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EFFECT OF DIFFERENT POSITIONS OF BENDING IN ROSE (*ROSA HYBRIDA* L.) VARIETIES UNDER PROTECTED CULTIVATION

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Abstract– The current investigation was carried out at, Department of Floriculture and Landscape Architecture College of Horticulture, Mudigere, to study the Effect of Different Positions of Bending in Rose (*Rosa hybrida* L.) Varieties under Protected Cultivation. Among different interactions, V_1B_1 recorded maximum plant height (132.38 cm) maximum inter nodal length (6.40 cm), maximum number of shoots per plant (4.31). In case of quality and yield attributes, V_1B_1 showed minimum days for first flower bud appearance, days taken for harvest from first bud appearance and days taken for harvest after bending (31.40 days , 15.03 and 50.44 days, respectively), maximum stalk length (73.46 cm), stem girth (7.67), flower bud length (3.82 cm), flower bud diameter (3.22 cm) and vase life (13.30 days) were also observed in V_1B_1.As far as parameter concerned same interaction i.e., V_1B_1 was found to be high yielder with respect to number of flowers per plant (4.80) and flowers per meter square (46.00).V_1B_1 was found superior over all other interactions. Hence, the commercial bending of rose bended at shoot junction bud could be taken up as effective cultural practice in rose.

INTRODUCTION

Since ancient times, the rose has been the flower to represent love, adoration, innocence, peace, friendship, affection, passion and other virtues. Roses are first among top 10 cut flowers in the global market. It is cultivated for a variety of uses, including garden flowers, aesthetic value, cut flowers for decoration, loose flowers for garland and the production of a number of goods, including rose oil, rose water, gulkhand, rose attar etc.

It belongs to the family Rosaceae,the genus Rosa consists of about 120 species, out of which only eight species are cultivated *viz., Rosa chinensis, Rosa damascena , Rosa foetida, Rosa gallica, Rosa gigantea, Rosa moschata, Rosa multiflora* and *Rosa wichuriana.*

The production of roses, one of the cut flowers, is a highly lucrative industry with considerable export potential. Due to a shortage of domestic production, there is a particularly high demand for cut rose flowers in the European markets from November to Marchdue to the harsh winter. The buyer at the international market is said to desire very high-quality rose cut flowers. Despite the high cost of controlled greenhouse production, polyhouses naturally ventilated buildings covered with polyethylene film can produce high quality flowers year around (Shivaprasad *et al.,* 2016). In addition, it is simple to protect crops from harsh weather conditions and the occurrence of pests and diseases.

During the 80's the cultivation technique of bending the shoots in greenhouse cut roses was developed by Japanese growers (Real *et al*., 2007). This system is always combined with hydroponics (*e.g.,* rockwool or coir as substrate in open or closed systems) so that high quality of cut flowers can be produced. In the bending cultivation system, rose plants are also planted in rows, but the canopy

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height is low. Main characteristic of this system is that the blind, weak or early flowering shoots are bent low to the ground. The bending of shoots is done year-round, towards the outside of the bed and these shoots form the photosynthetic, almost horizontal, canopy of the plant; while the stronger basal shoots arising subsequently from the crown will be harvested later as cut flowers. Thus, a heterogeneous canopy structure is formed by upright flower shoots and horizontally bent canopy shoots, which will fill the space between the plants and between the rows. This way, no leaf area is sacrificed and the light is intercepted by basal shoots that emerge from or near the primary shoot (Kim and Lieth, 2004). Altering the plant's architecture by shoot bending (Ohkawa and Suematsu, 1999; Tsujita and Blom, 1996) and increasing the height of the basal shoots, the plant is encouraged to grow in a healthy way a bottom-up architecture that increases photosynthesis by increasing leaf surface area, resulting in a tall and sturdy flower stalk.

MATERIALS AND METHODS

The present investigation on Effect of Different Positions of Bending in Rose (*Rosahybrida* L.) Varieties Under Protected Cultivation was carried out at Department of Floriculture and Landscape Architecture polyhouse, College of Horticulture, Mudigere, during the year 2021-2022. The experiment laid out in Factorial Randomized Complete Block Design with four replications. Healthy budded plants were obtained from Manjunath nursery hosur, T.N. They were planted on at spacing of 50 cm row to row and 17cm between plant to plant.

