

Full length Research Paper

Effect of Fertilizer Concentration on the Growth Performance of *Cassia nodosa* Buch.-Ham. ex Roxb. and *Cassia fistula* L. Seedlings under Greenhouse Conditions of Kuwait

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Fertilizer application is a common practice adopted in nurseries for the production of healthy seedlings since addition of the right amount of fertilizer can promote profuse flowering and foliage growth in flowering trees. *Cassia nodosa* Buch.-Ham. ex Roxb. (Pink shower) and *Cassia fistula* L. (Golden shower) are two flowering trees that are tolerant to hot arid climates and produce abundant masses of colorful flowers for long durations. Since plants require adequate amount of nutrients to ensure optimum yield, it is essential to find out the appropriate quantity of fertilizer required for the seedlings based on the plants actual growth. Therefore, the Kuwait Institute for Scientific Research (KISR) initiated this project to evaluate the growth response of *Cassia nodosa* and *Cassia fistula* species individually to different nutrient concentrations and to detect the best treatment among three levels of fertilization. The study revealed that both the species of *Cassia* exhibited maximum plant height and number of leaves when N: P: K was applied at 1g/l in a growing medium comprising of sand: peat moss: humus (1:1:1 v/v) compared to other fertilizer levels.

Keywords: Flowering trees, nutrient concentrations, arid climate

INTRODUCTION

Cassia fistula and *Cassia nodosa* are ornamental trees which are well known mainly for their landscaping attributes, tolerance to drought conditions and low maintenance requirements (Ghouse *et al.*, 1980). *Cassia* trees are moderately drought and salt tolerant and widely grown as an ornamental fragrant flowering tree in tropical and subtropical areas in the world and hence attempts have been made to introduce these trees to Kuwait conditions (Al-Menaie, *et al.*, 2008). Establishment of tree plantations need large numbers of healthy, uniform and hardened seedlings to ensure maximum survival and vigor after planting in the field. Nutrient availability and soil texture determine biomass allocation, seedling

growth and survival Gerhardt and Frederickson (1995). According to Mhango (2000) and Swai (2002), mortality in seedlings could be attributed to factors such as inappropriate growth media and nutritional deficiencies. *Cassia fistula* usually grows well in a fertile well drained soil (Llamas, 2003). Hence, fertilizer application is a common practice in the nursery to produce healthy and sizeable seedlings. Usually, fertilization practices are rarely based on any quantitative knowledge of the requirements of the species being planted. Addition of the correct amount of fertilizer can promote healthy flower production and foliage growth for flowering trees. A moderate rate of growth and green color is preferred for most woody plants whereas excessive vigor with lush, green leaves and long shoot growth is often undesirable. Since fertilization is essential to ensure optimum yield it is imperative to find out the suitable fertilizer concentration for *Cassia nodosa* (Pink shower) and *Cassia fistula*

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Table 1. Plant Height recorded for *Cassia nodosa* (cm)

Treatments	1MAP	2MAP	3MAP	4MAP	5MAP	6MAP
T1	7.53	15.16	26.03	42.2	54.3	73.3
T2	7.35	14.7	22.4	33.7	47.1	52.2
T3	7.5	12.6	16.8	26.5	38.3	40.6
Significance	NS	NS	***	***	***	***
SEM	-	-	±1.15	±1.79	±1.42	±1.85

MAP: Months After Planting

***: Significant at $P < 0.001$

NS: Non significant

SEM: Standard Error of Mean.

(Golden shower) seedlings based on the plants actual growth. The objective of this study was to determine the growth response of *Cassia nodosa* and *Cassia fistula* species individually to different nutrient concentrations and to detect the best treatment among three levels of fertilization. The results of this study have provided some useful guidelines for the fertilization of these species in the nursery to facilitate the development of protocols for the successful establishment of plantations under arid climatic conditions of Kuwait.

MATERIALS AND METHODS

Since the native soils of Kuwait is sandy and not suitable for cultivation, three-month old seedlings were transplanted in 14-cm plastic pots filled with a growing medium comprising of sand, peat moss, and humus at a ratio 1:1:1 during 2008 (May-October). Three fertilization regimes at the rate of 1, 2 and 3 g/l (T1, T2 and T3) were tried to ascertain the most appropriate concentration. A commercially available fertilizer containing NPK at 15:15:15 with trace elements (Mg, Fe, Zn, B, Mn, Mo) was applied once in every two weeks during the period of study. The required quantity of fertilizer for each treatment was weighed, dissolved in water and was applied to the seedlings.

The design of the experiment was a randomized complete block, consisting of three treatments (T1, T2 and T3) and 10 replicates, with 10 plants per replicate. There were a total of 300 plants. The seedlings were placed in the greenhouse at the Kuwait Institute of Scientific Research (KISR) main campus. During the study period the average temperature inside the greenhouse was 29°C. Since *Cassia* is a tree, long term studies were needed to draw a final conclusion regarding the effect of fertilizer concentration on plant growth. The preliminary results of the NPK fertilization trial are here presented and tree responses were discussed in terms of vegetative growth. Plant heights, number of leaves and

chlorophyll index were recorded at monthly intervals for a period of six months. Chlorophyll index was measured using chlorophyll content meter (CCM-200). Seedling responses to varying fertilizer levels were analyzed using R procedure for analysis of variance (Crawley, 2005). The knowledge of these growth patterns could be important for making decisions related to fertilization and modifying the fertilization regimes may be a helpful strategy to improve the landscaping value.

