Vesicular Arbuscular Mycorrhizae For Black Pepper Nurseries.

Black pepper plantation are raised from cuttings produced in the nurseries. The important diseases affecting black pepper are *Phytophthora* foot rot caused by *Phytophthora capsici* and slow decline caused by feeder root damage by the fungus *P. capsici* or plant parasitic nematodes namely *Radopholus similis* and *Meloidogyne incognita* either alone or in different combinations. These pathogens also affect black pepper plants in nursery and often these pathogens are carried inadvertently to the field along with the planting material. Hence, production of healthy disease free planting material is imperative in establishing a healthy plantation. Management of black pepper nurseries through application of VAM is effective and economical.

What is VAM ?

Vesicular-arbuscular mycorrhizae (VAM) is the symbiotic (mutually beneficial) association of fungi with the root system of crop plants. Almost all the cultivated plants excepting the members of the family cruciferae (mustard family) and chenopodiaceae are mycorrhizal. VAM fungi initially infect the host roots at the zone of root elongation, penetrate the cell and establish as root pathogens. After establishment the mycelia project outside the root and function as root hairs. They absorb water and nutrients and the same are transported to the roots of host plants. Inside the cortical cells of host roots, the fungus forms highly branched hyphae called arbuscles. The mycelia (fungal threads) of VAM is both intra and inter cellular (spread in between cells and also inside the cells) and the inter cellular mycelia produce globose enlarged sac like structures, called vesicles which store reserve food materials and this later transforms into a chla- mydospore which are reproductive propagules. These spores, when come in contact with fresh roots, germinate and start fresh infections (Plate 1). Since, these fungi produce these characteritic structures namely, vesicles and arbuscles these fungi are called vesicular arbuscular mycorrhizhal fungi (VAMF or VAM). There are about eight genera which belong to the order endogonales which form endomycorrhizal associations with crop plants.

How do they benefit plants?

The mycelia of VAM fungi which project from cortical cells into the soil funcions as root hairs and helps in absorption of nutrients and water. VAM fungi are known for their role in increasing phosphorus uptake and accumulation in host roots. These fungi are efficient in marginal and degraded soils. The mycelium extend beyond the zone of 'P' depletion and mines this nutrient and supplies to the

plants. In return, it depends upon carbohydrates from host plants. The absorptive surface of roots in VAM colonized plants are increased and hence absorb more water and nutrients. VAM protects plants from transplantation shock and also reduces moisture stress. Due to the altered physiology of roots, it protects roots against root pathogens. The root knot nematode *Meloidogyne incognita* infestation is prevented in several crop plants. In black pepper, VAM incorporation in nursery mixture enhances rooting, growth of cuttings and suppresses root rot caused by three root pathogen namely, *Phytophthora capsici*, *Radopholus similis*, and *Meloidogyne incognita*. Besides improving the health of plants due to enhanced absorption of water and nutrients, it also suppresses root pathogens. The mode of action are varied and some of the methods are listed below.

(i) By occupying the site of infection.

Both *P. capsici* and *M. incognita* perfer the zone of elongation for the initial infection. Occupation of this site by VAM fungi prevent the pathogens from entering.

(ii) Altered physiology

VAM fungi alter the root physiology and the altered physiology does not permit the second stage juveniles of *M. incognita* to moult into the next stage, thereby preventing formation of galls.

(iii) Enhanced root production

Addition of VAM also enhances rooting. The root loss induced by pathogen is compensated by the enhanced production of roots. In case of *R. similis*, although the roots are damaged, the increase in healthy roots, offsets the damage caused by *R. similis*.

In addition to 'P', several other nutrients like Mn, Cu, Ca, and Zn, are absorbed by mycorrizal plants. The effects of VAM are well expressed in soils deficient in nutrients.

How to multiply VAM ?

As the VAM fungi are obligate symbionts (thrive and multiply only in living roots), they cannot be cultured in artificial media and hence require living plants for their multiplication. They are cultured on roots of graminaceous host such as sorghum, maize etc. The host roots and the soil in which they are grown are used as inoculum.

Preparation of soil mixture

Forest soil and sand are mixed in equal proportions or alternatively, soil and perlite are mixed and autoclaved for 1 h at 15 lbs pressure, to eliminate the pathogens present in soil. This could also be done by soil solarization.

Soil solarization : The nursery mixture prepared is spread in an open area (1m wide and convenient length 30 cm height), covered with transparent polythene sheet (150 guage thick) and the sides or sealed with mud. Due to the heat of the sunlight the soil temperature under the polythene sheet may go up to 50-55°C. Because of the high soil temperature the pathogen propagules present are killed. The solarization may be done for 30-45 days during summer.

