Effect of NPK on growth and flower yield of Hibiscus *(Hibiscus rosa-sinensis)*

ABSTRACT

The research work was conducted in the Horticulture Research Farm, Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj during the year 2019-2020. The experiment was conducted in randomized block design with three replication & 12 treatments. Treatments were allocated randomly to each replication each treatment comprised of one plants which made a total of 36 plants. The best results were achieved in treatment T4 NPK (100:105:105) gram per plant with maximum plant height (113.62), maximum number of leaves per plant (71.99), maximum number of branches per plant (10.07), minimum days to bud initiation (43.31 days), minimum days taken flowering (49.87 days), maximum number of flower per plant(15.83), maximum flower diameter(cm) (13.06), flower weight(g) was found maximum (3.82), number of flower was found maximum (39575) along with maximum cost benefit ratio (1: 1.46).

Introduction

Hibiscus is a genus of more than 200 species of deciduous and evergreen shrubs, trees, annuals, and herbaceous perennials, widely distributed in warm-temperate subtropical and tropical regions. Hibiscus rosa-sinensis shrubs are exotic and make great container plants on patios and decks **(Nau, 2011).** H. rosa-sinensis (rose of China) is a rounded, bushy, evergreen, large shrub or small tree with hairless or slightly hairy shoots and ovate to broadly lance-shaped, glossy, dark green leave (15 cm long), with toothed margins. Solitary, 5-petaled, bright crimson flowers, 10 cm across, with yellow anthered red stamens, are produced from the leaf axils from the summer to autumn. Flower colors range from crimson to orange, yellow, or white. Cooperi cultivar of H. rosa-sinensis is a compact (1-2 m), with lance-shaped leaves marbled olive green and white, sometimes tinted pink and bearing red flowers **(Brickell, 1997).**

The tropical Chinese hibiscus, or China rose (Hibiscus *rosa-sinensis*), which may reach a height of 4.5 metres (15 feet), rarely exceeds 2 metres in cultivation. It is grown for its large somewhat bell-shaped blossoms. Cultivated varieties have red, white, yellow, or orange flowers. The East African hibiscus (H. *schizopetalus*), a drooping shrub with deeply

lobed red petals, is often grown in hanging baskets indoors. Many species of Hibiscus are grown for their showy flowers or used as landscape shrubs. Hibiscus has also medicinal properties and takes part as a primary ingredient in many herbal teas. This plant is popular landscape shrub, creates a bold effect with its bed textured, glossy dark green leaves and with 4- 6 inch wide and up to 8 inch long, showy flowers, produced throughout the year and grows up to 7-12. Sometimes its demand time to time increases during different Puja festivals. Hibiscus is propagated through vegetative methods by cutting and grafting for produce quality planting material on large scale. Cutting is most convenient method of propagation **Chatse and Kedar (2021).**

The cutting should be taken from new growth or softwood. Softwood is branches on the hibiscus that have not yet matured. The hibiscus cutting should be 4 to 6 inches (10 to 15 cm.) long. Remove everything but the top set of leaves. A slant cut give at the base of the cuttings and each cutting. A transverse cut give at top of each cutting. Dip the bottom of the hibiscus cutting in rooting hormone then place the cutting in well-drained soil and in partial shade. The cuttings should be rooted in about eight weeks **Chatse and Kedar (2021).**

Hibiscus rosa sinensis, a highly potential functional and valuable medicinal plant, has been reported in the ancient medicinal literature with beneficial effects in various disorders of humans. This is a tropical shrub, with large, glossy green leaves and spectacular trumpet shaped flowers. Its medicinal values have been mentioned in traditional folk medicines for variety of diseases **Eman *et al.*, (2017).**

Keeping all the above points in view, the present investigation conducted on Hibiscus with the following objective.

- To find the most suitable treatment for plant growth and flower yield of *Hibiscus rosa sinensis.*
- To work out the economics of different treatments.

MATERIAL AND METHODS

A field experiment entitled "Effect of NPK on growth and flower yield of Hibiscus *(Hibiscus rosa-sinensis)*" was carried out in the Horticulture Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology and Sciences during the year 2019-2020. The hibiscus cuttings were planted in the pits with dimension $30cm^2$ at a spacing of 1mx1m containing mixture of 5 kg FYM & vermicompost. The experiment was conducted in Randomized block Design with (11+1)

treatments and three replications. The experiment includes NPK application, at an interval of 30,60,90,120,150 and 180 days. Plants were selected randomly from each treatment per replication and their observations were recorded at 30 days interval. Data were statistically analyzed by the method suggested by Fisher and Yates, 1963.