Rose plants were selected and pruned at the height of 50 cm from the ground level new vegetative shoots were produced from pruned plants after 30 days. Bending of mother shoot after planting which enhance the bottom breaks. When after one month the shoots were bent as per the treatment towards path newly emerging shoots attained pencil size thickness, pinching of apical bud to promote more basal shoots leaving 5 pair of leaves in strong shoot and 3 pair in weak shoot and also bending of unproductive, weak stems were done repeatedly during the entire experimental period to enhance the production of basal shoots (bottom breaks) to ensure leaf area. Pruning was also done to remove pest and disease affected parts of the plant and unproductive shoots

The treatments consist of two factors *viz*., (Factor-1-V_1– Tajmahal, V_2 - Peach Avalanche, V_3 – Rockstar, V_4 – Nobless Pink, V_5 – Golden Strike and Factor-2-B_1 - At shoot junction bud, B_2 - Above the first leaf bud, B_3 - Above the second leaf bud, B_4 - Above third leaf bud, B_5 - No bending) with 25 combinations. Observations were recorded after bending from the five randomly tagged plants. After harvest flower stems at equal length were kept in tap water for vase life study. The leaves were used for the chlorophyll content observed in spectrophotometer.

RESULTS AND DISCUSSION

Among the different combinations, V_1B_1*viz*., Tajmahal (V_1) + bending at shoot junction bud (B_1) was found to be superior over other combinations V_1B_1 treatment significantly recorded the highest plant height (132.38 cm), number leaf lets per plant (55.67 cm), plant spread E-W (44.21 cm) and N-S (42.00 cm) and inter nodal length (6.40 cm) (Zhang *et al*., 2020) stated that availability of more number of leaves in a plant help in manufacture of more photosynthates which results in increasing plant height and produce more number of branches per plant. It has been reported that bending of the primary shoots promotes the formation of axillary shoots by breaking apical dominance (Tsanakas *et al*. (2017).

Days taken for first bud appearance (31.40 days), days taken for harvest from first bud appearance (15.03 days), days taken for harvest after bending (50.44 days), the highest stalk length (73.46 cm) was observed in the treatment V_1B_1 (Table 1) Tsanakas *et al*. (2017) accredited following additional benefits of bending in the rose. In the bent system, the harvested flowering shoots typically encompass the basal shoots, which are characterized by their strength and length. In the same treatment, highest length of flower bud (3.82 cm) and increased diameter of flower bud (3.22cm) were observed (Table 2).

The treatment that V_1 B_1 combination also recorded maximum flower stem girth (7.67 mm), maximum number of flowers per plant (4.80), maximum number of flowers per square meter (46.00) and vase life (13.30 days) followed by V1B3 which is on par with each other (Table 2).

The growth and flower parameters are superior due to the interaction effect of bending along with verities. The bent stem produces an abundance of photosynthesizing leaves, ensuring a sufficient

Table 1. Effect of different levels of shoot bending of rose varieties for growth and flower parameters

Treatments	Plant height (cm)	No. of leaft lets per plant	Plant spread (cm) E-W	Plant spread (cm) N-S	Internodal length (cm)	Dyas to first bud appearance	Days to harvest from first bud appearance	Days to harvest after bending	Stalk length (cm)
V_1B_1	132.38	55.67	44.21	42.00	6.40	31.40	15.03	50.44	73.46
V_1B_2	126.19	46.21	37.86	37.17	6.14	31.99	15.71	52.20	70.55
V_1B_3	123.26	42.23	35.63	33.90	5.90	32.85	15.88	54.23	69.11
V_1B_4	118.39	38.91	32.05	31.98	5.79	33.13	16.21	56.54	65.22
V_1B_5	115.55	32.21	29.80	28.50	5.06	34.28	16.74	57.66	62.45
V_2B_1	125.70	38.35	31.53	32.00	6.12	32.03	15.81	52.65	67.55
V_2B_2	120.48	36.28	31.86	32.17	6.06	32.96	15.95	54.52	65.75
V_2B_3	115.82	34.23	31.38	32.51	5.74	33.23	16.07	56.35	64.13
V_2B_4	113.65	31.12	30.44	29.38	5.61	34.05	16.26	56.93	62.14
V_2B_5	109.82	29.44	28.39	27.95	4.82	34.96	16.78	57.93	60.11
V_3B_1	127.22	48.23	40.15	38.15	6.23	31.66	15.23	51.63	71.52
V_3B_2	123.88	43.83	35.00	32.98	6.17	32.22	15.66	53.17	68.11
V_3B_3	119.18	38.13	30.53	33.15	5.84	33.02	15.90	55.61	66.55
V_3B_4	115.12	36.36	29.80	28.98	5.15	33.85	16.39	56.34	64.12
V_3B_5	111.19	31.22	29.88	29.00	5.00	34.52	16.72	57.77	61.75
V_4B_1	124.51	43.16	34.92	33.16	6.18	31.91	15.61	52.50	69.30
V_4B_2	120.47	37.31	31.39	30.00	5.90	32.75	15.79	54.17	66.12
V_4B_3	115.03	35.15	28.96	29.01	5.72	33.11	15.96	55.90	64.84
V_4B_4	113.56	34.00	28.63	31.00	5.55	33.85	16.22	56.81	63.77
V_4B_5	110.39	30.83	29.63	30.05	4.97	34.85	16.65	57.85	59.90
V_5B_1	124.00	35.66	30.15	31.18	6.16	33.30	15.97	53.76	67.14
V_5B_2	117.98	33.18	30.83	29.86	5.70	33.54	16.19	54.67	65.13
V_5B_3	113.86	31.00	30.63	28.00	5.61	34.23	16.51	56.56	63.88
V_5B_4	110.22	29.45	29.10	30.28	5.42	34.44	16.59	56.99	61.35
V_5B_5	108.14	28.35	28.00	27.50	4.55	35.02	16.96	58.83	58.16
SEm±	1.15	0.37	0.28	0.33	0.05	0.34	0.17	0.59	0.65
CD @5%	3.26	1.06	0.81	0.95	0.15	0.95	0.50	1.66	1.83

