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Influence of biofertilizers on leaf nutrient status and flower quality of carnation cv Sunrise

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ABSTRACT

The experiment was conducted under naturally ventilated polyhouse to study the influence of biofertilisers on leaf nutrient status and flower quality of carnation cv Sunrise. The plants were inoculated with biofertilizers arbuscular mycorrhiza + *Azospirillum* + phosphate solubilizing microorganisms and then fertigated with water soluble fertilizers. This treatment was compared with the plants which were only given water soluble fertilizers and commercial straight fertilizers. Significant variation was observed in leaf nutrient status as influenced by different fertilization treatments. Biofertilizers supplemented with water soluble fertilizer treatment resulted in maximum nitrogen, phosphorus and potassium content. Maximum stem length and stem sturdiness were recorded in the plants given biofertilizer treatment.

Keywords: *Azospirillum*; biofertilizers; carnation; commercial straight fertilizers; PSM; water soluble fertilizers; VAM

INTRODUCTION

Floriculture is the field which is gaining importance both at the national and international market with the increase in demand for cut flowers. Carnation (*Dianthus caryophyllus* L) is one of the important cut flower crops in the international flower market. The lucrative and flourishing business of quality cut flowers has led to uncontrolled and indiscriminate use of chemical fertilizers, insecticides, fungicides and growth promoters. Chemical fertilizers applied in fields have adverse effects on soil health and environment also. Hence potential alternatives and eco-friendly products have to enter the scene to educate the farming community so that they can reap the same benefits of chemicals from naturally occurring substances like organic manures or biofertilizers. Since mid-eighties biofertilizers have emerged as a supplement to mineral fertilizers and hold a promise to improve the yield as well as quality of crops. Biofertilizers are the products containing living cells of different types of microorganisms which have an ability to mobilize nutritionally important elements from non-usable to usable form through biological processes. *Azotobactor*, *Pseudomonas*, *Azospirillum*, AM, phosphate solubilizing microorganisms etc are the important biofertilizers used in floricultural crops. Biofertilizers are ready to use live formulates of such beneficial microorganisms which on application on seeds, seedlings or soil mobilize the availability of nutrients particularly by their biological activity and help to build up the micro-flora and in turn improve the soil health. Various biofertilizers viz *Azotobacter, Azospirillum*, phosphate solubilizing bacteria and AM fungi show their suitability for application in different flower crops such as rose, tuberose, carnation, marigold, aster, jasmine etc. Use of biofertilizers is well documented by Wen and Chang (1994) who reported that plants had higher fresh weight, dry weight and more N, P, Zn and cu uptake when inoculated with AM fungi (*Glomus etunicatum*). Similarly in cymbidium orchid, AM inoculation resulted in increased dry weight and enhanced the absorption of N, P and K (Zhau et al 1999). In an another study Chaudhary (2009) observed that the biofertilizers application (*Azotobacter*, PSB and AM) with lower N and P doses advanced the flowering and sprouting of bulbs and reduced the amount of chemical fertilizers in tuberose cv Double. In chrysanthemum maximum flower diameter, vase life of cut flowers and shelf-life of loose flowers was observed in the plants inoculated with biofertilizer combination (*Azospirillum* + PSB + 50% vermicompost) (Airadevi 2012). In the year 2013 Prabhat et al revealed that the application of AM, vermicompost and vermiwash in combination enhanced plant height, number of leaves, spike length, number of florets, vase life, number of corms/m^2 and weight of corms in gladiolus cv Prosperity. But in carnation reports on biofertilizers are meager. Therefore there is a need to study the response of biofertilizers on nutrient uptake by leaves and flower quality of carnation.

