Current Research in Biological Sciences (2025);1(1): 20-27 **ISSN: XXXX-XXXX**

RESEARCH ARTICLE

On the Positive Impact of Mycorrhiza VAM fungi Application on Maize Plants (Zea mays)

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Abstract: *The solution of an efficient native VAM endophyte is an important Prerequisite for successful implementation of any mycorrhizal inoculation programme. The presence study has been carried out with the following objectives.*

To assess the occurrence and distribution of VAM fungi associated with Rhizosphere soil and roots of Vigna catjang and Phaseolus mungo which were collected from two different localities. To identify the efficient native VAM fungi and their multiplication and influence on the growth nutrition and biochemical compounds of Glomus by pot culturing method. Glomus fasiculatum, Glomus geospore were most abundant species found in the root zone soils of all study sites. Influence of native strains of VAM fungi namely Acaulospora by Glomus Gigaspora, Margarita, Glomus fasiculatum were selected for the growth nutrition and biochemical compounds.

The genus Glomus in general, Glomus fasiculatum in particular was the predominant colonizing species followed by Glomus geosporum in both test plants. The present study had helped to boundaring the knowledge about VAM in relation to ecological and physiological aspects which could help in developing suitable applications to improved growth of certain oil yielding crop plants in Sandy loam soil.

Keywords: *Fungi, Zea mays, VAM Mycorrhiza.*

1. INTRODUCTION

Mycorrhiza is beneficial association between the roots of plants and fungi. It is a distinct morphological structure, which is a result of mutualistic symbiosis between specific root inhabiting fungi and plant root. The term "Mycorrhiza" coined by "Frank"(1885)describes the structure formed by the association of plant root with fungi.

Mycorrhiza can be broadly classfied into ectomycorrhizae, endomycorrhizae and ectoendomycorrhizae. Among the endomycorrhizae types vesicular-arbuscular mycorrhizae is common, wide spread and more important. Mycelia of these fungi invade the roots of the host plant and proliferate within Vesicular-arbuscular (VA). Mycorrhizal infection is characterized by the formation of vesicles and arbuscules in the root cortex, which also contain inter and intracellular aseptate hyphae connected with an external mycelium. The VAM fungi are mainly found in crop plants and they have very ancient origin during back to the early land plants (Simon et al., 1998).

1.1. Significance of VAM

VAM fungi helps the plants to survive in phosphorous deficient soil. VAM is well adapted to eutrophic soil, and the fungi are especially active in phosphate and zinc uptake from the soil. It is now established that many plants cannot grow adequately without VAM fungi, especially in phosphate deficient soils, VAM fungi promotes plant growth by enhancing the uptake of phosphate through the Mycorrhizal root (Smith and Gianinazzi – Pearson 1988).

The VAM fungi also stimulate the beneficial organisms like Rhizobium, Azotobacter and phosphate solubilizer in the Rhizosphere. VAM fungi increase the physiological nature of absorbing surface area of the root system. VAM fungi also increase the availability of roots to plant resulting in more growth under drought conditions. VAM association also induces the phyto hormones like indole acetic acid, gibberellic acid and cytokinemins etc.,

VAM fungi increase the tolerance of plants to droughts, high soil temperature and extremes of soil acidity caused by high levels of metals such as manganese and aluminum. They provide protection from certain plant pathogenic fungi and nematodes that attack roots. (Zak, 1964). VAM fungi modify transpiration rates and the composition of Rhizosphere microflora by excretion of conflating compounds. Ex: Ectoenzymes.

One of the major changes in mycorrhizal plants is the reduced membrane permeability due to increase in nutrition. VAM induction of growth substances such as Indole acetic-acid (IAA) , Indole propionic acid (IPA) and indolic compounds has been demonstrated (Moser 1959); Ulrich, 1960 and Stuzeiczyk et al., 1977). The mycorrhizal infection also induces the production of auxins. These associations might benefit the most plant particularly under limited soil moisture.

Numerous techniques are available for the mass inoculum production of VAM in an almost sterile environment. However, the convenient method of producing large quantities of inoculum is by the traditional ‘pot culture’ technique developed. Several host plants including sudan grass, bahia grass, sorghum, maize and onion have been studied for the suitability in producing VAM inoculum (Bagyaraj. 1992).

1.2. VAM in relation to plant disease

VAM enhance the plant growth through increased nutrient uptake, states tolerance and disease resistance. 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 plants dry mater production. Roots support a multitude of microorganims that in concert, can have profound influence on growth and survival of the plants – VAM fungi can alter the root caudation pattern, exchange chitinolytic activity and alter photosynthetic and respiratory deficiencies. VAM positive plants are known to exhibit varied resistance towards soil borne and doliar pathogens. The known interactions of mycorrhizae into the plant. To improve their productivity pathogens, significant of plant cell walls, changed phosphate nutrition resulting in alter exudation by roots and formation of inhibitory low molecular weight compounds.

