Plant Archives Vol. 25, Supplement 1, 2025 pp.2934-2942 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-1.405

EFFECT OF SPACING AND FERTILIZER LEVELS ON YIELD, COST ECONOMIC RETURNS, LEAF NUTRIENT COMPOSITION AND SOIL NUTRIENT STATUS IN CRAPE JASMINE (*TABERNAEMONTANA DIVARICATA* L. R. BR. EX ROEM. & SCHULT.)

Gowtham K. M.[1*], Basavarajappa H. R.[2], Sanjeevraddi G. Reddi[2], Anasubai S. Hosagoudar[3] and Ramanagouda Hadlageri[4]

[1]Department of Floriculture and landscaping, College of Horticulture, University of horticultural sciences, Bagalkot, Karnataka, India
[2]Department of Natural Resource Managment, College of Horticulture, University of horticultural sciences, Bagalkot, Karnataka, India.
[3]Department of Floriculture and landscaping, Horticulture research and extension centre (HREC), Kanabaragi, University of horticultural sciences, Bagalkot, Karnataka, India
[4]Department of Entomology, College of Horticulture, University of horticultural sciences, Bagalkot, Karnataka, India
*Corresponding author E-mail: gowthampandigowtham@gmail.com
(Date of Receiving : 14-10-2024; Date of Acceptance : 31-12-2024)

ABSTRACT

Investigations were carried out to study the "Effect of spacing and fertilizer levels on yield, cost economic returns, leaf nutrient composition and soil nutrient status in Crape Jasmine (*Tabernaemontana divaricata* (L.) R. Br. ex Roem. & Schult.)" at the Floriculture Block, MHREC (Main Horticultural Research and Extension Centre), College of Horticulture, University of Horticultural Sciences, Bagalkot, during the year 2023-24. The experiment was laid out in a factorial RCBD with three replications, comprising three levels of fertilizer and three different spacings, resulting in nine treatment combinations. The highest fertilizer level (F_3) recorded the maximum values for yield parameters, available soil nutrients and leaf nutrient status (N, P_2O_5 and K_2O). Among various spacing levels, the maximum hundred-flower-bud weight and flower bud yield per plant, along with higher available soil and leaf nutrient status (N, P_2O_5, and K_2O), were observed at the optimum spacing (S_2), except for yield per plot and per hectare, which were reported at the closer spacing (S_1). In terms of different treatment combinations, the maximum hundred-flower-bud weight, flower bud yield per plant and higher available soil and leaf nutrient status (N, P_2O_5 and K_2O) were recorded in the S_2F_3 treatment combination, except for yield per plot and per hectare, which were recorded in the S_1F_3 treatment combination. The highest gross returns and net returns, with a benefit-cost ratio of 1.95, were observed in the S_1F_3 (1.5 x 1.2 m, 40:80:80 g NPK/plant/year) treatment combination, followed by the S_2F_3 (2.0 x 1.5 m, 40:80:80 g NPK/plant/year) treatment combination, with a benefit-cost ratio of 1.94.

Keywords: Crape Jasmine, *Tabernaemontana divaricata* (L.) R. Br. ex Roem. & Schult., fertilizer, spacing, available soil and plant nutrient status (N, P_2O_5 and K_2O) and benefit cost ratio.

Introduction

Tabernaemontana divaricata (L.) R. Br. ex Roem. & Schult., commonly known as crape jasmine, is a tropical perennial shrub native to India and widely cultivated across Southeast Asia. It belongs to the Apocynaceae family and is highly valued for its ornamental beauty and medicinal properties. The plant grows up to 5–6 feet tall, with glossy green leaves and white, pinwheel-shaped flowers that bloom year-round, making it a popular choice for landscaping. Known by various names across India, such as Nandibatallu (Kannada), Chandini (Hindi) and Nandivriksha (Sanskrit), it produces buds resembling jasmine, ideal for garlands and religious ceremonies due to their good shelf life. The plant's milky latex has earned it the nickname "milk flower" (Samantha *et al.*, 2015). Medicinally, *T. divaricata* flowers contain alkaloids like coronaridine, which are used in traditional treatments for eye injuries, skin diseases and inflammation. It thrives in sunny, well-drained soils and is easily propagated through stem cuttings. Additionally, its longer shelf life and year-round flowering habit make it a valuable substitute for *Jasminum sambac*, especially during the winter months when *J. sambac* is in low supply due to religious festivals. Its low maintenance, requiring moderate watering and occasional pruning, further adds to its popularity in gardens and public spaces.

