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Standardization of growing substrate and irrigation appendage nutrition in rose (*Rosa hybrida*) cv. 'Grand Gala'

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Acclaimed as the Queen of the flowers, roses are one of the nature's beautiful creations among all the flowers. Roses are the top ranking cut flowers and are the largest traded flowers in the world and share about 51% of the world flower market. The global floriculture market is valued around US $ 11-billion and India accounts for a mere 0.2% of the global export business in cut flowers and associated floricultural products. Presently, growing of flowers in our country is practiced in open field conditions. Flowers grown in open conditions are exposed to various biotic and abiotic stresses. Under such conditions, it is not possible to produce blemish free, high quality flowers in terms of bud size, stem length, lush green leaves and pests and diseases free materials which are normally produced under controlled environments in other countries. Therefore, it makes imperative to take up cut flower cultivation of roses for better quality under greenhouse conditions particularly when production of cut flower is made for export purpose.

A variety of commonly used mineral components as growing media under protected environment for commercial flower production are sand, grit, pumice, perlite, vermiculite, clay granules, rockwool, etc. A good medium maximizes root and shoot growth by providing a proper ratio of air to water space, good nutrient uptake by the roots, adequate drainage and water holding capacity furthermore fertigation is one of the most advanced technologies and ideally suited for polyhouse to get high production of quality flowers.

In view of foregoing facts, it is therefore, considered appropriate to assess growing media (locally available alternate organic and inorganic substrates like cocopeat, FYM, compost, vermicompost, saw dust, rice husk, etc.) for efficient release of water, nutrients and to develop appropriate and effective methodology for nutrition through water soluble fertilizers. As a consequence of above facts an investigation was carried out at Model Floriculture Center, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar to find out best growing media composition and prompt fertigation schedule for market lead cut rose variety 'Grand Gala' under protected condition.

One year old budded plants of rose cv. 'Grand Gala' were planted on September 10, 2011 under polyhouse at the spacing of 30x25 cm with 6 plants/bed having the size of bed 1m^2 and the height of plant was observed at the end of each year (i.e. April flush of each year). The cultivar 'Grand Gala' belongs to hybrid tea group, which is the world's top most cultivar used as cut flower. Five growing media *viz*; Soil + FYM (G_1), Soil + Vermicompost (G_2), Soil + Cocopeat (G_3) and Soil + Rice husk (G_4) mixed in the ratio of 2: 1 (v/v) and G_5 (Soil) taken as control were used for experiment. N, P and K were applied through irrigation water starting from 4th week of planting in month of October. 50, 100 and 150 and 0 ppm concentration of NPK were applied through water soluble fertilizers. Rate of application of fertigation solution was 10 litres per m^2 and fertigation frequency was kept twice a week. For the present experiment there were five growing media and four fertilizer levels as mentioned and replicated thrice. Observations regarding plant growth flower morphology, yield and vase life were recorded at end of April flush on both years. Pooled observations for both growing years i.e. 2011 and 12 and 2012 and 13 were analyzed statistically with two-way analysis of variance as described by Pansey and Sukhatme (1952).

The observations recorded on plant height indicated that the plant height was maximum in growing media G_2 (soil + vermicompost, 97.63 cm) which was followed by G_1 (97.29 cm) and this maximum value was recorded significantly higher over all other growing media other than G_1 (97.29 cm). Although lowest value of plant height (90.08 cm) was found in soil (control) which was significantly lower than all other values. Data regarding fertilizer doses revealed that minimum plant height (93.31 cm) was found in control (no fertilizer) whereas, maximum height was observed in nutritional dose of 150 ppm NPK (96.29 cm) which was significantly higher than all other fertilizer doses. When interactions data were studied it revealed that maximum value for plant height was recorded in G_4F_3 (100.61 cm) which was significantly higher than all other interaction but was statistically at par with G_1F_1. Lowest plant height was observed in G_5F_4 (87.22 cm) which was significantly lower than all other interactions. Lofty plant height with modified growing media and fertigated N P K might be due to soil fortification and balanced dose of primary nutrients. Reasonable nutrition and optimal substrate conditions interaction synergistically resulted in convenient nutrient uptake and their utilization in maximum biomass synthesis. The marked increase in plant height may be attributed towards the use of inorganic nitrogen *viz.*, NO^-_3 and NH^+_4 form. As supply of nitrogen increases the cell number and cell size, it is due to the fact that N is an essential constituent of protein and low nitrogen availability must cause

