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Original Research Paper

Evaluation of *Heliconia* for growth, flowering and flower yield

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ABSTRACT

Heliconia is utilized as ornamental plants, usually being grown both as landscaping plants and as cut flowers, owing to colour and the longer durability of its floral bracts. Forty-one genotypes of Heliconia were evaluated for growth, flowering and flower yield. Significant variation was observed among genotypes for vegetative and floral characteristics. The results revealed that the maximum number of leaves per sucker was recorded in *H. hirsuta* followed by *H.* 'Golden Torch Adrian' and *H.* 'GT Sunshine', while, maximum plant height was recorded in varieties *viz.*, *H. caribea* (459.33 cm) followed by *H.* 'She' (337.67 cm) and *H. rauliniana* upright (305.00 cm). However, maximum leaf length was observed in *H. caribea* (314.33 cm) followed by *H.* 'She' (203.67 cm) and *Heliconia metallica* (175.00 cm). Maximum sucker production was recorded in *H.* 'Tropics' followed by *H. psittacorum* 'Petra' and *H.* 'Guyana'. Among the flowering traits, early flower initiation was recorded in Golden Torch (136.00 days) followed by Lady Di (152.00 days). The rachis length ranged from 72.67 cm (*H.* 'Golden Torch') to 10.00 cm (*H.* 'Hirsuta'), however, longest spike was recorded in *H.* '*rauliniana* upright' (131.33 cm) followed by *H. rostrata* 'Parrots Beak' (115.67 cm) and *H. rostrata* Ten Days (97.00 cm), whereas, shortest spike was recorded in *H. bihai* (9.33 cm).

Keywords: Bracts, Heliconia, speciality flower, spike, sucker

INTRODUCTION

Heliconia is a popular specialty flower with varied forms and rich colour, which is in high demand in global as well as domestic markets. It belongs to the family Heliconiaceae and are native to South and Central America and Islands of South Pacific. The genus has about 250-300 species distributed primarily in Neotropical areas from North of Mexico to South of Brazil (Malakar & Biswas, 2022). Heliconia derive their beauty from highly modified leaves or bracts and colour varies from pink, red, orange, yellow, green, with different combinations of sizes and shapes. Flower spikes as well as the foliage of Heliconia are used for flower arrangements, landscaping, potted plants, cut foliage etc. Selection of promising genotypes of Heliconia for production of cut flowers with quality is vital for expanding floral industry. Hence, there is a need to identify suitable varieties of Heliconia for production of quality flowers and high yield. This will bring a vast scope for expansion of the crop on a commercial scale to meet the domestic as well as export demand. Considering this, the present study was undertaken to evaluate 41 Heliconia genotypes for growth, flowering and flower yield under open grown conditions.

MATERIALS AND METHODS

The experiment was undertaken at Hadapsar Research farm, ICAR-Directorate of Floricultural Research, Pune during 2017-2020 with two replications in randomized block design. The treatment consisted of 41 genotypes of *Heliconia viz.*, *H. psittacorum* 'Kathy', *H. psittacorum* 'Petra', *H. stricta* 'Jamaican Dwarf', H-23, *H.* spp. 'Prince of Darkness', *H. psittacorum* 'Lady di', *H. bihai* 'Schaefer', *H.* 'Kenya Red', *H. rostrata* 'Parrots beak', *H. bihai* 'Dwarf', *H. psittacorum* x *H. spathocircinata* 'Golden Torch', *H. psittacorum* 'Sassy', *H. psittacorum* 'Strawberries and Cream', *H. metallica, H. psittacorum* x *H. spathocircinata* 'Alan Carle', *H. latispatha,* H-13 'Silver Dust', *H. bihai* 'Firebird', *H.orthotricha* 'She', H-25, *H. latispatha* 'Distans', *H. psittacorum* x *H. spathocircinata* 'Guyana', *H. bihai* 'yellow', *H.* 'Red', 'Pedro Ortiz', *H. stricta* 'Iris', *H. psittacorum* x *H. spathocircinata* 'Adrian', *H. psittacorum* x *H. spathocircinata* 'Tropics', *H. psittacorum* x *H. spathocircinata* 'Yellow Parrot', 'Golden Torch