Successful production of any crop depends on many factors such as soil fertility, irrigation, plant density and plant protection measures. However, the manurial schedule and spacing play a major role in crop production and productivity. Proper spacing helps ensure the availability of nutrients, aeration and light intensity, which allows the crop to express itself properly in terms of quantity and enhanced quality. Among essential nutrients, nitrogen, phosphorus and potassium are the most important and are required in sufficient quantities to attain better plant growth and flowering. Cost and returns analysis for various crops is helpful in identifying suitable regions for commercial production to ensure a year-round supply of flowers through extensive cultivation. Crop requirements, nutrient absorption patterns and post-harvest soil and plant nutrient status are quite important for fertilizer recommendations for a crop in a given agroclimatic situation. Keeping all these points in view, the present investigation on the "Effect of spacing and fertilizer levels on yield, cost economic returns, leaf nutrient composition and soil nutrient status in Crape Jasmine (*Tabernaemontana divaricata* (L.) R. Br. ex Roem. & Schult.)" was carried out.

Materials and Methods

A field experiment was conducted during year of 2023-24 at Floriculture block, MHREC (Main Horticultural research and extension centre), College of Horticulture, University of Horticultural Sciences, Bagalkot-587104, Karnataka, India. For this experiment 5-month-old *T. divaricata* plot was selected. The treatment comprises 3 levels of fertilizer (F1: 20:40:40, F2: 30:60:60 and F3: 40:80:80 g of NPK/plant/year) and 3 different spacings (S1: 1.5 x 1.2 m, S2: 2.0 x 1.5 m and S3: 2.5 X 1.8 m) in 09 treatment combinations. These treatment combinations were replicated thrice and laid out in a Factorial RCBD design. Nitrogen, phosphorus and potash were applied in the form of urea, di ammonium phosphate and muriate of potash, respectively. Fertilizer distribution occurred in four stages at two-month intervals (during month of May, July, September and November). Other cultural operations were carried out as per recommendations.

From each treatment, five plants were randomly selected for recording growth and yield parameters, including flower yield per plant, per plot and per hectare, as well as the weight of 100 flower buds. Flower buds were harvested on alternate days throughout the research period, and the cumulative yield was calculated. The initial and final soil nutrient status (N, P_2O_5 and K_2O) was analyzed before and after the implementation of all treatments by collecting soil samples from a depth of 15-30 cm in a zigzag pattern across the entire field initially. Final soil samples were collected individually from all treatments. The 3rd and 4th leaves from the apex were collected from each treatment to estimate leaf nutrient status (N, P_2O_5 and K_2O). The benefit-cost ratio was calculated using standard methods: the Micro-Kjeldahl method for nitrogen, the Vanadomolybdate method for phosphorus, and the flame photometer method for potassium estimation.

Table 1: Initial available nutrient status of soil (before treatment imposition)

Sl. No.	Properties	Values
1.	Available nitrogen (N)	203.49 kg / ha
2.	Available phosphorus (P_2O_5)	23.90 kg / ha
3.	Available potassium (K_2O)	279.30 kg / ha