a decrease in protein synthesis which causes a decrease in cell size especially in cell division. Ammonical form of nitrogen maintains a higher leaf N level than NO_3^- and extended the period of photosynthesis. Akin results correlating plant height increment with FYM added substrate and balanced nutrition supplement also have been reported by Hazarika and Dhaduk (2010) in Dutch rose and Dhiman *et al.* (2010) in Chrysanthemum. A significant increase in plant height was obtained with 300 ppm N, 300 ppm P and 200 ppm K per week and use of FYM fortified media in rose cv. 'Montezuma' (Mishra *et al.*, 2002). When collective data gaze at number of flower production per m^2 for both years (2012 and 2013) analyzed, it was observed that growing media G_2 (soil + vermicompost) had more number of flowers (68.76) which was significantly higher than all growing media except G_3 (67.92) which was found at par to it, moreover minimum number of flowers was recorded in G_5 (32.65). When nutritional doses were observed, it was found that F_3 exhibited maximum number of flowers (62.19) and which was significantly higher than all other nutritional levels and minimum flower count per m^2 was recorded in F_4 (57.33). Interactions between growing media and nutritional doses revealed that maximum numbers of flowers were observed in interaction between G_3F_3 (79.05) and minimum in G_5F_4 i.e. control. G_3F_3 was significantly higher than all other interactions. From the above result analysis, it can be concluded that G_2 and F_3 exhibited maximum number of flowers whereas G_5 and F_4 (control) showed lower number of flowers and interaction between them G_3F_3 and G_5F_4 recorded maximum and minimum number of flowers. Results obtained on number flowers per m^2 that in case of rice husk addition and fertigation with 150 ppm NPK were maximum and the treatments effects were statistically at par. The increase in number of flower may be due to the increased leaf area which could have led to increased production and accumulation of photosynthates from leaves (source) to flowers (sink). Per unit area flower in gerbera also increased when fertigated with water soluble fertilizers (Sujatha *et al.*, 2002). Bhattacharjee and Mukharjee (1981), and Cheng (1987) also recorded increased flower yield in orchids and gloxinia, respectively, when grown in amended media.

Collective data analysis for year 2012 and 2013 revealed maximum flower bud length (5.02 cm) was found in growing media G_4 (soil + rice husk) followed by G_2 (soil + vermicompost). Minimum flower bud length (2.91 cm) was recorded in G_5 (soil). Among nutritional doses, maximum flower bud length (4.58 cm) was recorded in F_3 (150 ppm NPK) and interactions between growing media and nutritional doses were found non-significant. The reason behind higher bud length might be judicious endow of phosphorus and potash boost-up the process of flower bud growth. Organic stuff amended growing media also alleged favor for brisk growth in meristematic regions and this might be synergized by prompt supply of nutrients moreover resulted in flower bud length. Similar findings have also been reported by Nandre *et al.* (2005) in China aster, Shashidhara and Gopinath (2005) in *Calendula officinalis* cv. Red Orange, Godse *et al.* (2006) in gladiolus and Thane *et al.* (2007) in gerbera. Gaurav *et al.* (2001) found that 175 ppm K and N, and P at 50 ppm increased the length of flowers buds in roses under naturally ventilated polyhouse conditions.Analysis for the data parenting number of petals per flower revealed that lowest value (23.85) was observed in growing media G_5 (control) soil while, maximum number of petals per flower was depicted in G_2 (28.11) which was significantly higher than other growing media. Highest number of petals per flower were recorded in F_3 (28.16) which were significantly higher than F_2 and F_4 but were at par with F_1 and F_3.F_4 (25.41) Observations in terms of interactions revealed that lowest petals number (19.27) was recorded in G_5F_4 control (soil). Maximum number was observed in G_2F_3 (30.5) which was the interaction of soil + vermicompost and 150 ppm NPK and was found significantly higher to all interactions. More petals were produced by balanced fertigation along with optimally fortified growing media by vermicompost and this increase may be due to more number of branches produced by this treatment which resulted in more carbohydrate synthesis which increased number of petals. Maximum number of petals (25.41) in rose cv. First Red was also reported by Ashok and Rengasamy (2000) who studied the effect of fertigation with ammonium nitrate @150 mg per liter along with use of 20 percent vermicompost in growing media.

