RESPONSE OF N, P AND K ON THE GROWTH AND FLOWERING OF HIPPEASTRUM (*Hippeastrum hybridum* Hort.)

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Abstract

An experiment was conducted at the Horticultural Research Field of Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Salna, Gazipur during September 2008 to May 2009 to determine the response of hippeastrum (cu. 'Apple Blassom) to different combinations of nitrogen, phosphorus and potassium levels. There were 14 treatment combinations comprising four levels of nitrogen viz. 0, 100, 200, and 300 kgha^{-1}; five levels of phosphorus viz. 0, 200,300, 400 and 500 kgha^{-1} and five levels of potassium viz. 0, 100, 200, 300 and 400 kgha^{-1} with an exclusively Cowdung treatment at the rate of 10 tha^{-1} . The experiment was laid out in a Randomized Complete Block Design with three replications. The growth and flowering parameter of hippeastrum were significantly influenced by combined application of N, P & K.The highest values in respect of leaves per plant (8.6), leaf breadth (5.4 cm), number of plants per bulb (3.07), flower scape per plant (2.07), flowers per scape (4.2), length and diameter of flower (14 cm x 13.83 cm), flower scape (43.33 cm x 29.37 cm) and flowering duration (10.7 days) were observed with $N_{200}P_{400}K_{300}$. The same treatment showed earliness in days to flower scape emergence (172.3 days), days to flower bud appearance (185.3 days) and days to first flower open (189.3 days). The biggest flower (14.00 cm x 13.83 cm), longest flower scape (43.33 cm), maximum number of flowers per scape (4.20), and maximum flowering duration (11.5 days) were also exhibited by the treatment $N_{200}P_{400}K_{300}$ .The control treatment ($N_0P_0K_0$) recorded the lowest values except days to first leaf emergence, days to flower scape emergence, days to flower bud appearance and days to first flower open.

Keywords: Hippeastrum, Nitrogen, Phosphorus, Potassium, flower yield.

Introduction

Hippeastrum (*Hippeastrum hybridum* Hort.) is a newly introduced flower in Bangladesh. It is an ornamental bulbous flowering plant belonging to the family Amaryllidaceae having large and showy flowers with many bright colours (Zandbergen, 1980) which is commonly known as Royal Dutch Amaryllis (Jana, 1995). They are suitable for planting in the bed, pot, rockery, shrubbery, greenhouse

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garden and also in landscaping. This flower is cultivated to a small scale in the peri-urban areas primarily for the supply to some city markets. Being a new crop, its fertilizer management is not known. As most of the soils of Bangladesh are deficient in major nutrients particularly N, P & K, so judicial application of those nutrients can play a good role in successful production of hippeastrum.

Response of every crop in Bangladesh to nitrogen application is well documented since this element is deficient all over the country. Nitrogen is absorbed as NH_4^+ form by young plants whereas NO_3^- is the principal form utilized during the late growth stages. However, plants vary in their proportion of ammonium versus nitrate utilization (Bennett, 1993).

Proper management of nitrogen fertilization for hippeastrum bulb production is critical. Several studies showed that when bulbous plants are cultivated on the field, multiple applications of smaller amounts of nitrogen are the most efficient in reducing nitrate losses through leaching. Usually it is recommended that one third of the nitrogen is applied early in the growing season (1-8 weeks after planting) and the remaining two thirds of nitrogen will be applied in the late part of the growing season. This approach ensures nitrogen availability during the vegetative and reproductive phase of most bulbous plants (Slangen *et al.*, 1989; Batal *et al.*, 1994; Diaz-perez *et al.*, 2003).

Phosphorus deficiency is considered as one of the major constraints to successful crop production. The ion absorption is determined by the pH of the soil. There is a notable effect of nitrogen on phosphorus uptake by plants.

