Effect of Spacing, Nitrogen and Phosphorus on Growth, Flowering and Yield of Heliconia cv. Golden Torch under Nethouse

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Abstract

The present investigation was undertaken under net house conditions with an objective to study the effect of spacing, nitrogen and phosphorous on growth, flowering and yield of heliconia cv. Golden Torch at Floriculture Research Scheme, ASPEE College of Horticulture and Forestry, NAU, Navsari, Gujarat, India during the year 2007-08. The experiment was laid out in a Randomized Block Design with Factorial concept (FRBD) with three replications and twenty-four treatment combinations, comprising of two levels of spacing ($S_1$=50 x 40 cm and $S_2$=75 x 40 cm), four levels of nitrogen ($N_0$=00, $N_1$=100, $N_2$=200 and $N_3$=300 kg N/ha) and three levels of phosphorus ($P_0$=00, $P_1$=50 and $P_2$=100 kg P$_2$O$_5$/ha). The potassium @ 100 kg/ha and FYM @ 5 kg/m$^2$ were applied as a common dose. The collected data was analysed by adopting 'Analysis of Variance' technique and the experimental results revealed that, among spacing treatments, planting of heliconia at a spacing of 50 x 40 cm ($S_1$) enhanced growth, yield and quality parameters as compared to those planted at 75 x 40 cm ($S_2$). Whereas, in case of nitrogen and phosphorus fertilizers, application of 300 kg N/ha and 100 kg P$_2$O$_5$/ha, respectively were found to significantly increased the growth, yield and quality parameters as compared to other levels. Among the different interactions, the significant effect of $S \times N$ interaction for number of suckers per clump at 9 MAP, number of flowers per hectare and flower yield per hectare was obtained with the treatment combination of $S_1N_3$. Similarly, $S \times P$ interaction was found significant for number of flowers per hectare which were higher under $S_1P_2$. Likewise, the significant effect of $N \times P$ interaction was also obtained for number of suckers per clump, number of bracts per flower and flower yield per hectare with better shelf life with the treatment combination of $N_3P_2$. Hence it can be concluded that, for obtaining higher yield and flower quality, heliconia cv. Golden Torch should be planted at 50 x 40 cm spacing and fertilize with 300:100:100 kg NPK per hectare.

Keywords: cv. Golden Torch, Heliconia, Nitrogen and Phosphorous, Spacing

1. Introduction

Heliconia (Heliconia spp.) belongs to family Heliconiaceae and is amongst the most attractive of all the exotic tropical flowering plants. They are gaining popularity as a commercial cut flower due to diversity in their colour and form. The flower colour of many species ranges from pink, red, and orange to yellow. Heliconias are native to Central and South America, the Caribbean Islands and some of the islands of South Pacific. India has an annual production of about one lakh stems which accounts for less than one per cent of the total production of the country and the fifty per cent of this production comes from West Godavari district of Andhra Pradesh. It is also gaining popularity as commercial flower crop in North-Eastern region states, Kerala, parts of Tamil Nadu, Karnataka, Maharashtra, West Bengal and is well adapted to all major agro climatic zones of the country and can be cultivated up to the height of 3,000 to 4,000 feet above mean sea level. 'Golden Torch' (synonym, Parrot’s flower) is most widely cultivated variety bearing especially large golden boat shaped bracts with golden yellow flowers and is used in flower arrangement, as a cut flower, as a potted plant and in landscaping. The tropical, humid and heavy
rainfall region of South Gujarat and medium black soils are conducive for cultivation of heliconia. Out of various factors responsible for successful growing of heliconia, planting at proper spacing and application of manures and fertilizers are one of the most important factors. As the crop is newly introduced in India, not much research work has been done to standardize package of practices and it is still in its infancy and there is need to standardize the optimum agro-techniques to get higher yield per unit area and therefore, the present investigation was being taken under net house in order to study the effect of spacing and nutrition on growth, flowering and yield of heliconia cv. Golden Torch.