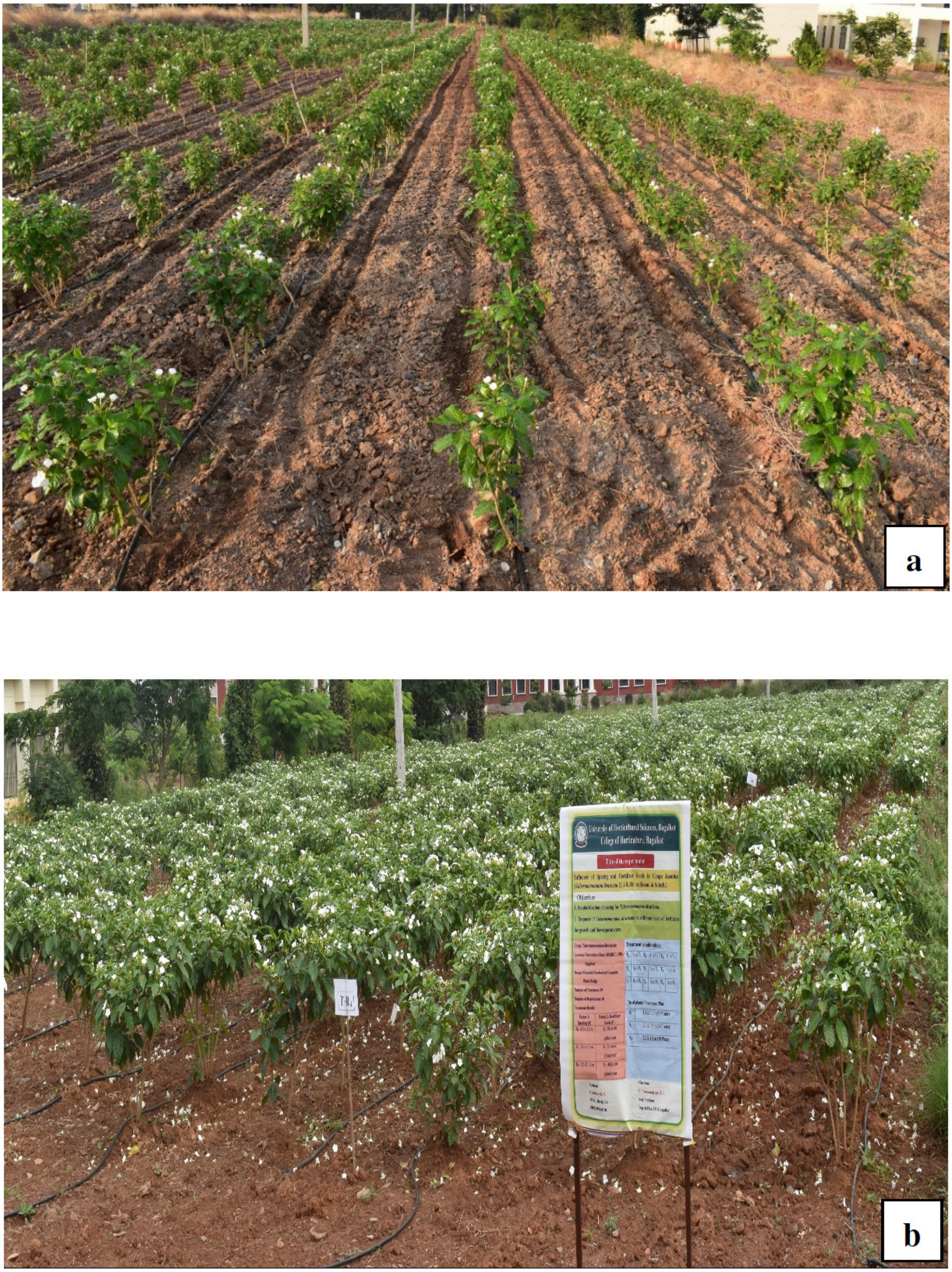


Plate 1 : General view of the Experimental site at initial (a) and flowering stage (a)

a) Plant **b) Inflorescence**

c) Leaf **d) Flower bud** **e) Flower**

Plate 2 : Morphology of Crape Jasmine (*Tabernaemontana divaricata* (L.) R. Br. ex Roem. & Schult.)

Results and Discussion

Effect of different spacings and fertilizer levels on yield parameters of Tabernaemontana divaricata

Hundred flower bud weight (g), Flower bud yield per plant (kg), per plot (kg) and per ha (t).

The different plant spacing showed significant effect on yield parameters (Table 2). The maximum hundred flower bud weight (95.66 g) and flower bud yield per plant (1.27 kg) was recorded at spacing of S2 (2.0 × 1.5 m), which was on par (93.91 g) with S3 (2.5 × 1.8 m) and minimum (92.02 g and 1.00 kg) in S1 (1.5 × 1.2 m). The optimum spacing received adequate plant nutrients, no inter competition among plants, favorable growing atmosphere which contributed maximum number of inflorescence and flowers per plant, increase in hundred flower bud weight and flower bud yield per plant (kg). The result achieved from the present study was in conformity with the findings of Sumangala *et al.* (2013) in Jasmine and Ansar *et al.* (2014) in rose. The highest flower yield per plot and per hectare (30.03 kg and 5.57 tonnes, respectively) were observed at spacing of S1 (1.5 X 1.2 m) and minimum (14.40 kg and 2.67 tonnes, respectively) was in S3 (2.5 X 1.8 m). This might be due to higher plant population at closer spacing. The results obtained from the present study was similar with the findings of Subiya *et al.* (2017) in rose, Manimaran and Ganga (2022) in Jasmine.

