Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2020; 9(1): 2094-2097
Received: 16-11-2019
Accepted: 18-12-2019

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Influence of different levels of fertigation and growth regulators on architecture of dutch rose cultivars

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Abstract
Increased concentration of gibberellic acid combined with 120 percent of recommended dose of fertilizers as fertigation significantly increased the internodal length and in turn plant height, mean number of branches per plant and plant spread respectively. Though all the varieties positively responded for the treatments but variety Grand gala produced significantly superior quality of growth when plants were treated with 120 per cent of fertigation in combination with 300 ppm of GA_3.

Keywords: Fertigation, ppm

Introduction
Many aspects were emerging contributor to agricultural field in which one of the main factors is the cultivation of ornamental roses which have very high market demand in world wide. Flower arrangements have its unique place from very early civilization in global level.
Cut flower required less management practices and give a valuable price as compared with other ornamental plants. Therefore very large research is needed to conduct on cut flower production technology, which covers all aspects of cut flower production such as section and breeding of potential varieties, pruning, management of crops and crop harvest technology. Scores of millions of roses are sold every year and the demand for this cut flower. However, production potential is not fully exploited. There is a need to establish this enterprise on modern lines and conduct extensive research on all aspects of rose production technology, which may include section and breeding of potential varieties, pest and disease control, pruning practices, crop management and post harvest technology.
Among the various factors responsible for high crop yield, supply of appropriate quantity of nutrients and growth regulators at appropriate time, plays a vital role in enhancing the productivity and quality. Nutrients are normally applied as a basal dose and top dressing the nutrients applied in the form of fertilizers are subjected to leaching, fixation and losses in the soil. Further, the nutrients traverse deeper to areas beyond the active root zone and become unavailable to the plant. In many cases, the effective utilization of nutrients by the plant is less than fifty per cent of the fertilizers applied. Hence, nutrients through fertigation can be applied uniformly to each and every plant even on daily basis, thereby creating an ideal and optimum environment for the plants to absorb the required nutrients. Since, the required nutrients are made available uniformly, through frequent application, the wastage is drastically reduced. As a result fertigation improves the crop yield substantially.
Optimum plant nutrition is very essential in plant growth, if it is not in sufficient amount, it reduced vigor of plant and affect yield of crops. The addition of NPK fertilizer level increases flower production (Uma and Gowda, 1987) [14]. Two important factors play very good role in the production of plant such is water and nutrients. Fertigation make these two key factors for water and nutrients for better quality and yield. Fertigation is the low cost and improved rates of seasonal fertilizer application over traditional fertilizer application. Nevertheless, in fact rose are constantly harvested and have a large fluctuation transpiring area as compared with other crops, therefore care must be taken when scheduling fertigation. Great emphasis have been focusing on to get maximum fertilizer utilization, higher yield and uniform irrigation water, all these we can achieve through fertigation frequency and suitable fertilizer application with optimum quantity of irrigation water. Hence, there is a great scope to improve the quality of rose flowers to emulate the flowers of international standard through fertigation and application of growth regulators at various stage of crop growth.

Materials and Method

The research work entitled "Effect of different levels of fertigation and growth regulators on growth, yield and quality of rose cultivars under polyhouse condition" was taken at Department of horticulture, UAS, Bangalore. The experiment was laid out in the polyhouse following the recommended package of practices for roses. Major nutrients (N, P & K) as per the recommendations were supplied by fertigation in the morning hours. Micronutrients (Multiplex) were supplied as foliar spray at 0.2 per cent at monthly intervals. The nutrients were given in splits at weekly intervals as per treatment. Growth regulators at required concentrations were prepared. To prepare 200 ppm GA_3, 200 mg of GA_3 was dissolved in 1ml 0.1 N NaOH and volume was increased up to one liter using distilled water. Whereas, humic acid was directly dissolved in water and then applied to plants as foliar spray.

