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S Kumar
Assistant professor, Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalai Nagar, Tamil Nadu, India

K Haripriya
Professor, Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalai Nagar, Tamil Nadu, India

Sanjeev Kumar
Assistant Professor, Department of Plant Pathology, Faculty of Agriculture, Annamalai University, Annamalai Nagar, Tamil Nadu, India

Ajish Muraleedharan
Assistant Professor, Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalai Nagar, Tamil Nadu, India

S Kamalakannan
Assistant Professor, Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalai Nagar, Tamil Nadu, India

Correspondence
S Kumar
Assistant professor, Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalai Nagar, Tamil Nadu, India

Effect of cycocel on growth, flowering and yield of *nerium* (*Nerium odorum* L.)

S Kumar, K Haripriya, Sanjeev Kumar, Ajish muraleedharan and S Kamalakannan

Abstract
An experiment was carried out to study the effect of CCC on growth, flowering and yield of *Nerium odorum* cv. Rose Single at the farmer's field in Keelaiyur village, Tharangambadi taluk, Nagapattinum district, Tamil Nadu. The treatments were comprised of different concentration of cycocel @ 1000, 1500, 2000, 2500 ppm and control was maintained by spraying with distilled water. The experiment was laidout in randomized block design with four replications. The results revealed that among the different concentration of cycocel used, higher concentration of CCC @ 2500 ppm-T_5 recorded the maximum reduction in plant height, leaf area, early flowering and maximum duration of flowering. However, the treatment T4- CCC 2000 ppm recorded the increased number of primary branches per plant, secondary branches per plant, number of leaves per plant, plant spread, flower diameter, hundred flower weight, number of flowers per plant, flower yield per plant and flower yield per plot.

Keywords: *Nerium*, CCC, cycocel, growth retardant, growth, flowering and yield

1. Introduction
Nerium botanically called as *Nerium odorum* L. have been referred as the glory of the garden belonging to the family Apocynaceae. Fresh flowers are used for garland making, worshipping in home and temple, hair adornment and floral decorations. The shrub is having an ornamental value for avenue planting, border planting and potted plants (Huxley, 1992) [1]. Apart from its ornamental use and loose flower production, this shrub is also known for its medicinal purpose (Adome *et al*., 2003) [2]. Among the loose flowers grown in Tamilnadu, *nerium* occupies 5th place with respect to its volume in trade after jasmine, chrysanthemum, rose and crossandra. Its cultivation is estimated around 1,408 ha with the production of 33,780 t (Kannan *et al*., 2016) [3]. During the last one and a half decade, *nerium* witnessed a steady increase in cultivable area and production of loose flowers. In the recent past, the use of synthetic plant growth regulating chemicals like CCC has gained momentum as a practical tool for crop regulation particularly for cut flower and loose flower production. Growth retardant like CCC is synthetic compound that either slows down the cell division or inhibits the cell elongation. This is mainly used because of their retarding effects on shoot growth, breaking of apical dominance which induce dwarfness with increased number of lateral branches and ultimately increased the yield. Hence, the present study was undertaken to ascertain the most appropriate concentration of CCC for improving the growth, flowering and yield of *Nerium odorum* cv. Rose Single.

2. Materials and Methods
The present investigation was carried out at the farmer's field in Keelaiyur village, Tharangambadi taluk, Nagapattinum district, Tamilnadu. Two years old bushes of uniform size and vigour were selected for the experiment. The plants were originally propagated from stem cuttings and planted at a spacing of 1m x 1m. The plants were pruned by cutting back the shoots at 45 cm height from the ground level. To each plant a fertilizer mixture of 120:120:120g N, P, K and FYM at the rate of 10 kg were applied. The entire doses of P, K and one third of N were applied as basal after pruning and remaining N was applied as two split doses. Other cultural operations such as irrigation, weeding and plant protection were followed uniformly for all plants. The treatments comprised of CCC @ 1000, 1500, 2000, 2500 ppm and control was maintained by spraying with distilled water alone. The first spray was given on newly emerged shoots 60 days after pruning as per treatment schedule. 30 days after the first spray, second spray was employed. Four plants were maintained for each replication and the experiment was laid out in a randomised block design with five different treatments and four replications. Observations were recorded on growth, flowering and yield parameters.