Potassium is important in cell growth primary by through its effect on cell extension. With adequate potassium, cell walls are thicker and provide more tissue stability. This effect on cell growth normally improves resistance to lodging, pests and diseases. Potassium is required for production of high energy phosphate and is involved in starch as well as protein synthesis (Bennett, 1993).

Attention should therefore, be paid to the proportionate application of nitrogen, phosphorus and potassium. An excess amount of one nutrient element causes a relative or absolute deficiency of the other nutrients. The opposite is also true if there is a deficiency of some nutrient. In both cases the result is an "unbalanced diet" for the plants (Bergmann, 1992). In such a situation, balanced application of N, P & K which are deficient in most of our soils is imperative. Keeping this point in mind, the present study was undertaken to determine the response of hippeastrum to the application of different combinations of nitrogen, phosphorus and potassium levels.

Materials and Method

The experiment was carried out at the Horticultural Research Farm of Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU),

Salna, Gazipur during September 2008 to May 2009.The experimental site was located in the centre of the Madhupur Tract at about 24.09^0 North latitude and 90.26^0 East longitude having a mean elevation of 8.5 m on the sea level. The soil of the experimental field belongs to Salna series of Shallow Red Brown Terrace Soils. The soil is silty clay loam in texture and acidic in nature being characterized by poor fertility status and impeded internal drainage. Chemical characteristics of soil were pH 6.2, organic matter content 0.95%, total N 0.05%, available P 26.0 mg kg^{-1}, copper 5.0 mg kg^{-1}, iron 53.0 mg kg^{-1}, manganese 46 mg kg^{-1}, exchangeable K 0.3 meq100^{-1}g soil, available S 13.6 mg kg^{-1}, and available Zn 1.86 mg kg^{-1} (Golder, 2000).

 The experiment was laid out in a Randomized Complete Block Design with three replications. The total number of unit plots were 42 (14 x 3), each measuring 1.0 m x 1.0 m with 30 cm ridge around each plot and the blocks and plots were separated by 1.0m and 0.75m, respectively. There were 14 treatment combinations comprising four levels of nitrogen viz. 0, 100, 200, and 300 kgha^{-1}; five levels of phosphorus viz. 0, 200, 300, 400 and 500 kgha^{-1} and five levels of potassium viz. 0, 100, 200, 300 and 400 kgha^{-1} with cowdung treatment at the rate of 10 tha^{-1}. The treatment combinations are shown in Table 1 under Result and Discussion section.

Nitrogen, phosphorus and potassium were applied in the form of urea, triple super phosphate (TSP) and muriate of potash (MOP), respectively. The entire quantity of cowdung and TSP and one-third each of urea and MOP were applied during plot preparation. The rest of urea and MOP were applied in two equal installments, 30 and 60 days after emergence. The variety of Hippeastrum used was Apple Blossom. Intercultural operations like irrigation, weeding, pest and disease control measures were taken as and when required. Data on different growth and flowering characteristics were collected from randomly selected 10 plants of each individual plots. The flower scape was cut when the buds were fully elongated. Harvesting was done early in the morning and the stalks were placed in water. The recorded data for different characters were analyzed statistically using MSTAT- C to find out the variation among the treatments. Treatment means were compared by Duncan's Multiple Range Test (DMRT) for interpretation of results (Gomez and Gomez, 1984).

Results and Discussion

The effect of different levels of nitrogen, phosphorus and potassium application on the growth and flowering of Hippeastrum cv. Apple Blossom are shown in different tables and figures.

Days to first leaf emergence

Days required for the first leaf emergence of hippeastrum varied significantly with different levels of N, P & K application (Table 1). It appears that the earliest leaf

emergence (15.3 days) commenced with the treatment T_4 ($N_{300}P_{400}K_{300}$) and T_{13} (cowdung 10 tha^{-1}) and are statistically similar with T_3 ($N_{200}P_{400}K_{300}$) while 36.0 days were required for treatment T_9 ($N_{200}P_{400}K_0$). Thus, higher dose of N, P & K combination and cowdung alone were most suitable for the first leaf emergence of hippeastrum bulb, but in absence of K and other combination of N and P it took longer time for the first leaf emergence.