Filling of Pots and raising inoculum

Once the soil is sterilized, it is filled in 30cm diameter earthen pots. While filling the pots, the stock inoculum of **VAM** (root and soil obtained from Research Stations) may be filled in alternating layers. After this, sorghum seeds @ eight seeds/pot may be planted and watered. Once

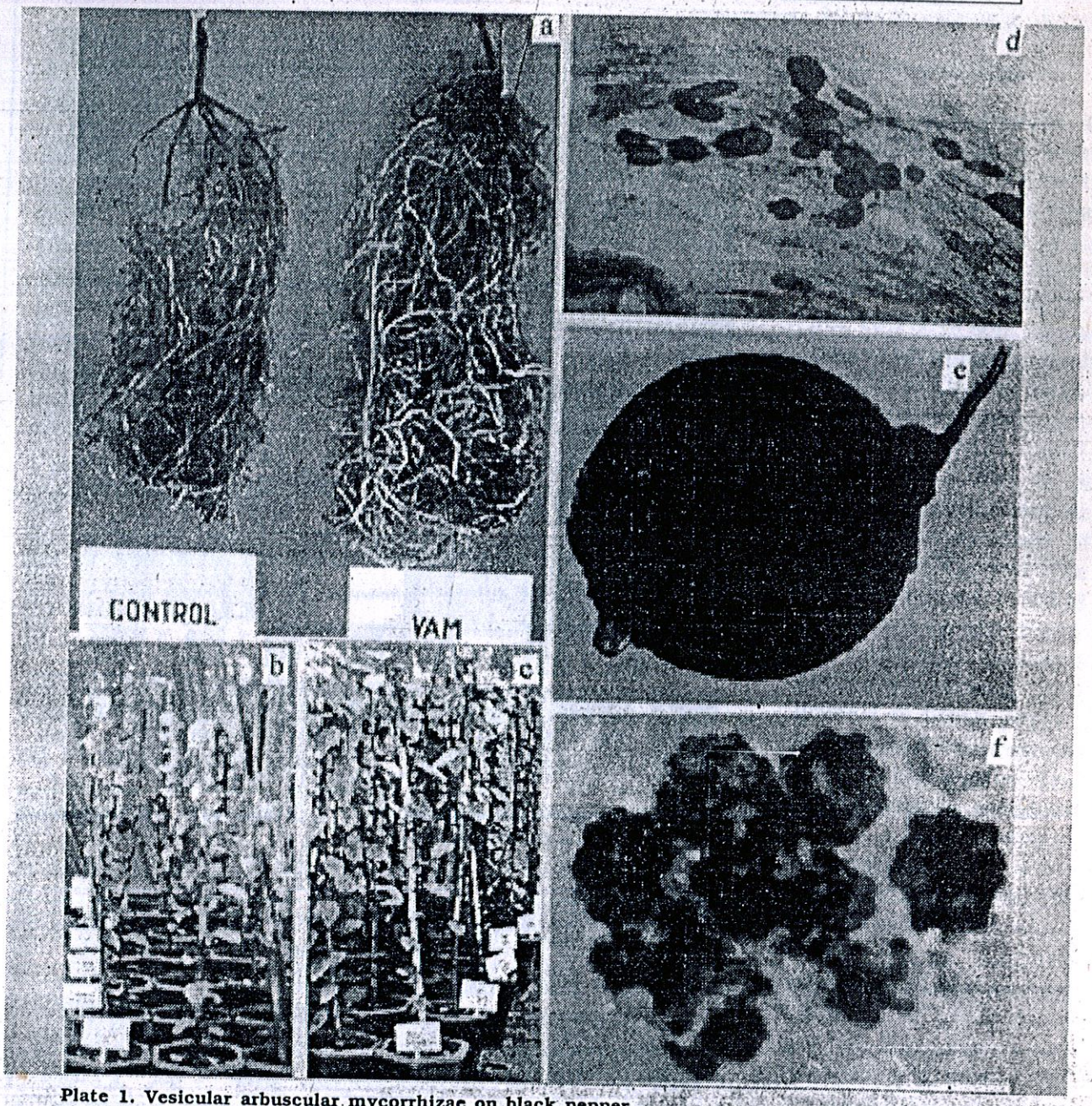

Plate 1. Vesicular arbuscular mycorrhizae on black pepper
a) Enhanced rooting. b) Yellowing and stunting due to root damage by *P. capsici*, *R. similis* and *M.incognita*. c) VAM inoculated plants show no symtom even after inoculating with *P. capsici*, *R, similis* and *M. incognita*. d) Vesicles and arbuscles in black pepper root. e) Azygospore of *Gigaspora gigantea*. f) Sporocarps of *Glomus* sp.

the seeds germinate, only five seedlings may be retained/pot and other removed. The plants may be watered and allowed to grow for six weeks. After six weeks of growth, watering may be withdrawn and plants allowed to dry. Once the shoots dry, this may be removed and soil along with root system may be used as inoculum.