MATERIAL and METHODS

The investigation was carried out in the experimental farm of Department of Floriculture and Landscape Architecture, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, HP under naturally ventilated polyhouse. The rooted cuttings of carnation cultivar Sunrise were planted at a spacing of 20 x 15 cm in completely sterilized media consisting of soil + FYM + sand (2:1:1 v/v), soil + FYM + cocopeat (2:1:1 v/v) and soil + FYM + sawdust (2:1:1 v/v). Basal dose of N, P and K was given in the form of calcium ammonium nitrate (CAN), single super phosphate (P_2O_5) and muriate of potash (K_2O) in the ratio of 20:20:10 g NPK/m^2. Besides the application of basal dose @ 100 ppm N and 140 ppm K was applied through water soluble fertilizers (F_1) and commercial straight fertilizers (F_2) biweekly after three weeks of plantation. In water soluble fertilizers multi K was used while in commercial straight fertilizers potassium nitrate was used as a source of potassium. To study the biofertilizer response on quality flower production, the plants were inoculated with biofertilizers (AM + *Azospirillum* + PSM) and then fertigated with water soluble fertilizers and this treatment (F_3) was compared with F_1 and F_2. The biofertilizer combination was applied to rhizosphere of the plants after 10 days of plantation (for preparing the biofertilizer mixture, 100 g inoculants of *Azospirillum* and PSM were mixed individually in 900 g of well dried FYM to make 1 kg pack of each and mixed with 1 kg pack of carrier based AM). This biofertilizer mixture was applied at the rate of 5 g/plant. In biofertilizer treated plants, water soluble fertilizers (100 ppm N and 140 ppm K) were given after 40 days. The biofertilizer treated plants (F_3) were compared with the plants which were only given chemical fertilizers containing water soluble fertilizers (F_1) and commercial straight fertilizers (F_2) and the leaf nutrient status and flower quality were evaluated (stem length and stem sturdiness) using completely randomized experimental design (CRD) and data of two years were pooled and analysed.

Leaf analysis for N, P and K contents was done at the flower harvesting stage. The leaves at fifth and sixed node from apex were collected for analysis. Nitrogen was determined by micro-kjeldahl method, potassium by flame photometrically and phosphorus by vanado-molybdate yellow colour method. To evaluate stem sturdiness, cut flowers having stem length 55 cm were held horizontally at a point 25 cm above the cut end and the deviation of flower head below the horizontal plane with the natural curvature of the stem was recorded into two categories (A grade below 200^{O} deviation and B grade above 200^{O} deviation).

RESULTS and DISCUSSION

Significant variation was observed in leaf nutrient status as influenced by different fertilization treatments (Table 1). Biofertilizer supplemented with water soluble fertilizers (F_3) resulted in significantly maximum percentage of nitrogen, phosphorus and potassium leaf content (2.160, 0.266 and 3.633% respectively) in all the growing media. Minimum N, P and K content was noticed in the plants fertigated with commercial straight fertilizers (F_2).

Maximum increase in N content with biofertilizer treatment may be due to better condition of soil health and increase in population of microorganisms (*Azospirillum*) which fixed N in soil and ultimately increased leaf N content. The findings are in congruence with the findings of Rai and Gaur (1982) who studied enhanced N uptake when the wheat plants were inoculated with *Azospirillum*. Okon

Table 1. Effect of biofertilizers on nitrogen content of leaves (%) of carnation cv Sunrise

Treatment	G_1	G_2	G_3	Mean
Nitrogen				
F_1	2.017 (1.420)	2.15 (1.466)	2.067 (1.438)	2.078 (1.441)
F_2	1.950 (1.396)	2.123 (1.457)	2.059 (1.435)	2.044 (1.429)
F_3	2.129 (1.459)	2.209 (1.486)	2.140 (1.463)	2.160 (1.470)
Mean	2.032 (1.425)	2.161 (1.470)	2.089 (1.445)	
Phosphorus				
F_1	0.246 (0.864)	0.280 (0.883)	0.263 (0.873)	0.263 (0.873)
F_2	0.241 (0.861)	0.276 (0.881)	0.261 (0.872)	0.259 (0.871)
F_3	0.250 (0.866)	0.277 (0.882)	0.270 (0.878)	0.266 (0.875)
Mean	0.246 (0.864)	0.278 (0.882)	0.265 (0.874)	
Potassium				
F_1	3.480 (1.865)	3.763 (1.940)	3.560 (1.887)	3.601 (1.897)
F_2	3.423 (1.850)	3.620 (1.903)	3.547 (1.883)	3.530 (1.879)
F_3	3.517 (1.875)	3.740 (1.933)	3.643 (1.909)	3.633 (1.906)
Mean	3.601 (1.864)	3.708 (1.925)	3.633 (1.893)	