Leaves per plant

Active leaf number was counted and highly significant variation was found due to different levels of N, P & K treatment (Table 1). Leaf number varied from 5.40 to 8.60 per plant. The highest number of leaves (8.60) was recorded with the treatment T_3 ($N_{200}P_{400}K_{300}$) which was statistically similar with T_{11} ($N_{200}P_{400}K_{200}$), T_{12} ($N_{200}P_{400}K_{400}$), T_5 ($N_{200}P_0K_{300}$) and T_{10} ($N_{200}P_{400}K_{100}$). The lowest number of leaves per plant was noted with the control T_{14} ($N_0P_0K_0$). Similar results were also reported by Dash *et al.* (2003) and Jaggi (2005) in onion. Shah *et al.* (1984) observed that higher doses of N, P & K encouraged producing higher number of leaves per plant in gladiolus.

Plant height

Plant height of hippeastrum was measured after flowering. It was observed that plant height was influenced significantly by different levels of N, P & K application (Table 1). The tallest plant (63.8 cm) was recorded in T_4 ($N_{300}P_{400}K_{300}$) and the shortest plant (48.1 cm) was found in control (T_{14}). The maximum vegetative growth was recorded with the application of higher levels of nitrogen. Shah *et al.* (1984) also found in gladiolus that increasing N rates influenced the plant growth. Maximum vegetative growth in tuberose with the highest dose of 300 kg Nha^{-1} was recorded by Yadav *et al.* (1985).

Leaf breadth

Leaf breadth of hippeastrum varied from 4.13cm to 5.40 cm over the treatments (Table 1). The broadest leaf (5.40cm) was recorded with T_3 ($N_{200}P_{400}K_{300}$) which was followed by and statistically similar with T_{10} ($N_{200}P_{400}K_{100}$), T_{11} ($N_{200}P_{400}K_{200}$), T_7 ($N_{200}P_{300}K_{300}$), T_{13} (cowdung @ 10 tha^{-1}), T_2 ($N_{100}P_{400}K_{300}$) and T_6 ($N_{200}P_{200}K_{300}$). The narrowest leaf (4.13cm) was produced from the control treatment ($N_0P_0K_0$) produced. This result is in agreement with that of Prodhan *et al.* (2004) reporting that combined application of N at 400 kgha^{-1} and K at 300 kgha^{-1} showed the highest values for leaf area. Low levels of nitrogen and phosphorus reduced the growth and affected flowering in tulip, as reported by Cheal and Winsor (1986).

Plantlets bulb^{-1}

Plantlets per bulb of hippeastrum were counted at the time of bulb lifting from the plot. Highly significant variation occurred in plantlets per bulb due to different N, P & K treatments (Table 1). The maximum plantlets per bulb (3.07) was obtained from the treatment T_3 ($N_{200}P_{400}K_{300}$) followed by T_{12} ($N_{200}P_{400}K_{400}$), T_{13} (cowdung @ 10 tha^{-1}) and T_{10} ($N_{200}P_{400}K_{100}$). The T_{14} (control) treatment produced the minimum (1.60) plantlets per bulb; it was statistically similar to T_1 ($N_0P_{400}K_{300}$), T_2 ($N_{100}P_{400}K_{300}$) and T_{11} ($N_{200}P_{400}K_{200}$). Similar result was also reported by Jana and Bose (1980) in hippeastrum where they obtained the maximum yield of bulbs, bulb-lets and flowers with a combined application of 200 kg N, 400 kg P and 200 kg K per hectare.