Sunshine', *H. chartaceae* 'Temptress', *H. stricta* 'Lobster Claw', *H.* Jacquinii, *H.* 'Fireflash', *H. hirsuta, H.* 'Meccas Pink', *H. rostrata* 'Ten Days', *H. rauliniana* upright, *H. caribea, H. angusta* 'Red Christmas' and *H. accuminata* 'Guyana'. Suckers of all the genotypes were planted at a spacing of 1.5 x 1.5 m. Uniform cultural operations were carried out throughout the experiment. Various vegetative traits *viz.*, plant height, number of leaves and suckers per plant, number of leaves per sucker, leaf length, leaf width, leaf petiole length and floral characters *viz.*, days to first flowering, rachis length, spike length, number of bracts per floret per spike, internodal length, width and length of bract, number of flowering shoots per plant were recorded. Data recorded were subjected to statistical analysis and analysis of variance (ANOVA) was used to test the significance of genotypic differences (Panse and Sukhatme, 1985).

RESULTS AND DISCUSSION

Vegetative traits

Heliconia genotypes under the study exhibited wide variation for vegetative characters (Table 1). Vegetative characters are significantly important as they play a vital role in deciding the good crop yield. Maximum plant height was recorded in varieties *viz.*, *H. caribea* (459.33 cm) followed by *H.* 'She' (337.67 cm) and *H. rauliniana* 'upright' (305.00 cm). The genotypes *H. psittacorum* 'Strawberries and Cream', 'Pedro Ortiz', *H. angusta* 'Red Christmas', *H. psittacorum* 'Lady di', *H.* spp. 'Prince of Darkness', *H. hirsuta, H. psittacorum* 'Kathy', *H. bihai* 'Dwarf' and *H. stricta* 'Jamaican Dwarf' recorded less than one meter height, which can be best suited as potted plants. The genotypes *H. stricta* 'Lobster Claw', *H. psittacorum* x *H. spathocircinata* 'Guyana', *H. psittacorum* x *H. spathocircinata* 'Alan Carle', *H.* 'Fireflash', *H. latispatha* 'Distans', *H. bihai* 'Firebird', *H. psittacorum* x *H. spathocircinata* 'Yellow Parrot', *H. psittacorum* x *H. spathocircinata* 'Golden Torch', *H.* 'Meccas Pink', *H.* 'Kenya Red', *H. bihai* 'Schaefer', 'Golden Torch Sunshine', *H. psittacorum* 'Petra' and *H. psittacorum* x *H. spathocircinata* 'Adrian' were intermediate with 1 to 2 meter plant height and could be used as border plants in landscaping. However, the genotypes *H. caribea, H. orthotricha* 'She', *H. rauliniana* 'upright', *H. rostrata* 'Ten Days', *H. metallica, H. latispatha, H. jacquinii*, *H. rostrata* 'Parrots beak', *H. chartaceae* 'Temptress', *H. psittacorum* x *H. spathocircinata* 'Tropics', *H. psittacorum* 'Sassy' and *H. stricta* 'Iris' were recorded more than 2 meter high and could be used for hedging/screening purpose in landscaping. Wider variation for plant height in different Heliconia have been reported (Sheela et al., 2007). Such variations in plant height among the Heliconia genotypes could be attributed mainly due to genetic makeup of the genotype.

Productivity of Heliconia is dependent on suckering habit and number of flowering suckers per clump in a year, while, suckering habit determines its commercial viability. Total number of suckers produced is a critical factor in determining yield potential of a cultivar. Maximum sucker production was recorded in *H.* 'Tropics' followed by *H. psittacorum* 'Petra' and *H.* 'Guyana'. Ramachandrudu & Thangam (2012) and Thangam et al. (2014) also reported variability in number of suckers per plant in Heliconia. High variability for the number of suckers per clump, may be due to ploidy levels, genomic constitution, more aeration and light due to suckering nature of genotypes (Dalawai et al., 2017; Nihad et al., 2019).

