus densiflorus* cv. 'Sprengeri' at 210 days after planting

Treatments	Plant spread N-S (cm)	Plant spread E-W (cm)	No. of cladophylls plant^{-1}	No. of primary branches cladophylls^{-1}	No. of cladodes cladophyll^{-1}
T_1	36.08	48.98	29.97	32.27	785.35
T_2	39.94	54.88	33.79	36.29	874.48
T_3	41.33	57.51	35.51	38.32	917.36
T_4	34.69	46.25	28.24	30.45	743.75
T_5	38.10	51.78	31.84	34.32	827.71
T_6	43.32	60.33	37.54	40.29	957.35
T_7	46.24	66.05	41.27	44.12	1046.41
T_8	49.98	71.71	44.89	47.91	1133.41
T_9	44.71	63.26	39.51	42.11	999.43
T_{10}	48.14	68.94	43.04	45.94	1086.64
T_{11}	52.14	74.66	46.86	49.92	1182.06
T_{12}	32.53	43.24	26.25	28.44	695.10
SED	0.48	1.18	0.71	0.62	17.77
CD (p=0.05)	1.02	2.51	1.51	1.26	37.69

Table 2: Effect of nano fertilizers on growth and yield of *Asparagus densiflorus* cv. 'Sprengeri' at 210 days after planting

Treatments	No. of cladodes primary branch^{-1}	Fresh wt. of cladophylls plant^{-1}(g)	Dry wt. of cladophylls plant^{-1}(g)	No. of tubers plant^{-1}	Fresh wt. of roots and tubers plant^{-1}(g)	Dry wt. of roots and tubers plant^{-1} (g)
T_1	26.39	110.37	10.48	37.95	174.89	32.93
T_2	29.36	120.95	12.12	44.85	196.15	38.13
T_3	30.67	126.09	13.09	48.29	206.92	40.67
T_4	24.96	105.64	9.42	34.39	164.07	30.29
T_5	27.89	115.74	11.26	41.24	185.21	35.44
T_6	32.26	131.16	14.22	51.85	217.58	43.46
T_7	34.84	141.03	16.02	58.75	238.30	48.24
T_8	37.80	150.88	17.85	65.59	259.70	53.23
T_9	33.47	135.96	15.11	55.08	227.98	45.79
T_{10}	36.35	146.02	16.99	62.10	249.24	50.92
T_{11}	39.57	156.40	18.90	69.41	270.71	56.10
T_{12}	23.26	100.22	8.29	30.60	153.06	27.46
SED	0.41	1.48	0.17	1.32	3.72	0.83
CD (p=0.05)	0.89	3.05	0.38	2.81	7.89	1.77