2. Material and Methods

The present experiment was carried out during 2007-08 at Floriculture Research Scheme, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari, Gujarat, India. The climate of this region is typical tropical, characterized by fairly hot summer, moderately cold winter and most humid and warm monsoon. The soil of Navsari campus is medium black, which is very deep, rich in organic matter and potash, having good water holding capacity and reasonably suitable for cultivation of heliconia. The rhizomes of heliconia cv. Golden Torch were procured from Paradise Plant Nursery, P.O.-Peringhavu, Thrissur-18, Kerala State. The experiment was laid out in a Randomized Block Design with Factorial concept (FRBD) with three replications and twenty-four treatment combinations, comprising of two levels of spacing (\(S_1=50 \times 40 \, \text{cm}\) and \(S_2=75 \times 40 \, \text{cm}\)), four levels of nitrogen (\(N_0=00, \, N_1=100, \, N_2=200\) and \(N_3=300 \, \text{kg} \, \text{N/ha}\)) and three levels of phosphorus (\(P_0=00, \, P_1=50\) and \(P_2=100 \, \text{kg} \, \text{P}_2\text{O}_5/\text{ha}\)). The potassium @ 100 kg/ha and FYM @ 5 kg/m\(^2\) were applied as a common dose. The land was prepared by ploughing followed by harrowing and levelling and was bring to fine tilth. The crop was grown under 50 per cent shade net house having a size of 50 m length, 30 m width, and 3.5 m height and was covered with net from all the sides. Irrigation was given immediately after planting with the help of water can for 2 months and then was applied through pipe or as flooding at an interval of 8 to 10 days depending upon soil moisture condition. No special care was needed in this crop, drenching of 0.1 per cent Bavistin at a rate of 100 ml per plant was done in wilted plants along with spraying of Diathane M-45 (0.2%) and Streptocyclin (0.1%) for controlling leaf spot and bacterial wilt. However, no any serious pests were observed during the experiment. The crop responses to the different treatments under present investigation were evaluated on the basis of vegetative, flowering, yield and quality parameters. The collected data was analysed by adopting ‘Analysis of Variance’ technique as described by.

3. Result and Discussion

In the present investigation, the results obtained are discussed under following headings.

3.1 Effect of Spacing, Nitrogen and Phosphorus on Growth Parameters

The data pertaining to growth parameters of heliconia are presented in Tables 1 and 2 and the results are interpreted under following headings.

3.1.1 Plant Height

It is evident from Table 1 that, the effect of spacing was found non-significant on plant height at 3 MAP whereas the effect was significant at 6, 9 and 12 MAP and significantly taller plants (60.41, 121.83 and 164.03 cm, respectively) were observed under closer spacing of 50 x 40 cm (\(S_1\)) as compared to \(S_2\). Whereas, application of nitrogen significantly influenced the plant height in heliconia after 3, 6, 9 and 12 months of planting and it was found significantly superior (37.80, 65.44, 129.11 and 173.33 cm, respectively) with higher level of nitrogen at 300 kg N/ha (\(N_3\)) but was at par with \(N_2\) followed by \(N_1\). In case of phosphorus, the effect on plant height at 3 MAP was found non-significant but was significant at 6, 9 and 12 MAP where \(P_2\) produced significantly taller plants of 63.25, 125.29 and 167.04 cm, respectively. All the interactions were found to be non-significant with respect to plant height at 3, 6, 9 and 12 MAP.