1.3. VAM plant disease response

Interaction of VAM with Rhizosphere microorganisms have received considerable attention and a variety of response have been described broadly these can be summarized as follows.

VAM infection, in general protects plants from soil -borne fungi. Higher nutrient concentration in mycorrhizal plants make such plants more susceptible to foliar pathogens. No definite relationship appears to exist between bacterial infection into mycorrhizae. Pre - mycorrhizal infection of transplanting crops protect the plants from nematode infection.

1.4. Physical mechanisms

Significations is reputed to prevent penetration of mycorrhizal plants by Fusarium oxysporum (Define and Schoenback, 1978). A stronger vascular system in mycorrhizal plants gives a strength and reduces the effect of vascular pathogens (Schoenback 1979).

1.5. Physiological mechanisms

Nutritional changes

The host – pathogen relationship is influenced indirectly through physiological alteration and competition for space and host resources. Though increase in the phosphate nutrition VAM fungi expands root growth.

Biological mechanism

*B*ecause of their impact on host physiology, VAM fungi excreta a selective pressure on the microbial population in the mycro – rhizophere, some of this can result in specific effects on roots pathogens, for example Meyer and Linderman (1986) showed that the organism and zoospore production by the root pathogen Phytophthora cinnamomi was reduced in the presence of rhizophore leachates from VAM in sweat corn and chrysanthemium. According to Cecilia and Bagyaraj (1987) was studied the pot cultures of Glomus fasilacultum barbourd the angle actinomycetes. Antagonistic to Fusarium solani and Pseudomonas Solanacearum by than actinomycetes VAM negative control or other mycorrhizal fungi species.

Ectomycorrihizae

Ectomycorrhizae grow as external sheath around the tip of the root, with limited intercellular penetration of the fungus into the cortical regions of the root. They are predominantly found in the beech, oak, birch and coniferous trees. More than 5000 species of fungi are involved in ectomycorrhizal symbiotic relationships. Their mycelia extend far out into the soil and play an important role in transfer of nutrients to the plants. Eg. Pisolithus tinctorius.

Endomycorrihizae

Endomycorrhizal are of particular interest. In this association the fungal hyphae penetrate the outer cortical cells of the plant root. They grow intracellularly and forms coils, swellings or minute branches. Two characteristic intracellular structures are calles vesicles and arbuscules and thus endomycorrhizae are called as Vesicular arbuscular mycorrhizae abbreviated as VA mycorrhizae.

Endotrophic mycorrhizae are found in wheat, corn, beans, tomatoes, apples, oranges and many commercial corps. Among the endomycorrhizal type, VAM are very common. VAM is the wide spread type of plant fungal infection. The fungal symbionts are ubiquitous soil inhabitants. They have been found diverse habitats ranging from arctic to the tropics, arid to aquatic environments.

Objectives of our work

1. To isolate the VAM spore from the Rhizosphere region of the two plants namely Vigna catjang .L and Phaseolus mungo L.
2. To study the mass cultivation of spores by the cress inoculation methods in Allium cepari seedlings.
3. To screen the phosphotase content in the various type of mycorrhizal spores.
4. To asses the growth influencing activity in the Zea mays by VAM spores inoculation methods.
5. To asses the growth and yield parameters in Zea mays after treated the VAM and Blue green algae in the experimental pots and compared with the control.

2. MATERIALS AND METHODS

2.1. Quantification and identification of VAM fungi spores

A small amount of soil from the Rhizosphere region of Vigna catyung.L and Phaseolus mungo was dug out by a trowel to a depth of 10 to 15 cm cutter scraping away the top 1 to 2 cm soil and collected in a polythene bag. The soil samples in the polythene bags were brought into laboratory and deep-freezer stored at 2 to 5ºC until the endomycorrhizal spores were isolated.

2.2. Processing of soil samples by wet sieving and decanting method

100gm of soil was suspended in about 500ml of water. Heavier particles gradually settled down, and the liquid was decanted through a 710µm sieve to remove the larger particles of organic matter and root.

2.3. Identificaton of vam fungi

Based upon microscopic characters, the VAM spores were identified, by using the keys and manuals provided by Hall and Fish (1979). Trappe (1982), Walker and Koske (1987), Schenck and Perez (1987), Morton (1988) and Morton and Benny (1990). Microphotographs were taken with the help of Nikon Optiphot No.2 compound microscope.

