



OCCURRENCE OF VAM FUNGAL GENERA IN SOME VEGETABLE PLANTS IN EASTERN UTTAR PRADESH OF AZAMGARH DISTRICT

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ABSTRACT

Vesicular arbuscular mycorrhizal fungi are very well known due to their importance in promoting growth and development of plants especially vegetables. These fungi can be grown easily, stored and multiplied with simple means, also the application of these fungi is generally on the layer of the soil or near the roots in the inner layers of the soils. The growth of the VAM fungi is very easy and they are highly adjustable to any soil and environmental conditions. Also use of this VAM fungi will increase the uptake of nutrient from the soil through symbiotic relationships between plants and fungi. Mycorrhiza is a mutualistic association between fungi and higher plants. This type of association is considered as a "functionally distinct organ" involved in mineral nutrient uptake from the soil. The term 'Mycorrhiza' in its broadest sense in the non-pathogenic association of fungi and the roots of higher plants. It has been observed that VAM fungal inoculation provides beneficial results in the plant growth both in controlled and open field condition. The present study was conducted in Azamgarh district where the plants are grown throughout the year to observe VAM fungal genera that are associated with 16 vegetable plants.

KEYWORDS: VAM Fungi, Vegetable Plants and Azamgarh

Mycorrhiza is a mutualistic association between fungi and higher plants (Menge 1983). Frank (1885) coined the term mycorrhizae. The Term 'mycorrhiza' in its broadest sense is the non-pathogenic association of fungi and the roots of higher plants. The root fungus association is symbiotic, and the whole association is considered as a 'functionally distinct organ' involved in mineral nutrient uptake from the soil (Kar 1993).

Vegetables are considered as important source of nutrition, dietary fiber and many other health benefits. Vegetables are a part of every meal all over the world. Vegetables are mixed with several other eatables to make a new dish. These vegetables are eaten not only by humans but also by some herbivore animals. Vegetables are eaten raw sometimes half boiled and completely cooked. In some dishes vegetables are deep fried to increase the taste. In India vegetables are eaten along with rice, roti, parathas and dosa sometimes, whereas in many other countries they are added afresh to the bread making it very tasty. These breads sometimes referred to as sandwich, pizzas and other dishes. Several times vegetables are mixed with meat to enhance the taste and quantity of the food served (Tedersoo *et al.* 2018).

It is well known and proved that the people who consume more vegetables are known to be safe with less risks of certain harmful diseases like cancers, heart strokes etc. These vegetables are very useful in minimizing the calories intake by providing several

vitamins and minerals. Now a days a lot of people switched to vegetarian food called veganism due to the increasing importance of vegetables in our day to day lives (Spatafora *et al.* 2016). It is always known that Health is Wealth, and that is possible with the use of vegetables in our day to day lives. It is proven that the vegetables provide both mental health and physical health. In some reviews improper mental health is due to improper food habits. Such experiences paved way to draw possible links between use of vegetables and positive mental health by reducing the risks of certain syndromes in both children and adults. Also certain health benefits are listed by important central agencies like improved bone health, Weight balance, Proper vision, High antioxidant properties, skin and hair health etc. (Johns 2014).

Many nutrients are available for different vegetables like proteins from Spinach, Broccoli, Sprouts, Peas, Legumes etc. Whereas zinc and iron is obtained from Spinach, Hemp, Peas and Beans which are very useful in creating responses for the increase of dopamine which is very helpful in reducing the risks of syndromes. Also, vitamins and minerals are obtained from Broccoli having high calcium, Cabbage and Cauliflower provides best vitamin C, whereas Lettuce provides vitamin B and Spinach provides vitamin K (Nakmee *et al.* 2016). Due to the above important nutrition benefits, vegetables are considered as the most important source of health. Also,

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the cultivation of vegetables is very easy and it takes very less time compared to cereal production. They require very less water and fertilizers to grow. These vegetables can also be grown in homes under kitchen garden. With a very less input in cultivation maximum benefits is obtained in vegetable production (Posta and Due 2020).