3.1.2 Number of Suckers Per Clump

The significant difference was found in case of number of suckers per clump at 3 and 6 MAP (Table 1). The rhizomes planted at closer spacing (\(S_1\)) recorded significantly higher number of suckers (1.59 and 3.50 at 3 and 6 MAP, respectively) as compared to wider spacing (\(S_2\)). Further the effect due to the spacing was found non-significant at 9 MAP but at 12 MAP, wider spacing (\(S_2\)) was found significantly superior over closer spacing (\(S_1\)).
which recorded 8.03 numbers of suckers per clump. Moreover, the data presented in Table 1 also indicated that different levels of nitrogen significantly influence the sucker production per clump at 3, 6, 9 and 12 MAP. With the increased in dose of nitrogen, concurrent linear and significant increase in the sucker production was observed. Significantly maximum number of suckers per clump (1.76, 4.22, 5.98 and 9.78, respectively) were produced with the application of 300 kg N/ha (N₃). In case of phosphorous levels, number of suckers per clump at 3, 6, 9 and 12 MAP found to be increased with the increase in levels, where P₂ (100 kg P₂O₅/ha) produced significantly maximum number of suckers (1.65, 3.86, 5.50 and 8.79, respectively). The interaction effect between spacing, nitrogen and phosphorus with respect to sucker production at 3 MAP was found to be non-significant, but the interaction effect of N x P (Table 2) was found significant at 6, 9 and 12 MAP where N₂P₂ combination recorded higher values of 5.0, 7.24 and 11.50, respectively. Likewise, S x N interaction was also found significant only at 9 MAP where treatment combination of S₁N₃ produced significantly maximum number (6.16) of suckers and was at par with S₂N₃.

Table 1. Effect of spacing, nitrogen, phosphorus and their interaction on growth parameters of heliconia cv. Golden Torch

