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Impact of neem coated urea (NCU) on flowering, yield and quality of China aster (*Callistephus chinensis*)

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ABSTRACT

An experiment was conducted to study the effect of neem coated urea (NCU) on growth, flowering and yield of China aster (*Callistephus chinensis*) var. Arka Kamini at College of Horticulture, Bengaluru. The experiment was laid out in randomised complete block design (RCBD) with seven treatments replicated thrice. The study revealed T_3 (100 per cent RDN through neem coated urea in two split doses + 120 kg P_2O_5 + 60 kg K_2O) recorded better result with respect to growth, flowering and yield attributes, where as least values were observed in T_7 (50 per cent RDN through neem coated urea in two split doses + 120 kg P_2O_5 + 60 kg K_2O).

Key words: *Neem coated urea, China aster, Split doses, Arka Kamini*

Introduction

China aster (*Callistephus chinensis* (L.) Nees.) is a semi hardy annual and commercial flower crop belonging to the family Asteraceae. The plant is a diploid (2n=18). It is an important annual crop of our country and grown throughout the world. The crop is native to China and have spread to European countries and other tropical countries during 1731 AD (Desai, 1967).

It is one among the important flower crop widely grown in and around Bengaluru, Chitradurga and Kolar districts of Karnataka. It is grown successfully in open condition for year-round production in *kharif, rabi and summer* seasons to have continuous supply of flower to the market.

Consumption of primary nutrient nitrogen has increased from 0.6 million tonnes in 1965-66 to 16.95 million tonnes in 2014-15 and India has emerged as the second largest consumer of nitrogen in the world. Since 1970's, urea is the major source of fertilizer-N contributing to 83.10 per cent of total fertil-

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izer-N consumed in India (FAI, 2015). The direct application of fertilizers is subjected to losses. In case of N fertilizers leaching and volatilization losses are more, only 30 to 40 per cent of the added N fertilizers used by the crops (Rizwan *et al.*, 2008).

When urea is applied to the soil, it undergoes various transformations to form several other nitrogen forms, of which some are susceptible to losses and therefore lead to reduced availability of nitrogen to crop plants. Most notable two broad categories of transformations are hydrolysis of urea by urease enzyme which rapidly converts amide form of N present in urea to ammonium-N and further, nitrification brought about by a group of nitrifying bacteria leads to conversion of ammonium-N to nitrate-N. Although plants can use both ammonium-N and nitrate-N with equal ease, ammonium-N is susceptible to loss via ammonia gas, and nitrate-N can escape soil-plant system through leaching below the rooting zone and in gaseous forms like denitrification leading to reduced fertilizer N use efficiency.

Nitrification inhibitors when applied along with urea reduce losses of applied N thereby resulting in improved yield of crops. In early 1970's, it was observed that oil extracted from the seeds of neem (*Azadirachta indica* L.), a tall perennial tree growing widely in the tropics and subtropics, and the cake left after oil extraction possess nitrification inhibition properties. Hence, usage of slow-release sources of nitrogen like neem coated urea supplies N at critical stages of crop growth and through its split application reduces the N loss, but the extent of losses and efficiency of applied N varies for different soil conditions.

Materials and Methods

The experiment was conducted in the research block of Department of Floriculture and Landscape Architecture, College of Horticulture, Bengaluru during the period from November 2019 to February 2020 (*rabi* season). The experiment was laid out in Randomized Complete Block Design (RCBD) with 7 treatments replicated thrice. The treatment details are as follows,

T_1: Control (20 tonnes FYM ha^{-1} and 180:120:60 kg N, P_2O_5, K_2O ha^{-1})

T_2: 100 per cent recommended dose of nitrogen (RDN) through neem coated urea as basal dose + 120 kg P_2O_5 + 60 kg K_2O

T_3: 100 per cent RDN through neem coated urea in two split doses + 120 kg P_2O_5 + 60 kg K_2O

T_4: 75 per cent RDN through neem coated urea as basal dose + 120 kg P_2O_5 + 60 kg K_2O

T_5: 75 per cent RDN through neem coated urea in two split doses + 120 kg P_2O_5 + 60 kg K_2O

T_6: 50 per cent RDN through neem coated urea as basal dose + 120 kg P_2O_5 + 60 kg K_2O

T_7: 50 per cent RDN through neem coated urea in two split doses + 120 kg P_2O_5 + 60 kg K_2O

Observations recorded includes, plant growth parameters like plant height (cm), plant spread (cm), primary and secondary branches (nos.) were recorded at 30, 60 and 90 days after transplanting. Flower parameters like days to first flowering (DAT), days to 50 per cent flowering (DAT) and duration of total flowering (days) were recorded. Yield attributes like number of flowers per plant, individual flower weight (g), 100 flower weight (g) and flower yield per plant (g $plant^{-1}$) were recorded.