Results and Discussion

After analyzing the data, the following data, the following outcomes were noted.

Table 1 Treatment details

SL.NO	TREATMENTS	TREAMENTS COMBINATION
1	T_0	**Control**
2	T_1	NPK (25:30:30) gram per plant
3	T_2	NPK (50:55:55) gram per plant
4	T_3	NPK (75:80:80) gram per plant
5	T_4	NPK (100:105:105) gram per plant
6	T_5	NPK (125:130:130) gram per plant
7	T_6	NPK (150:155:155) gram per plant
8	T_7	NPK (175:180:180) gram per plant
9	T_8	NPK (200:205:205) gram per plant
10	T9	NPK (225:230:230) gram per plant
11	T10	NPK (250:255:255) gram per plant
12	T11	NPK (275:280:280) gram per plant

GROWTH PARAMETERS

Height of plant (cm)

The plant height was influenced by different levels of NPK at 30,60,90,120,150 DAP. The maximum plant height was observed in the treatment T4 NPK (100:105:105) gram per plant followed T_3 NPK (75:80:80) gram per plant and the minimum was observed in the treatment T_0 Control N: P: K (0:0:0) gram per plant. The data is shown is Table 2.

Table 2 Plant height at 30,60,90,120,150 and 180 DAT

Treatment S. No.	Treatments details	Plant height (cm)					
		30 DAT	60 DAT	90 DAT	120 DAT	150 DAT	180 DAT
T_0	Control	34.80	39.32	43.84	49.65	55.10	59.25
T_1	NPK (25:30:30) gram per plant	62.02	67.90	73.35	79.57	85.72	90.24
T_2	NPK (50:55:55) gram per plant	67.12	73.56	79.16	85.72	92.05	96.41
T_3	NPK (75:80:80) gram per plant	82.23	89.05	94.49	100.90	107.15	111.29
T_4	NPK (100:105:105) gram per plant	84.55	91.01	96.42	102.98	109.39	113.62
T_5	NPK (125:130:130) gram per plant	81.35	88.17	93.72	100.16	106.60	111.11
T_6	NPK (150:155:155) gram per plant	76.28	82.74	88.19	94.63	100.96	105.62
T_7	NPK (175:180:180) gram per plant	73.87	80.39	86.02	92.34	98.62	103.02
T_8	NPK (200:205:205) gram per plant	73.99	80.24	85.38	91.63	98.04	102.32
T_9	NPK (225:230:230) gram per plant	73.61	80.06	85.18	91.30	97.55	102.36
T_{10}	NPK (250:255:255) gram per plant	76.68	83.01	88.23	94.56	100.89	105.44
T_{11}	NPK (275:280:280) gram per plant	74.41	80.86	86.07	92.88	99.02	103.18
	F-Test	S	S	S	S	S	S
	S.Ed. (+)	2.00	1.942	2.02	1.93	2.08	1.98
	C.D. at 0.5%	4.14	4.02	4.15	4.01	4.31	4.11

Number of leaves per plant

The Number of leaves per plant was influenced by different levels of NPK at 30,60,90,120,150 DAP The maximum number of leaves per plant (71.99) was observed in the

treatment T_4 NPK (100:105:105) gram per plant and was found to be minimum (38.94) in the treatment T_0 Control N:P:K 0:0:0 g/plant. The data is shown is Table 3

Table 3 Number of leaves per plant at 30,60,90,120,150 and 180 DAT

Treatments No.	Treatments details	Number of leaves per plant					
		30 DAT	60 DAT	90 DAT	120 DAT	150 DAT	180 DAT
T_0	Control	14.06	17.51	23.76	31.79	32.69	38.94
T_1	NPK (25:30:30) gram per plant	18.39	24.71	37.23	46.95	52.99	65.51
T_2	NPK (50:55:55) gram per plant	16.75	22.89	35.30	46.53	51.45	63.86
T_3	NPK (75:80:80) gram per plant	22.56	29.08	41.52	54.34	58.23	70.67
T_4	NPK (100:105:105) gram per plant	24.53	30.65	43.06	55.37	59.58	71.99
T_5	NPK (125:130:130) gram per plant	21.37	27.62	39.95	54.44	57.11	69.44
T_6	NPK (150:155:155) gram per plant	18.80	25.11	37.32	46.15	52.47	64.68
T_7	NPK (175:180:180) gram per plant	20.62	26.87	39.39	47.79	54.71	67.23
T_8	NPK (200:205:205) gram per plant	19.44	25.56	37.97	46.28	53.15	65.56
T_9	NPK (225:230:230) gram per plant	20.26	26.78	39.10	47.80	54.32	66.64
T_{10}	NPK (250:255:255) gram per plant	21.48	27.58	39.99	48.46	55.23	67.64
T_{11}	NPK (275:280:280) gram per plant	20.16	26.38	38.71	47.10	53.83	66.16
	F-Test	**S**	**S**	**S**	**S**	**S**	**S**
	S.Ed. (+)	**0.98**	**1.05**	**0.96**	**1.00**	**1.02**	**0.99**
	C.D. at 0.5%	**2.03**	**2.18**	**1.99**	**2.09**	**2.11**	**2.07**

