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The role of vesicular arbuscular mycorrhizal (VAM) fungi in improving plant growth is well documented. Its importance in various crop plants are known to benefit because of this symbiotic association (Jeffries, 1987) and several horticultural crops like chilli (Bagyaraj and Sreeramulu, 1982), marigold (Bagyaraj and Powell, 1985), banana (Iyer et al., 1988) has been reported.

A survey made by Govinda Rao (1989), Selvaraj and Subramanian (1990) and Sullia and Prabha Sampath (1990) indicated the association of VAM fungi in different medicinal plants. However, an extensive survey on the association of VAM fungi in medicinal plants at different regions of Karnataka is yet to be elucidated to understand the mycorrhizal status of different medicinal plants.

The research on VAM in medicinal plants is gaining importance as the cultivation of these crops started recently. These fungi are involved in improving water and nutrient uptake (Pai et al., 1993; Sreeramulu and Bagyaraj, 1999; Rajan et al., 2000), production of growth promoting substances (Allen et al.,
1991) and in protecting plants against root invading organisms such as parasitic nematodes and phytopathogenic fungi (Bagyarak, 1984). Further these fungi also play an important role in improving nodulation and nitrogen fixation in legumes (Mosse, 1973; Hayman, 1983) which is mainly attributed to improved phosphorus nutrition.

The results of present investigation on the extent of mycorrhization and the growth response of three important medicinal plants viz., Phyllanthus amarus, Solanum viarum and Vetivera zizanioides to VAM fungi (Glomus fasciculatum and Glomus mosseae, Trichoderma viride and Aspergillus awamori) was studied by conducting a pot culture experiments using an autoclaved sand soil mixture (1:1) and field experiments in replicated randomised block design. The per cent VAM association, the height of plants fresh and dry weight of plants micro and macro elements from soil and plant material were recorded at different age levels of 60 and 120 days.

The per cent root colonization was negligible or absent in different treatments. This upholds the observation made by earlier workers. Mohan Kumar and Mahadevan (1984) examined
28 medicinal plants belonging to 20 families did not observe VAM colonization. They attributed that this may perhaps be due to secondary substances like alkaloids, tannins etc., present in medicinal plants.

The per cent mycorrhizal colonization varied from plant to plant. This difference could be attributed to variation in the host plant species and the soil type. Mohan Kumar and Mahadevan (1987) reported the effect of certain ecological factors such as soil, pH temperature, moisture, organic matter macro and micro elements of the soil on VAM distribution in Kalakad reserve forest in India.

Similar to this mycorrhizal spore numbers also varied from plant to plant in the present study *Phyllanthus* plants inoculated with *G. fasciculatum* and *T. viride* showed maximum spore numbers at different age levels compared to single inoculation.

**Effect of VAM fungi and other bioinoculants on growth of *Phyllanthus amarus* (Pot experiment)**

Species of VAM fungi can either directly influence plant growth through nutrient uptake or indirectly by improving soil conditions. But, the fungus has practical significance only if the
fungus can benefit the plant. The efficiency of the fungus, however, depends on the local environment, soil conditions and the host plant (Abbott and Robson, 1984). It is also known that VAM fungi are not host specific. However, the extent of colonization and their effects can differ with different host plant and endophyte combinations (Mosseae, 1973). Eventhough, a particular species of VAM fungus can colonize many host plants always prefer certain hosts exhibiting maximum symbiotic response. This led to the concept of host preference in VAM fungi. There are many reports available to uphold the existence of host preference by VAM fungi (Reena and Bagyaraj, 1990; Sreenivasa, 1992; Reddy et al., 1996; Sreeramulu and Bagyaraj, 1997).

In the present study effect of VAM along with T. virride and A. awamori was carried out under glass house conditions using Phyllanthus, Solanum and Vetiveria on the host. The observations recorded on growth and biomass production varied with different treatments. Phyllanthus plants inoculated with G. fasciculatum and A. awamori showed significant increased shoot height and plant biomass (Table 2). Among the two VAM fungi
tested *G. fasciculatum* resulted in better growth along with *A. awamori* in *Phyllanthus* plants compared to *G. mosseae* and other treatments.

**Response of *Solanum viarum* to inoculation with VAM fungi *T. viride* and *A. awamori***

The growth observations made on 60 and 120 day plants of *Solanum* (Table 5) showed that inoculation with VAM fungi with *A. awamori* resulted in significant increase in plant height, number of leaves, plant biomass compared to uninoculated control. These results are in agreement with the reports of earlier workers (Gaur and Rana, 1990) who observed improved growth because of inoculation with VAM and PGPR in different plants.

