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Research Article

EFFECT OF GROWING MEDIA ON GROWTH AND FLOWERING OF CUT ROSES UNDER THE PROTECTED ENVIRONMENTAL CONDITIONS

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Abstract- The experiment was conducted at the experimental unit of the Department of Horticulture, College of Agriculture, Indore (M.P.). Experiment was conducted under naturally ventilated polyhouse. Uniformly developed budded plants of Dutch roses were planted in double row system at spacing of 40 x 40 cm from row to row and plant to plant, respectively, thereby adjusting 12 plants per 2.4 m^2 plot. The experiment was laid out in a Factorial Completely Randomized Design (CRD Factorial) with three soil based substrates like; soil + FYM + sand (G_1), soil + FYM + cocopeat (G_2) and soil + FYM + sawdust (G_3) mixed in 2:1:1 (v/v) and three fertilizers treatments *viz*., water soluble fertilizers (F_1), commercial straight fertilizers (F_2) and Biofertilizers + water soluble fertilizers (F_3), thereby making a total of nine treatment combinations which were replicated thrice. Results revealed that plants grown in a medium containing soil + FYM + sawdust and fertilized with water soluble fertilizers (G_3F_1) resulted in maximum plant height (75.28 cm), Earlier flower bud initiation (124.70 days), Leaf area (35.45 cm^2), Size of flower (9.09 cm), No. of flowers per plant (15.9) and Flower yield of 2,61,800 flower stems per hectare.

Keywords- Rose, Biofertilizers, Cut flowers and protected environment.

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Introduction

Rose (*Rosa spp*.) belongs to the family of 'Rosaceae' and is one of the nature's most beautiful creations and is universally claimed as 'Queen of Flowers'. Roses are the top ranking cut flowers and are the largest traded flowers in the world and shares about 51 % of world flower market [1]. No other flower is a better symbol of love, adoration, innocence and other virtues than the rose and not in our time only, but so it has been for thousands of years.

Roses can be cultivated on open land, but under controlled conditions the flowers exhibit the best quality attributes required for the market. Therefore, it makes imperative to take up cut flower cultivation under polyhouses conditions particularly when production of cut flowers is for export purpose.

The most commonly used organic substances are peat, wood bark, sphagnum moss, cocopeat, sawdust, rice husks, leaf mould and compost, but they oxidize readily and compact easily which decreases the pore spaces and aeration. The organic substances have high C/N ratio which sometimes results in nutritional problems to the plants. Therefore, coarse mineral components are used to improve drainage and aeration by increasing the proportions of large air filled pores.

Material and Methods

The experiment was conducted at the experimental unit of the Department of Horticulture, College of Agriculture, Indore (M.P.). The experiment was conducted under naturally ventilated polyhouse. Uniformly developed budded plants of Dutch roses were planted in double row system at spacing of 40 x 40 cm from row to row and plant to plant, respectively, thereby adjusting 12 plants per 2.4m^2 plot. The experiment was laid out in a Factorial Completely Randomized Design (CRD Factorial) with three soil based substrates namely; soil: FYM: sand (G_1), soil : FYM : cocopeat (G_2) and soil : FYM : sawdust (G_3) mixed in 2:1:1 (v/v) and three fertilizers treatments *viz*., water soluble fertilizers (F_1), commercial straight fertilizers (F_2) and Biofertilizers + water soluble fertilizers (F_3), thereby making a total of nine treatment combinations which were replicated three times.

Result and Discussion

Maximum plant height was recorded at 50 DAP, 100 DAP and at the time of first flower harvest. Plant attained maximum height (75.28 cm) at the time of first flower harvest when grown in a medium containing soil + FYM + sawdust and fertigation with water soluble fertilizers. Earliest flower bud initiation (124.7 days) was observed in G_3F_1 *i.e.*, in a medium containing soil + FYM + sawdust and fertigated with water soluble fertilizers. Plants with maximum leaf area (35.45 cm^2) was observed when grown in a medium containing soil + FYM + sawdust and fertilized with water soluble fertilizers. Among the vegetative characters, the plant height and leaf area were markedly influenced when the plants were grown in a medium containing soil + FYM + sawdust (2:1:1, v/v) and fertilized with water soluble fertilizers (G_3F_1). It resulted in maximum plant height (75.28) at the time of first flower harvest and maximum leaf area (35.45 cm^2). This marked increased in these vegetative characters 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, therefore, increases overall leaf production. 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 then causes a decrease in cell size especially in cell division. Ammonical form of N maintained a higher leaf N level than NO_3^- and extended the period of photosynthesis. The presence of calcium stimulates the absorption of NH_4^+ form of nitrogen in plants. As the calcium concentration increases NH_4^+ absorption then plant growth also increases. It has been emphasized by various workers that the medium component should not be considered for their inherent nutritive value, but for their ability to maintain and supply nutritional elements in plant root zone.