RESULT AND DISCUSSION

Cassia seedlings responded differently under different fertilizer concentrations. Tables 1-6 present the plant height, number of leaves and chlorophyll index recorded for *Cassia nodosa* and *Cassia fistula* under different nutrient concentrations.

Cassia nodosa: As far as plant height was concerned, the treatments were not significant at one and two months after planting (MAP). From three to six MAP, the treatments were highly significant at $P \leq 0.001$ (Table 1). At six MAP, the plant height was higher in T1 (73.30cm) compared to T2 (52.20 cm) and T3 (40.60 cm). Regarding the number of leaves produced, the treatments were highly significant at $P \leq 0.001$ from two to six MAP. More leaves were produced by T1 (325.60) compared to T2 (308.70) and T3 (293.10) (Table 2). The fertilizer concentration treatments did not have significant effects on chlorophyll index at one and two MAP. From three MAP onwards the treatments were highly significant and at six MAP the values recorded were 13.60, 20.10 and 16.50 for T1, T2 and T3, respectively (Table 3).

Cassia fistula: Seedling growth response was more pronounced in T1 (NPK at 15:15:15 at 1g/l) compared to higher doses of 2g/l and 3g/l. In T1, plants were bigger, leaves were darker and more pronounced than in other treatments. T1 in 1MAP have smaller plant height (5cm), than T2 (8.70cm) and T3 (8.65cm) and later T1 recorded more plant length compared to T2 and T3. The results

Table 2. Number of Leaves in *Cassia nodosa*

Treatments	1MAP	2MAP	3MAP	4MAP	5MAP	6MAP
T1	87.6	166.4	183.90	250.80	299.7	325.60
T2	80.9	125.6	138.80	230.70	284.70	308.70
T3	93.3	130.1	135.80	219.61	245.70	293.10
Significance	NS	***	***	***	***	***
SEM	-	±6.33	±2.83	±5.91	±6.39	±4.33

MAP: Months After Planting

***: Significant at $P < 0.001$

NS: Non significant

SEM: Standard Error of Mean.

Table 3. Chlorophyll Index of Leaves of *Cassia nodosa*

Treatments	1MAP	2MAP	3MAP	4MAP	5MAP	6MAP
T1	11.51	12.33	12.79	11.16	14.20	13.60
T2	12.02	12.33	17.70	18.44	18.22	20.10
T3	11.25	11.85	15.40	15.90	15.86	16.50
Significance	NS	NS	***	***	***	***
SEM	-	-	±1.13	±1.006	±0.95	±0.95

MAP: Months After Planting

***: Significant at $P \leq 0.001$

NS: Non significant

SEM: Standard Error of Mean.

Table 4. Plant Height recorded for *Cassia fistula* (cm)

Treatments	1MAP	2MAP	3MAP	4MAP	5MAP	6MAP
T1	5.00	13.00	18.00	33.00	34.00	42.60
T2	8.70	12.50	13.87	20.30	26.30	27.87
T3	8.65	10.90	13.44	21.40	25.40	28.39
Significance	***	***	***	***	***	***
SEM	±0.83	-	±0.33	±1.12	±1.06	±2.29

MAP: Months After Planting

***: Significant at $P \leq 0.001$

NS: Non significant

SEM: Standard Error of Mean.

indicated that at higher fertilizer doses there was no further improvement in seedling growth. At six MAP, T1 recorded a plant height of 42.60 cm and the values were 27.87 cm and 28.39 cm for T2 and T3, respectively (Table 4). Analysis revealed that there was a highly significant difference among the different nutrient concentrations tested for plant height from three to six MAP. The highest number of leaves was recorded by T1 compared to the other two treatments and they were

significantly different during the six months period of the study. At six MAP, the values were 55.70, 42.50 and 37.00 respectively (Table 5). The fertilizer concentration treatments did not have significant effects on chlorophyll index at one and two MAP. From three to six MAP the treatment effects were highly significant and at 6 MAP the values recorded were 13.80, 16.30 and 19.40, respectively for T1, T2 and T3 (Table 6).

Table 5. Number of Leaves recorded in *Cassia fistula*

Treatments	1MAP	2MAP	3MAP	4MAP	5MAP	6MAP
T1	14.00	18.30	25.20	37.20	39.60	55.70
T2	11.30	14.20	17.80	24.20	27.90	42.50
T3	16.80	16.90	18.27	25.00	28.50	37.00
Significance	*	***	***	***	***	***
SEM	±1.77	±0.87	±0.68	±0.95	±1.20	±1.02

MAP: Months After Planting

*, ***: Significant at P<0.05, 0.001 levels respectively

SEM: Standard Error of Mean.

Table 6. Chlorophyll Index of *Cassia fistula* Leaves

Treatments	1MAP	2MAP	3MAP	4MAP	5MAP	6MAP
T1	10.69	8.82	14.20	13.75	13.18	13.80
T2	10.62	9.94	15.40	15.90	15.70	16.30
T3	8.14	12.10	17.70	18.50	18.70	19.40
Significance	NS	NS	***	***	***	***
SEM	-	NS	±0.59	±0.58	±0.82	±0.85

CONCLUSION

The study revealed that the plant height and number of leaves of *Cassia nodosa* and *Cassia fistula* were higher in T1 in which N: P: K at 1g/l was applied and the soil mixture was sand: peat moss: humus (1:1:1 v/v). This may be due to the fact that the treatment T1 has the capability to absorb the supplied nutrients compared to the other treatments. The number of leaves was also higher in T1 and this proved that seedling growth of *Cassia* is more pronounced in T1 compared to the other fertilizer levels. Increased fertilizer levels might have lessened the plants capacity to absorb the nutrients from the soil in both species.

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