The Pharma Innovation Journal 2022; 11(12): 1706-1710

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(12): 1706-1710

www.thepharmajournal.com
Received: 13-10-2022
Accepted: 16-11-2022

Laxmi Patil
Part of Ph.D. (Agri.) Thesis Submitted to University of Agricultural Sciences, Dharwad, Karnataka, India

Biradar MS
Associate Professor (Horticulture), Hi-Tech Horticulture Unit, MARS, UAS, Dharwad, Karnataka, India

Patil VS
Professor, Department of Horticulture, UAS Dharwad, Karnataka, India

Math KK
Professor, Department of Soil Science and Agricultural Chemistry, UAS, Dharwad, Karnataka, India

Patil HY
Professor and Head, Department of Crop Physiology, UAS, Dharwad, Karnataka, India

Corresponding Author:
Laxmi Patil
Part of Ph.D. (Agri.) Thesis Submitted to University of Agricultural Sciences, Dharwad, Karnataka, India

Influence of growing condition, spacing and nutrition on growth and yield of *Heliconia* genotypes

Laxmi Patil, Biradar MS, Patil VS, Math KK and Patil HY

Abstract
In the recent years, *Heliconia* introduced to the flower trade and recognizing itself as an unexploited ornamental variety of unusual elegance which is identified as an emerging cut flower becoming popular in all metropolitan cities of India. It is mainly sold as exclusive (tropical) flower in mixed bouquets and flower arrangements. A high value flower crop can assure sizable income to farmers with minimum investment and care. This crop is being grown as an ornamental plant in the garden. Hence, it is necessary to develop suitable agro techniques to enhance production of high quality flowers. Therefore, field trial was undertaken at the Department of Horticulture, University of Agricultural Sciences, Dharwad during 2021-22 to understand the influence of growing condition, spacing and nutrition to improve the growth and yield of *Heliconia* genotypes. The experiment was laid out in strip plot design with three replications and sixteen treatment combinations comprised of two growing conditions as main plot (M_1: Coconut garden and M_2: Shade house) and combinations of genotypes, spacing and nutrition as eight sub plots [G_1: *H. latispatha* Orange, G_2: *H. psittacorum* Kenea Red, S_1: 40 cm × 40 cm, S_2: 40 cm × 60 cm, N_1:100% recommended dose of fertilizer (RDF) and N_2:75% RDF]. Result indicated significant difference with all growth and yield parameters. Plants in shade house took less number of days to first flowering and exhibited highest values for all the characters compared to plants in coconut garden. The interaction found significant for plant height (139.38 cm) which was higher under T_{13} ($M_2G_2S_1N_1$). Treatment combination T_{11} ($M_2G_1S_2N_1$) recorded highest number of leaves shoot^{-1} (7.83) and suckers clump^{-1} (12.10). T_{15} ($M_2G_2S_2N_1$) recorded maximum plant spread (61.03), leaf length (44.15 cm) and leaf breadth (18.22 cm), took less number of days to first flowering (132.45), 50 percent flowering (172.50). T_{15} ($M_2G_2S_2N_1$) registered maximum number of flowers clump^{-1} (16.67) and yield ha^{-1} (50.00 lakh flowers) and the same treatment combination can be suggested to get higher yield in *Heliconia*.

Keywords: *Heliconia*, growing condition, genotypes, spacing, nutrition, flower yield

Introduction

India has better scope for floriculture in the future as there is a shift in trend towards tropical flowers and this can be gratefully exploited. Heliconias, birds of paradise and ornamental ginger also known as red ginger (*Alpinia purpurata*), are just a few examples of tropical floriculture species that account for a comparatively small segment of the European flower industry. In the recent decades, *Heliconia* introduced to the flower trade, recognizing itself as an ornamental variety of unusual elegance (Maria *et al*., 2014) [9]. *Heliconia* is a member of the Heliconiaceae family, consists of a single genus with about 89 species and more than 350 varieties (Malakar *et al*., 2015) [8]. They are indigenous to Central and South America, possessing chromosome number 2n (4x)=24. A herbaceous, perennial, tropical, rhizomatous plant, propagated by rhizome bits, suckers, or side shoots that emerge from the clumps and very rarely by seeds. But recently, heliconias are grown as an ornamental plant in gardens and regarded as an emerging exotic cut flower gaining popularity in all metropolitan cities of India. It is an outstanding flower for the floriculture industry as a cut flower due to its brilliant colours, distinctive inflorescence, long straight peduncles, and good post-harvest life. In India it is grown in the existing coconut gardens and in some places under protected conditions, particularly in shade houses as it requires partial shade. With little effort and expense, farmers can guarantee a significant return with this new, high-value flower crop.