Table 1. Growth characteristics of hippeastrum under different levels of N, P & K application

Treat-ment	Treatment combination (kg ha^{-1})			Days to first leaf emergence	Leaves plant^{-1} (no.)	Plant height (cm)	Leaf breadth (cm)	Plantlets bulb^{-1} (no.)
	N	P	K					
T_1	0	400	300	27.0 cd	6.00 bc	51.5 def	4.67 bc	1.67 c
T_2	100	400	300	23.7 de	6.40 bc	50.3 ef	4.93 ab	1.73 c
T_3	200	400	300	16.0 gh	8.60 a	55.5 bcd	5.40 a	3.07 a
T_4	300	400	300	15.3 h	6.80 bc	63.8 a	4.67 bc	2.00 bc
T_5	200	0	300	29.0 bc	7.40 ab	55.9 bcd	4.80 ab	2.13 bc
T_6	200	200	300	31.7 b	6.47 bc	54.8 b-e	4.93 ab	1.80 bc
T_7	200	300	300	23.3 e	5.87 bc	53.7 cde	5.00 ab	2.2 bc
T_8	200	500	300	19.3 fg	6.40 bc	57.2 bc	4.53 bc	2.07 bc
T_9	200	400	0	36.0 a	6.93 abc	53.4 cde	4.60 bc	2.20 bc
T_{10}	200	400	100	30.3 bc	7.00 abc	51.6 def	5.07 ab	2.33abc
T_{11}	200	400	200	22.3 ef	7.67 ab	55.3 b-e	5.00 ab	1.80 c
T_{12}	200	400	400	20.3 ef	7.47 ab	59.5 ab	4.67 bc	2.60 ab
T_{13}	Only cowdung 10 t/ha.			15.3 h	6.53 bc	51.6 def	5.00 ab	2.40 abc
T_{14}	control			29.0 bc	5.40 c	48.1 f	4.13 c	1.60 c
Level of significance				**	**	**	*	**
CV(%)				5.71	9.58	3.28	6.81	13.54

Means having same letter(s) and without letter(s) in a column are not significant by DMRT. ** indicates significant at 1% level, * indicates significant at 5% level.

Days to flower scape emergence

Days taken to flower scape emergence of hippeastrum was significantly affected by different levels of NPK fertilizers and cowdung alone (Table 2). The earliest

flower scape emerged at 172.3 days after planting (DAP) in T_3 ($N_{200}P_{400}K_{300}$) and was statistically at par with T_6, T_{11}, T_{12}, T_{13}, T_4, T_5, T_3 and T_2 while late flower scape emergence at 194.3 DAP was found with control i.e. ($N_0P_0K_0$) which was statistically similar with treatment T_7 ($N_{200}P_{300}K_{300}$), T_8 ($N_{200}P_{500}K_{300}$) and T_9 ($N_{200}P_{400}K_0$). Jana (1995) from microscopical studies on hippeastrum reported that the application of fertilizer needs to be completed by the onset of flower initiation which happened to be 120 days after planting of bulbs.

Days to flower bud appearance

Time required to flower bud appearance of hippeastrum varied significantly with different N, P & K treatments (Table 2). Early flower bud (185.3 DAP) was found in T_3 ($N_{200}P_{400}K_{300}$) followed by T_{12} ($N_{200}P_{400}K4_{00}$) and T_6 ($N_{200}P_{200}K_{300}$). The plant in control treatment ($N_0P_0K_0$) took the maximum time (207.3 DAP) to produce flower bud in the experiment. This result is an agreement with the findings of Bhattacharjee (1981) who found that application of 200 kg of N per hectare induced early flowering in gladiolus cv. 'Friendship' over lower doses whereas in the cultivar 'Vink's Glory' an addition of 500 kg Nha^{-1} resulted in delayed flowering (Shah *et al.,* 1984).

Days to first flower open

Non-significant difference was observed in case of first flower open of hippeastrum by different levels of N,P & K fertilizers (Table 2). However, it can be revealed that days to the first flower open was the earliest (189.3 DAP) in T_3 ($N_{200}P_{400}K_{300}$) which was closely followed by T_{12} ($N_{200}P_{400}K_{400}$) and T_6 ($N_{200}P_{200}K_{300}$). The control ($N_0P_0K_0$) plant took the longest time (212.0 DAP) for the first flower open. The results are in agreement with the findings of Singh and Akhilesh (2003) who explained earlier flowering with K at the rate of 90 and 120 $kgha^{-1}$.