Results

Significant differences were obtained with respect to varieties, growth regulators, levels of fertigation, interaction effects between variety-fertigation and fertigation-growth regulators for the character plant height at both the seasons. Non-significant differences were observed between varieties and growth regulators interaction at second season.

Treatments V_4 (75.46 cm & 73.48 cm), G_2 (69.21 cm & 68.28 cm) and F_2 (67.18 cm & 68.28 cm) produced plants of maximum height. Interaction between V_4F_2 (82.29 cm & 80.54 cm) recorded maximum plant height, while G_2F_2 (74.57 cm & 72.29 cm) and G_1F_2 (73.06 cm & 74.31) were on par with each other for the character plant height. However, interactions V_4G_2 (90.27 cm) resulted in maximum plant height only in one season. Shorter plants were produced by the interactions of V_3G_3 (42.16 cm & 42.88 cm), V_3F_0 (42.80 cm & 39.35 cm) and G_4F_0 (49.93 cm & 48.56 cm) during two seasons 1 and 2 respectively.

While V4 treated plants (4.54 & 4.61) recorded maximum number of primary branches per plant as compared to rest of the treatments in seasons 1 and 2 respectively. While, treatment G_2 (4.70 & 5.00) induced higher number of primary branches per plant as compared to G_1 (4.27 & 4.35), G_3 (4.35 & 3.79) and G_4 (3.63 & 3.96) in the seasons 1 and 2 respectively, and treatment F_2 (4.93 & 5.32) produced maximum branches per plant when compared with F_0 (3.30 & 3.44) and F_1 (3.94 & 4.06) during the seasons 1 and 2 respectively. The interactions V_4F_2 (5.90 & 5.98) and G_2F_2 (5.48 & 5.93) recorded the highest mean number of primary branches per plant in the seasons 1 and 2 respectively.

Maximum plant spread was observed in treatments V_4 (884.03 cm^2 & 494.68 cm^2), G_2 (624.01 cm^2 & 404.29cm^2) and F_2 (687.49 cm^2 & 414.06 cm^2) in seasons 1 and 2, respectively. Interactions V_4F_2 (606.24 cm^2), V_4G_2 (599.67 cm^2) and G_2F_1 (494.76 cm^2) recorded maximum plant spread as compared to rest of the treatments (Table 2 and Table 3).

Discussion

Increased concentration of gibberellic acid combined with 120 percent of recommended dose of fertilizers as fertigation significantly increased the internodal length and in turn plant height respectively. When varieties were compared, it was found that Grand Gala showed a tendency of vigorous growth. The same results were depicted when factors like varieties, growth regulators and levels of fertigation were interacted each other. The results obtained were in accordance with (Palai *et al*., 2002) [7] who noticed increased plant height with the application of 400:300:200ppm NPK per plant per week in rose cv. Montezuma, Suganya *et al*, 2007 [13] and (Qasim *et al*., 2008) [9] who stated that NPK at 500 ml applied at 2 days interval in rose was optimum for vegetative growth. However humic acid reduced the plant height drastically in all the varieties. These results are in accordance with the findings (Meybodi *et al*., 2012) [5] who stated that, an increase in humic acid concentration caused a reduction in the height of the plants.

The increment in plant height with the application of GA is primarily due to cell division and cell elongation resulting in increase in internodal distance and number of internodes there by the mean plant height was increased. The steep increase in plant height with GA was also in conformity with Bankar and Mukhopadhyay (1982) [2] who found that GA_3 at 100 to 250 ppm increased the stem length and internodal length in rose Cv. Queen Elizabeth. Padmapriya and Chezhiyan (2003) [6] studied morphological characters of 4 cultivars of chrysanthemum as influenced by GA_3 and reported that plant height was increased drastically with increase in concentration of GA_3. These results are in accordance with the findings of Gowda (1980) [3] in rose Cv. Super Star, Gowda (1988) [4] in rose Cv. American Heritage, Sadanand *et al*. (2000) [11] in rose Cv. First Red, Ramesh and Singh (2003) [10] in Carnation.