Owing to its widespread use, it is vital to develop appropriate agro techniques to enhance production of high quality flowers by set of cultural and management techniques, such as a growing environment, adequate spacing, optimum fertilizer dosage, irrigation, plant protection. A proper nutrition dose and planting density will certainly help in determining the amount and period of fertilizer application for higher production and subsequent higher yield in *Heliconia*. There is adequate information available regarding the shade tolerance and reproductive habits of *H. latisphatha* (cv. Orange) and *H. psittacorum* (cv. Kenea Red). Therefore, it is crucial to assess how different shaded conditions affect inflorescence yield and quality in order to gather knowledge that can help with better light management in the production environment. Hence present investigation was carried out to understand the influence of growing condition, spacing and nutrition to improve the productivity and quality of *Heliconia* genotypes.

Material and Methods

The experiment was conducted at Hi-tech Horticulture Unit under shade house and New Orchard, Spice unit, under existing coconut garden, Department of Horticulture, College of Agriculture, Dharwad at 15˚ 48' North latitude and 74˚ 98' East longitudes during 2021-22. It includes different aspects like growing condition (M_1: Coconut garden and M_2: Shade house), genotype [G_1: Orange (*H. latispatha*) and G_2: Kenea Red (*H. psittacorum*)], spacing (S_1: 40 × 40 cm and S_2: 40 × 60 cm) and nutrition (N_1:100% RDF and N_2:75% RDF). The planting materials of promising *Heliconia* genotypes *viz*., Orange (*H. latispatha*) and Kenea Red (*H. psittacorum*) were collected from Hi-tech Horticulture Unit, Main Agricultural Research Station, University of Agricultural Sciences, Dharwad. Recommended dose of fertilizers for *Heliconia* (40:20:20: N, P_2O_5 and K_2O g/m^2/year) were applied as per the package of practice of University of Horticultural Sciences, Bagalkot. The experiment was carried out in strip plot design with three replications and 16 treatment combinations, growing condition being considered as main plot and combination of genotype, spacing and nutrition is considered as sub plot treatments (C_1: $G_1S_1N_1$, C_2: $G_1S_1N_2$, C_3: $G_1S_2N_1$, C_4: $G_1S_2N_2$, C_5: $G_2S_1N_1$, C_6: $G_2S_1N_2$, C_7: $G_2S_2N_1$ and C_8: $G_2S_2N_2$). The statistical analysis of the data was done by standard methods of analysis of variance as given by Panse and Sukhatme (1985). Fifty percent shading green colour net was placed above and all sides of the structure to manage the light intensity and temperature during hot weather as one of the growing conditions for *Heliconia* and plants were grown as an intercrop (Inter row space) under the existing 40 year old coconut garden established with Arasikeri Tall variety is considered as another growing condition. Raised beds were prepared for the experiment with the size of 1 m width, 30 cm height leaving 50 cm walking space in between the beds. Fresh rhizomes were planted during March, 2021 in paired row on raised bed with specified spacing both in coconut garden and shade house condition. 50 percent of N along with 100 percent of P_2O_5 and K_2O were applied as basal dose and remaining 50 percent of N was applied after two months of planting. The data was recorded on different growth and yield parameters from five tagged plants and average was statistically analyzed.