2.4. Pot culture technique

The pot was filled with red soil and inoculated with the Zea mays after the growth the VAM spores are inoculated and incubated for 2 weeks. In the second pot the red soil was filled and inoculated with the Zea mays after the growth and inoculated with the VAM spores and onion root fragments are also inoculated. In the third the sandy soil was filled and inoculated with the Zea mays after the growth and inoculated with VAM spores and phosphobacteria and incubated for 2 weeks. In the forth the pot was filled with sandy soil and inoculated with Zea mays and spinkle with water and add the VAM spores plus cyanobacteria and incubated for 2 weeks and growth was observed.Finally the control was taken and filled with red soil and inoculate the Zea mays.

3. RESULTS

Vesicular Arbuscular Mycorrhizae of beneficial fungi that penetrate and colonize the root of the plant. Then sent out flaments into the surrounding soil. In recent years significance of VAM spores and its enumeration have been fed one by various investigators.

The plant fungal relationship is an elegant association and its development is evidently are regulated are regulated by several factors.

3.1. Significance of the vam

Vigno Catjang and Phaseolus mungo are important pulses variety summer crop plants were selected from two different localities at Kancheepuram district. The enumeration of the VAM colonization present in the Rhizosphere and root give a positive result for the two plants species. The VAM species isolated from the study sites about 12 number of the spore belonging to the three genera namely Aculospora, Gigaspora and Glomus.

3.2. Effect and vam on plant growth of zea mays

Mycorrhizae inoculated plant shows the significant result of root and shoot length, leaf length, leaf breath and total chlorophyll, protein, than the uninoculated control

The experimental plants of Zea mays inoculated VAM along showed a slight increased phonological character like plant height, leaf length, leaf breath and root length Tables 1-4.

Phytochemical characters like total chlorophyll, protein, carbohydrates, Ash, increased in VAM +Phosphobacteria treated plants than the uninoculated control plants Tables 1-4.

The second treatments like VAM plus onion root fragment inoculated with the Zea mays shows the significantly increased rate of growth and phytochemical concentrations then the uninoculated plants Tables 1-4..

The third method of pot culture treatment in Zea mays with VAM spores and phosphobacterium give a promising level of the increased results for the phonological characters like shoot length, leaf length, breath and phytochemical characters Tables 1-4.

The last treated plants of Zea mays with BGA and VAM spores. They show the partial increasing results of phonological and phytochemical concentration then the uninoculated control Tables 1-4.

The VA Mycorrhizal status was considerably higher in all inoculated treatment combined in control. The extent of colonization varied in to the different treatment.

The result show that Zea mays slightly different their the response to inoculation with VAM and BGA. But they give a better activity only occur in VAM plus phosphobacteria inoculated plants then other treatments.

4. DISCUSSION

The present study for the VA Mycorrhizae status of an essential for the commertially available plants like Zea mays growth and yields. The number of majority of the G. Vesicular Arbuscular Mycorrhizal studies was completed by the previous investigates for the and think about the different in approach.

In this study the sites selection as well as the selection of commercially available Zea Mays were used for the pot culture experiment and mixed with the VAM spore derived from the Rhizosphere soil of Vigna Catjang and Phaseolus mungo.

Reena singh and Alok Adholeya (2001) was described the interrelationship between the climatic conditions soil types into the Vesicular Arbuscular Mycorrhizal colonization. In our present studies also were in the climatic condition and soil types also responsible for the increasing number of Vesicular Arbuscular Mycorrhizal colonization in the clone vicinity soil regions two pulses crops.

The VAM fungi are associated with the plant in a mutually beneficial relationship. The VAM fungi next to reside the root. To expose at to 200 times as the area available to the root alone.

The influence of different VAM inoculam in Zea mays with a reference to plant height, dry weight, Mycorrhizal spore in root zoon. Leaf length, leaf breath and total chlorophyll, proteins phosphatase enzyme activity.

5. CONCULSION

Vesicular Arbuscular Mycorrhizal fungi – and plant relationship is an elegant association and its development evidently regulated by several factors. Such as the physico – chemical characteristics soil fertility.Vesicular Arbuscular Mycorrhizal fungi can increase the disease resistance against root pathogens, especially, when the VAM fungi can adequately colonize the root before the pathogens. They are important in forming stable soil aggregates by binding soil particles in the filamentous mass as well as producing sticky substances that held the particles together.

The present investigations were enlisted the Vesicular Arbuscular Mycorrhizal spores responsible for the influencing the soil physico – chemical characters and increasing the soil fertility. The experimental crops of Zea mays L shows the prominent result of VAM and phosphobacteria treated pot and also contained increased level of phosphatase enzyme.