Cut foliage of Heliconia are used as backdrop material in flower arrangements, bouquet preparation as well as stage decorations. In the present study, wide variation was observed for various leaf traits. A leaf of lanceolate shape with medium width is highly preferred for floral decorations. Maximum number of leaves per sucker was recorded maximum in *H. hirsuta* followed by *H.* 'Golden Torch', 'Adrian' and *H.* 'GT Sunshine', however, it was recorded maximum per clump in *H.* 'Tropics' followed by *H.* 'Guyana' and *H.* 'Alan Carle'. Number of leaves on stem during inflorescence emergence can serve as a useful indicator for Heliconia growers to quantify the plants expected to bloom for market planning.

Maximum leaf length was observed in *H. caribea* (314.33 cm) followed by *H.* 'She' (203.67 cm) and *Heliconia metallica* (175.00 cm), it was recorded least in Jamaican dwarf (31.67 cm). Leaf width ranged from 6.33 cm (*H.* 'Strawberries and Cream') to 39.00 cm (*H. caribea*). Petiole length was recorded maximum in *H.* 'She' followed by *H. caribea* and *H. latispatha,* whereas, least observed in *H.* 'Hirsuta'. Qualitative descriptors related to petiole have been reported (Malakar & Biswas, 2022). Heliconia genotypes *viz.*,