Certain fungal species like VAMF are very well known and proven fungal species in improving the soil and plant conditions under biotic and abiotic stresses. These fungi are known as VAM fungi belonging to Glomeromycota class and are found at the base of higher trees. These fungi are known to be well adapted to terrestrial living compared to other fungi. This group of fungi are well known to develop symbiotic relationship with the plant so that the frequency of the movement of nutrients and water from the soil to the plants are increased at a great level. These VAMF are found to be in the regions or soil conditions where there is continuous incidence of biotic and abiotic stresses. This VAMF is a major class which involves Molds, Mushrooms and Yeasts. All these are involved in nutrient enhancement whereas molds are mostly utilized for this purpose in different combinations (Parihar and Bora 2018).

As vegetables are very important for our living due to our daily dependence protecting them from harmful diseases and pests also by increasing their yield is very much beneficial in meeting the needs. Almost all the vegetable plants are known to host AMF thereby to improve their nutrient content and become tolerant to several stresses, by increasing their biomass content and photosynthetic ability. Several families like Amaryllidaceae, Fabaceae, Cucurbitaceae Asteraceae etc. show their dependency towards VAMF for these added benefits in the growth and development of the crop (Ban *et al.* 2011). These VAMF are not only helpful to the plant but also very much helpful to the soil by increasing the nutrient content in the soil. Also, these soils are known to have high porosity compared to non-mycorrhizal soils. Whereas, the appearance of the soils, soil density, soil structure and texture and known to change in a positive way due to the use of VAMF bioinoculants (Sharma *et al.* 2021)

Hence, the present study was conducted in eastern Uttar Pradesh of Azamgarh district, where the vesicular plants are grown throughout the year to observed vesicular arbuscular mycorrhizal (VAM) fungal genera that are associated with 16 vegetable plants.

MATERIALS AND METHODS

Eastern Uttar Pradesh Azamgarh District occupies 4234 sq. Km of Uttar Pradesh. It is located between 25° 38" and 26° 27' North of latitude and the meridians of 82° 40' and 83° 52' East of longitude. It is bounded by Mau on the East, Gorakhpur on the North, Ghazipur on the South East, Jaunpur on the South West, Sultanpur on the West and Ambedkarnagar on the North West. Azamgarh experiences a humid subtropical climate with large variations between summer and winter temperatures. Summers are long, from early April to October with monsoon seasons, and are also extremely hot. The temperature ranges between 22°C to 46°C in summers. Winters in Azamgarh see very large diurnal variations, with warm days and downright cold nights. Cold waves from the Himalayan region cause temperature to dip across the city in the winter from December to February and temperature below 5°C are not uncommon. Fog is common in the winters which hot dry wind (loo) in the summers. The average rainfall in 1110 mm (44 in).

Collection of different plants with their roots and soil were done randomly around Azamgarh in three replications. Root samples were washed in tap water and cut into one centimeter pieces in length. Root samples were cleared and stained using Phillips and Hayman (1970) technique. Root colonization was measured according to the Giovannetti and Mosse (1980) method. 100 Gram of rhizosphere soil samples were analyzed for their spore isolation by wet sieving and decanting method Gerdmann and Nicolson (1963). Identification of VAM fungal genera up to species level was done using the Manual for Identification by Schenck and Perez (1990).

RESULTS AND DISCUSSION

Vegetable plants species along with their VAM fungi characterizations are presented in the Table-1. All the tested plants were colonized by VAM fungi. The percentage of colonization was highest in *Pisum sativum* (94%), than other plants whereas, lowest percentage found in *Lactuca sativa* (44%). Hyphal and vesicles types of colonization were found in roots of different plant. Hyphae were almost common in all tested plants. Maximum number of spores (309) was observed in rhizosphere soil of *Pisum sativum*. Minimum number of spores (30) was observed in rhizosphere soil of *Lagenaria siceraria*. Four genera were observed, viz. *Acaulospora* spp., *Gigaspora* spp., *Glomus* spp. and *Scutellospora* spp. Highest number of VAM fungal genera and species were associated with *Pisum sativum* while the lowest number was associated with *Lactuca sativa*. Among VAM fungal

species, *Acaulospora* spp were found dominating followed by *Glomus* spp; *Scutellospora* spp and *Gigaspora* spp were found poorly distributed.