Results and Discussion

Vegetative traits

Main, sub plot treatments and interaction had significant effect on vegetative parameters of *Heliconia* (Table 1). Among the growing condition, shade house recorded significantly maximum plant height (113.55 cm) as compared to coconut garden (100.57 cm). Among subplot treatments, significantly maximum plant height (134.88 cm) recorded in Kenea Red planted at 40 × 40 cm distance and applied with 100 percent of RDF (C_5: $G_2S_1N_1$). It was on par with C_7: $G_2S_2N_1$ (129.73 cm) and C_6: $G_2S_1N_2$ (122.49 cm). Whereas, the lowest plant height (78.47 cm) was recorded in subplot treatment with Orange planted at 40 × 60 cm distance receiving 75 percent of RDF (C_4: $G_1S_2N_2$). The interaction data reveals that, tallest plants (139.38 cm) were observed in T_{13} ($M_2G_2S_1N_1$) treatment combination *i.e.* Kenea Red genotype planted at 40 × 40 cm distance under shade house with 100 percent RDF which was on par with T_{15}: $M_2G_2S_2N_1$ (135.62 cm) and T_{14}: $M_2G_2S_1N_2$ (133.10 cm). While the lowest height was reported in T_4: $M_1G_1S_2N_2$ (77.83 cm) treatment combination.

Comparison of data in Table 1 reveals that the maximum plant spread was observed in plants grown under shade house (53.92 cm) as compared to coconut garden (51.24 cm). Subplot treatment having Kenea Red planted at 40 × 60 cm with application of 100 percent RDF (C_7: $G_2S_2N_1$) has recorded significantly maximum plant spread (59.11 cm), which was on par with C_8: $G_2S_2N_2$ (57.47 cm), C_5: $G_2S_1N_1$ (56.41 cm) and C_6: $G_2S_1N_2$ (54.95 cm). Whereas, the lowest plant spread was recorded in C_4: $G_1S_2N_2$ (45.31 cm) and C_2: $G_1S_1N_2$ (45.62 cm). Plant spread differed significantly owing to interaction of main and sub plot treatments. Significantly greater spread of 61.03 cm was noticed in T_{15}: $M_2G_2S_2N_1$ combination (Kenea Red planted at 40 × 60 cm under shade house with 100 percent of RDF), which was on par with T_{16}: $M_2G_2S_2N_2$ (59.47 cm) while, lowest spread was noticed in T_4: $M_1G_1S_2N_2$ (42.72 cm).

Planting *Heliconia* under shade house exhibited maximum leaf length (36.74 cm) and breadth (16.70 cm) compared planting under coconut (33.21 cm and 15.19 cm respectively). Among eight subplot treatments, C_7: $G_2S_2N_1$ (Kenea Red planted at 40 × 60 cm spacing with 100 percent of RDF) exhibited maximum leaf length (42.04 cm) and breadth (17.47 cm), which was on par with C_8: $G_2S_2N_2$. The lowest values were recorded from C_2: $G_1S_1N_2$ (27.99 cm and 14.45 cm respectively). The interaction data reveals that maximum leaf length (44.15 cm) and breadth (18.22 cm) were observed in Kenea Red planted at 40 × 60 cm spacing under shade house with 100 percent of RDF (T_{15}: $M_2G_2S_2N_1$), which was on par with T_{16}: $M_2G_2S_2N_2$ (43.08 cm and 17.99 cm respectively). Whereas, minimum leaf length (27.56 cm) and breadth (14.10 cm) were recorded in T_2: $M_1G_1S_1N_2$.

It was observed that among the growing conditions, shade house produced maximum number of leaves per plant (5.39) and suckers per clump (9.92) compared to coconut garden (5.07 and 7.65 respectively). Among sub plot treatments, Orange at 40 × 60 cm spacing with 100 percent of RDF (C_3: $G_1S_2N_1$) produced more number of leaves per plant (5.76) and suckers per clump (10.94), which was on par with C_4: $G_1S_2N_2$ (5.60 and 9.95 respectively). However, C_5: $G_2S_1N_1$ produced lesser number of leaves per plant (4.45) and suckers per clump (7.01). Interaction of main and sub plot reveals that T_{11}: $M_2G_1S_2N_1$ treatment combination registered maximum number of leaves per plant (6.03 cm) and suckers per clump (12.10), which was on par with T_{12}: $M_2G_1S_2N_2$ (5.87 and 11.60 respectively). Whereas, the lowest number (4.40 cm and 6.52 respectively) was recorded in T_5: $M_1G_2S_1N_1$ combination.