Among the four treatment compared with uninoculated control plants. The VAM and cross inoculated onion root fragments treated plants shows the significant result than the other treated plants. This method influenced the effective colonization of VAM spores in the plant root then the freely VAM spore inoculated plants.

6. SUMMARY

The solution of an efficient native VAM endophyte is an important Prerequisite for successful implementation of any mycorrhizal inoculation programme. The presence study has been carried out with the following objectives.

The genus Glomus in general, Glomus fasiculatum in particular was the predominant colonizing species followed by Glomus geosporum in both test plants. The present study had helped to boundaring the knowledge about VAM in relation to ecological and physiological aspects which could help in developing suitable applications to improved growth of certain oil yielding crop plants in Sandy loam soil.

Table 1: Effect of morphological parameters of Zea mays plants inoculated with VAM.

Treatments	Number of leaves/plant	Length of leaves (cm)	Breadth of leaves (cm)	Length of plant (cm)	Shoot length (cm)	Root length (cm)	Total length of plant (cm)
Control	7.1	20.0	2.5	65.5	41.5	9.0	74.5
VAM	9.0	26.9	3.6	69.3	49.4	10.2	79.5
VAM Onion Plant root	8.9	28.5	3.4	80.0	60.3	11.4	91.4
VAM+Phosphobacteria	12.0	31.0	3.9	82.1	69.6	11.6	93.7
VAM+BGA	8.4	26.7	3.2	79.1	54.3	10.3	89.4

Table 2: Effect on yield concepts of Zea mays plants inoculated with VAM.

Treatments	No.of Flowers	Root dry weight (Mg)	shoot Wet weight (Mg)
Control	2.4	25	42
VAM	3.4	32	54
VAM Onion Plant root	3.8	27	47
VAM +Phosphobacteria	5.4	43	58
VAM+BGA	4.2	38	46

Table 3: Effect of biochemical parameters of Zea mays plants inoculated with VAM.

Treatments	Chlorophyll (mg/g)	Protein (mg/g)	Carbohydrate (mg/g)	Amino acids (mg/g)	Inorganic phosphoru s (mg/g)
Control	1.06	0.92	13.14	3.6	2.02
VAM	1.82	0.98	14.80	5.6	2.13
VAM Onion Plant root	1.84	0.97	14.80	8.67	2.32
VAM +Phosphobacteria	3.86	2.0	16.11	19.60	4.18
VAM+BGA	2.30	1.0	15.27	12.24	2.72

Table 4: Effect of biochemical parameters of Zea mays plants inoculated with VAM

Treatments	Reducing sugar (mg/g)	Ash (mg/g)	Alkaline phosphatase (mg/g)
Control	1.62	30	0.29
VAM	1.65	45	0.37
VAM Onion Plant root	1.90	45	0.35
VAM +Phosphobacteria	4.78	46	0.59
VAM+BGA	3.33	40	0.45

7. REFERENCES

Abbott, L.K. and A.D.Robson, 1984. The effect of mycorrhizae on plant growth. In VA- Mycorrhizae (eds.), C.L.Powell and D.J. Bagyaraj, CRC press, (nc.) Brca Raton, florida, pp.113-130.

Altieri, M.A., 1995 Agroecology: the science of sustainable. Agriculture, Boulder, Cobrudo, USA: West view Press, pp.433.

Bhavani Singh, Jamaluddin and Singh, B: 2000. Fusarium root rot of Acacia nilotica and its control. Indian Forestry 3.

Bougher, N.L and Malajczuk. N. 1986. An undiscribed species of homogenous cortinarius associated with Eucalyptus in western Australia. Transactions of the British Mycological Society 86(2): 301 – 304.

Chu-Chou, M. and Grace, L. 1979 Endogone flamicora as a mycorrhiza symbiont of Douglas fir New Zealand N.Z.J. for science 9: 344-347.

Chu-Chou, M. and Grace, L.J. 1982. Mycorrhizal fungi of Eucalyptus in the North Island of New Zealand. Soil biology and biochemistry 14 (2): 133 – 137.

Cucu – Acikalin, E. and Yesiloglu, T. 1999. The importance of Mycorrhizae in citrus and usage possibilities. Ziraat Faxiiltesi Dergisi, Akdeniz Universitesi. 12(1): 121 – 130.

Danielson, R.M.; Griffiths, C.L. and Parkinson, D. 1984. Effects of fertilization on the growth and mycorrhizal development of container –grown Jack pine seedlings, Forest science 30(3) : 828 – 835.