Number of branches per plant

The no. of branches per plant was influenced by different levels of NPK at 30,60,90,120,150 DAP. The maximum number of branches per plant (10.07) was observed in the treatment T_4 NPK (100:105:105) gram per plant and was found to be minimum (6.86) in the treatment T_0 Control N:P: K 0:0:0 g/plant. The data is shown is Table 4

Table 4 Number of branches per plant at 30,60,90,120,150 and 180 DAT

Treatments No.	Treatments details	Number of branches per plant					
		30 DAT	60 DAT	90 DAT	120 DAT	150 DAT	180 DAT
T_0	Control	1.10	2.31	3.36	4.58	5.64	6.86
T_1	NPK (25:30:30) gram per plant	2.17	3.45	4.66	5.96	8.29	9.71
T_2	NPK (50:55:55) gram per plant	2.26	3.59	4.82	6.14	8.55	9.90
T_3	NPK (75:80:80) gram per plant	2.51	3.72	4.90	6.18	8.48	10.10
T_4	NPK (100:105:105) gram per plant	2.63	3.88	5.11	6.33	8.65	10.07
T_5	NPK (125:130:130) gram per plant	2.48	3.71	4.92	6.23	8.67	10.13
T_6	NPK (150:155:155) gram per plant	2.20	3.47	4.69	5.89	8.41	9.93
T_7	NPK (175:180:180) gram per plant	2.06	3.29	4.49	5.77	8.43	9.88
T_8	NPK (200:205:205) gram per plant	2.15	3.37	4.60	5.82	8.34	9.75
T_9	NPK (225:230:230) gram per plant	2.16	3.41	4.65	5.88	8.44	10.07
T_{10}	NPK (250:255:255) gram per plant	2.25	3.48	4.70	5.94	8.45	9.96
T_{11}	NPK (275:280:280) gram per plant	2.18	3.42	4.63	5.77	8.49	9.94
	F-Test	**S**	**S**	**S**	**S**	**S**	**S**
	S.Ed. (+)	**0.118**	**0.115**	**0.116**	**0.121**	**0.136**	**0.134**
	C.D. at 0.5%	**0.244**	**0.238**	**0.241**	**0.250**	**0.282**	**0.277**

Days to bud initiation

The days to bud initiation was influenced by different levels of NPK at 30,60,90,120,150 DAP. The Days to bud initiation was found to be minimum (43.31 days) in the treatment T_0 NPK 0:0:0 gram per plant and maximum (68.07 days) in the treatment T_4 Control N:P: K (100:105:105)g/plant. The data is shown is Table 5

Days taken to flowering

The days taken to flowering was influenced by different levels of NPK at 30,60,90,120,150 DAP.The days taken to flowering was found to be minimum (49.87 days) in the treatment T_0 NPK 0:0:0gram per plant and maximum (84.59 days) in the treatment T_4 Control N:P: K (100:105:105)g/plant. The data is shown is Table 5

Number of flowers per plant

The number of flowers per plant was influenced by different levels of NPK at 30,60,90,120,150 DAP. The Number of flowers per plant was found to be maximum (15.83) in the treatment T_4 NPK (100:105:105) gram per plant and minimum (7.04) in the treatment T_0 Control N:P: K 0:0:0 g/plant. The data is shown is Table 5

Flower diameter (cm)

The flower diameter was influenced by different levels of NPK at 30,60,90,120,150 DAP. The flower diameter (cm) was found to be maximum (13.06) in the treatment T_4 NPK (100:105:105) gram per plant and minimum (10.13) in the treatment T_0 Control N:P: K 0:0:0 g/plant. The data is shown is Table 5

Flower weight (g)

The flower weight was influenced by different levels of NPK at 30,60,90,120,150 DAP. The flower weight (g) was found to be maximum (3.82) in the treatment T_4 NPK (100:105:105) gram per plant and minimum (2.07) in the treatment T_0 Control N:P: K 0:0:0 g/plant. The data is shown is Table 5