supply of additional assimilates and the effective translocation of carbohydrates to support the growth of shoots. Getachew *et al*. (2012). Szmagara *et al.* (2016) reported that due to the bending of stems increases the sprouting of high-quality flowers shoots and also increases plant height.

CONCLUSION

Effect of different positions of bending in rose (*Rosa hybrida* L.) varieties under protected cultivation unveiled noteworthy outcomes. Notably, among the interactions, V_1B_1 (Tajmahal variety + bending at the shoot junction bud) emerged as superior in comparison to other interactions across numerous parameters, encompassing vegetative attributes, flowering patterns and yield, quality. As a result, adopting the practice of bending roses at the shoot junction bud commercially proves to be an effective cultural approach. This practice was followed in effectiveness by bending above the first leaf bud and above the second leaf bud.

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Conflict of interest

The authors have declared that no conflict of interest exists.

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Table 2. Effect of different levels of shoot bending of rose varieties for quality and yield parameters

Treatments	Flower bud length (cm)	Flower bud diameter (cm)	Stem girth (mm)	Number of flowers per plant	Number of flowers per meter square	Vase life (days)
V_1B_1	3.82	3.22	7.67	4.80	46.00	13.30
V_1B_2	3.63	2.90	7.01	3.95	38.10	11.86
V_1B_3	3.52	2.74	6.71	3.72	35.05	10.88
V_1B_4	3.32	2.69	6.51	3.53	36.15	9.80
V_1B_5	2.93	2.52	6.17	2.71	28.10	9.10
V_2B_1	3.61	2.83	6.60	3.55	37.19	12.35
V_2B_2	3.35	2.70	6.35	2.93	34.20	10.90
V_2B_3	3.21	2.61	6.27	3.01	31.00	10.17
V_2B_4	3.13	2.49	6.05	2.69	29.85	9.48
V_2B_5	2.71	2.39	5.62	2.70	27.83	8.90
V_3B_1	3.77	2.93	7.20	4.12	42.17	12.86
V_3B_2	3.61	2.82	6.76	3.40	37.25	11.75
V_3B_3	3.41	2.67	6.50	3.21	36.18	10.36
V_3B_4	3.22	2.54	6.39	2.96	34.15	9.72
V_3B_5	2.81	2.49	5.93	2.78	28.16	9.00
V_4B_1	3.67	2.79	6.71	3.70	38.09	12.60
V_4B_2	3.42	2.75	6.45	3.25	35.65	11.05
V_4B_3	3.39	2.64	6.28	3.19	32.24	10.20
V_4B_4	3.12	2.53	6.10	2.97	29.83	9.69
V_4B_5	2.79	2.45	5.80	2.74	28.63	9.02
V_5B_1	3.58	2.70	6.45	3.42	35.17	11.90
V_5B_2	3.43	2.63	6.31	3.17	31.55	10.77
V_5B_3	3.17	2.52	6.18	3.02	28.19	10.15
V_5B_4	3.02	2.41	6.01	2.93	31.22	9.22
V_5B_5	2.69	2.35	5.50	2.63	27.01	8.62
SEm±	0.04	0.03	0.06	0.03	0.30	0.11
CD @5%	**0.10**	**0.08**	**0.17**	**0.11**	**0.85**	**0.31**

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