Table 2: Effect of various spacings on yield parameters of *Tabernaemontana divaricata.*

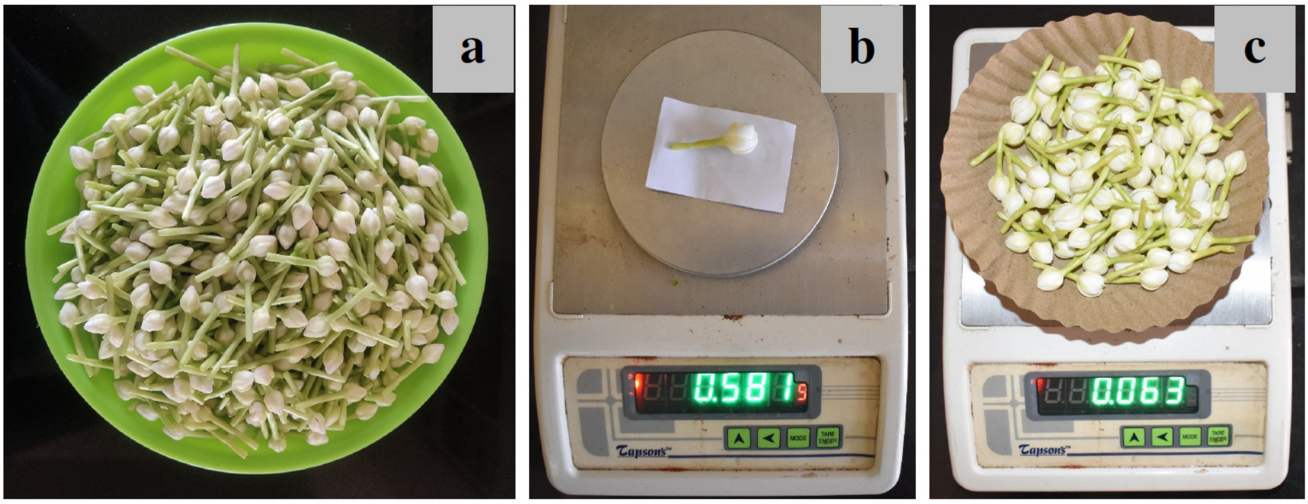
Treatments	Hundred flowerbud weight (g)	Flower bud yieldper plant (kg)	Flower bud yieldper plot (kg)	Flower bud yield per ha (t)
S1	92.02	1.00	30.03	5.57
S2	95.66	1.27	22.80	4.23
S3	93.91	1.20	14.40	2.67
S.Em. ±	**0.65**	**0.01**	**0.19**	**0.04**
C.D. at 5%	**1.96**	**0.03**	**0.58**	**0.11**

The different levels of fertilizers (N, P_2O_5 and K_2O) had significant influence on flower bud yield parameters. The maximum hundred flower bud weight (95.84 g), flower yield per plant (1.27 kg), per plot (24.63 kg) and per hectare (4.57 tonnes) were recorded at higher fertilizer level F3 (40:80:80 g of NPK/plant/year) and minimum (92.55 g, 1.03 kg, 20.03 kg and 3.72 t, respectively) was in F1 (20:40:40 g of NPK/plant/year) (Table 3). NPK is an essential nutrients for plants, which enhances flowering capacity. Available phosphorous in the soil for plants could result in higher number of inflorescences, flowers, flower yield per plant, per plot and per hectare. The results were similar with the findings of Shoram *et al.* (2012) and Mangroliya *et al.* (2021) in Jasmine.

Table 3: Effect of different fertilizer levels on yield parameters of *Tabernaemontana divaricata*

Treatments	Hundred flowerbud weight (g)	Flower bud yieldper plant (kg)	Flower bud yieldper plot (kg)	Flower bud yield per ha (t)
F1	92.55	1.03	20.03	3.72
F2	93.19	1.17	22.57	4.18
F3	95.84	1.27	24.63	4.57
S.Em. ±	**0.65**	**0.01**	**0.19**	**0.04**
C.D. at 5%	**1.96**	**0.03**	**0.58**	**0.11**

Among combination of spacing and fertilizers (Table 4). The maximum hundred flower bud weight (100.01 g) and flower bud yield per plant (1.40 kg) were significantly maximum in treatment combination of S2F3 and minimum (92.11 g and 0.90 kg, respectively) was in S1F1. In optimum spacing no inter competition among plants, which contributed maximum inflorescence and flowers leads to increase in weight and yield of flower buds per plant (kg). The maximum flower yield per plot (33.10 kg) and per hectare (6.13 tonnes) was recorded in treatment combination S1F3 and minimum (13.20 kg and 2.45 t, respectively) was in S3F1. Closer spacing with higher fertilizer doses gave the higher flower yield per plot and per hectare. This type of achievement might be due to higher plant population. The trend is same as that of Manjula *et al.* (2023) in nerium and Kurabet (2015) in crossandra.