Table 1 : Evaluation of Heliconia genotypes for vegetative growth

Genotype	Plant height (cm)	Suckers/ plant (Nos.)	Leaves/ sucker (Nos.)	Leaves/plant/ clump (Nos.)	Leaf length (cm)	Leaf width (cm)	Leaf petiole length (cm)
H. psittacorum 'Kathy'	79.67	64.33	4.67	134.33	51.33	9.50	14.33
H. psittacorum 'Petra'	104.66	79.67	4.66	153.00	56.00	7.00	17.67
H. stricta 'Jamaican Dwarf'	39.33	28.00	3.33	82.00	31.67	8.00	9.00
H-23	103.33	13.66	4.33	32.67	62.66	11.33	16.33
H. spp. 'Prince of Darkness'	89.00	15.33	3.67	43.33	53.67	13.00	17.00
H. psittacorum 'Lady di'	91.33	64.67	4.33	150.33	47.33	8.33	10.00
H. bihai 'Schaefer'	111.33	49.0	3.66	137.00	48.67	10.33	9.67
H. 'Kenya Red'	113.00	76.000	4.66	177.00	58.00	11.00	15.66
H. rostrata 'Parrots beak'	229.67	59.33	5.33	178.33	73.66	16.33	20.33
H. bihai 'Dwarf'	50.66	61.33	5.00	107.33	44.33	10.34	15.67
H. psittacorum x *H. spathocircinata* 'Golden Torch'	128.67	53.00	4.33	110.67	81.33	13.67	27.33
H. psittacorum 'Sassy'	220.33	59.00	4.00	134.00	104.00	20.68	41.33
H. psittacorum 'Strawberries and Cream'	93.67	39.00	4.33	98.00	55.33	6.33	18.67
H. metallica	271.00	55.33	4.00	198.67	175.00	26.00	64.33
H. psittacorum x *H. spathocircinata* 'Alan Carle'	186.67	63.67	4.33	277.00	123.00	14.07	49.67
H. latispatha	256.33	56.66	4.00	217.67	167.67	24.00	66.00
H-13 'Silver Dust'	136.00	9.00	4.67	33.67	54.00	16.00	15.00
H. bihai 'Firebird'	149.67	46.00	4.33	181.67	92.33	17.33	35.00
H. orthotricha. 'She'	337.66	45.99	3.67	164.00	203.67	26.33	87.00
H-25	220.00	25.00	4.33	96.00	128.00	13.00	55.33
H. latispatha Distans	167.33	17.67	3.67	58.67	82.67	14.67	29.00
H. psittacorum x *H. spathocircinata* 'Guyana'	189.00	61.67	4.00	245.67	115.00	13.66	51.33
H. bihai 'yellow'	123.00	26.00	4.67	126.00	84.00	11.00	38.00
H. 'Red'	217.00	12.00	4.33	44.00	148.00	28.50	58.00
H. 'Pedro Ortiz'	93.00	10.67	4.66	43.33	60.00	25.00	14.33
H. stricta 'Iris'	212.33	47.33	4.00	185.33	150.66	21.00	57.67
H. psittacorum x *H. spathocircinata* 'Adrian'	102.00	13.00	5.33	55.67	58.67	11.50	22.00
H. psittacorum x *H. spathocircinata* 'Tropics'	221.00	99.00	2.67	394.33	139.33	16.33	54.67
H. psittacorum x *H. spathocircinata* 'Yellow Parrot'	146.00	65.33	3.33	194.00	87.33	12.33	34.33
H. 'Golden Torch Sunshine'	109.00	27.00	5.33	142.00	64.33	11.67	18.33
H. chartaceae 'Temptress'	228.33	10.33	4.33	38.33	141.33	28.00	54.00
H. stricta 'Lobster Claw'	194.00	46.00	4.33	179.00	84.00	12.50	34.00
H. 'Jacquinii'	234.67	33.33	3.67	122.00	158.67	27.17	53.67
H. 'Fireflash'	168.33	32.99	4.00	131.33	93.00	15.33	34.33
H. hirsuta	88.00	8.00	6.00	45.00	46.00	10.00	5.00
H. 'Meccas Pink'	123.00	41.00	5.33	198.00	79.00	13.00	32.00
H. rostrata 'Ten Days'	290.00	24.33	3.33	78.33	115.00	20.67	13.67
H. rauliniana 'upright'	305.00	46.00	4.33	178.67	140.33	25.17	52.33
H. caribea	459.33	30.67	3.99	117.00	314.33	39.00	80.00
H. angusta 'Red Christmas'	91.67	44.33	5.33	223.00	48.33	13.33	23.67
H. accuminata 'Guyana'	165.66	77.00	4.00	302.67	97.00	13.32	41.33
S.E.m+	10.09	7.64	0.41	21.99	5.91	0.92	3.50
CD (P=0.05)	30.26	22.92	1.24	65.98	17.73	2.77	10.51

Guyana, Tropics, Alan Carle, *H.* 'Red and *H. latispatha* produced desirable quality leaves for decoration purpose.

Flowering characters

Significant differences were observed among Heliconia genotypes for days taken for first flowering (Fig. 1). *H. psittacorum* varieties recorded early flowering, which is ideal to catch early market. Data revealed that the commercial Heliconia genotype Golden Torch also recorded early flower initiation (136.00 days) followed by Lady di (152.00 days). The genotypes *H. psittacorum* varieties *viz.*, Golden Torch, Lady Di, Kathy, Sassy, Petra, Strawberries and Cream, Kenya Red and Alan Carle were ready for market at earlier dates compared to robust varieties like H. 'Red', *H. wagneriana* and *H. stricta* 'Iris' which recorded delayed flowering. Majority of Heliconia genotypes under the study recorded first flowering within 300 days from the date of planting of suckers. Catley and Brooking (1996) also reported that *H. psittacorum* cv. Golden Torch initiated flowering in 140-146 days after planting. Dalawai et al., (2017) reported that *H. latispatha* 'Orange' shown its first visible flower in 110.88 days, whereas, *H. wagneriana* 'Red' was late to initiate flower (316.50 days).