Figures in parentheses are square root transformed values, F_1= Water soluble fertilizers, F_2= Commercial straight fertilizers, F_3= Biofertilizers + F_1, G_1= Soil + FYM + sand (2:1:1), G_2= Soil + FYM + cocopeat (2:1:1), G_3: Soil + FYM + sawdust (2:1:1)

$CD_{0.05}$

	N	P	K
Growing media (G)	0.01	0.02	0.019
Fertilization (F)	0.01	0.02	0.019
Interaction (G x F)	NS	NS	NS

and Kapulnik (1986) also reported higher yields in *Azospirillum* inoculated plants due to enhanced N fixation. The increment in phosphorus content is attributed to increased ability of phosphorus to plant roots due to the application of AM and phosphate solubilizing microorganisms. Similarly Govindrajan and Thangaraju (2001) stated that biofertilizer inoculated plants are able to absorb nutrients from soil at faster rate resulting in accumulation of more dry matter, N, P and K in the stems and leaves. It may also be due to the principle benefit of VAM association with plant roots in exploration of more soil volume thereby making the nutrients available by decreasing the distance for diffusion of phosphoric ions and increasing the surface area for the absorption of nutrients such as N, K, Mg and Zn (Hayman and Mosse 1973). Increased P uptake in marigold was recorded by Bagyaraj and Powell (1985) due to AM inoculation. Sreenivasa (1992) while studying the response of chilli to inoculation of efficient AM fungi observed an increased in nutrient in chilli mainly P, Zn, Mn and Fe at 50 per cent recommended dose of added P than with the un-inoculated plants.

Maximum stem length (60.40 cm) and sturdiness (76.44%) was recorded in biofertilizer supplemented treatment (F_3) (Table 2). This may be attributed to the efficient association of microorganisms with plant roots and their ability to enhance uptake of nutrients such as N, P, K, Mg and Zinc and hence resulted in the plants with maximum stem length and sturdiness. Likewise increased plant height was observed in marigold (Balasubramanium 1987) and jasmine (Manomani 1992) when these plants were given *Azospirillum* application. This treatment may be due to the production of phytohormones by *Azospirillum* fungi which stimulates growth and morphology of roots. It was also noticed that maximum percentage (75.33%) of 'A' grade flowers was obtained from the treatment consisting of biofertilizers (F_3). This indicates that biofertilizers enhance nutrient uptake and produce growth promoting substances like IAA and GA_3 resulting in better flower quality.

Table 2. Effect of biofertilizers on stem length (cm) and stem sturdiness (%) of carnation cv Sunrise

Treatment	Stem length				Stem sturdiness			
	G_1	G_2	G_3	Mean	G_1	G_2	G_3	Mean
F_1	50.90	62.27	59.20	57.46	64.00 (53.15)	76.00 (60.72)	72.00 (58.09)	70.67 (57.32)
F_2	49.03	60.47	58.60	56.03	62.67 (52.34)	75.33 (60.28)	75.33 (60.28)	71.11 (57.63)
F_3	54.67	65.40	61.30	60.46	65.33 (53.94)	82.67 (65.43)	81.33 (64.43)	76.44 (61.27)
Mean	51.53	62.71	59.70		64.00 (53.14)	78.00 (62.14)	76.22 (60.93)	

Figures in parentheses are square root transformed values, F_1= Water soluble fertilizers, F_2= Commercial straight fertilizers, F_3= Biofertilizers + F_1, G_1= Soil + FYM + sand (2:1:1), G_2= Soil + FYM + cocopeat (2:1:1), G_3: Soil + FYM + sawdust (2:1:1)

$CD_{0.05}$

	Stem length	Stem sturdiness
Growing media (G)	1.34	2.22
Fertilization (F)	1.34	2.22
Interaction (G x F)	NS	NS

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