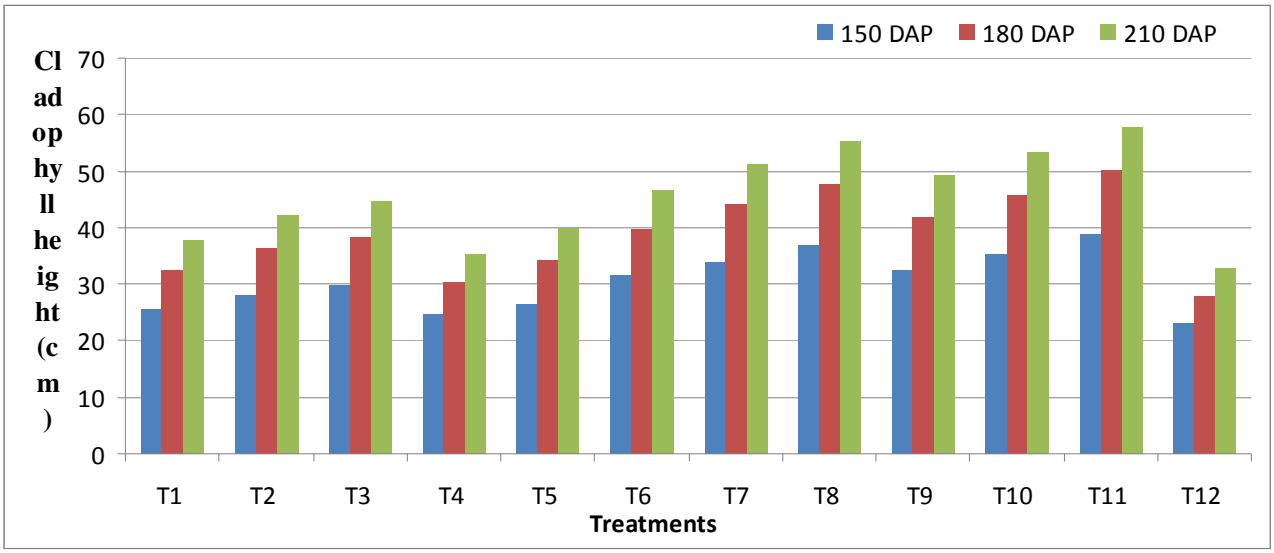

Fig. 1 : Effect of nano fertilizers on cladophyll height (cm) in *Asparagus densiflorus* cv. 'Sprengeri'

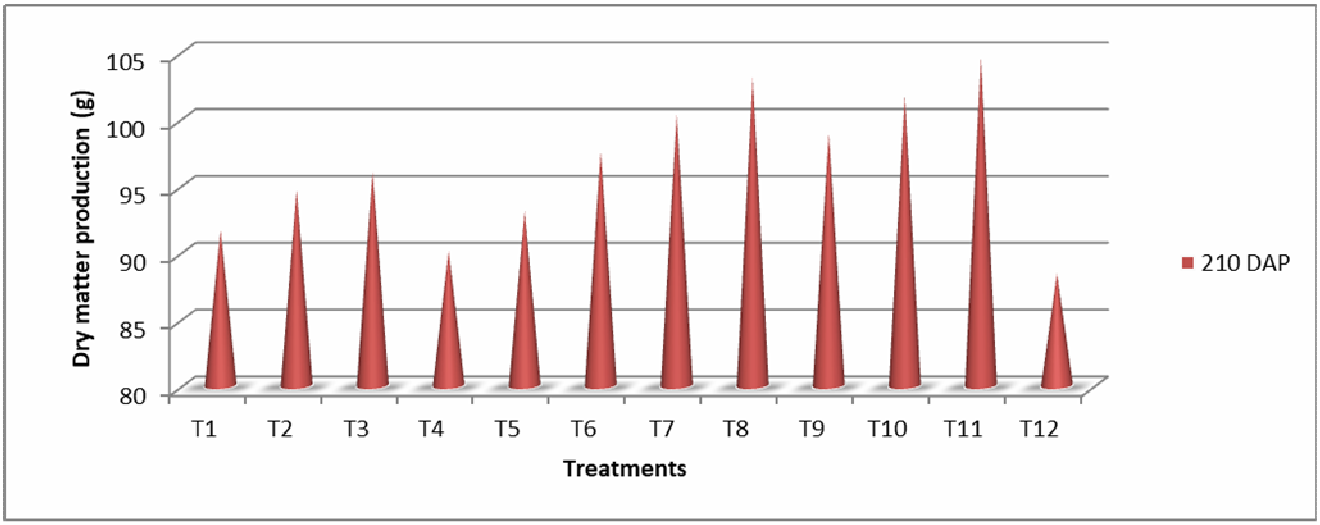

Fig. 2 : Effect of nano fertilizers on dry matter production (g) in *Asparagus densiflorus* cv. 'Sprengeri'

References

Abdel-Aziz, H.M., Soliman, M.I., Abo Al-Saoud, A.M. and El-Sherbeny, G.A. (2021). Waste-Derived NPK Nano fertilizer enhances growth and productivity of *Capsicum annuum* L. *Plants,* **10(6),** 1144.

Abdel-Salam, M. (2018). Response of lettuce (*Lactuca sativa* L.) to foliar spray using nano urea combines with mycorrhiza. *J. Soil Sci. Agric. Eng.,* **9(10),** 467-472.

Alhasan, A.S., Al-Ameri, D.T., Jawad, A.H. and Talib, Q.J. (2021). Effect of foliar application of NPK nano-fertilizer on some agronomic traits and essential oil of sweet basil (*Ocimum basilicum* L.) grown under the shade-net house conditions. *Nat. Vol. Essent. Oils,* **8(6),** 2018-2024.

Bhattacharjee, S.K. (2006). Domestic trade in flowers and potted plants. Vistas in Floriculture, pp.65.