Length of rachis and spike are important characters which decides aesthetic appeal, display value and usefulness for various floral decorations. The data pertaining to various floral traits is furnished in Table 2. The rachis length ranged from 72.67 cm (*H.* 'Golden Torch') to 10.00 cm (*H.* 'Hirsuta'), however, longest spike was recorded in *H.* '*rauliniana* upright' (131.33 cm) followed by *H. rostrata* 'Parrots Beak' (115.67 cm) and *H. rostrata* Ten Days (97.00 cm), while, shortest spike was recorded in *H. bihai* (9.33 cm). Higher spike length enables easy handling of the inflorescence, making it suitable for flower arrangements and bouquet making. The commercial genotypes *viz.*, Kathy, Petra, Prince of Darkness, Lady Di, Kenya Red, Guyana, Adrian, Tropics produced spike length of more than 50 cm, which are ideal for flower decoration. Auclar et al. (2022) opined that very short stems limit their use in arrangements, with a minimum stem length of 80 cm being required. On the other hand, large stems greater than 1.51 m, require careful handling to avoid tip-over or unwanted breakage.

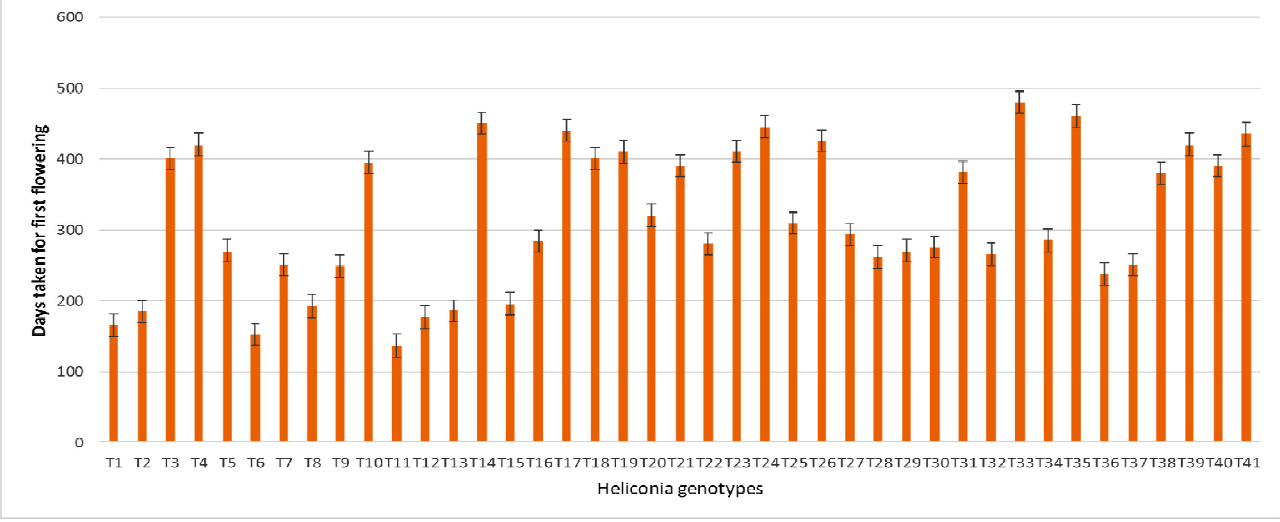

Fig. 1 : Days taken for first flowering among different Heliconia genotypes under the study