T_6 (S_2F_3): S_2 (2.0 x 1.5 m) + F_3 (40:80:80 g NPK/plant/year)

Plate 3 : Effect of spacing and fertilizer levels on Harvesting stage (a), Induvisual (g) (b) and Hundred flower bud weight (g) of *Tabernaemontana divaricata.*

Table 4: Effect of various spacings and fertilizer levels on yield parameters of *Tabernaemontanadivaricata*

Treatments	Hundred flower bud weight (g)	Flower bud yield per plant(kg)	Flower bud yield per plot (kg)	Flower bud yieldper ha (t)
S1F1	92.11	0.90	27.10	5.02
S1F2	92.17	1.00	29.90	5.54
S1F3	91.79	1.10	33.10	6.13
S2F1	93.01	1.10	19.80	3.67
S2F2	93.95	1.30	23.40	4.34
S2F3	100.01	1.40	25.20	4.67
S3F1	92.53	1.10	13.20	2.45
S3F2	93.47	1.20	14.40	2.67
S3F3	95.73	1.30	15.60	2.89
S.Em. ±	**1.13**	**0.02**	**0.33**	**0.06**
C.D. at 5%	**3.39**	**0.05**	**1.00**	**0.19**

Effect of different spacings and fertilizer levels on available soil nutrient status (N, P_2O_5 and K_2O) of Tabernaemontana divaricata.

Available soil nitrogen (N) (kg/ha), phosphorus (P_2O_5) (kg/ha) and potassium (K_2O) (kg/ha)

The available soil nutrient status (N, P_2O_5 and K_2O) was significantly influenced by spacing (Table 5). The maximum available soil N, P_2O_5 and K_2O (184.21, 23.77 and 270.97 kg/ha, respectively) was recorded at a spacing of 2.0 x 1.5 m (S2), which was comparable to the 2.5 x 1.8 m spacing (S3) for N and P_2O_5, with values of 182.42 and 23.42 kg/ha, respectively. The minimum values were recorded at 1.5 x 1.2 m spacing (S1), with 175.26, 21.48 and 258.33 kg/ha, respectively. This variation may be due to the accumulation of more nutrients in wider spacings compared to closer spacings, where there is increased competition among plants for nutrients due to higher plant density. Similar findings were observed by Nagaraja (2013) in chrysanthemum and Paramagoudar (2015) in spider lilly.

Table 5: Effect of various spacings on soil nutrient status (N, P_2O_5 and K_2O) of *Tabernaemontana divaricata*

Treatments	N (kg/ha)	P_2O_5 (kg/ha)	K_2O (kg/ha)
S1	175.26	21.48	258.33
S2	184.21	23.77	270.97
S3	182.42	23.42	265.48
S.Em. ±	**0.95**	**0.13**	**0.43**
C.D. at 5%	**2.84**	**0.39**	**1.30**

The fertilizer application of 40:80:80 g NPK per plant per year (F3) resulted in higher available soil N, P_2O_5 and K_2O (199.89, 27.46 and 293.78 kg/ha, respectively), while the minimum values (159.16, 18.47 and 243.97 kg/ha, respectively) were observed in F1 (40:80:80 g NPK per plant per year) (Table 6). This may be due to the higher dose of fertilizers leading to greater accumulation of nutrients in the soil after uptake by plants. These results are consistent with the findings of Chamakumari *et al*. (2017) and Diwivedi *et al*. (2018) in jasmine.

Table 6: Effect of different fertilizer levels on soil nutrient status (N, P_2O_5 and K_2O) of *Tabernaemontana divaricata.*

Treatments	N (kg/ha)	P_2O_5 (kg/ha)	K_2O (kg/ha)
F1	159.16	18.47	243.97
F2	182.85	22.74	257.03
F3	199.89	27.46	293.78
S.Em. ±	**0.95**	**0.13**	**0.43**
C.D. at 5%	**2.84**	**0.39**	**1.30**