| Treatments | Plant height | Number of suckers per clump | Number of leaves per longest shoot | Leaf area at 6 MAP (cm²) |
|------------|--------------|-----------------------------|-----------------------------------|------------------------|
|            | 3 MAP (cm)  | 6 MAP (cm)                  | 9 MAP (cm)                        | 12 MAP (cm)            |
|            | 3 MAP | 6 MAP | 9 MAP | 12 MAP | 3 MAP | 6 MAP | 9 MAP | 12 MAP | 3 MAP | 6 MAP | 9 MAP | 12 MAP |
| SPACING (S) |       |       |       |       |       |       |       |       |       |       |       |       |       |
| S₁ = 50 x 40 cm | 36.01 | 60.41 | 121.83 | 164.03 | 1.59 | 3.50 | 4.66 | 7.48 | 2.91 | 4.95 | 6.15 | 6.99 | 305.24 |
| S₂ = 75 x 40 cm | 35.49 | 53.63 | 114.69 | 155.50 | 1.44 | 3.16 | 4.81 | 8.03 | 2.79 | 4.61 | 5.78 | 6.35 | 279.90 |
| S. Em. ± | 0.65 | 1.27 | 2.42 | 2.97 | 0.02 | 0.06 | 0.10 | 0.13 | 0.06 | 0.10 | 0.13 | 0.16 | 4.72 |
| C.D. at 5% | NS | 3.62 | 6.88 | 8.47 | 0.06 | 0.18 | 0.28 | 0.37 | 0.13 | 0.22 | 13.45 |
| NITROGEN LEVELS (N) |       |       |       |       |       |       |       |       |       |       |       |       |       |
| N₀ = 00 kg/ha | 32.35 | 50.19 | 99.94 | 140.22 | 1.16 | 2.24 | 3.24 | 5.29 | 2.33 | 4.39 | 5.22 | 5.83 | 259.79 |
| N₁ = 100 kg/ha | 36.28 | 53.73 | 118.11 | 158.50 | 1.48 | 3.19 | 4.46 | 7.58 | 2.75 | 4.61 | 5.78 | 6.35 | 293.37 |
| N₂ = 200 kg/ha | 36.58 | 58.72 | 125.89 | 167.00 | 1.65 | 3.67 | 5.27 | 8.37 | 3.00 | 4.81 | 6.25 | 6.90 | 314.40 |
| N₃ = 300 kg/ha | 37.80 | 65.44 | 129.11 | 173.33 | 1.76 | 4.22 | 5.98 | 9.78 | 3.33 | 5.28 | 6.39 | 7.32 | 302.72 |
| S. Em. ± | 0.92 | 1.80 | 3.42 | 4.21 | 0.03 | 0.09 | 0.14 | 0.19 | 0.08 | 0.14 | 0.18 | 0.22 | 6.68 |
| C.D. at 5% | 2.62 | 5.12 | 9.74 | 11.98 | 0.09 | 0.25 | 0.39 | 0.53 | 0.23 | 0.39 | 0.53 | 0.64 | 19.02 |
| PHOSPHORUS LEVELS (P) |       |       |       |       |       |       |       |       |       |       |       |       |       |
| P₀ = 00 kg/ha | 34.20 | 50.74 | 111.00 | 153.04 | 1.35 | 2.71 | 3.85 | 6.49 | 2.60 | 4.53 | 5.52 | 6.31 | 270.70 |
| P₁ = 50 kg/ha | 36.27 | 57.34 | 118.50 | 159.21 | 1.54 | 3.42 | 4.86 | 7.98 | 2.96 | 4.81 | 6.00 | 6.69 | 297.78 |
| P₂ = 100 kg/ha | 36.79 | 63.25 | 125.29 | 167.04 | 1.65 | 3.86 | 5.50 | 8.79 | 3.00 | 5.00 | 6.38 | 7.01 | 309.23 |
| S. Em. ± | 0.80 | 1.56 | 2.96 | 3.64 | 0.03 | 0.08 | 0.12 | 0.16 | 0.07 | 0.12 | 0.16 | 0.19 | 5.78 |
| C.D. at 5% | NS | 4.43 | 8.43 | 10.38 | 0.08 | 0.22 | 0.34 | 0.46 | 0.20 | 0.34 | 0.46 | 0.55 | 16.47 |
| INTERACTION EFFECT |       |       |       |       |       |       |       |       |       |       |       |       |       |
| S x N | NS | NS | NS | NS | NS | NS | S | NS | NS | NS | NS | NS | NS |
| S x P | NS | NS | NS | NS | NS | NS | S | NS | NS | NS | NS | NS | NS |
| N x P | NS | NS | NS | NS | NS | S | S | S | NS | NS | NS | NS | NS |
| S x N x P | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| C.V. % | 10.92 | 13.36 | 12.26 | 11.17 | 8.79 | 11.16 | 12.41 | 10.20 | 12.07 | 12.21 | 13.15 | 14.29 | 9.68 |
3.1.3 Number of Leaves Per Longest Shoot

The effect of spacing was found non-significant on number of leaves per longest shoot at 3 MAP (Table 1) but the effect was significant at 6, 9 and 12 MAP. Significantly maximum numbers of leaves (4.95, 6.15 and 6.99, respectively) were obtained under closer spacing ($S_1$). Significant differences for leaves production due to application of different levels of nitrogen was also found at 3, 6, 9 and 12 MAP. Among them, application of 300 kg N/ha ($N_3$) resulted in maximum number of leaves (3.33, 5.28, 6.39 and 7.32, respectively), however it was at par with $N_1$ level at 9 and 12 MAP. Number of leaves per longest shoot at 3, 6, 9 and 12 MAP were also found to be increased with increased in phosphorus levels and $P_2$ (100 kg/ha) produced significantly maximum number of leaves (3.00, 5.00, 6.38 and 7.01, respectively) but was at par with $P_1$ during whole growth period. The interaction effects of spacing, nitrogen and phosphorus were failed to show any significant effect on number of leaves per longest shoot at 3, 6, 9 and 12 MAP.