Grand Gala produced plants with maximum number of branches as compared to other varieties. The productivity of the crop depends primarily on the framework and cultural operations. This could be the reason why varieties differed significantly with each other with respect to number of primary branches produced. However, fertigation with 120 percent of recommended dose (4.93 and 5.32) and Gibberellic acid at 300 ppm (4.70 & 5.00) concentration produced significantly higher number of primary branches per plant. While, the interactions V_4F_2 (5.9 & 5.98), G_2F_2 (5.48 & 5.93) and V_4G_2 (5.21) also maintained the same trend in producing significantly higher branches. This could probably due to application of optimum level of nutrients in a readily available form. Similar views were expressed by Anwar *et al*, (1999) who studied the effect of N, K fertilizers on vegetative growth of Rose, Vidhya Sankar and Bhattacharjee (2000) [15] who obtained increased number of basal shoots with optimum level of nitrogen in roses and (Qasim *et al*., 2008) [9] who stated that NPK at 500 ml applied at 2 days interval in rose was optimum for vegetative growth.

Increase in the number of branches per plant as a result of GA_3 application can be explained in the light of the fact that GA_3 interacts with auxins thus reducing the apical dominance and thereby results in the increased number of axillary branches. Similar results have been reported by Prabhat Kumar *et al*. (2003) [8] in China aster.

Table 1: Plant height, number of branches per plant and plant spread as influenced by varieties, growth regulators and levels of fertigation

Treatment	Mean plant height (cm)		Mean no. of branches per plant		Mean plant spread (cm^2)	
Variety	**Season 1**	**Season 2**	**Season 1**	**Season 1**	**Season 1**	**Season 2**
V_1-First Red	62.60	63.57	503.27	503.27	503.27	254.92
V_2-Noblesse	60.22	61.09	616.08	616.08	616.08	253.32
V_3-Gold Strike	46.54	47.89	298.05	298.05	298.05	251.69
V_4- Grand Gala	75.46	73.48	884.03	884.03	884.03	494.68
F-test	*	*	*	*	*	*
SEm ±	0.29	0.64	45.76	45.76	45.76	6.02
CD at 5%	1.02	2.24	158.38	158.38	158.38	20.83
Growth regulator						
G_1-200 ppm GA_3	64.54	66.01	583.93	583.93	583.93	345.19
G_2 -300 ppm GA_3	69.21	68.28	624.01	624.01	624.01	404.29
G_3 -0.2% Humic acid	56.06	57.07	531.08	531.08	531.08	249.17
G_4 - 0.4% Humic acid	55.02	54.66	562.43	562.43	562.43	255.96
F-test	*	*	*	*	*	*
SEm ±	0.25	0.40	46.70	46.70	46.70	4.04
CD at 5%	0.87	1.40	161.61	161.61	161.61	14.01
Fertigation						
F_0-100% RDF Soil application	55.97	54.85	446.59	446.59	446.59	279.34
F_1- 80% Fertigation	60.46	61.39	592.00	592.00	592.00	247.55
F_2-120% Fertigation	67.18	68.28	687.49	687.49	687.49	414.06
F-test	*	*	*	*	*	*
SEm ±	0.83	1.93	159.32	159.32	159.32	17.98
CD at 5%	2.87	6.69	551.56	551.56	551.56	62.24

* Significant at 5% level

Table 2: Plant height, number of branches per plant and plant spread as influenced by interaction between variety, growth regulators and fertigation