Flower scape per plant

Flower scape per plant of hippeastrum was counted at the time of flower harvested. Significant variation was observed in the number of flower scape per plant due to different levels of N,P & K fertilizers and cowdung alone (Table 2). The highest number of flower scape per plant (2.07) was observed in T_3 ($N_{200}P_{400}K_{300}$) which was closely followed by T_{13} (cowdung @ 10 tha^{-1}) and the lowest (1.00) was in the control ($N_0P_0K_0$). In a sand culture experiment, Bose *et al.* (1980) reported that treatment with high level of nitrogen caused maximum plant growth and number of flower stalks and flowers. Treatment with phosphorus at the rate of 400 kg per hectare significantly increased the number of flower stalks and flowers as reported by Jana and Bose (1980).

Table 2. Flowering characteristics of hippeastrum under different levels of nitrogen, phosphorus and potassium application

Treatment	Treatment combinations ($kgha^{-1}$)			Days to flower scape emergence	Days to flower bud appearance	Days to first flower open	Flower scapeplant^{-1} (no.)
	N	P	K				
T_1	0	400	300	184.0 a-d	198.0 a-d	204.0	1.07 e
T_2	100	400	300	182.3 a-d	196.0 a-d	200.0	1.27 cde
T_3	200	400	300	172.3 d	185.3 d	189.3	2.07 a
T_4	300	400	300	180.7 a-d	193.7 a-d	198.7	1.93 abc
T_5	200	0	300	181.3 a-d	192.3 a-d	196.7	1.07 e
T_6	200	200	300	176.7 cd	189.3 bcd	193.7	1.33 b-e
T_7	200	300	300	192.7 ab	207.0 a	211.7	1.40 a-e
T_8	200	500	300	190.7 abc	205.0 ab	208.7	1.60 a-e
T_9	200	400	0	190.7 abc	203.3 abc	207.3	1.13 de
T_{10}	200	400	100	188.7 abc	201.0 a-d	207.3	1.60 a-e
T_{11}	200	400	200	179.7 a-d	192.7 a-d	198.0	1.20 de
T_{12}	200	400	400	176.7 bcd	187.7 cd	192.7	1.80 a-d
T_{13}	Only cowdung 10 t/ha.			180.0 a-d	194.3 a-d	196.0	2.00 ab
T_{14}	control			194.3 a	207.3 a	212.0	1.00 e
Level of significance				*	*	ns	**
CV (%)				4.34	4.17	4.39	17.34

Means having same letter(s) and without letter(s) in a column are not significant by DMRT.
** indicates significant at 1% level, * indicates significant at 5% level and 'ns' indicates non-significant.

Flowers per scape

Highly significant difference was observed in number of flowers per scape of hippeastrum due to different levels of N, P & K fertilizers (Table 3). The maximum flowers per scape (4.20) was produced by the plant in T_3 ($N_{200}P_{400}K_{300}$) which was statistically similar with T_{13} (cowdung @ 10 tha^{-1}), T_8 ($N_{200}P_{500}K_{300}$) and T_{11} ($N_{200}P_{400}K_{200}$) whereas, the minimum (2.00) flowers per scape was noted with no N, P & K application ($N_0P_0K_0$). The result is in agreement with the findings of Bhattacharjee *et al.* (1982) who stated that the number of flowers per plant increased with the application of NPK.