Chauhan, A. (2023). Effect of pre-soaking of potato (*Solanum tuberosum* L.) tubers in nano-urea and nano-zinc on its growth, quality and yield. *Pharma Innovation J.,* **12(7),** 980-995.

Chauhan, R. and Hu, D. (2023). Effect of traditional fertilizer, nano fertilizer and micronutrient on growth, yield and quality of Chilli (*Capsicum annum* L.). *Int. J. Environ. Clim. Change,* **13(9),** 2740-2746.

De Bang, T.C., Husted, S., Laursen, K.H., Persson, D.P. and Schjoerring, J.K. (2021). The molecular-physiological functions of mineral macronutrients and their consequences for deficiency symptoms in plants. *New Phytol.,* **229(5),** 2446-2469.

De Rosa, M.C., Monreal, C., Schnitzer, M., Walsh, R. and Sultan, Y. (2010). Nanotechnology in fertilizers. *Nat. Nanotechnol.,* **5(2),** 91-91.

Elsadek, M.A., Abd El, M.Z.Y.M. and Fattah, M.M.K. (2020). Effect of different ratios nano fertilizer and gibberellic acid on the vegetative growth and chemical compositions of *Codiaeum variegatum* (L.) cv. Gold Dust. *Hortscience J. Suez Canal Univ.,* **9(1),** 31-44.

El-Shawa, G.M., Alharbi, K., AlKahtani, M., AlHusnain, L., Attia, K.A. and Abdelaal, K. (2022). Improving the quality and production of philodendron plants using nanoparticles and humic acid. *Horticulturae,* **8(8),** 678.

Ghormade, V., Deshpande, M.V. and Paknikar, K.M. (2011). Perspectives for nano biotechnology enabled protection and nutrition of plants. *Biotechnol. Adv.,* **29(6),** 792-803.

Hegab, R., Abou Batta, W. and El-Shazly, M. (2018). Effect of mineral, nano and bio nitrogen fertilization on nitrogen content and productivity of *Salvia officinalis* L. plant. *J. Soil Sci. Agric. Eng.,* **9(9),** 393-401.

Hussein, S., Abido, A.I., Weheda, B. and Gaber, M.K. (2016). Effect of organic and nano fertilization as substitutes of mineral fertilization on the growth and chemical composition of marigold (*Tagetes erecta* L.) plants. *J. Adv. Agric. Res.,* **22(1),** 122-135.

Kamaluddin, A.A., Mohsin, R.M. and Kamil, A.N. (2022). Effect of NPK nano fertilizer on vegetative, flowering, and content traits of *Kalanchoe blossfeldiana. Tikrit J. Agric. Sci.,* **22(3),** 113-119.

Kazem, A.T., Issa, F.H. and Abdulla, A.A. (2021). Effect of nano NPK fertilizer on growth and early yield of eggplant. In. *IOP Conference Series, Earth and Environmental Science*, 923(1), pp. 012013.

Mahewish, H.H., Radi, F.H. and Radhi, M.N. (2021). Response of rosemary plant to the effect of Nano-NPK fertilizer and biological factors and their effect on the active substances. *Univ. Thi-Qar J. Agric. Res.,* **10(1),** 39-48.

Mahil, E.I.T. and Kumar, B.A. (2019). Foliar application of nanofertilizers in agricultural crops-A review. *J. Farm Sci.,* **32(3),** 239-249.

Mahmoodi, P., Yarnia, M., Rashidi, V., Amirnia, R. and Tarinejhad, A. (2018). Effects of nano and chemical fertilizers on physiological efficiency and essential oil yield of *Borago officinalis* L. *Appl. Ecol. Environ. Res.,* **16(4),** 4773-4788.

Meena, R.S. and Yadav, R.S. (2015). Yield and profitability of groundnut (*Arachis hypogoea* L.) as influenced by sowing dates and nutrients levels with different varieties. *Legume Res.,* **38(6),** 791-797.

Merghany, M.M., Shahein, M.M., Sliem, M.A., Abdelgawad, K.F. and Radwan, A.F. (2019). Effect of nano-fertilizers on cucumber plant growth, fruit yield and its quality. *Plant Arch.,* **19(2),** 165-172.

Mohamadipoor, R., Sedaghathoor, S. and Mahboub Khomami, A. (2013). Effect of application of iron fertilizers in two methods 'foliar and soil application' on growth characteristics of *Spathiphyllum* illusion. *Eur. J. Exp. Biol.,* **3(1),** 232-240.