Maximum size of flower (9.09 cm) was observed in G_3 F_1 *i.e.*, in a medium containing soil + FYM + sawdust and fertigated with water soluble fertilizers .Number of flowers per plant was highest (15.9), when plants grown in a medium containing soil + FYM + sawdust and fertilized with water soluble fertilizers. Heaviest flower stem (42.87 g) was observed from the medium consisting of soil + FYM + sand and fertigated with commercial straight fertilizers (G_1F_2).Maximum flower yield (2,61,800) *i.e.*, number of flowers per hectare (2,61,800) was recorded from plants grown in a medium containing soil + FYM + sawdust and fertigated with water soluble fertilizers.

In general, it is recommended that rose plants grow well in fertile and well drained medium having adequate organic matter. For quick and adequate absorption of nutrients, pH and EC are important. Various author have suggested the different soil regimes like 6.2-6.8 [2-4], 6.0 [5] and 6.0-6.5 [6] 5.5-6.3 [7] and [8], 5.5-7.0 [9] and [10], while soil salinity level (EC) maintained less than one [3,6] and 1.5 dsm^{-1} [7].

Table-1 *Effect of different treatments on different growth characters*

Treatments	Plant height at the time of first flower harvest	Days taken for first flower bud initiation	Flower bud length	Leaf area (cm^2)
G_1	67.79	129.73	2.77	29.31
G_2	66.8	130.07	2.85	26.37
G_3	72.84	126.17	2.6	30.49
SEm(d)±	**0.47**	**0.47**	**0.04**	**0.76**
CD at 5%	**0.98**	**0.99**	**0.09**	**1.6**
F_1	69.45	127.47	2.69	30.53
F_2	69.67	129.67	2.76	27.9
F_3	68.32	128.83	2.77	27.74
SEm(d)±	**0.47**	**0.47**	**NS**	**0.76**
CD at 5%	**0.98**	**0.99**	**NS**	**1.6**
G_1F_1	63.96	127.5	2.73	29.39
G_1F_2	68.67	131.9	2.8	24.06
G_1F_3	70.73	129.8	2.78	34.49
G_2F_1	69.1	130.2	2.88	26.76
G_2F_2	68.49	129.6	2.84	26.99
G_2F_3	62.82	130.4	2.83	25.37
G_3F_1	75.28	124.7	2.47	35.45
G_3F_2	71.85	127.5	2.64	32.65
G_3F_3	71.4	126.3	2.69	23.37
SEm(d)±	**0.81**	**0.82**	**NS**	**1.32**
CD at 5%	**1.70**	**1.71**	**NS**	**2.77**

Growing medium, cation exchange capacity range for optimal plant response is 0.1 to 1.0 meq/cm^3. Medium does not hold sufficient nutrients against leaching at cation exchange capacity below this level and above 1.0 meq/cm^3 as the matrix begin to compete with root systems for ions. The desirable ranges for bulk density, percent maximum water content (volume basis) and percent drainable pore space are 0.15-0.75, 20-30 and 5-10, respectively, provided that within these ranges water relations and aeration should be sufficiently good to allow maximum nutrient absorption [11]. Management of edaphic factors plays an important role in increasing productivity. As in other crops, in cultivation of roses too, growing medium should be sufficiently firm and dense to hold the plant, should be highly decomposed with a C/N ratio of 20:1, sufficiently porous, low in salinity level, high in cation exchange capacity and water holding capacity. To obtain these desired characteristics, the different components like soil, sand, FYM, sawdust, cocopeat etc. are used.

Table-2 *Effect of different treatments on different yield characters*

Treatments	Flower pedicel length (cm)	Size of flower (cm)	Number of flowers per plant	Weight of flower stem (g)	Flower yield per hectare	Vase life of flowers (Days)
G_1	8.21	8.29	6.27	33.91	1,42,100	7.25
G_2	7.83	8.39	11.03	31.04	1,98,600	7.13
G_3	7.34	8.91	13.53	36.52	2,28,200	7.55
SEm(d)±	**0.18**	**0.11**	**0.38**	**0.5**	**6241.74**	**NS**
CD at 5%	**0.38**	**0.24**	**0.8**	**1.05**	**13113.89**	**NS**
F_1	7.88	8.74	10.53	33.43	1,94,900	6.87
F_2	7.62	8.5	9.87	36.45	1,8,7000	7.72
F_3	7.88	8.35	10.44	31.59	1,87,200	7.33
SEm(d)±	**NS**	**0.11**	**NS**	**0.5**	**NS**	**0.26**
CD at 5%	**NS**	**0.24**	**NS**	**1.05**	**NS**	**0.55**
G_1F_1	8.32	8.15	4.83	27.81	1,21,500	6.43
G_1F_2	8.34	8.87	7.15	42.87	1,59,700	7.85
G_1F_3	7.97	7.85	6.83	31.04	1,45,000	7.46
G_2F_1	8.17	8.99	10.85	32.42	2,01,500	7
G_2F_2	7.26	8.04	12.4	32.84	2,15,600	7.4
G_2F_3	8.06	8.15	9.85	27.87	1,78,600	6.99
G_3F_1	7.15	9.09	15.9	40.06	2,61,800	7.19
G_3F_2	7.27	8.6	10.05	33.65	1,84,800	7.9
G_3F_3	7.6	9.05	14.63	35.85	2,37,900	7.55
SEm(d)±	**NS**	**0.2**	**0.66**	**0.86**	**10811**	**NS**
CD at 5%	**NS**	**0.42**	**1.38**	**1.82**	**22713.92**	**NS**