Basically, heliconias in their natural habitat perform well under partial shade compared to full sunlight. This might be due to exploitation of genetic potential with low light intensity and high relative humidity under shade net situation (Babu *et al*., 2019) [2]. Increased shade influenced plant height along with other attributes and there was decrease in vegetative growth due to reduction in chlorophyll content per leaf area under intermediate shade of coconut as opined by Sudhakar and Kumar (2012) [13]. The increase in plant height under closer spacing might be due to competition for light and other agro inputs and it is quite natural that when more plants per unit area are retained, there is tendency of a plant to grow taller along with genetic constitution of genotype. These results are in close conformity with the reports of Suseela *et al*. (2016) [14] who stated effect of spacing levels in tuberose. Increase in level of nutrient doses resulted in maximum plant height, plant spread, leaf length, leaf breadth, suckers per clump and leaves per plant coupled with wider spacing that provided more space to the plant for its growth. These results are in accordance with Aklade *et al*. (2016) [1] who observed that highest leaf area, number of suckers and leaves in *Heliconia* with maximum nitrogen level. Bharti *et al.* (2016) [3] noted that increasing levels of NPK up to 250:320:200 kg NPK/ha has showed a significant effect on plant growth. Dalvi *et al*. (2022) [4] also reported that spacing and nitrogen levels had influence on vegetative characters of tuberose.

Flowering traits

The data presented in Table 2 reveals that growing condition had significant effect on number of days to first flowering and 50 percent flowering with minimum days in shade house (182.10 and 213.01 respectively) as compared to coconut garden (194.20 and 230.00 respectively). Among sub plot treatments, Kenea Red at 40 × 60 cm spacing with 100 percent RDF (C_7: $G_2S_2N_1$) was earlier to have first flowering (137.90 days) and 50 percent flowering (179.73 days), which was on par with C_8: $G_2S_2N_2$, C_5: $G_2S_1N_1$ and C_6: $G_2S_1N_2$. Whereas, C_2: $G_1S_1N_2$ took maximum number of days (238.35 and 265.43 respectively). Interaction data shows that Kenea Red at 40 × 60 cm spacing under shade house with 100 percent RDF (T_{15}: $M_2G_2S_2N_1$) took minimum number of days to first flowering (132.50) and 50 percent flowering (172.50), which was on par with T_{16}: $M_2G_2S_2N_2$ and T_{13}: $M_2G_2S_1N_1$. On contrary, T_4: $M_1G_1S_2N_2$ (249.50 and 279.27 days respectively) and T_2: $M_1G_1S_1N_2$ (248.17 and 279.57 days respectively) were last to enter flowering stage.

This variation in flowering could be due to cultivar character and enhanced vegetative growth might have influenced the early transformation of vegetative growth into reproductive stage as observed in the present study as well as earlier conclusions by Sudhakar and Kumar (2012) [13] and De-Souza *et al.* (2016) [6] in *Heliconia*, Shwetha *et al*. (2014) [12] and Deepa *et al*. (2019) [5] in gerbera. Thus, the use of shading is beneficial for the production of *Heliconia* plants, resulting in earlier flowering. Along with harnessing the advantages of shade house as growing environment, wider spacing and 100 percent RDF helps in better exploitation of genetic potential of particular genotype resulting in early flowering by efficient utilization of nutrients by plants at wider spacing.

The cumulative yield data reveals that, the highest number of cut flowers per clump (12.32) and yield per hectare (4.34 lakh flowers) were recorded in shade house condition compared to coconut garden (9.47 and 1.44 lakh flowers). Significantly the highest number of cut flowers per clump (14.80) and yield per hectare (3.34 lakh flowers) were obtained in Kenea Red planted at 40 × 60 cm spacing with 100 percent RDF (C_7: $G_2S_2N_1$), which was statistically on par with C_3: $G_1S_2N_1$ whereas, C_2: $G_1S_1N_2$ registered minimum number of cut flowers per clump (6.83) and yield per hectare (2.27 lakh flowers). Interaction of main and sub plot treatments exhibited significant influence on number of cut flowers per clump and flower yield per ha. Kenea Red planted at 40 × 60 cm spacing under shade house with 100 percent RDF (T_{15}: $M_2G_2S_2N_1$) recorded maximum number of cut flowers per clump (16.67) and yield per hectare (5.00 lakh flowers), followed by T_{11}: $M_2G_1S_2N_1$ and T_{16}: $M_2G_2S_2N_2$. While minimum number of cut flowers per clump (5.93) and yield per hectare (1.13 lakh flowers) were obtained in T_2: $M_1G_1S_1N_2$.