Nair, R., Varghese, S.H., Nair, B.G., Maekawa, T., Yoshida, Y. and Kumar, D.S. (2010). Nano particulate material delivery to plants. *Plant sci.,* **179(3),** 154-163.

Panse, V.G. and P.V. Sukhatme. (1985). Statistical methods for agricultural workers II. Edn., ICAR, New Delhi, India.

Patil, R.T., Patil, B.C., Seetharamu, G.K., Mukund Shiragur, S., Nishani, R.S. and Mahantesha, N.B.N. (2020). Influence of photoselective shade nets on growth and yield of Asparagus. *Int. J. Chem. Stud.,* **8(6),** 2525-2528.

Rathod, B.S., Laxmi, K.V., Cheena, J., Krishnaveni, V. and Kumar, B.N. (2022). Studies on effect of nano urea on growth of French basil (*Ocimum basilicum* L.) cultivars under Southern Telangana conditions. *Pharma Innovation J.,* **11(12),** 4160-4164.

Saikia, P. and Gogoi, A.S. (2023). Growth and yield of Tea (*Camellia sinensis*) as influenced by Nano urea during pre and post pruning operation. *Int. J. Plant Soil Sci.,* **35(20),** 1177-1185.

Sarhan, A.M., Habib, A.M., Fahmy, A., Noor El-Deen, T.M. and Selim, A. (2022). Effect of nano, bio, chemical fertilization and leaves extract of moringa plant on flowering and chemical constituents of gladiolus plant. *Egypt. J. Chem.,* **65(7),** 221-230.

Sathyan, D. (2022). Effect of nano nutrients on pea growth and yield (*Pisum sativum* L.). *Pharma Innovation J.,* **11(9),** 1895-1898.

Sayah, Z.N. and Jameel, D.A. (2020). Effect of nano NPK balanced fertilizer (20-20-20) on some vegetative and fruiting growth of *Cucurbita pepo* L. *EurAsia. J. BioSci.,* **14(2),** 6627-6633.

Sharma, S.K., Sharma, P.K., Mandeewal, R. L., Sharma, V., Chaudhary, R., Pandey, R. and Gupta, S. (2022). Effect of foliar application of nano-urea under different nitrogen levels on growth and nutrient content of pearl millet (*Pennisetum glaucum* L.). *Int. J. Plant Soil Sci.,* **34(20),** 149-155.

Singh, M.D. (2017). Nano-fertilizers is a new way to increase nutrients use efficiency in crop production. *Int. J. Agric. Sci.,* **9(7),** 0975-3710.

Sowmiya, P. and Karuppaiah, P. (2021). Effect of media and nutrition on growth, yield and quality of *Asparagus densiflorus* cv. 'Sprengeri' L. *Ann. Plant Soil Res.,* **23(4),** 419-423.

Subramani, T., Velmurugan, A., Bommayasamy, N., Swarnam, T. P., Ramakrishna, Y., Jaisankar, I. and Singh, L. (2023). Effect of nano urea on growth, yield and nutrient use efficiency of okra under tropical island ecosystem. *Int. J. Agric. Sci.,* **19,** 134-139**.**

Tarafdar, J.C., Xiong, Y., Wang, W.N., Quinl, D. and Biswas, P. (2012). Standardization of size, shape and concentration of nanoparticle for plant application. *Appl. Biol. Res.,* **14(2),** 138-144.

Venkatesh, M., Babu, K.K., Prasanth, P., Lakshminarayana D. and Kumar, S.P. (2022). Study on effect of different levels of nitrogen in combination with nano urea on growth and yield of marigold (*Tagetes erecta* L.) cv. Pusa Narangi Gainda. *Pharma Innovation J.,* **11(11),** 1313-1317.

Vidyasree, P., Veenajoshi, D.N.S., Gouthami, P. and Sathish, G. (2022). Standardization of nano urea and composition of potting media on growth and quality of *Philodendron scandens. Pharma Innovation J.,* **11(12),** 4802-4812.

Vinayaka, S. (2022). Influence of nano urea on growth and yield of Jamun cv. AJG-85 under HDP system. *Pharma Innovation J.,* **11(12),** 354-356.