The quality of cut roses depends upon the availability of macro and micro-nutrients which are available to the plants. The most important nutrient which determined the are nitrogen in NO_3^- and $NH4^+$ form, P, K, Ca, Mg, and S among the macronutrients, whereas Zn, B and Fe among the micronutrients. Various authors have described the different nutritional requirement of rose under different agro-climatic conditions. [7] suggested that the quantity of soil nutrients required by rose is NO_3^- (25-75 ppm), P (4-6 ppm), K (30-80 ppm), Ca (80 ppm), Mg (5 ppm) for Indian sub-continental conditions. Presence of Mg, which is an essential constitute of chlorophyll molecule also stimulate the leaf quality as it plays an essential role in photosynthesis and carbohydrate metabolism because many of the enzymes requires Mg as an activator in which ATP is involved. The significant increase in these growth parameters may be due to additive effect of sawdust which improved moisture and nutrient status of the soil. The improved nutritional status has direct effect on carbon allocation in plant tissues due to increased leaf area and photosynthetic role.

Characters *viz*., flower bud length, flower pedicel length and vase life of flowers was found to be non-significant.

The flowering parameters included earliness to flowering, size of flower, increased flower yield and quality and quantity of blooms. Though polyhouse provides an adjustable environment for the plant but each crop has a specific requirement of temperature and light which ultimately determines the quality and yield. In the present studies, when soil + FYM + sawdust containing growing medium along with water soluble fertilizers (G_3F_1) was used, it resulted in earliest flowering (124.7), maximum flower size (9.09 cm), increased flower yield per hectare (2,61,800) and maximum number of flower per plant (15.9). [12] had also obtained earliest flowering in *Dendrobiums,* when grown in sawdust based media. [13] increased in flower size may be due to the increased leaf area which could have led to production and accumulation of photosynthates from leaves (source) to flower (sink). Flower size in gerbera also increased when fertigated with water soluble fertilizers [14]. The sawdust amended media showed increased in fresh weight in rose and gerbera [15] and [16]. In polyhouse, the manipulation of temperature and light is possible to improve the yield. In case of roses, various temperature regimes which affects the flowering have been suggested by various workers, where the night temperature being more critical. [8] suggested 16°C night temperature to be optimum for rose cultivation, whereas, 22-27°C day temperature being optimum. Similarly, [17] also advocated that a night temperature of 16°C is optimum but day temperature above 30°C hampers photosynthesis, thereby, reducing the quality and quantity of cut rose bloom. [18,19] also recorded increased flower yield in orchids and gloxinia, respectively, when grown in sawdust amended media. Being humus like products, sawdust showed analogous properties, which stimulated nutrients uptake, assimilation and had positive effect on protein synthesis and vegetative growth, hence increased the yield [20]. Fertigation with water soluble fertilizers in tuberose also improved flower yield [21].

The higher productivity with G_3F_1 (soil + FYM + sawdust and fertigated with water soluble fertilizers) under the present experimental conditions was due to the optimum and balanced supply of plant nutrients present in the substrate which are essential at all critical growth stages [22], which in turn, encouraged the plant to grow better due to increased carbohydrate synthesis. The preference of organic manure in this medium increased the nutrient status and moisture content which increases the leaf area, uptake of nutrients, as well as the rate of photosynthesis which in turn increased the quality and quantity of blooms.

Conclusion

The parameters namely, plant height, leaf area, earliness for flower bud initiation, size of flower, number of flowers per plant and flower yield per hectare were significantly increased and recording maximum values when plants grown in a medium containing, soil + FYM + sawdust and fertigated with water soluble fertilizers (G_3F_1). In general, the treatment combination G_3 F_1 *i.e.*, medium containing soil + FYM + sawdust and fertigated with water soluble fertilizers gave the best results pertaining to growth and flowering of cut roses in naturally ventilated polyhouse under protected conditions.

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Abbreviations: FYM : Farmyard manure

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