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Effect of VAM inoculation on vegetative growth in *Carum carvi* L(Shah Jira)

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ABSTRACT

"Shah jire" *Carum carvi* L is an important medicinal and spice herb belonging to family Apiaceae. The herb has historically been utilised as food and medicinal for both people and animals. Given its significance, the current research was done to examine the effects of VAM *Glomus fasciculatum* on growth parameters. Positive outcomes were seen for several vegetative growth parameters. VAM increases plant's ability to absorb phosphate, which enhances growth and development. The findings of the current study make it abundantly evident that *Carum carvi* L. reacts well to mycorrhizal inoculation in a pot environment.

Keywords: VAM, *Carum carvi*, Mycorrhiza, Germination

INTRODUCTION

The biennial plant *Carum carvi* L., sometimes known as caraway, belongs to the Apiaceae (Umbelliferae) family. It is indigenous to northern Africa, western Asia, and Europe. Caraway is well-known for its flavourful seeds, which are employed as spices in a variety of dishes. Caraway plants may reach heights of 30 to 60 cm. Given that they both come from the same family and have fluffy, finely split leaves, they resemble carrot leaves. It blooms in umbels, or flat-topped clusters, of tiny white or pinkish flowers in the second year of development. The dark, crescent-shaped seeds have a distinct flavour and perfume. Especially in European cuisines, caraway seeds are used as a spice in a broad variety of meals.They taste warm, sweet, somewhat spicy, and have a fennel or anise undertone. Breads, cakes, biscuits, sausages, stews, and soups are a few examples of common applications. Additionally, they are utilised in liqueurs like kummel and aquavit. (Joshi and Soulimani, 2020).

Traditional medicine has historically used caraway seeds. They are used to treat symptoms like bloating, indigestion, and gas since it is

thought that they contain digestive characteristics. Aromatherapy also makes use of caraway oil, which is produced from the seeds. Usually, *Carum carvi* carvi is cultivated from seeds. It enjoys full light and does best in well-drained soil. It is a cool-season crop that may be produced in a variety of settings, however temperate zones are where it is most frequently farmed. Although they have somewhat distinct flavours, anise, fennel, or dill seeds can be substituted for caraway seeds in recipes if they are not readily available. Carum carvi has a long history of usage in both culinary and medicinal traditions and is still a widely used spice today. It is valued for its unique flavour as well as for its possible health advantages (Mahboubi, 2018).

VAM stands for vesicular arbuscular mycorrhizal fungi. They have symbiotic relationships with most plants. This is a mutualistic relationship. Plants' phosphate absorption capacity is improved, which aids in growth and development. Mycorrhizal fungi and plants have a symbiotic interaction. They grow in close proximity to the roots and play an essential role in soil nutrient concentration and transmission to the plant. In exchange, the plant provides sugars to the fungus. This is a mutualistic relationship. They increase plant phosphate absorption capacity, which aids in growth and development. *Glomus fasciculatum* was chosen as the VAM for the project (Smith and Read, 2002).

MATERIAL AND METHODS

Investigation was conducted at the Department of Botany, Arts, Commerce and Science College ,Narayangaon, Pune to study the response of Three commercially important plant *Carum carvi* L to VA mycorrhizal inoculation. Mature healthy seeds of *Carum carvi* L were collected from local area, Narayangaon Tal. Junnar, Dist. Pune (Maharashatra) and used in all the experiments. Earthen pots with 30cm diameter, and depth, with a hole at the base for drainage system were selected and were filled with 3 kg of sterilized soil mixture of sand: soil: FYM in 1: 2: 1 proportion. The pots were placed in full sunlight and were watered till field capacity a day before sowing and alternate days till the final harvest. Recommended phosphate fertilizer was procured from Suryakant agro service, Kalamb added at different levels as suggested in various treatments.

In *Carum carvi* L there were five sets with five treatments in sterilized soil as follows

UP00 (Control, uninoculated, without phosphate &VAM). **IP00** (VAM Inoculated, without phosphate). **UP100** (VAM un-inoculated with 1gm phosphate per pot). **IP100** (VAM Inoculated with 1gm phosphate perpot). **IP75** (VAM Inoculated with 0.75gm phosphate perpot). **IP50** (VAM Inoculated with 0.50gm phosphate perpot).

The similar sets were made for non-sterilized soil also. Ten root segments of each species were collected and subjected for detection of mycorrhizal colonization. The root segments were fixed in F.A.A. for 24hours and were autoclaved in 10%KOH. The autoclaved root segments were washed in 1percent HCl-and stained with cotton blue in lactophenol. The stained roots were mounted on microslide in lactophenol and were observed under microscope for the presence and kind of VAM fungi. Identification is attempted solely on manual for identification of VAM fungi by Schenck and Perez, (1987) Frequency was calculated using the formula,

$$Frequency\ of\ mycorrhizal\ colonization = \frac{No.\ of\ Mycorrhizal\ root\ segments}{Total\ no.of.\ root\ segments} X100$$

RESULTS AND DISCUSSION

UP00 (Control , un-inoculated, without phosphate & VAM). **IP00** (VAM Inoculated, without phosphate). **UP100** (VAM un-inoculated with 1gm phosphate per pot). **IP100** (VAM Inoculated with 1gm phosphate per pot). **IP75** (VAM Inoculated with 0.75gm phosphate per pot). **IP50** (VAM Inoculated with 0.50gm phosphate per pot). Standard *deviation (SD).