T_1: *H. psittacorum* 'Kathy',T_2: *H. psittacorum* 'Petra', T_3: *H. stricta* 'Jamaican Dwarf',T_4: H-23,T_5: *H.* spp. 'Prince of Darkness', T_6: *H. psittacorum* 'Lady di', T_7: *H. bihai* Schaefer, T_8: *H.* Kenya Red, T_9: *H. rostrata* 'Parrots beak', T_{10}: *H. bihai* Dwarf, T_{11}: *H. psittacorum* x *H.spathocircinata* 'Golden Torch', T_{12}: *H. psittacorum* 'Sassy', T_{13}: *H. psittacorum* 'Strawberries and Cream', T_{14}: *H. metallica*, T_{15}: *H. psittacorum* x *H. spathocircinata* 'Alan Carle', T_{16}: *H. latispatha,* T_{17}: H-13 Silver Dust, T_{18}: *H. bihai* Firebird, T_{19}: *H. orthotricha* 'She', T_{20}: H-25, T_{21}: *H. latispatha* 'Distans', T_{22}: *H. psittacorum* x *H. spathocircinata* 'Guyana', T_{23}: *H. bihai* 'Yellow', T_{24}: *H.* Red, T_{25}: *H.* 'Pedro Ortiz', T_{26}: *H.stricta* 'Iris', T_{27}: *H. psittacorum* x *H. spathocircinata* 'Adrian', T_{28}: *H. psittacorum* x *H. spathocircinata* 'Tropics', T_{29}: *H. psittacorum* x *H. spathocircinata* 'Yellow Parrot', T_{30}: Golden Torch Sunshine, T_{31}: *H. chartaceae* 'Temptress', T_{32}: *H. stricta* 'Lobster Claw', T_{33}: *H.* Jacquinii, T_{34}: *H.* Fireflash, T_{35}: *H. hirsuta,* T_{36}: *H.* Meccas Pink, T_{37}: *H. rostrata* 'Ten Days', T_{38}: *H. rauliniana* 'Upright', T_{39}: *H. caribea,* T_{40}: *H. angusta* 'Red Christmas' and T_{41}: *H. accuminata* 'Guyana'

Table 2 : Evaluation of Heliconia genotypes for flowering traits

Genotype	Rachis length (cm)	Spike length (cm)	Bacts/floret/ spike (Nos.)	Internodal length between florets/bract (cm)	Width of bract (cm)	Length of bract (cm)	Flowering shoots/plant (Nos.)
H. psittacorum 'Kathy'	12.17	61.67	3.33	3.77	1.93	9.83	32.33
H. psittacorum 'Petra'	10.67	64.33	3.67	2.67	2.00	9.67	29.67
H. stricta 'Jamaican Dwarf"	13.00	20.33	3.33	0.93	2.03	7.70	18.33
H-23	20.00	60.00	4.33	2.00	2.00	14.70	5.00
H. spp. 'Prince of Darkness'	15.00	51.67	4.67	2.57	2.00	13.00	6.67
H. psittacorum 'Lady di'	10.33	73.00	4.00	2.66	2.00	9.67	43.33
H. bihai 'Schaefer'	12.00	76.33	3.33	2.67	2.33	11.67	12.33
H. 'Kenya Red'	14.00	71.33	4.33	2.00	2.00	9.67	9.67
H. rostrata 'Parrots beak'	36.00	115.67	15.67	1.33	3.00	6.33	1.33
H. bihai 'Dwarf'	39.00	9.33	3.67	2.67	2.00	15.67	11.00
H. psittacorum x *H. spathocircinata* 'Golden Torch'	72.67	17.00	4.67	2.00	2.00	16.67	33.00
H. psittacorum 'Strawberries and Cream'	69.00	10.33	3.00	1.33	2.00	9.00	24.00
H. psittacorum x *H. spathocircinata* 'Alan Carle'	23.33	80.00	6.00	4.17	2.27	20.67	14.00
H. bihai 'Firebird'	24.00	51.00	3.33	5.67	2.03	15.67	1.33
H. orthotricha 'She'	33.00	82.00	5.33	3.50	2.13	19.33	4.33
H-25	21.67	96.67	5.00	4.00	2.10	16.00	16.00
*H. latispatha I'*Distans'	21.33	72.33	4.00	2.83	0.57	20.00	27.33
H. psittacorum x *H. spathocircinata* 'Guyana'	22.00	86.00	4.00	2.23	2.00	13.00	1.67
H. bihai 'yellow'	14.00	60.00	3.33	3.00	2.03	10.00	1.33
H. 'Red'	35.00	60.33	5.33	3.10	4.90	17.23	2.33
H. stricta 'Iris'	35.01	76.67	5.33	4.50	2.50	22.00	1.33
H. psittacorum x *H. spathocircinata* 'Adrian'	13.00	57.00	3.33	2.17	1.33	12.50	4.33
H. psittacorum x *H. spathocircinata* 'Tropics'	16.00	78.00	3.33	2.67	2.50	11.00	8.33
H. psittacorum x *H. spathocircinata* 'Yellow Parrot'	16.33	63.33	4.33	2.70	1.70	15.00	29.00
'Golden Torch Sunshine'	15.33	59.33	4.67	2.53	2.07	11.33	17.00
H. 'Fireflash'	13.00	66.00	3.67	2.00	0.53	15.00	19.00
H. hirsuta	10.00	47.00	3.33	2.33	1.33	10.00	1.33
H. Meccas 'Pink'	16.00	46.00	5.00	3.00	1.33	15.00	8.00
H. rostrata 'Ten Days'	25.00	97.00	10.00	3.00	2.33	10.50	1.33
H. rauliniana 'upright'	40.00	131.33	10.67	5.33	1.17	27.00	21.33
H. caribea	40.67	95.33	8.33	5.17	3.00	19.33	1.67
H. angusta 'Red Christmas'	12.00	59.67	3.67	2.67	2.33	9.17	11.00
H. accuminata 'Guyana'	13.02	54.08	4.52	2.35	1.99	11.21	18.51
S.E.m+	1.74	4.51	0.55	0.32	0.17	0.68	2.51
CD (P=0.05)	5.22	13.54	1.66	0.97	0.51	2.03	7.53