**Response of *Vetiveria zizanioides* to inoculation with VAM fungi *T. viride* and *A. awamori***

The role of VA mycorrhizal on plant growth have often been related to the increase in uptake of immobile nutrients, especially phosphorus and other micronutrients. Various mechanisms have been suggested for the increase in the uptake of P and other micronutrients. These include: exploration of larger soil volume, faster movement of mineral elements particularly P into mycorrhizal hyphae and solubilization of soil phosphorus by P solubilizing microorganisms (Bolan, 1991).

In the present investigation, all the individual as well as dual inoculated treatments showed significant increase in mineral nutrients than uninoculated control plants. The highest NPK was observed in *G. fasciculatum* and *Aspergillus awamori* treated plants followed by *G. fasciculatum* treated alone. This proved the synergistic interaction of *G. fasciculatum* with both *A. awamori* added together. These results are in conformity with the observations made by Sumana (1999).

From the pot culture study, giving weightage to shoot and biomass which is economically important part of the plant, it was concluded that *G. fasciculatum* along with P solubilizer *Aspergillus awamori* is the best combination for all the three crop
plants tested and their performance can be further enhanced through co inoculation with other plant growth promoting microorganisms. Similarly, improved plant growth due to mycorrhizal inoculation in different plant species were observed by many workers (Gurrumurthy, 1997; Sumana, 1999; Tanuja, 2000).

**Effect of VAM fungi and other bioinoculants on mycorrhizal status and growth of test plants (field experiment)**

Dual inoculation with *G. fasciculatum* and *Aspergillus awamori* (Tables 10, 12 & 14) significantly increased per cent mycorrhizal root colonization and spore numbers in the root zone soil compared to uninoculated control. This brings out the efficiencies of introduced VAM fungus in the field against the native VA mycorrhizal fungi. It has been found that some plant growth promoting rhizo microorganisms in the rhizosphere of mycorrhizae can modify / alter the establishment of mycorrhizal symbiosis. They help by improving the growth of mycelium either indirectly or detoxifying the substrate or directly by producing organic acids used by the fungus as carbon source and by emitting volatile substances responsible for specific selectivity (Duponnois and Garbaye, 1991). These organisms might alter plant growth by the hormones they synthesize (Azcon, 1989).
Many workers have observed increased root colonization and spore numbers in root zone soil due to inoculation of VAM alone and its co inoculation with soil microflora in different plant species including medicinal plants (Whitelaw et al., 1999).

Shoot biomass production was significantly higher in the dual inoculation treatments G. mosseae and A. awamori compared to control in 120 day old plants. This envisages that dual inoculation of G. fasciculatum with A. awamori enhanced the biomass production in Phyllanthus amarus compared to control. The above results upholds the findings of Gaur and Rana (1990) who reported that increased dry matter production of wheat due to dual inoculation of VAM with Pseudomonas striata. Similarly, Aparna (2000) reported the increased biomass of the medicinal plant Andrographis paniculata to dual inoculation with G. mosseae and Trichoderma harzianum.

Plant mineral element content of P. amarus and Vetiveria zizanioides was significantly higher than other treatments (Table 3 and 6). Similar observations on better uptake of micro nutrients due to inoculation with VAM fungi alone or together with beneficial microflora have been made by many workers (Liu et al.,
1994; Katiyar et al., 1995; Wang-Shoushang et al., 1997; Sumana, 1998) in different crops.

Many workers have observed increased root colonization and spore number in root zone soil due to inoculation of VAM alone and its coinoculation with soil microflora in different plant species including medicinal plants (Whitelaw et al., 1999 and Aparna, 2000).

The effect of inoculation of P. amarus, Solanum viarum and Vetiveria zizanioides with VAM fungi, A. awamori, T. viride has not been studied earlier. The results of this study clearly brought out the beneficial aspect of VAM fungi and plant growth nutrition.

The mycorrhizal inoculation along with A. awamori and Trichoderma viride has been reported to impart resistance to the host against disease (Schonbeck, 1979). Further mycorrhizal application along with other beneficial microorganisms to these plants enhance their effectiveness. Hence, inoculation of the nursery bed with microbial inoculants can easily be followed by the growers.