The current study clearly shows that *Carum carvi* L. reacts effectively to mycorrhizal inoculation under pot conditions. In both sterilised and non-sterile soil, plants infected with VAM at 100 percent prescribed phosphate grew the tallest and the shortest. When compared to un-inoculated control plants, VAM and phosphate increased growth by a factor of two. Many studies found that using VAM alone or in combination with phosphate boosted growth. Mosse *et al.,* (1969) discovered that mycorrhizal onion seedlings grew faster in sterilised and non-sterile soil than untreated plants. In hydroponic cultivation, Arafat *et al*., (1995) observed higher growth in *Vicia faba*.

Table 1: Growth performance of *Carum carvi* L.in response to various levels of phosphate, and VAM in non-sterilized and sterilized soil.

Soil type	Non sterilized					
Set	I	II	III	IV	V	VI
Treatments	UP00	IP00	UP100	IP100	IP75	IP50
Parameters	*	*	*	*	*	*
Plant height (cm)	60.2 ±0.1	63.30±0.1	66.1 ± 0.1	69.01 ± 0.2	65.00 ± 0.2	65.00±0.01
Avg. No. of Leaves/branch	9.00 ± 00	11.00±00	10.66±0.1	15.00±0.11	12.00±0.1	11.03±0.1
% VAM Colonization	00	10.2	00	39.2	18.6	8.5
Spore count (Per 50 gm of soil)	00	10	00	26	29	23

Soil type	Sterilized					
Set	I	II	III	IV	V	VI
Treatments	UP00	IP00	UP100	IP100	IP75	IP50
Parameters	*	*	*	*	*	*
Plant height (m)	60.2 ±0.1	62.20±0.1	65.3 ± 0.1	68.06 ± 0.2	62.00 ± 0.1	63.00±0.02
Avg. No. of Leaves/branch	9.00 ± 00	10.00±00	11.66±0.1	14.00±0.01	11.00±0.2	10.03±0.2
% VAM Colonization	00	11.3	00	40.1	19.3	10.2
Spore count (Per 50 gm of soil)	00	11	00	27	30	24

In both sterilised and non-sterile soil, plants injected with VAM at 100 percent prescribed phosphate had the most leaves and the fewest. When compared to combinations of VAM and phosphate, VAM or Phosphate alone had no discernible impact. Reena and Bagyaraj (1990) detected a similar tendency in Red Maple (*Acer rubrum*) described by Daft and Hacskaylo (1977) and *Tamarindus Indica*, L.*, Acacia nilotica*, and *Calliandra calothyrus* reported by Daft and Hacskaylo (1977). Plants that have been inoculated with VAM without phosphate have a two-fold increase in total leaf area when compared to uninoculated plants without phosphate. VAM with 50% recommended phosphate increases tenfold when compared to uninoculated plants without phosphate.

In general, inoculation of VAM with prescribed phosphates results in an increase in leaf area per plant. Similarly, Biermann and Linderman (1983) found that inoculated plants had more total leaf area than uninoculated plants in China aster. In sterilised and non-sterile soil, the percentage of VAM colonisation was greater in mycorrhizal plants with 50 percent prescribed phosphate. Okon *et al.* (1996) discovered a similar phenomenon in *Gliricidia sepum* and *Senna siamea.* In non-sterile soil, VAM with 50% prescribed phosphate had the highest number of Mycorrhizal spores.

Clamydospores were not found in plants that had not been infected. This shows that the amount of infective propagules in the soil is limited, and that native fungi have lower infectivity than inoculant fungi. Furthermore, at 100 percent prescribed phosphate and greater soil phosphate levels, there is a reduction in VAM colonisation. VAM colonisation increases in nonsterilized soil injected with VAM, as demonstrated by Bagyraj and Manjunath (1980) in Cotton Cowpea and Menge *et al.* (1998) in Citrus.

Recent studies conducted by Kanade AM and Bhosale RS (2013a) in *Dolichos lab-lab*,Kanade AM and Bhosale RS (2013b) in *Sida acuta*, Kanade AM and Bhosale RS (2014) in *Cassia* AM Kanade and RS Bhosale (2019) *Portulaca oleracea*Kanade AM, Bhosale RS and Inamdar VG (2019) in *Anethum graveolens* AM Kanade and RS Bhosale (2020) in *Trachyspermum Ammi*and A. M. Kanade and R. S. Bhosale (2020 in *Hibiscus sabdariffa*. supports the finding of present investigation.

CONCLUSION

Present investigation clearly indicates that *Carum carvi* L. responds well to *Glomus fasciculatum*. VAM inoculation in combination with Phosphate at all levels increased height of shoot, Total leaf area and Dry biomass in both non sterilized and sterilized soil.

Conflict of Interest: None of the authors have any conflicts of interest to disclose.

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