Results and Discussion

Among different treatments, plants which received 100 per cent (180 kg ha^{-1}) recommended dose of nitrogen (RDN) through neem coated urea in two split doses (T_3) showed significant increase in plant height (48.33 cm) followed by treatment T_4 (41.06 cm) which received 75 per cent recommended of nitrogen through neem coated urea, while least plant height of 26.66 cm was recorded in treatment which received 50 per cent RDN through neem coated urea in two split doses. It is evident that nitrogen is one of the major key elements for the plant growth and increase in nitrogen supply accelerates the synthesis of chlorophyll and amino acids which enhances the vegetative growth in terms of plant

Table 1. Plant height (cm) at different growth stages of China aster var. Arka Kamini as influenced by varied levels of neem coated urea

Treatments	Plant height (cm)		
	30 DAT	60 DAT	90 DAT
T_1	16.20	29.53	33.20
T_2	18.93	31.93	31.06
T_3	19.20	43.00	48.33
T_4	15.53	35.73	41.06
T_5	20.60	35.33	38.13
T_6	14.86	25.13	30.26
T_7	10.20	21.86	26.66
S. Em±	1.85	1.12	1.25
CD @ 5 %	5.70	3.75	3.85

height, stem length, number of leaves *etc.* The present finding is in accordance with the study concluded by Devlin (1973) and Mengel and Kirkby (1987) in marigold.

Highest plant spread of 15.66 cm in E-W direction was recorded in treatment which received 75 per cent recommended dose of nitrogen through neem coated urea as basal dose, while significantly lowest value (10.00 cm) was recorded in treatmentwhich received 50 per cent recommended dose of nitrogen through neem coated urea in two split doses. In North-South direction, significantly highest plant spread was recorded in treatment T_3 (23.26 cm) which received 100 per cent recommended dose of nitrogen through neem coated urea in two split doses, while significantly lowest value was observed in T_7 (9.13 cm) which received 50 per cent recommended dose of nitrogen through neem coated urea in two split doses. The significant differences in plant spread are due to the optimum availability of nitrogen which promotes vegetative growth, cell differentiation and plant spread coupled with ample availability of optimum sunlight during the entire plant growth period. This is in confirmatory with the results of Devlin (1973) and Gaikwad *et al*. (2004) in China aster var. Phule Ganesh White.

The number of primary (3.50) and secondary branches (28.66) were found significantly highest in the treatment which received 100 per cent recommended dose of nitrogen through neem coated urea in two split doses. While the significantly lowest number for primary (2.46) and secondary branches (13.33) was recorded in treatment which received 50 per cent recommended doses of nitrogen in two split doses. The significant differences in number of primary and secondary branches are due to the availability of optimum doses of nitrogen at the critical growth period of the plant life cycle, which in turn have increased the vegetative growth coupled with pinching further increased the branching in the plant. These results are in confirmatory with the findings of Mantur (1988), Singh and Sangama (2000) in China aster.

Early flower bud emergence (63 DAT) was observed in treatment which received 100 per cent rec-

Table 2. Plant spread (cm) in East-West and North-South direction at different growth stages of China aster var. Arka Kamini as influenced by varied levels of neem coated urea

Treatments	East-West (cm)			North-South (cm)		
	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT
T_1	8.00	10.60	12.50	9.66	12.13	17.50
T_2	9.00	10.93	13.50	12.16	19.13	21.33
T_3	10.00	11.06	15.33	16.26	23.26	28.66
T_4	11.66	12.73	15.66	13.00	19.66	22.33
T_5	7.00	8.33	12.00	10.00	11.60	14.50
T_6	7.00	9.20	11.00	9.16	10.26	14.00
T_7	6.16	8.86	10.00	7.16	9.13	13.33
S. Em±	0.09	0.37	0.34	0.16	0.40	0.30
CD @ 5 %	0.29	1.13	1.04	0.50	1.22	0.93

Table 3. Primary branches and secondary branches at different growth stages of China aster var. Arka Kamini as influenced by levels of neem coated urea