Flower length

A noticeable variation in the length of flower was recorded due to application of different levels of N, P & K and cowdung application alone (Table 3). The longest

flower (14.0 cm) was measured with T_3 ($N_{200}P_{400}K_{300}$) which was statistically similar with that of T_{13} (cowdung @10 tha^{-1}), T_{12} ($N_{200}P_{400}K_{400}$) and T_{10} ($N_{200}P_{400}K_{100}$). The shortest flower (10.67 cm) was produced with control ($N_0P_0K_0$). Similar result was also reported by Jana and Bose (1980) who observed that the number of flowers and their size (diameter and length) were improved under high levels of nitrogen and phosphorus.

Flower diameter

Flower diameter was significantly influenced by different levels of N, P & K supplement (Table 3). The biggest flower diameter of 13.83 cm was found in plants grown under T_3 ($N_{200}P_{400}K_{300}$) which was statistically similar with T_{13} (cowdung @ 10 tha^{-1}) and T_{12} ($N_{200}P_{400}K_{400}$). The smallest flower diameter of 10.00 cm was recorded with the control treatment. This might be due to higher dose of nitrogen in combination with optimum dose of potassium and phosphorus leading to the better growth and development of plants resulted in high flower diameter in T_3 treatment. This result is in agreement with the findings of Singh *et al.* (1965) and Bhattacharjee *et al.* (1982).

Flower scape length

Flower scape length of hippeastrum was measured at the time of harvesting. Flower scape length was influenced significantly by different levels of N P K fertilizers and cowdung alone (Table 3).The longest flower scape (43.3 cm) was recorded in T_3 ($N_{200}P_{400}K_{300}$) and the shortest flower scape (26.0cm) was produced by control ($N_0P_0K_0$) treatment. This might be due to fact that increasing N rates delayed flowering but influenced plant growth in terms the number of leavesplant^{-1}, spike length and number of floretsspike^{-1}. The results are in close agreement with the findings of Bhattacharjee (1981) who reported that 200 kg Nha^{-1} increased flower spike length of tuberose. Similar results were also reported by Bankar and Mukhopadhyay (1980) in tuberose and Gowda *et al.* (1988) in gladiolus.

Flower scape diameter

Different levels of N, P & K fertilizers exhibited significant variation on flower scape diameter of hippeastrum (Table 3). The maximum value for flower scape diameter (29.4cm) was obtained with T_3 ($N_{200}P_{400}K_{300}$) and the minimum (20.00 cm) was recorded with plants that grown without application of N, P & K fertilizers. Jana and Bose (1980) observed that bulbs grown under $N_{200}P_{400}$ produced the widest flower stalks, whereas the narrowest flower stalk appeared in plants under N_0P_0 which is comparable with the present study.

Table 3. Effect of N, P & K on flower and flower scape characteristics of hippeastrum

Treat-ment	Treatment combinations (kgha^{-1})			Flowers Scape^{-1} (no.)	Flower length (cm)	Flower diameter (cm)	Flower scape length (cm)	Flower scape diameter (mm)
	N	P	K					
T_1	0	400	300	2.13 d	11.00 gh	10.17 hi	32.00 b	23.57 b
T_2	100	400	300	2.73 bcd	11.17 fgh	11.50 d-g	26.00 b	23.85 b
T_3	200	400	300	4.20 a	14.00 a	13.83 a	43.33 a	29.37 a
T_4	300	400	300	3.67 ab	12.67 bcd	12.17 c-f	26.00 b	22.29 bc
T_5	200	0	300	2.67 bcd	11.50 e-h	10.83 ghi	29.67 b	23.04 b
T_6	200	200	300	3.53 ab	12.00 c-g	11.33 e-h	27.33 b	21.82 bc
T_7	200	300	300	3.20 abc	12.17 b-f	12.17 c-f	31.00 b	23.81 b
T_8	200	500	300	4.00 a	12.50 b-e	11.83 c-g	31.00 b	23.83 b
T_9	200	400	0	2.40 cd	11.67 d-h	11.17 f-i	33.00 b	24.00 b
T_{10}	200	400	100	3.60 ab	13.00 abc	12.67 a-d	33.00 b	24.26 b
T_{11}	200	400	200	3.87 a	12.50 b-e	12.50 b-e	30.83 b	24.12 b
T_{12}	200	400	400	3.67 ab	13.17 ab	12.83 abc	29.17 b	23.18 b
T_{13}	Only cowdung @10 t/ha.			4.07 a	13.83 a	13.50 ab	31.50 b	23.60 b
T_{14}	control			2.00 d	10.67 h	10.00 i	26.67 b	20.00 c
Level of significance				**	**	**	**	**
CV (%)				11.38	3.11	3.84	8.11	4.24

Means having same letter(s) in a column are not significant by DMRT. ** indicates significant at 1% level.