Data under different characters were analyzed statistically as suggested by Panse and Sukhatme (1978) [4].

3. Results and Discussion

3.1 Effect of CCC on growth attributes of *Nerium odorum* cv. Rose Single

The results of experiment as presented in table 1. revealed that the vegetative growth of *Nerium odorum* cv. Rose Single varied significantly with CCC treatments. The marked reduction in plant height was observed due to increase in concentration of CCC. The maximum retardation was obtained with T_5- CCC 2500 ppm (115.21 cm) followed by T_4- CCC 2000 ppm (124.63 cm). While the plants in control plot (T_1) recorded the taller (156.17 cm). Similar results were reported earlier by Singh (2004) [5] in rose, [6]Porwal *et al*. (2002) [6] in damask rose. The suppression of plant height is due to the action of CCC as an antiauxin, with stimulation and dwarfing properties and suppression of apical dominance as suggested by Crafts *et al.* (1950) [7]. All the concentration of CCC significantly promoted the number of primary and secondary branches. Maximum number of primary and secondary branches was observed with T_4- CCC 2000 ppm (6.78 and 47.75 respectively) followed by T_5- CCC 2500 ppm (6.61 and 46.54 respectively) and minimum was recorded with T_1- control (5.94 and 39.74 respectively). It is mainly due to the inhibitory effect of plant growth retardants on the cell division in the apical bud which subsequently might have stopped the growth of the main axis. This in turn would have accelerated the growth of lateral buds and enhanced the number of branches by CCC treatment. These have supportive evidence from the findings of Nage Gowda and Narayana Gowda (1990) [8] in *J. Sambac* and Aswath *et al.* (1994) [9] in China aster.

All the cycocel treatments significantly influence the number of leaves per plant and plant spread. T_4- CCC 2000 ppm recorded the maximum number of leaves per plant (983.64) and maximum plant spread (111.17 cm). This was followed by T_5- CCC 2500 ppm with the values of 934.37 and 108.48 cm respectively. The least number of leaves per plant (763.92) and plant spread (102.86 cm) was registered with control. This is mainly due to the influence of growth retardants on arresting the shoot growth and lateral buds developed into shoots by destruction of apical dominance, which ultimately increased the number of leaves and plant spread. This is in line with the findings of Venkatesan (1999) [10] in triploid crossandra and Sujatha *et al.* (2002) [11] in gerbera. However, the leaf area was found to be reduced by the application of higher concentration of cycocel. The maximum reduction in leaf area (20.72 cm^2) was noticed with T_5- CCC 2500 ppm, followed by T_4- CCC 2000 ppm (21.91 cm^2). The treatment T_5 and T_4 are on par with each other. The maximum leaf area (26.92 cm^2) was observed with control. The reduction in leaf area as a result of application of growth retardants could perhaps be due to reduction in cell size and construction of cell. The findings of this study are in conformity with the earlier reports of Kavitha (2001) [12] in jasmine and Khan and Tewari (2003) [13] in dahlia.

3.2 Effect of CCC on flowering attributes of *Nerium odorum* cv. Rose Single

Application of growth retardants was found to produce significant effects on the flowering characteristics of *Nerium odorum* cv. Rose Single (table 2). Early flowering was observed with T_5- CCC 2500 ppm (121.69 days) followed by T_4- CCC 2000 ppm (127.15 days). Maximum delay was observed with T_1- control (142.27 days). The early flowering due to the application of plant growth retardants might have been due to the fact that such plants have build up sufficient food reserves at initial stages. These reserve foods could have been utilized for the reproductive growth with a restriction in vegetative growth which was evident in the plants treated with cycocel. Murali and Gowda (1988) [14] observed that CCC treated jasmine plants came to flowering earlier because of the anti-gibberellin action of CCC. A reduction in the level of endogenous gibberellin might be a prerequisite for floral induction which was achieved by the CCC sprays. The total flowering period was significantly increased by the application of cycocel. Among the various treatments, higher concentration of CCC (2500 and 2000 ppm) recorded significantly higher duration of flowering (182.92 and 177.08 days) and minimum was observed in control (159.13 days). These results were in accordance with the reports of Sridhar (2006) [15] in jasmine and Khandelwal *et al.* (2003) [16] in African marigold.