4. Leaf Area

Leaf area was measured from the third leaf of longest shoot from each tagged plant at 6 MAP and the data is presented in Table 1. The leaf area varied significantly with different spacing and was recorded significantly maximum (305.24 cm$^2$) in $S_1$, while application of nitrogen at 200 kg/ha and phosphorus at 100 kg/ha resulted in significantly maximum values of 314.40 and 309.23 cm$^2$, respectively but it was at par to $N_3$ followed by $N_1$ in case of nitrogen and $P_1$ for phosphorus. The interaction effects were found non-significant with respect to leaf area.

4. Effect of Spacing, Nitrogen and Phosphorus on Flowering, Yield and Quality Parameters

The data pertaining to flowering, yield and quality parameters are presented in Tables 3, 4 and 5 and the results are interpreted under following headings.

4.1 Effect Due to Spacing

Significant results were obtained for all the parameters

| Treatments | $N \times P$ | $S \times N$ |
|------------|-------------|-------------|
|            | $P_0$ | $P_1$ | $P_2$ | $S_0$ | $S_1$ | $S_2$ |
| $N_0$      | 1.67  | 2.35  | 2.70  | 3.00  | 3.32  | 3.42  | 5.12  | 5.25  | 5.50  | 3.29  | 3.20  |
| $N_1$      | 2.96  | 3.10  | 3.50  | 3.73  | 4.50  | 5.15  | 6.08  | 8.00  | 8.67  | 4.06  | 4.87  |
| $N_2$      | 3.05  | 3.70  | 4.25  | 4.11  | 5.50  | 6.19  | 7.10  | 8.50  | 9.50  | 5.15  | 5.39  |
| $N_3$      | 3.15  | 4.51  | 5.00  | 4.57  | 6.13  | 7.24  | 7.67  | 10.17 | 11.50 | 6.16  | 5.80  |

S. Em. $+$ 0.15 0.24 0.32 0.20
C.D. at 5% 0.43 0.68 0.92 0.56
under study. Where, significantly minimum number of days (214.00) for first flower appearance, maximum spike length (119.65 cm), stalk length (43.89 cm), rachis length (22.77 cm), number of bracts per flower (4.89), length of lowermost bract (18.79 cm), diameter of lowermost bract (2.17 cm), shelf life (21.92 days), vase life (10.29 days), number of flowers per clump (4.57) and flower yield per hectare (2.3 lakhs nos.) were obtained under closer spacing (S₁) as compared to wider spacing (S₂) (Table 3). The superiority of S₁ with respect to flowering, yield and quality parameters might be due to better growth of plants in terms of biomass production which resulted in adequate supply of photosynthates for development of sink. Whereas, greater flower yield per hectare might be due to the fact that more number of plants were accommodated in S₁. The results are in conformity of those obtained by ⁷ and ⁸ in heliconia.

4.2 Effect Due to Nitrogen
The difference due to different levels of nitrogen was found significant, where N₁ (300 kg/ha) registered significantly minimum number of days for first flowering (204.17), larger spikes (128.83 cm), maximum length of flower stalk and rachis (49.50 cm and 23.26 cm, respectively), more number of bracts per flower (5.72), maximum length and diameter of lowermost bract (19.68 cm and 2.21 cm, respectively), greater shelf and vase life (24.44 days and 11.75 days, respectively), higher number of flowers per clump and per hectare (5.83 nos. and 2.6 lakhs nos., respectively) but it was at par with N₂ in case of days to first flowering, spike length, rachis length, length and diameter of lowermost bract (Table 3). This was largely attributed due to better growth of plants in terms of biomass production which results in adequate supply of photosynthates for development of sink and thereby more vegetative growth due to increase in the amount of assimilates that are required for enhancement of flowering. The number of days required for flowering decreased with increasing levels of nitrogen. Similar results were also observed by ⁵ in tuberose. Increase in length of spike and rachis with higher level of nitrogen may be due to higher supply of nitrogen which might have increased the amount of assimilates that are needed for improvement in length of spike and rachis. These results are in accordance with the findings of ⁶ and ⁷ in tuberose.