Increased number of flowers might be due to superior vegetative growth, early flowering and more number of flowering shoots in *Heliconia* grown as solo crop under shade house with controlled environmental factors without incidence of pests and diseases. Sudhakar and Kumar (2012) [13], Muraleedharan and Karuppaiah (2015) [10] and De-Souza *et al.* (2016) [6] reported plants grown under shade house results in consistent growth and improved yield capacity. More number of plants per unit area resulted in harvesting maximum yield in terms of cut flowers per hectare under shade house, while 30 percent gross area is utilized for *Heliconia* planting resulted in lesser number of flowers in coconut garden. (Sudhakar and Kumar, 2012 and Paulino *et al*., 2013) [13, 11]. Wider spacing provide more space to plant which helps to utilize more soil water, nutrition, air and light coupled with higher dose of nutrients could be related to the corresponding increase in growth parameters like number of leaves, leaf length and breadth which might have resulted in higher photosynthesis, early flowering and yield per plant. Similar results with respect to yield and yield components had been reported earlier by several workers in *Heliconia* (Girish, 2006, Sushma *et al*., 2012 and Aklade *et al*., 2016) [7, 15, 1]. Closer spacing might have experienced luxurious vegetative growth (at the cost of reproductive growth) in terms of plant height and number of non flowering shoots per clump that leads to poor aeration, less penetration of sunlight, higher interplant shade and more moisture content within the plant community hence yielded less number of flowers per unit area. Since the flower stem is the end product of heliconias, the quantity of inflorescence is a crucial factor. Therefore, higher number of produced flower stems enables greater competitiveness and increased profitability for producers.

Table 1: Influence of growing condition, spacing and nutrition on vegetative parameters of *Heliconia* genotypes

Treatments	Plant height (cm)	Plant spread (cm)	Leaf length (cm)	Leaf breadth (cm)	No. of leaves plant^{-1}	No. of suckers clump^{-1}
Main plot (M) - Growing condition						
M_1: Coconut garden	100.57	51.24	33.21	15.19	5.07	7.65
M_2: Shade house	113.55	53.92	36.74	16.70	5.39	9.92
S.Em. ±	1.21	0.16	0.42	0.08	0.04	0.12
CD @ 5%	7.38	0.96	2.57	0.48	0.22	0.72
Sub plot (C) - Genotypes, spacing and nutrition						
C_1: G_1 S_1 N_1	93.77	49.25	29.76	15.16	5.12	9.43
C_2: G_1 S_1 N_2	86.28	45.62	27.99	14.45	5.37	8.57
C_3: G_1 S_2 N_1	90.95	52.57	31.21	16.36	**5.76**	**10.94**
C_4: G_1 S_2 N_2	78.47	45.31	29.74	15.04	5.60	9.95
C_5: G_2 S_1 N_1	134.88	56.41	39.97	16.31	4.45	7.01
C_6: G_2 S_1 N_2	122.49	54.95	38.36	15.78	4.78	7.65
C_7: G_2 S_2 N_1	129.73	59.11	42.04	17.47	5.41	8.70
C_8: G_2 S_2 N_2	119.93	57.47	40.76	16.99	5.37	8.00
S.Em. ±	5.12	2.22	0.80	0.19	0.14	0.52
CD @ 5%	15.54	6.74	2.41	0.59	0.43	1.59
Interactions (M×C)						
T_1: $M_1G_1S_1N_1$	88.90	49.13	28.73	14.91	4.93	7.80
T_2: $M_1G_1S_1N_2$	78.05	45.22	27.56	14.10	5.27	6.47
T_3: $M_1G_1S_2N_1$	83.47	52.27	30.17	15.60	5.48	9.78
T_4: $M_1G_1S_2N_2$	77.83	42.72	28.54	14.45	5.33	8.30
T_5: $M_1G_2S_1N_1$	130.38	54.61	37.02	15.07	4.40	6.52
T_6: $M_1G_2S_1N_2$	111.88	53.35	35.29	14.70	4.73	6.60
T_7: $M_1G_2S_2N_1$	123.83	57.19	39.93	16.73	5.28	8.09
T_8: $M_1G_2S_2N_2$	110.23	55.47	38.43	15.99	5.13	7.61
T_9: M_2 $G_1S_1N_1$	98.63	49.37	30.78	15.41	5.30	11.07
T_{10}: $M_2G_1S_1N_2$	94.52	46.02	28.42	14.79	5.47	10.67
T_{11}: $M_2G_1S_2N_1$	98.43	52.87	32.24	17.12	6.03	12.10
T_{12}: $M_2G_1S_2N_2$	79.10	47.90	30.93	15.63	5.87	11.60
T_{13}: $M_2G_2S_1N_1$	139.38	58.20	42.92	17.56	4.50	7.51
T_{14}: $M_2G_2S_1N_2$	133.10	56.55	41.43	16.87	4.83	8.70
T_{15}: $M_2G_2S_2N_1$	135.62	61.03	44.15	18.22	5.53	9.30
T_{16}: $M_2G_2S_2N_2$	129.63	59.47	43.08	17.99	5.60	8.38
S.Em. ±	2.72	0.78	0.81	0.29	0.07	0.51
CD @ 5%	8.25	2.36	2.46	0.87	0.21	1.56