3.3 Effect of CCC on yield attributes of *Nerium odorum* cv. Rose Single

Different concentrations of CCC significantly affect all the yield attributes of *nerium* cv. Rose single (table 2). The maximum flower diameter (4.31 cm), hundred flower weight (37.68 g) number of flowers per plant (1813.18), flower yield per plant (689.14g) and flower yield per plot (13.81kg) was recorded with T_4- CCC 2000 ppm. This was followed by T_5- CCC 2500 ppm (4.24 cm, 36.61 g, 1738.25, 628.71g and 12.56kg respectively). The treatments T_4 and T_5 are on par with each other for all the yield attributes except flower yield per plant and flower yield per plot. While the minimum value was noticed with control with the values of 3.45cm, 31.24g, 1358.24, 416.52g and 8.31kg respectively. It is a well known fact that cycocel played a major role in suppression of apical dominance, which resulted in increased biometric characters like more no of branches and leaves which resulted in production of maximum leaf area compared to control, which might have resulted in production and accumulation of more photosynthates that were diverted to the Sink (flower) resulting in more number of flowers with better size, weight and ultimately the yield (Mohamed Ahmed *et al.*, 1988, Sujatha *et al.*, 2002) [17, 18]. The positive effects CCC in increasing flower weight, flower diameter, number of flowers per plant, flower yield per plant and flower yield per plot observed in this experiment are in conformity with the findings of Ramesh *et al.* (2001) [19] in China aster and Dutta *et al.* (1993) [20].

Table 1: Effect of CCC on growth attributes of *Nerium odorum* cv. Rose Single

Treatments	Plant height (cm)	Number of primary branches	Number of secondary branches	Number of leaves per plant	Plant spread (cm)	Leaf area (cm^2)
T_1- Control	156.17	5.94	39.74	763.92	102.86	26.92
T_2- CCC 1000	145.75	6.19	42.19	814.83	104.77	25.18
T_3- CCC 1500	135.31	6.28	44.27	872.51	106.45	23.85
T_4- CCC 2000	124.63	6.78	47.75	983.64	111.17	21.91

T_5- CCC 2500	115.21	6.61	46.54	934.37	108.48	20.72
SED	4.17	-	0.95	23.43	0.76	0.61
CD(p=0.05)	8.43	NS	1.93	47.12	1.53	1.24

Table 2: Effect of CCC on flowering and yield attributes of *Nerium odorum* cv. Rose Single

Treatments	Days to 1st flowering (days)	Duration of flowering (days)	Flower diameter (cm)	Hundred flower Weight (g)	Number of flowers per plant	Flower yield per plant (g)	Flower yield per plot (Kg)
T_1- Control	142.27	159.13	3.45	31.24	1358.24	416.52	8.31
T_2- CCC 1000	137.75	165.58	3.78	33.46	1473.64	501.48	10.00
T_3- CCC 1500	131.64	171.44	3.98	34.93	1621.73	572.36	11.42
T_4- CCC 2000	127.15	177.08	4.31	37.68	1813.18	689.14	13.81
T_5- CCC 2500	121.69	182.92	4.24	36.61	1738.25	628.71	12.56
SED	1.86	2.08	0.08	0.64	41.65	21.17	0.48
CD(p=0.05)	3.78	4.21	0.15	1.31	85.23	43.72	1.01

4. Conclusion

It is concluded that application of cycocel @ 2000 ppm on 60 and 90 days after pruning was found to be beneficial in increasing the flower yield and its quality of *nerium*.

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