Number of flowers per ha

The no. of flower per ha. was influenced by different levels of NPK at 30,60,90,120,150 DAP. The number of flowers per ha was found to be maximum (39575) in the treatment T_4 NPK (100:105:105) gram per plant minimum (17591.67) in the treatment T_0 Control N:P: K 0:0:0 g/plant. The data is shown is Table 5

Table 5 Days to bud initiation, Days taken to flowering, Number of flowers per plant, Flower diameter (cm), Flower weight (g), Number of flowers per ha

Treatments No.	Treatments details	Days to bud initiation	Days taken to flowering	Number of flower per plant	Flower diameter (cm)	Flower weight (g)	Number of flower per ha
T_0	Control	68.07	84.59	7.04	10.13	2.07	17591.67
T_1	NPK (25:30:30) gram per plant	52.16	60.61	12.52	11.47	2.62	31308.33
T_2	NPK (50:55:55) gram per plant	50.17	59.10	11.48	11.16	2.57	28700
T_3	NPK (75:80:80) gram per plant	46.03	53.55	14.54	12.74	3.70	36358.33
T_4	NPK (100:105:105) gram per plant	43.31	49.87	15.83	13.06	3.82	39575
T_5	NPK (125:130:130) gram per plant	48.42	57.05	14.07	12.91	3.61	35166.67
T_6	NPK (150:155:155) gram per plant	48.18	57.33	13.57	12.61	3.31	33925
T_7	NPK (175:180:180) gram per plant	54.81	65.33	12.78	12.37	3.31	31950
T_8	NPK (200:205:205) gram per plant	54.72	63.87	12.44	11.52	3.54	31108.33
T_9	NPK (225:230:230) gram per plant	52.77	62.29	13.06	11.98	2.80	32641.67
T_{10}	NPK (250:255:255) gram per plant	58.47	67.69	13.24	12.08	2.63	33108.33
T_{11}	NPK (275:280:280) gram per plant	62.28	71.64	14.44	12.07	2.44	36108.33
	F-Test	**S**	**S**	**S**	**S**	**S**	**S**
	S.Ed. (+)	**1.918**	**1.925**	**0.515**	**0.186**	**0.122**	**1286.81**
	C.D. at 0.5%	**3.978**	**3.99**	**1.067**	**0.386**	**0.253**	**2668.698**

Benefit cost ratio for cultivation

The Benefit cost ratio was found to be maximum (1: 1.46) in the treatment T_4 NPK (100:105:105) gram per plant and minimum (1:0.21) in the treatment T_0 Control N:P: K 0:0:0 g/plant. The data is shown in Table 6

Table 6 Economics of different treatments and benefit cost ratio for cultivation of *Hibiscus rosa sinensis*

Treatment No.	Treatment	Cost of cultivation Rs. /ha	Flower yield q /ha	Sale Rate Rs/q	Gross Return Rs. /ha	Net Return Rs./ ha	Benefit Cost Ratio
T_0	Control	116685	17591.67	8	140733.36	24048.36	0.21
T_1	NPK (25:30:30) gram per plant	119978.48	31308.33	8	250466.64	130488.16	1.09
T_2	NPK (50:55:55) gram per plant	122813.62	28700	8	229600.00	106786.38	0.87
T_3	NPK (75:80:80) gram per plant	125648.77	36358.33	8	290866.64	165217.87	1.31
T_4	NPK (100:105:105) gram per plant	128483.91	39575	8	316600.00	188116.09	1.46
T_5	NPK (125:130:130) gram per plant	131319.06	35166.67	8	281333.36	150014.30	1.14
T_6	NPK (150:155:155) gram per plant	134154.20	33925	8	271400.00	137245.80	1.02
T_7	NPK (175:180:180) gram per plant	136989.35	31950	8	255600.00	118610.65	0.87
T_8	NPK (200:205:205) gram per plant	139824.49	31108.33	8	248866.64	109042.15	0.78
T_9	NPK (225:230:230) gram per plant	142659.64	32641.67	8	261133.36	118473.72	0.83
T_{10}	NPK (250:255:255) gram per plant	145494.78	33108.33	8	264866.64	119371.86	0.82
T_{11}	NPK (275:280:280) gram per plant	148329.93	36108.33	8	288866.64	140536.71	0.95

Conclusion

On the basis of present investigation, it is concluded that, treatment T_4 which is application of NPK (100:105:105) was found to be the best in the terms of growth parameter and yield Parameter of Hibiscus and Cost benefit ratio is 1: 1.46.

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