4.3 Effect Due to Phosphorous
Looking to the effect of phosphorus (Table 3) on days to first flower appearance, significantly minimum values (210.00 days) were recorded under P₁ (100 kg/ha) whereas, significantly maximum length of spikes, stalks and rachis (125.47 cm, 45.33 cm and 22.33 cm, respectively), more of bracts (5.08), longer bracts (18.92 cm), greater bract diameter (2.20 cm), maximum shelf and vase life (24.13 and 10.81 days, respectively), more number of flowers per clump (4.94) and maximum number of flowers per hectare (2.2 lakhs) were recorded with the application of 100 kg P₂O₅/ha (P₂) and it was statistically on the same bar with P₁ for days to flower appearance, stalk length, rachis length, length and diameter of lowermost bract. The increased biomass production due to higher phosphorus level may be contributed to the best results for all the flowering parameters under study. The superiority of 100 kg P₂O₅/ha for minimum days to flowering, maximum flower stalk length and rachis length, higher number of flowers per m² were also reported by ⁹ in heliconia. The results of the experiments are also in conformity of those obtained by ⁷ and ⁸.

4.4 Interaction Effects
All the interactions of spacing, nitrogen and phosphorus were failed to show any significant effect on number of days to first flowering, spike length, stalk length, rachis length, length and diameter of lowermost bract and vase life in heliconia. However, in case of S x N interaction (Table 4), S₁N₁ recorded significantly maximum number of flowers per clump and per hectare (6.33 and 3.3 lakhs, respectively). Further, significantly higher flower yield of 2.7 lakhs per hectare was produced under S₁P₁ treatment combination (Table 4). Likewise, interaction effect of N x P was also found significant with respect to number of bracts per flower, shelf life and number of flowers per hectare, where treatment combination of N₃P₂ recorded significantly higher values of 6.67, 30.17 days and 3.1 lakhs, respectively (Table 5). Increased in flowers yield under closer spacing may be due to more plant population per unit area. The result also showed that the combined application of nitrogen and phosphorus increased flower yield and its attributes which might be due to balanced utilization of nutrients, further the ill effect of nitrogen is also eliminated due to combined application of nitrogen with higher level of phosphorus.
Table 3. Effect of spacing, nitrogen, phosphorous and their interaction on flowering, yield and quality parameters of heliconia