G_1: Orange (*H. latispatha*) S_1: 40 × 40 cm N_1:100% RDF
G_2: Kenea Red (*H. psittacorum* S_2: 40 × 60 cm N_2:75% RDF

Table 2: Influence of growing condition, spacing and nutrition on flowering and flower yield of *Heliconia* genotypes

Treatments	Days to first flowering	Days to 50% flowering	Number of flowers clump^{-1}	Flower yield ha^{-1} (in lakhs)
Main plot (M) - Growing condition				
M_1: Coconut garden	194.20	230.00	9.47	1.44
M_2: Shade house	182.10	213.01	12.32	4.34
S.Em. ±	1.74	2.10	0.24	0.06
CD @ 5%	10.62	12.75	1.43	0.35
Sub plot (C) - Genotypes, spacing and nutrition				
C_1: G_1 S_1 N_1	233.77	259.22	8.57	2.86
C_2: G_1 S_1 N_2	238.35	265.43	6.83	2.27
C_3: G_1 S_2 N_1	221.70	245.82	13.67	3.07
C_4: G_1 S_2 N_2	233.72	256.57	12.93	2.94
C_5: G_2 S_1 N_1	146.62	188.28	8.60	2.75
C_6: G_2 S_1 N_2	148.33	190.67	8.30	2.86
C_7: G_2 S_2 N_1	137.90	179.73	14.80	3.34
C_8: G_2 S_2 N_2	144.82	186.32	13.43	3.03
S.Em. ±	6.65	11.44	0.43	0.14
CD @ 5%	20.18	34.71	1.30	0.41
Interactions (M×C)				
T_1: $M_1G_1S_1N_1$	243.90	273.50	7.27	1.38
T_2: $M_1G_1S_1N_2$	248.17	279.57	5.93	1.13
T_3: $M_1G_1S_2N_1$	229.60	254.83	12.13	1.58
T_4: $M_1G_1S_2N_2$	249.50	279.27	11.07	1.44
T_5: $M_1G_2S_1N_1$	146.27	191.93	8.27	1.57
T_6: $M_1G_2S_1N_2$	148.13	188.13	6.33	1.20
T_7: $M_1G_2S_2N_1$	143.30	186.97	12.93	1.68

T_8: $M_1G_2S_2N_2$	144.77	185.77	11.80	1.53
T_9: $M_2G_1S_1N_1$	223.63	244.93	9.87	4.34
T_{10}: $M_2G_1S_1N_2$	228.53	251.30	7.73	3.40
T_{11}: $M_2G_1S_2N_1$	213.80	236.80	15.20	4.56
T_{12}: $M_2G_1S_2N_2$	217.93	233.87	14.80	4.44
T_{13}: $M_2G_2S_1N_1$	146.97	184.63	10.27	4.52
T_{14}: $M_2G_2S_1N_2$	148.53	193.20	8.93	3.93
T_{15}: $M_2G_2S_2N_1$	132.45	172.50	16.67	5.00
T_{16}: $M_2G_2S_2N_2$	144.87	186.80	15.07	4.52
S.Em. ±	4.96	7.03	0.45	0.16
CD @ 5%	15.05	21.33	1.35	0.50

G_1: Orange (*H. latispatha*) S_1: 40 × 40 cm N_1:100% RDF
G_2: Kenea Red (*H. psittacorum* S_2: 40 × 60 cm N_2:75% RDF

Conclusion

From the present study it can be concluded that shade house as growing condition, 40 × 60 cm spacing and 100 percent recommended dose of fertilizer is optimum for growth and flower yield of both *Heliconia* genotypes.