Inoculation of black

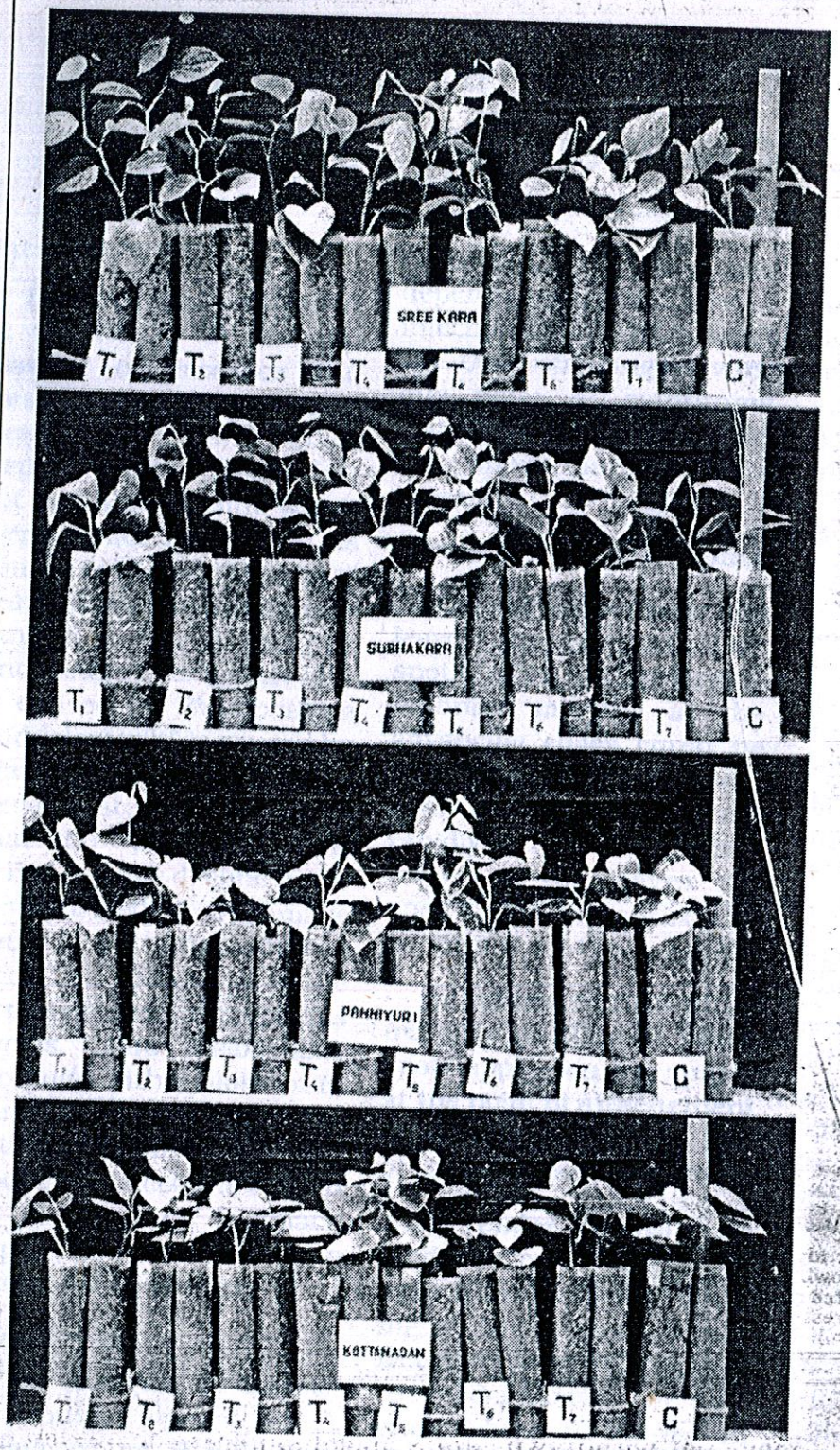

Plate 2. Black pepper varieties inoculated with VAM isolates showing enhanced growth.

pepper cuttings.

The root system of sorghum along with soil may be taken, the roots are cut into bits and mixed with soil. This inoculum contain about 650-1100 propagules per 100 cc of soil. At the time of inoculating black pepper cuttings, nursery mixture may be prepared and bags filled. While filling 100 cc of **VAM** inoculum, may be added to Poly bags of size 15 cm X25 cm. The addition of **VAM** inoculum to the nursery mixture ensures enhanced rooting and growth of black pepper cutting and suppression of root pathogens. The **VAM** isolates obtained from black pepper rhizosphere were screened and seven efficient isolates were identified. These isolates when inoculated on four varieties of black pepper, all the isolates enhanced growth of cuttings (Plate 2).

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