| Treatments | Days to first flower appearance | Spike length (cm) | Stalk length (cm) | Rachis length (cm) | No. of bracts/flower | Length of lowermost bract (cm) | Diameter of lowermost bract (cm) | Shelf life (days) | Vase life (days) | No. of flowers / clump | No. of flowers / ha (lakh nos.) |
|------------|---------------------|-------------------|------------------|-------------------|---------------------|-----------------------------|-----------------------------|-----------------|-----------------|-------------------|------------------------|
| SPACING (S) |                                   |                   |                  |                   |                     |                             |                             |                 |                 |                   |                        |
| S₁ = 50 x 40 cm | 214.00 | 119.65 | 43.89 | 22.77 | 4.89 | 18.79 | 2.17 | 21.92 | 10.29 | 4.57 | 2.3 |
| S₂ = 75 x 40 cm | 224.92 | 112.85 | 40.64 | 19.73 | 4.47 | 17.31 | 2.08 | 19.97 | 9.69 | 4.14 | 1.6 |
| S. Em. + | 3.72 | 2.23 | 0.88 | 0.45 | 0.10 | 0.35 | 0.03 | 0.35 | 0.15 | 0.09 | 0.04 |
| C.D. at 5% | 10.58 | 6.36 | 2.51 | 1.29 | 0.27 | 1.01 | 0.09 | 0.99 | 0.42 | 0.25 | 0.11 |
| NITROGEN LEVELS (N) | |                   |                  |                   |                     |                             |                             |                 |                 |                   |                        |
| N₀ = 00 kg/ha | 235.33 | 99.89 | 33.06 | 19.17 | 4.00 | 16.59 | 2.04 | 17.83 | 8.47 | 2.83 | 1.2 |
| N₁ = 100 kg/ha | 224.00 | 114.23 | 42.39 | 19.89 | 4.17 | 17.67 | 2.09 | 19.72 | 9.19 | 3.75 | 1.7 |
| N₂ = 200 kg/ha | 214.33 | 122.06 | 44.11 | 22.69 | 4.83 | 18.26 | 2.15 | 21.78 | 10.56 | 5.00 | 2.2 |
| N₃ = 300 kg/ha | 204.17 | 128.83 | 49.50 | 23.26 | 5.72 | 19.68 | 2.21 | 24.44 | 11.75 | 5.83 | 2.6 |
| S. Em. + | 5.25 | 3.16 | 1.25 | 0.64 | 0.14 | 0.50 | 0.04 | 0.49 | 0.21 | 0.12 | 0.05 |
| C.D. at 5% | 14.97 | 8.99 | 3.55 | 1.82 | 0.39 | 1.43 | 0.12 | 1.40 | 0.59 | 0.35 | 0.15 |
| PHOSPHORUS LEVELS (P) | |                   |                  |                   |                     |                             |                             |                 |                 |                   |                        |
| P₀ = 00 kg/ha | 229.88 | 107.13 | 39.17 | 19.48 | 4.21 | 17.08 | 2.03 | 18.00 | 8.94 | 3.71 | 1.6 |
| P₁ = 50 kg/ha | 218.50 | 116.17 | 42.29 | 21.94 | 4.73 | 18.16 | 2.14 | 20.71 | 10.23 | 4.42 | 2.0 |
| P₂ = 100 kg/ha | 210.00 | 125.47 | 45.33 | 22.33 | 5.08 | 18.92 | 2.20 | 24.13 | 10.81 | 4.94 | 2.2 |
| S. Em. + | 4.55 | 2.73 | 1.08 | 0.55 | 0.12 | 0.43 | 0.04 | 0.42 | 0.18 | 0.11 | 0.05 |
| C.D. at 5% | 12.96 | 7.79 | 3.07 | 1.58 | 0.34 | 1.24 | 0.10 | 1.21 | 0.51 | 0.30 | 0.13 |

| INTERACTION EFFECT | | | | | | | | | | | |
| S x N | NS | NS | NS | NS | NS | NS | NS | NS | S | S |
| S x P | NS | NS | NS | NS | NS | NS | NS | NS | NS | S |
| N x P | NS | NS | NS | NS | S | NS | NS | S | NS | S |
| S x N x P | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| C.V. % | 10.16 | 11.52 | 12.51 | 12.79 | 12.32 | 11.77 | 8.45 | 9.94 | 8.83 | 11.95 | 11.66 |

Table 4. Effect of interaction of S x N and S x P in heliconia cv. Golden Torch on flowers yield

| Treatments | S x N | S x P |
|-----------|-------|-------|
|           | No. of flowers per clump | No. of flowers per hectare (lakh nos.) | No. of flowers per hectare (lakh nos.) |
|           | N₀  | N₁  | N₂  | N₃  | N₀  | N₁  | N₂  | N₃  | P₀  | P₁  | P₂  |
| S₁       | 3.00 | 3.72 | 5.22 | 6.33 | 3.00 | 3.72 | 5.22 | 6.33 | 1.4 | 2.0 | 2.7 |
| S₂       | 2.67 | 3.78 | 4.78 | 5.33 | 1.8 | 1.5 | 1.8 | 2.0 | 1.3 | 1.6 | 1.8 |
| S. Em. + | 0.17 |       |       |       | 0.07 |       |       |       | 0.06 |       |       |
| C.D. at 5% | 0.49 |       |       |       | 0.21 |       |       |       | 0.19 |       |       |
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