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Response of Carnation Varieties (*Dianthus caryophyllus*) to Mycorrhizal Fungi under Naturally Ventilated Polyhouse Conditions in Prayagraj, India

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

The present investigation entitled, Response of carnation varieties (*Dianthus caryophyllus*) to mycorrhizal fungi under naturally ventilated polyhouse conditions in Prayagraj was conducted at horticulture research field, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, U.P, during the winter season (2022). The experiment was laid out in Factorial Randomized block design (FRBD) with 3 varieties and 5 VAM treatments in 15 treatments and each replicated thrice. From the present investigation, Variety-3 (Kiro-yellow) treated with 10g VAM per plant performed better for plant

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height (55.44cm), primary branches (7.22), bud diameter (21.72mm), and yield per plant (5.74). In terms of flower diameter (6.16cm) and vase life (13.33 days) Variety-1 (Cervantes) treated with 10g VAM performed better. In terms of first bud initiation Variety-2 (Baltico-White) treated with 5g VAM per plant showed better performance (59.11 days).

Keywords: Carnation; VAM; varieties; bio-fertilizers; yield.

1. INTRODUCTION

The second-most popular flower in the world now is the carnation (*Dianthus caryophyllus*). On important occasions, carnations are frequently worn to convey feelings of love, intrigue, and distinction. It is the flower of choice on Mother's Day since it is a sign of mother's love. The fact that these flowers were used to adorn Greek athletes' crowns suggests that the English name "carnation" is derived from the Greek word "coronation." The carnation is Spain's official flower. They are believed to be native to the Mediterranean region and have the diploid chromosome number 2n=30.

Biofertilizers seek to increase their efficiency, create fresh microbial strains, perfect application methods, and make them more compatible with contemporary farming methods. A sustainable and environmentally friendly method of managing nutrients in floriculture is provided by biofertilizers. They have the potential to increase soil health, reduce the negative effects of conventional farming methods on the environment, and promote the production of food that is sustainable. Biofertilizers have proven to be cost-effective, environmentally friendly inputs with great yields for floriculture crops. Rhizobium, Azospirilium, Azotobacter, Phosphobacteria, and Mycorrhizae are examples of commonly utilized biofertilizers [1-3].

Mycorrhizae are a type of fungus that creates nodules in symbiotic relationships with plants. Plays a significant part in the ecosystem's nutrient cycling and shields plants from environmental stress [4,5]. Mycorrhizae enables the plant to absorb additional nutrients and moisture, which promotes plant growth and hastens the emergence of roots. Because the symbiosis improves nutrient cycling, roots, plant establishment, and vegetative development, accelerates budding and flowering, and promotes the plant's ability to resist drought and salt stress, the application of Mycorrhizae to carnations promotes plant growth, enhances flowering, and increases yield [6-9].

Different types of mycorrhizae are commonly used in Vesicular Arbuscular Mycorrhizae (VAM) in the floriculture industry. VAM is considered a bio-fertilizer as it has the capability of fixating phosphates present in the soil. As an integral part of the root system, they interact with other microorganisms in soil and result in increased root exudation approaching about 25% of the plant dry matter production.VAM Bio-Fertilizer facilitates better water absorption, especially during water stress conditions and facilitates efficient absorption of various macro and micronutrients, primarily phosphorus. Its natural capability is also to increase the percentage content of trace elements. This is why it is widely used for the restoration of the fertility of barren or abandoned lands. For improving the crop quality in ornamental crops VAM is recommended [10]. For carnation, VAM along with other biofertilizers increases plant height, reduces the number of days for first flowering, maximum size and best vase life [11] and acts as the best supplement for improving flower production incarnation.

From previous studies, conducted with 0,1,3 gm of VAM concentrations present investigation was conducted with the following objective "Response of carnation varieties to mycorrhizae fungi to floral parameters and yield parameters in Prayagraj conditions" with 0,2.5,5,7.5,10gm concentration of VAM.