Data as regards vase life in ordinary tap water exhibited that maximum vase life was found in growing media G_4 (10.32 days) and minimum was found in G_5 (8.14 days). Maximum value for vase life (10.32 days), it was significantly higher than all other growing media. Effect of nutritional doses and interactions did not show any significant effect on vase life. Like to above all vegetative and flower characters, combination of growing substrates and fertigation doses, some improvement in vase life were also reported. It might be due to overall food nutrient status of flowers under these substrates combinations and proper nutrient supplement. These findings are matching with those of Kathiresan and Venkatesha (2002) in gladiolus and Barreto *et al.* (2002) in gerbera.

Minimum days (11.86) from bud appearance to harvesting were recorded in G4 (soil + ricehusk) wile longest duration was recorded (16.04) from bud appearance to harvesting was recorded in G_1 (soil + FYM). Among nutritional levels and interactions between growing media and nutrition no significant results were found. Reduction in days taken to bud appearance to harvesting with organic stuff amended growing media and irrigation with soluble fertilizers might be due to enhanced photosynthetic rate which increases carbohydrate reserves of the plants resulted in hasty growth and development. Talukdar and Barooah (1987) had also obtained shrieked duration of flower growth and development in *Dendrobiums*, when grown in sawdust based media. Early

harvesting and reduced duration of harvestable flower production in roses in response to NPK @ 300 ppm was also observed (Palai *et al.*, 2002).

NPK Application in the form of fertigation and growing media modification with mortal organic stuff lofted plant growth (plant height) and increased flower yield (number of flowers per m^2) of *Rosa hybrida* L. cv. 'Garand Gala'. Moreover these treatments were also effective to increase flower size (flower bud length) and number of petals per flower. Treatments were also effective to reduce the duration from bud appearance to harvesting and vase life of flowers in ordinary tap water. Best results were observed with NPK fertigation @ 150 ppm and use of rice husk in growing media although synergetic effect of these treatments were also most effective to improve growth, yield and quality of rose cv. 'Grand Gala'.

Table 1. Effect of growing media and nutrition supplement through irrigation water on plant growth yield and flower bud size in rose cv. 'Grand Gala'.

Treatments	Days taken for Initiation of germination	Days taken to 50% germination	Germination (%)	Survival (%)of seedlings
GA_3 100 ppm	7.60	8.40	91.99	29.01
GA_3 200 ppm	7.40	8.00	94.66	28.19
GA_3 300 ppm	7.20	7.80	97.33	30.19
KNO_3 1%	8.40	10.00	84.00	27.05
KNO_3 2%	8.40	9.40	89.33	26.92
KNO_3 5%	9.40	12.40	81.33	27.89
Salicylic acid 100 ppm	9.40	11.40	81.33	27.94
Salicylic acid 200 ppm	9.40	10.80	80.00	25.14
Water soaking	10.20	12.60	81.33	23.02
Control	11.80	14.20	64.00	22.88
CD (0.01)	0.88	1.38	7.39	NS

Table 2. Effect of growing media and nutrition supplement through irrigation water on flower quality, flowering duration and vase life in rose cv. 'Grand Gala'

Treatment	Number of petals per flower					Days taken from bud appearance to harvesting					Vase life in tap water				
	F_1	F_2	F_3	F_4	Mean	F_1	F_2	F_3	F_4	Mean	F_1	F_2	F_3	F_4	Mean
G_1	26.22	26.61	29	25.33	26.79	16.22	16.33	15.5	16.11	16.04	9.55	9.55	9.22	9.66	9.50
G_2	28.5	25.67	30.5	27.77	28.11	16.22	15.39	15.17	15.28	15.51	9.61	10.00	9.50	8.72	9.46
G_3	28.11	27.11	26.72	27.67	27.40	13.55	15.39	14.33	12.5	13.94	10.67	10.72	10.66	11.05	10.77
G_4	28.22	28.22	28.94	27.00	28.09	12.16	13.28	10.50	11.50	11.86	10.83	11.16	11.00	10.72	10.93
G_5	25.00	25.50	25.61	19.27	23.85	12.22	15.33	14.72	19.5	15.44	7.33	8.61	9.39	7.89	8.31
Mean	27.21	26.62	28.16	25.41		14.08	15.14	14.04	14.98		9.60	10.01	9.95	9.61	
CD	G		F	G x F		G		F	G x F		G		F	G x F	
	1.95		1.48	2.96		1.28		NS	NS		0.41		NS	NS	

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