The display value of Heliconia increases with increase in number of bracts. In the present study, highest number of bracts/florets per spike was recorded in *H. rostrata* 'Parrots Beak' (15.67 cm) followed by *H. rauliniana* upright (10.67 cm) and *H. rostrata* Ten Days (10.00 days). The genotype with longer inflorescence in Heliconia has a greater number of bracts per spike. *H.* '*rauliniana* upright' (131.33cm), *H.rostrata* 'Parrots beak' (115.67 cm) and *H. rostrata* Ten Days (97.0 cm) recorded longer inflorescence with more bract count per spike. Variation in number of bracts per plant might be due to its intrinsic factor (Kannan et al., 2019; Auclar et al., 2022).

Internodal length between florets/bract ranged from 0.93 cm (Jamaican dwarf) to 5.67 cm (Firebird). Higher bract size contributes to greater attractiveness. Highest bract width was observed in *H.* Red (4.90 cm), while, *H. psittacorum* varieties yielded smaller bracts. Light flower stem is a desirable characteristic for cut Heliconia. Thangam et al. (2014) also reported similar findings on varying width and length of bract and internodal length between florets/ bract among Heliconia genotypes.

Maximum number of flowering shoots per plant was recorded in the genotype *H.* 'Lady di' (43.33) followed by *H.* 'Golden torch' (33.00) and *H. psittacorum* 'Kathy' (32.33). The increase in spike yield might be attributed to the early flower initiation, greater production of suckers with more clumping might have resulted the production of greater number of spikes. Variations in flowering parameters in the present study might be attributed to the flowering cycle, probably related to the genetic makeup of individual genotypes and seasonality of flower production. The results of variations in spike yield are in conformity with the findings of Santhosh et al. (2018) and Meenakshi et al. (2012).

CONCLUSION

In the present investigation, the Heliconia genotypes Guyana, Tropics, Alan Carle, *H.* 'Red and *H. latispatha* produced desirable quality leaves for cut foliage purpose, while, genotypes with longer flowering duration *viz.*, Golden Torch, Lady Di, Kathy, Sassy, Petra and Strawberries and Cream were found suitable for landscaping. The genotypes *viz.*, Jamaican dwarf, Lady Di, Kathy, Strawberries and Cream, Sassy and *H. bihai* were found suitable as potted plants owing to their short and compact dense nature.

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