2. MATERIALS AND METHODS

The present investigation entitled, Response of carnation varieties (*Dianthus caryophyllus*) to mycorrhizal fungi under naturally ventilated polyhouse conditions in Prayagraj was conducted at horticulture research field, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, U.P, during the winter season (2022).

2.1 Geographic Location of the Site

Geographically, Prayagraj is situated in the South-Eastern part of Uttar Pradesh. It lies between the parallels of 24º 77' and 25º 47' north latitudes and 81º 19' and 82º 21' east longitudes.

2.2 Experiment Details

The experiment was laid out in Factorial Randomized Block Design with two factors (Factor A-varieties, Factor B-VAM) in fifteen treatments replicated thrice i.e.,(T_1) Variety-1 (Cerventes) + Control, (T_2) Variety-1 (Cerventes) + 2.5g VAM/Plant, (T_3) Variety-1(Cerventes) + 5g VAM/Plant, (T_4) Variety-1 (Cerventes) + 7.5g VAM/Plant, (T_5) Variety-1 (Cerventes) + 10g VAM/Plant,(T_6) Variety2 (Baltico) + Control, (T_7) Variety2 (Baltico) + 2.5g VAM/Plant, (T_8) Variety-2 (Baltico) + 5g VAM/Plant, (T_9) Variety-2 (Baltico) + 7.5g VAM/Plant, (T_{10}) Variety-2 (Baltico) + 10g VAM/Plant,(T_{11}) Variety-3 (Kiro) + Control, (T_{12}) Variety-3 (Kiro) + 2.5g VAM/Plant, (T_{13}) Variety-3 (Kiro) + 5g VAM/Plant, (T_{14}) Variety-3 (Kiro) + 7.5g VAM/Plant, (T_{15}) Variety-3 (Kiro) + 10g VAM/Plant. Health 12cm planting material procured from Rise n'shine Nursery, Pune, Maharastra.VAM is taken from KN Bioscience, Hyderabad. As per treatment two days before planting VAM is kept in pits as basal application, pits are made at 2 cm depth where the plant will be planted. For data collection, four plants from each treatment are selected data recorded after first pinching. The data recorded during the experiment were subjected to statistical analysis by using analysis of variance (ANOVA). The significant difference among the varieties was compared against the critical difference at a 5% level of significance ($CD_{0.05}$).

3. RESULTS AND DISCUSSION

3.1 Vegetative Parameters

The results of the experiment revealed plant height at 60 Days after pinching was recorded at 55.44cm in T_{15}Variety3(Kiro-yellow) treated with 10g VAM per plant followed by 54.44cm in T_5 Variety1(Cerventes-pink) treated with 10g VAM per plant smallest recorded 19.11cm in T_1 Variety1(Cerventes-pink) with control. A number of primary branches after 60 days after pinching more in number recorded 7.22 in T15 Variety3(Kiro-yellow) treated with 10g VAM per plant followed by 6.18 in T10 Variety2(Baltico-white) treated with 10g VAM per plant less in number recorded at 4.33 in T1 Variety1(Cerventes-pink) with control.

VAM in association with plant roots is known for the exploration of more soil volume thereby making the nutrients available for the diffusion of phosphate ions and increasing the surface area for absorption of nutrients such as N, K, Mn and Zn [12] in jasmine and Panj et al. [13] in gerbera) results are presented in Table 1.

3.2 Floral Parameters

The results of the experiment is revealed No. of days for first bud initiation from pinching less days recorded 59.11 in T8 Variety2(Baltico-white) treated with 5g VAM per plant followed by 68.55 in T15 Variety3(Kiro-yellow) treated with 10g VAM per plant more days recorded 84.9 in T6 Variety2(Baltico-white) with control. An increase in absorptive surface area of the roots due to VAM might have led to enhanced uptake and transportation of available water and nutrients like P, Zn, Fe, Mg and Cl, ultimately resulting in better sink for faster mobilization of photosynthates and early transformation of plant parts from vegetative to reproductive phase. Pathak and Kumar [14] in Gladiolus.