Flowering duration

Highly significant variation was observed in freshness of flowers produced under different levels of N, P & K application and cowdung alone (Fig. 1). It was found that flowers produced in T_3 ($N_{200}P_{400}K_{300}$) remained fresh for longer period (10.7 days) which was statistically varied with other treatments except the treatments T_7 ($N_{200}P_{300}K_{300}$) and T_{13} (Cowdung @ 10tha^{-1}). The shelf life of flowers was the lowest (4.7 days) in control. The increased flowering duration could be attributed to the increased phosphorus levels in the experiment. Similar findings were also observed by Bhattacharjee *et al.* (1982) in hippeastrum where higher duration from full bloom to flower deterioration was observed in plants grown in increased dose (400 kgha^{-1}) of phosphorus.
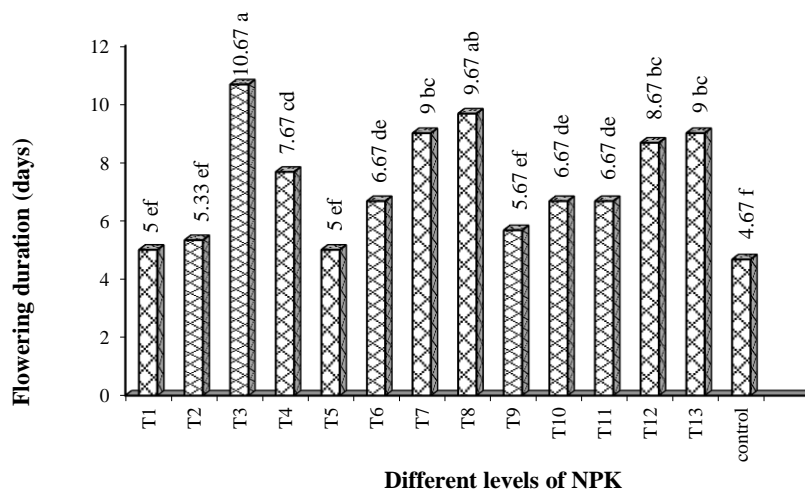
Fig. 1. Effect of different levels of NPK on flowering duration (days) of hippeastrum.

$T_1 = N_0P_{400}K_{300}$, $T_2 = N_{100}P_{400}K_{300}$, $T_3 = N_{200}P_{400}K_{300}$, $T_4 = N_{300}P_{400}K_{300}$, $T_5 = N_{200}P_0K_{300}$, $T_6 = N_{200}P_{200}K_{300}$, $T_7 = N_{200}P_{300}K_{300}$, $T_8 = N_{200}P_{500}K_{300}$, $T_9 = N_{200}P_{400}K_0$, $T_{10} = N_{200}P_{400}K_{100}$, $T_{11} = N_{200}P_{400}K_{200}$, $T_{12} = N_{200}P_{400}K_{400}$, T_{13} = Cowdung @ 10t/ha. and T_{14} = Control.

Conclusion

Combined application of N, P & K significantly influenced the growth and flowering of hippeastrum. Application at the rate of 200 kg N, 400 kg P and 300 kg K per hectare performed the best in terms of growth and flower production of hippeastrum. Thus this rate can be recommended for the healthy growth and high quality flower production of hippeastrum in Salna Series of Shallow Red Brown Terrace Soils of Madhupur Tract.

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