Treatments	Primary branches (No's)			Secondary branches (No's)		
	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT
T_1	1.90	2.61	3.03	9.46	12.26	17.83
T_2	2.00	2.60	3.00	12.00	18.53	21.66
T_3	2.23	2.80	3.06	16.60	23.46	29.00
T_4	2.00	2.61	3.50	12.66	19.00	22.66
T_5	2.00	2.60	3.26	10.00	11.93	14.50
T_6	1.80	2.60	3.00	9.33	10.66	14.00
T_7	1.60	2.50	2.46	7.00	9.46	13.33
S. Em±	0.01	0.01	0.05	0.16	0.57	0.27
CD @ 5 %	0.04	0.02	0.15	0.48	1.74	0.84

ommended dose of nitrogen through conventional urea, while it was delayed (68.33 DAT) in treatment which received 50 per cent recommended dose of nitrogen through neem coated urea in two splits doses. Minimum days for 50 per cent flowering (69 DAT) was observed in treatment T_1 which received 100 per cent nitrogen through conventional urea, while the higher number of days for flowering (77 DAT) was observed in treatment T_7 which received 50 per cent recommended dose of nitrogen through neem coated urea in two split doses. Significantly total flowering period was short (31 days) in treatment which received 100 per cent nitrogen through conventional urea, while it was longer and extended flowering days (34 days) was observed in treatment T_2, T_3 and T_4. Nitrogen accelerates protein synthesis thus promoting early floral primordial development. This could also be attributed to a higher CN ratio and increased plant metabolism. The increased vegetative growth and balanced CN ratio could lead to increased synthesis of carbohydrate which ultimately promoted greater flowering. The present finding is in accordance with the studies of Natarajan and Vijayakumar (2002), Singh and Singh (2002), Sehrawat *et al.* (2003), Gavhane *et al.* (2004) in marigold and Hunmili and Paswan (2003) in gerbera. However slow release of nitrogen by neem coated urea might have responsible for delayed flowering compared to the other treatments, but longer flowering days was noticed.

Significantly highest number of flowers per plant (54.00), individual flower weight (2.42 g), 100 flower weight of (231.66 g) and flower yield of (125.10 g plant^{-1}) was recorded in treatment T_3which received

Table 4. Flowering behaviour of China aster var. Arka Kamini as influenced by varied levels of neem coated urea

Treatments	Days to first flowering (DAT)	Days to 50 per cent flowering (DAT)	Duration of total flowering (days)
T_1	63.00	69.00	31.00
T_2	67.00	74.00	34.00
T_3	67.00	74.00	34.00
T_4	67.00	74.00	34.00
T_5	67.00	74.00	34.00
T_6	68.00	76.33	27.67
T_7	68.33	77.00	27.67
S. Em±	0.13	0.25	0.19
CD @ 5 %	0.39	0.78	0.57

Table 5. Flower yield attributes of China aster var. Arka Kamini as influenced by varied levels of neem coated urea

Treatments	Number of flowers per plant	Individual flower weight (g)	100 flower weight (g)	Flower yield per plant (g plant^{-1})
T_1	52.73	0.94	139.33	98.10
T_2	54.00	1.30	201.66	111.90
T_3	53.06	2.42	231.66	125.10
T_4	50.33	1.92	178.33	98.40
T_5	48.06	1.32	146.66	80.33
T_6	44.73	0.95	131.66	75.20
T_7	41.13	0.83	100.00	62.40
S. Em±	0.53	0.04	5.25	0.33
CD @ 5 %	1.63	0.12	16.17	1.03

100 per cent recommended dose of nitrogen through neem coated urea. However, the significantly least number of flowers per plant (41.13), individual flower weight (0.83 g), 100 flower weight of (100.00 g) and flower yield of (62.40 g plant^{-1}) was recorded in treatment T_7 which received 50 per cent recommended dose of nitrogen through neem coated urea. This is probably due to the increase in number of flowers per plant with the application of nitrogen coupled with pinching operation which might have significantly increased the vegetative growth that in turn have synthesized more plant metabolites which ultimately led to increase in flower production. This study is in confirmation with the findings of Chan *et al.* (1958) in carnation. Availability of optimum nitrogen might have brought protein synthesis and increased resistance against stress might have improved growth and development of the plant which have ultimately led to increase in flower size and average weight of flowers. The finding is in accordance with the results by Sharma *et al.* (2006) in chrysanthemum. Higher vegetative growth have resulted in production of more photosynthates and ultimately led to the increased flower weight and in turn yield of the crop. This is in accordance with the results by Mohit *et al.* (2008) in China aster.

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