VAM association is the most frequently observed symbiosis found in nature because of their broad association with plants and cosmopolitan

distribution (Harely and Smith 1983). Recently, Gaikwad *et al.* (2013) reported the occurrence of VAM fungi in Euphorbiaceae plants from India. VAM spore population also showed variation in the rhizosphere soils of selected plants. Variations of spore number have been reported recently by Sarwade *et al.* (2011) and recorded difference in spore numbers between plant species.

Table 1: Mycorrhizal position of root colonization, spore population and VAM fungal genera in vegetable plants in Eastern Uttar Pradesh Azamgarh

Sr. No.	Botanical Name	Local Name	Colonization (%)	Types of colonization	Spore population	VAM fungal genera
1.	<i>Abelmoschus esculentus</i>	Bhindi	54	H	67	<i>Glomus</i> spp <i>Acaulospora</i> spp
2.	<i>Allium cepa</i>	Onion	64	H	70	<i>Glomus</i> spp <i>Gigaspora</i> spp
3.	<i>Lagenaria siceraria</i>	Bottle gourd (Lauki)	45	H	30	<i>Glomus</i> spp <i>Acaulospora</i> spp
4.	<i>Capsicum annum</i>	Chillies	82	HV	261	<i>Acaulospora</i> spp
5.	<i>Cucumis sativus</i>	Cucumber (Khira)	56	HV	139	<i>Glomus</i> spp <i>Acaulospora</i> spp <i>Gigaspora</i> spp
6.	<i>Allium sativum</i>	Garlic	83	HV	148	<i>Glomus</i> spp <i>Acaulospora</i> spp
7.	<i>Benincasa hispida</i>	Ash gourd (Petha)	86	HV	186	<i>Glomus</i> spp <i>Acaulospora</i> spp
8.	<i>Momordica charantia</i>	Bitter gourd (Karela)	45	H	128	<i>Glomus</i> spp <i>Acaulospora</i> spp
9.	<i>Lactuca sativa</i>	Lettuce	44	H	64	<i>Glomus</i> spp <i>Acaulospora</i> spp
10.	<i>Coriandrum sativum</i>	Dhaniya	68	HV	83	<i>Glomus</i> spp <i>Acaulospora</i> spp <i>Gigaspora</i> spp
11.	<i>Phaseolus vulgaris</i>	Beans	68	HV	238	<i>Glomus</i> spp <i>Acaulospora</i> spp
12.	<i>Pisum sativum</i>	Peas	94	HV	309	<i>Glomus</i> spp <i>Acaulospora</i> spp <i>Gigaspora</i> spp
13.	<i>Cucurbita pepo</i>	Pumpkin (Kaddu)	99	HV	148	<i>Glomus</i> spp <i>Acaulospora</i> spp
14.	<i>Solanum lycopersicum</i>	Tomato	48	HV	168	<i>Glomus</i> spp <i>Acaulospora</i> spp <i>Gigaspora</i> spp <i>Scutellospora</i> spp
15.	<i>Solanum melanogena</i>	Brinjal	84	HV	188	<i>Glomus</i> spp <i>Acaulospora</i> spp
16.	<i>Praecitrullus fistulosus</i>	Apple gourd (Tinda)	67	H	128	<i>Glomus</i> spp <i>Acaulospora</i> spp

H = Hyphae, V = Vesicle

Present study revealed the occurrence of four VAM fungal genera viz., *Glomus*, *Acaulospora*, *Gigaspora*, and *Scutellospora*. *Acaulospora* were most dominant with plants growing in soils of Azamgarh. Recently, it has been confirmed by Sarwade *et al.* (2011). This contrast with the report by Sarwade *et al.* (2012) that *Glomus* species is dominant.

The root colonization by VAM fungi is a dynamic process. The results obtained from the present study suggest that all the test plants showed good colonization. However, percentage of root colonization varied plant to plant (Table-1). Variation in extent of medicinal plant species were observed and confirm earlier findings of Muthukumar and Udaiyan (2000).

CONCLUSION

The study suggests that the colonization percentage and number of VAM fungal spores differ between 16 plants. Highest number of mycorrhizal spores and root colonization of indicated that these plants species might be considered good host for VAM fungi under natural conditions. In conclusion, occurrence or distribution of VAM fungi varies with host ranges. Studies on distribution and mycorrhizal status of plants should enable us to understand the influence of these mycobionts on plant species diversity and distribution.

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