References

1. Aklade SA, Nehete DS, Patil SJ, Patel DP, Desai JR. Effect of spacing, nitrogen and phosphorus on growth, flowering and yield of *Heliconia* cv. Golden Torch under nethouse. Indian J. Sci. Technol. 2016;9(35):1-7.
2. Babu MS, Kumar BP, Swami DV, Krishna KU, Emmanuel N. Impact of shade net condition on growth, rhizome and yield characters of ginger. J Pharmacogn. Phytochem. 2019;8(3):3481-3485.
3. Bharti S, Pushpendra V, Devi S. Effect of different concentration levels of NPK on growth, flowering and yield of tuberose (*Polianthes tuberosa* L.) cv. Shringar. Int. J Agri. Sci. 2016;8(57):3137-3140.
4. Dalvi NV, Salvi BR, Pawar CD, Salvi VG, Burondkar MM, Dhekale JS, *et al*. Response of spacing and nitrogen levels on tuberose (*Polianthes tuberosa* L.) cv. Pune Single. Pharma Innov. J. 2022;11(3):1599-1603.
5. Deepa MS, Sudarshan GK, Keerthishankar K. Evaluation of gerbera (*Gerbera jamesonii*) cultivars for growth, flowering and yield under different growing structure. Int. J Chem. Stud. 2019;7(1):1138-1140.
6. De-Souza RRD, Beckmann-Cavalcante MZ, Silva AA, Silva EMD, Brito LPDS, Silva AO. Yield and quality of inflorescences of Golden Torch *Heliconia* in different shaded environments. Revista Brasileira de Engenharia Agrícola e Ambiental. 2016;20:128-132.
7. Girish J. Effect of growing conditions, spacing and nutrition on growth, flowering and flower yield of heliconia (*Heliconia* sp.). M.Sc. (Agri.) Thesis, University of Agricultural Sciences, Dharwad (India), 2006.
8. Malakar M, Acharya P and Biswas S. Evaluation of *Heliconia* species based on agro-morphological Traits. Int. J Agric. Environ. Biotechnol. 2015;8(4):957-964.
9. Maria C, Singureanu V, Denisa H and Erszebet B. Heliconias-Novelties and applicability in floral art. J Hort. For. Biotechnol. 2014;18(1):22-27.
10. Muraleedharan A, Karuppaiah P. Studies on the effect of shade and growing media on the growth and yield of anthurium (*Anthurium andraeanum*) cv. Tropical. Int. J Adv. Res. Eng. Sci. Technol. 2015;2(10):2394-2444.
11. Paulino AS, Albuquerque AW, Moura-Filho GM, Pereira FR. Heliconia Golden Torch: productivity and post-harvest quality under different sources and doses of silicon. Revista Brasileira de Engenharia Agrícola e Ambiental. 2013;17(6):615-621.
12. Shwetha KB, Seetharamu GK, Ansar H, Kumar SA. Assessment of gerbera (*Gerbera jamesonii* Bolus ex. Hooker F.) cultivars under different growing conditions. Madras Agric. J. 2014;101(10/12):390-395.
13. Sudhakar M, Kumar SR. Effect of different shading conditions on growth, flowering and yield of *Heliconia sp.* cv. Golden Torch. Asian J Hort. 2012;7(2):512-514.
14. Suseela T, Chandrasekhar R, Bhaskar VV, Salomi SR, Umakrishna K. Effect of spacing, bulb size and depth of planting on growth, flowering and vase life of tuberose (*Polianthes tuberosa* L.) cv. Suvasini., Int. Quarterly J Life Sci. 2016;11(4):2715-2720.
15. Sushma HE, Reddy BS, Kulkarni BS, Patil CP. Effect of spacing and inorganic nutrients on growth, flowering and nutrient status in *Heliconia* sp. Karnataka J Agric. Sci. 2012;25(4):485-487.