Treatment	Mean plant height (cm)		Mean no. of branches per plant		Mean plant spread (cm^2)	
V X G	**Season 1**	**Season 2**	**Season 1**	**Season 1**	**Season 1**	**Season 2**
V_1G_1	66.59	68.20	509.54	509.54	509.54	278.50
V_1G_2	67.83	69.47	565.23	565.23	565.23	345.81
V_1G_3	58.99	59.59	456.11	456.11	456.11	194.95
V_1G_4	42.74	42.75	361.66	361.66	361.66	150.32
V_2G_1	62.94	65.60	614.57	614.57	614.57	277.07
V_2G_2	65.34	67.83	654.72	654.72	654.72	277.07
V_2G_3	56.13	56.27	583.58	583.58	583.58	196.58
V_2G_4	56.47	54.66	611.46	611.46	611.46	202.00
V_3G_1	60.04	59.27	504.91	504.91	504.91	350.76
V_3G_2	53.38	55.57	321.48	321.48	321.48	334.05
V_3G_3	42.16	42.88	282.00	282.00	282.00	197.55
V_3G_4	30.51	31.08	217.00	217.00	217.00	150.17
V_4G_1	81.73	80.21	924.37	924.37	924.37	566.47
V_4G_2	90.27	80.25	954.62	954.62	954.62	599.67
V_4G_3	50.19	52.15	601.96	601.96	601.96	305.69
V_4G_4	49.43	49.17	650.02	650.02	650.02	315.89
F-test	*	NS	NS	NS	NS	*
SEm ±	0.50	0.81	93.40	93.40	93.40	8.09
CD at 5%	1.74	-	-	-	-	28.02
V X F						
V_1F_0	56.57	56.70	522.57	522.57	522.57	166.75
V_1F_1	59.03	61.17	360.85	360.85	360.85	185.95
V_1F_2	72.25	72.83	626.43	626.43	626.43	412.06
V_2F_0	56.17	57.88	633.99	633.99	633.99	188.20
V_2F_1	61.00	60.27	523.43	523.43	523.43	219.40
V_2F_2	63.49	65.12	690.83	690.83	690.83	352.30
V_3F_0	42.80	39.35	307.79	307.79	307.79	213.31
V_3F_1	46.07	49.66	238.50	238.50	238.50	256.10
V_3F_2	50.74	54.65	347.87	347.87	347.87	285.65
V_4F_0	68.33	65.47	903.63	903.63	903.63	421.90
V_4F_1	75.76	74.45	663.62	663.62	663.62	455.91
V_4F_2	82.29	80.54	1084.80	1084.80	1084.80	606.24
F-test	*	*	NS	NS	NS	*
SEm ±	0.41	0.96	79.69	79.69	79.69	8.99
CD at 5%	1.43	3.34	-	-	-	31.12

* Significant at 5% level

Table 3: Plant height, number of branches per plant and plant spread as influenced by interaction between fertigation and growth regulators

Treatment	Mean plant height (cm)		Mean no. of branches per plant		Mean plant spread (cm^2)	
G X F	Season 1	Season 2	Season 1	Season 2	Season 1	Season 2
G_1F_0	57.09	59.06	3.26	3.37	450.35	310.16
G_1F_1	63.49	64.65	4.05	4.08	600.41	272.10
G_1F_2	73.06	74.31	5.45	5.61	701.02	453.31
G_2F_0	64.21	60.12	3.56	3.80	514.16	365.23
G_2F_1	65.31	66.70	4.56	4.61	617.20	325.74
G_2F_2	74.57	72.29	5.48	5.93	717.28	494.76
G_3F_0	52.64	51.66	3.17	3.19	397.64	218.34
G_3F_1	56.32	58.24	3.48	3.75	568.86	223.64
G_3F_2	59.20	61.31	4.19	4.44	626.73	335.51
G_4F_0	49.93	48.56	3.20	3.38	424.23	193.65
G_4F_1	56.74	55.96	3.64	3.82	581.51	198.70
G_4F_2	58.37	59.47	4.08	4.66	681.54	345.54
F-test	*	*	*	*	NS	*
SEm ±	0.43	0.70	0.06	0.11	80.89	7.01
CD at 5%	1.51	2.43	0.20	0.39	-	24.27

* Significant at 5% level

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