Dell, B.; Malajczuk, N. and Thomson, G.T 1990. Ectomycorrhiza formation in Eucalyptus V.A. tuberculate ectomycorrhiza of Eucalyptus pilularis. New phytologist 114(4): 633 – 644.

Estrada, K.R.F.S., ; Bellei, M.M. and Silva, E. A; M.D.A 1993. Incidence of mycorrhiza in nursery and Eucalyptus spp. Forests in Vicosa, Minasgerais. Revista de Microbillogia. 24 (4): 232 – 238.

Gerdemann, J.W. and J.M. Trappe, 1974. The endogonaceae in the pacific worthwest, mycol. Mem.,5:1.

Gerdemann, J.W. and Nicolson, T.H. 1963. Spores of Endogone species extracted form soil by wet-seiving and decanting Trans Br. Myco. Soc. 46: 235 – 244.

Gong-Ming Qin, Wang-Feng zhen, Chen, Y.U.; Chen-Ying Long, Gong, M.Q.S wang, F.Z.; Chen, Y. and Chen, Y.L: 2000. Mycorrhizal fungal screening and inoculants effective forest – Research – Beijing;

Hung, L.L. 1983. Ectomycorrhizal inoculation of container –grown Taiwan red pine seedlings. Quarterly journal of Chinese forestry 16 (4).

Hung, L.L. Chien, C.Y. and Ying, S.L. 1982. Effect of soil fumigation and mycorrhizal inoculation on ectomycoorrhizal formation and growth of Taiwan red pine containerized seedlings 15 (4): 13 – 19

Jifon, J.L., Graham, J.H., Drouillard, D.L. and Syvertsen, J.P. 2002. Growth depression of Mycorrhizal citrus seedlings grown at high phosphorus supply is mitigated by elevated CO2. New Phytologist. 153 (1): 133 – 142.

Kamal Prasad and Prasad, K: 2000. Growth responses in Acacia nilotica (L) Del. Inoculated with Rhizobium and Glomus fasciculatum VAM fungi; Journal of Tropical forestry.

Kannan and lakshminarasimhan, 1988. Survey of Vesicular Arbuscular Mycorrhizae of maritime strand plants of point_calimere. Proc. First Asian Conference on mycorrhizae, Univ. of Madras, Madras, pp. 116-119.

Khan, S.N.; Kamala – Uniyal and Uniyal, K: 1999. Growth responses of two forest tree species to VAM and Rhizobium inoculations; Indian forester.

Koske, R.E. and Polson, W.R. Bioscience, 1984, 34, 420.

Koske, R.E., Sutton, J.C and Shepard, B.R., Can. J. Bot., 1975, 53, 87.

Levy, Y., Syvertsen. J.P. and Nemec, S (1983). Effect of drought stress and vesicular arbuscular mycorrhiza on citrus transpiration and hydraulic conductivity of roots. New phytologist, 93, 61 – 66.

Morton, J.B. 1988. Taxonomy of VAM fungi; classification, nomenclautre and identification Mycotaxon 32: 267 – 324.

Phillips, J.M and Hayman, D.S. 1970. Improved procedures for clearing roots and staining parasitic and vesicular arbuscular mycorrhizal fungus Glomus intraradices Can Jour. of Bot. 64: 1739 – 174.

Renna singh and Alok Adholeya, 2001. Biodiversity of AMF and agricultural potential: the first step towards the creation of a repository mycorrhizae News, 13(3): 23-24.

Schenek, N.C. and Perez, Y. 1987. Manual for the identification of VA mycorrhizal fungi. In VAM, University of Florida, Gainesville,

Sutton, J.C. 1973. Development of vesicular arbuscular mycorrhizal; in crop plants Can. J. Bot. 51: 2487 – 2493.

Thomson, B.D. Grove, T.S Malajczuk, N. Hardy, G. and E.St.J. 1996. The effect of soil pH on the ability of ectomycorrhizal fungi to increase the growth of Eucalyptus globulus Labill. Plant and soil 178 (2): 209 – 214.

Voiry, H 1981. Morphological classification ofoak and beech mycorrhiza in NE France European Journal of forest pathology 11 (5/6):

Walker, C. and Koske, R.E. 1987. Taxonomic concepts in the Endogonaceae, Glomus fasciculatum redescribed Phycotaxon 30 : 253 – 262.

Wang, C.W,; Luo, X.F. and Lee, Z. P 1985. The effect of ectomycorrhizal fungi on biomass production of Pinus tabulaeformis seedlings scientia silvae sinicae 21 (4): 375 – 382