The combined effect of different spacings and fertilizer levels proved significant differences on available N, P_2O_5 and K_2O in soil (Table 7). The highest available soil N, P_2O_5 and K_2O (205.25, 28.98 and 305.67 kg/ha, respectively) was observed in the S2F3 treatment, which was on par (203.49) with S3F3 for N and the minimum values (153.31, 17.70 and 242.34 kg/ha, respectively) were observed in S1F1 treatment combination. This could be attributed to reduced nitrogen uptake in plants, while the highest phosphorus and potassium content might be due to fixation of these elements, rendering them unavailable to plants. Similar results were investigated by Divyashree (2016) in gaillardia, Azharuddin *et al.* (2017) and Duggani (2016) in *Gomphrena globosa.*

Table 7: Effect of various spacings and fertilizer levels on soil nutrient status (N, P_2O_5 and K_2O) of *Tabernaemontana divaricata*

Treatments	N (kg/ha)	P_2O_5 (kg/ha)	K_2O (kg/ha)
S1F1	153.31	17.70	242.34
S1F2	181.54	21.03	253.36
S1F3	190.94	25.70	279.30
S2F1	162.72	18.21	243.81
S2F2	184.67	24.11	263.42
S2F3	205.25	28.98	305.67
S3F1	161.44	19.49	245.77
S3F2	182.33	23.08	254.30
S3F3	203.49	27.70	296.36
S.Em. ±	**1.64**	**0.22**	**0.75**
C.D. at 5%	**4.92**	**0.67**	**2.25**

Effect of different spacings and fertilizer levels on Nutrient composition (%) of leaf samples (N, P_2O_5 and K_2O) of Tabernaemontana divaricata.

Available leaf nitrogen content (N) (%), phosphorus content (P_2O_5) (%) and potassium content (K_2O) (%)

The nutrient composition (%) of leaf samples was significantly influenced by spacing (Table 8). The maximum N, P_2O_5 and K_2O content in leaves (2.06%, 0.14% and 1.22%, respectively) was observed in S2 (2.0 x 1.5 m), while the minimum (1.58%, 0.12% and 0.90%, respectively) was recorded in S1 (1.5 x 1.2 m). This may be because in wider spacing, nutrients are more readily available and plants face less competition for these nutrients. In contrast, in closer spacing, higher plant density increases competition for available nutrients, leading to lower nutrient uptake by individual plants. These findings are consistent with the results of Ahirwar *et al.* (2012) and Rolaniya *et al.* (2017) in African marigold.

Table 8: Effect of various spacings on nutrient composition (%) of leaf samples of *Tabernaemontana divaricata*

Treatments	N (%)	P_2O_5 (%)	K_2O (%)
S1	1.58	0.12	0.90
S2	2.06	0.14	1.22
S3	1.89	0.13	1.01
S.Em. ±	**0.02**	**0.001**	**0.01**
C.D. at 5%	**0.05**	**0.004**	**0.03**

The application of 40:80:80 g of NPK per plant per year (F3) resulted in significantly higher N, P_2O_5 and K_2O content in leaves (2.82%, 0.16% and 1.34%, respectively), while the lowest values (0.94%, 0.10% and 0.80%, respectively) were observed in treatment F1, which involved applying 20:40:40 g of NPK per plant per year (Table 9). This may be due to the application of a higher dose of nutrients, providing sufficient nutrition for plant growth and development, with effective utilization of sunlight and no competition between plants for nutrients, as would occur with closer spacing due to an increased plant population. These findings are consistent with the results of Bilji *et al.* (2022) and Ozukum *et al.* (2022) in jasmine.

Table 9: Effect of different fertilizer levels on nutrient composition (%) of leaf samples of *Tabernaemontana divaricata*

Treatments	N (%)	P_2O_5 (%)	K_2O (%)
F1	0.94	0.10	0.80
F2	1.77	0.13	0.99
F3	2.82	0.16	1.34
S.Em. ±	**0.02**	**0.001**	**0.01**
C.D. at 5%	**0.05**	**0.004**	**0.03**

Table 10: Effect of various spacings and fertilizer levels on nutrient composition (%) of leaf samples of *Tabernaemontana divaricata*

Treatments	N (%)	P_2O_5 (%)	K_2O (%)
S1F1	0.90	0.09	0.67
S1F2	1.43	0.12	0.96
S1F3	2.42	0.15	1.07
S2F1	0.97	0.10	0.80
S2F2	2.01	0.14	1.01
S2F3	3.19	0.18	1.85
S3F1	0.95	0.11	0.93
S3F2	1.88	0.13	1.00
S3F3	2.83	0.16	1.10
S.Em. ±	**0.03**	**0.002**	**0.02**
C.D. at 5%	**0.09**	**0.007**	**0.05**