Bud diameter highest was recorded at 21.72mm in T15 Variety3(Kiro-yellow) treated with 10g VAM per plant followed by 21.11mm in T10 Variety2(Baltico-white) treated with 10g VAM per plant lowest recorded at 14.16mm in T1 Variety1(Cerventes-pink) with control flower diameter highest was recorded 6.16cm in T5 Variety1(Cerventes-pink) treated with 10g VAM per plant followed by 6.03cm in T15 Variety3(Kiro-yellow) treated with 10g VAM per plant lowest recorded 4.66cm in T1 Variety1(Cerventes-pink) with control vase life longer duration recorded 13.33 in T5 Variety1(Cerventes-pink) treated with 10g VAM per plant followed by 12.5 in T15 Variety3(Kiro-yellow) treated with 20g VAM per plant shorter duration recorded 7.66 in T11 Variety3(Kiro-yellow) with control results are presented in Table 1.

3.3 Yield Parameters

No. of flowers per plant more flowers recorded 5.74 in T15 Variety3(Kiro-yellow) treated with 10g VAM per plant followed by 5.44 in T5 Variety1(Cerventes-pink) treated with 10g VAM per plant less buds recorded 1.67 in T1 Variety1(Cerventes-pink) with control.

The Mycelia network of VAM which penetrates deeply in the soil, thus widening the root zone for improving the availability of P and enhancing the uptake of certain minerals (Zn and S) including P and water Patel et al. [15] in African marigolds results are presented in Table 1.

Table 1. Response of carnation varieties to vegetative parameters, floral parameters, yield parameters

Treatments	Vegetative parameters		Floral Parameters				Yield per plant
	Plant height(cm)	Primary branches	First bud initiation(days from pinching)	Bud diameter (mm)	Flower diameter (cm)	Vase life	
T_1	19.11	4.33	73.67	14.17	4.60	8.17	1.67
T_2	31.33	4.78	81.78	15.67	5.05	8.33	2.22
T_3	35.33	4.67	84.02	17.33	5.38	9.50	2.78
T_4	43.56	5.11	82.78	19.06	5.82	11.67	4.33
T_5	54.44	5.45	73.22	21.06	6.17	13.33	5.45
T_6	23.44	5.56	84.89	15.89	4.88	7.17	2.11
T_7	29.22	5.78	82.56	18.33	5.32	7.67	3.00
T_8	34.56	5.67	59.11	18.61	5.63	8.33	3.78
T_9	45.78	5.00	82.67	19.83	5.75	9.67	4.22
T_{10}	52.89	6.18	73.67	21.11	5.95	11.33	5.11
T_{11}	24.78	4.78	82.11	18.17	4.80	7.17	2.44
T_{12}	31.89	4.89	71.89	19.67	5.20	7.33	4.56
T_{13}	34.89	4.67	76.67	16.11	5.62	9.33	4.11
T_{14}	46.11	4.89	73.44	19.78	5.77	10.17	4.89
T_{15}	55.44	7.22	68.56	21.72	6.03	12.50	5.75
Factors(AXB)							
C.D.(0.05)	2.92	0.93	0.79	1.93	0.15	N/A	0.55
S.Ed(±)	1.42	0.45	0.39	0.94	0.07	0.89	0.27

4. CONCLUSION

From the present investigation, it is concluded that the Variety-3(Kiro-yellow) treated with 10g VAM per plant performed better for plant height, primary branches, bud diameter, and yield per plant. In terms of first bud initiation Variety-2(Baltico-White) treated with 5g VAM per plant showed better performance. In terms of vase life, flower diameter Variety-1(Cerventes-pink) treated with 10g VAM per plant performed better. Over all best treatment, Variety-3(Kiro-yellow) was treated with 10g VAM in prayagraj conditions.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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