The combined effect of different spacings and fertilizer levels proved significant differences on nutrient composition (%) of leaf samples in *Tabernaemontana divaricata* (Table 10). The maximum N, P_2O_5 and K_2O content in leaves (3.19%, 0.18% and 1.85%, respectively) was observed in the S2F3 treatment and lowest (0.90%, 0.09% and 0.67%, respectively) was estimated in the S1F1 treatment combination. The highest nutrient content in the leaves was observed with the highest level of fertilizer application, decreasing with lower levels. This effect is likely due to synergistic interactions between nutrients, enhancing plant growth. The increased nutrient levels were attributed to carbohydrate accumulation, which progressed as the plants matured. Parallel results were examined by Divyashree in gaillardia (2016), Kurabet (2015) in crossandra and Manjula *et al.* (2023) in nerium.

Effect of different spacings and fertilizer levels on cost economic returns of Tabernaemontana divaricata.

Gross returns (Rs./ha), net returns (Rs../ha) and benefit cost ratio

Among the different treatment combinations, the highest gross returns (Rs. 6,13,000/ha) were obtained in S1F3 (1.5 x 1.2 m, 40:80:80 g NPK/plant/year) treatment combination, followed by (Rs. 5,54,000/ha) S1F2 (1.5 x 1.2 m, 30:60:60 g NPK/plant/year). The least gross returns (Rs. 2,45,000/ha) was obtained in S3F1 (2.5 x 1.8 m, 20:40:40 g NPK/plant/year) treatment combination. The highest net returns (Rs. 2,97,747/ha) was obtained in S1F3 (1.5 x 1.2 m, 40:80:80 g NPK/plant/year) treatment combination, followed by (Rs. 2,48,825/ha) S1F2 (1.5 x 1.2 m, 30:60:60 g NPK/plant/year). The least net returns (Rs. 63,030/ha) were obtained in S3F1 (2.5 x 1.8 m, 20:40:40 g NPK/plant/year) treatment combination. The highest benefit-cost ratio (1.95) was observed in S1F3 (1.5 x 1.2 m, 40:80:80 g NPK/plant/year) treatment combination, followed by (1.94) S2F3 (2.0 x 1.5 m, 40:80:80 g NPK/plant/year). The least benefit-cost ratio (1.35) was obtained in S3F1 (2.5 x 1.8 m, 20:40:40 g NPK/plant/year) treatment combination (Table 11). This might be due to the optimum utilization of nitrogen, phosphorus and potassium, coupled with closer spacing, which resulted in a higher plant population, leading to the production of more flower buds per unit area in this combination, which yielded a good price. Similar results were obtained by Manjula *et al.* (2023) in nerium, Duggani (2016) in *Gomphrena globosa* and Divyashree (2016) in gaillardia.

Table 11: Effect of various spacings and fertilizer levels on cost economic returns of *Tabernaemontana divaricata*

Treatments	Flower budyield per ha(t)	Total cost of cultivation (Rs./ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	Benefit: Cost ratio
S1F1	5.02	2,94,897	5,02,000	2,07,103	1.71
S1F2	5.54	3,05,175	5,54,000	2,48,825	1.82
S1F3	6.13	3,15,253	6,13,000	2,97,747	1.95
S2F1	3.67	2,28,946	3,67,000	1,38,054	1.61

S2F2	4.34	2,35,113	4,34,000	1,98,887	1.85
S2F3	4.67	2,41,161	4,67,000	2,25,839	1.94
S3F1	2.45	1,81,970	2,45,000	63,030	1.35
S3F2	2.67	1,86,083	2,67,000	80,917	1.44
S3F3	2.89	1,90,115	2,89,000	98,885	1.53

Conclusion

In the experimental study, it was finally concluded that the combination of optimum spacing S2 (2.0 x 1.5 m) with 40:80:80 g NPK/plant/year (F3) was identified as beneficial for achieving a superior quality of flower buds with maximum hundred flower bud weight, yield of flower buds per plant along with higher available soil and leaf nutrient status. The treatment combination of S1F3 (1.5 x 1.2 m, 40:80:80 g NPK/plant/year) recorded the maximum yield of flower buds per plot and per ha, with the highest gross returns, net returns and benefit-cost ratio, which was followed by the S2F3 treatment combination in Crape Jasmine.

References

Ahirwar M. K., Ahirwar K. and Shukla M., 2012, Effect of plant densities, nitrogen and phosphorous levels on growth, yield and flowering in African marigold. *Ann. plant Soil Res*., 14(2): 153-155.

Azharuddin S. G., Balaji S. K., Shafeeq B. and Bintory M. D. A., 2017, Influence of spacing, nitrogen, phosphorus and potassium fertilization on yield and economics of sweet William (*Dianthus barbatus*). *Trends in Biosciences*., 10(26): 5455-5458.

Bilji V. S., Prasad V. M. and Topno S. E., 2022, Effect of major mutrients (N: P: K) on plant growth and flower field of Jasmine (*Jasminum auriculatum). Int. J. Plant & Soil Sci*., 34(22): 1535-1539.

Chamakumari N., Saravanan S. and Ravi J., 2017, Effect of NPK and organic manures on plant growth, flower yield and flower quality parameters of Jasmine (*Jasminum sambac*) var. Double Mogra. *Agric. Update*, 12(2): 524-529.

Divyashree M. S., 2016, Standardization of spacing and NPK levels for growth, yield and quality of gaillardia *(Gaillardia pulchella* Foug.*)* under eastern dry zone condition. *M. Sc. (Horti.) Thesis*, Univ. Horti. Sci., Bagalkot (India).

Diwivedi R., Saravanan S., Shabi M. and Kasera S., 2018, Effect of organic and inorganic fertilizer on growth and flower yield of jasmine (*Jasminum grandiflorum* L.). *J. Pharma Innov*., 7(6): 683-686.

Duggani S., 2016. Standardization of spacing and fertilizer in Bachelor's Button (*Gomphrena globosa* L.) cv. AGS-5. *M. Sc. (Horti.) Thesis*, Univ. Horti. Sci., Bagalkot (India).

Kurabet P. T., 2015, Varietal evaluation, spacing and nutritional studies in Crossandra (*Crossandra undulaefolia* Salisb.). *M. Sc. (Horti.) Thesis*, Univ. Horti. Sci., Bagalkot (India).

Mangroliya R., Bhatt S., Tandel B. M., Patel H., Bhatt D. and Patel G., 2021, Nutrient management strategies through split application for optimizing growth, quality, yield and nutrient use efficiency in Jasmine. *J. Pharma Innov*., 10(7): 468-4972.

Manimaran P. and Ganga M., 2022, Effect of different plant spacing on growth, flower yield and quality of Jasmine spp. (*Jasminum nitidum). J. Pharma Innov*., 11(7):1531-1536.

Manjula B. S., Kulkarni B. S. and Munikrishnappa P. M., 2023, Effect of spacing, nutrition and their interaction on growth and yield of Nerium (*Nerium oleander* L.) cv. Pink Single. *Indian J. Agric. Res.*, 1: 1-5.

Nagaraja C. K., 2013, Effect of spacing and nutrition on growth and yield of annual chrysanthemum (*Chyrsanthemum coronarium* L.). *M. Sc. (Horti.) Thesis*, Univ. Horti. Sci., Bagalkot (India).

Ozukum S., Prasad V. M. and Topno S. E., 2022, Effect of NPK on plant growth, flower yield and flower quality of *Jasminum nitidum* cv. CO-1 (Star Jasmine). *J. Pharma Innov*., 11(1): 1423-1428.

Paramagoudar P., 2015, Studies on the effect of nutrients, plant density and growth regulators on growth and flower yield of spider lily (*Hymenocallis speciosa* L.). *Ph.D. (Horti.) Thesis*, Univ. Horti. Sci., Bagalkot (India).

Rolaniya M. S., Khandelwal S. K., Koodi S., Sepat S. R. and Choudhary A., 2017, Effect of NPK, biofertilizers and plant spacings on growth and yield of African marigold (*Tagetes erecta* Linn.). *J. Hort. Flora Res. Spectrum*., 6(1): 63-65.

Samanta D., Lahari K., Mukhopadhyay M. J. and Mukhopadhyay S., 2015, Karyomorphological analysis of different varieties of *Tabernaemontana coronaria*. *Cytologia*., 80(1): 67-73.

Shoram., Parekh N. S., Upadhyay N. V., Karapatiya B. A. and Patel H. C., 2012, Effect of nitrogen and phosphorus on vegetative growth and flower yield of Jasmine. Asian Journalof Horticulture., 7(1): 52-54.

Subiya R. Kengond., Priyanka T., Humajahan S., Vadrali and Patil B. C., 2017, Study on yield and quality of rose as effected by cultivars and planting geometry. *Int. j. pure appl. biosci*., 5(6): 544-550.