Diseases of black pepper (*Piper nigrum* L.) and their management

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ABSTRACT

Among the diseases reported on black pepper (*Piper nigrum* L.), blight, root rot and basal wilt in the nursery; foot rot, slow decline and anthracnose in the field are important. Stunted disease, phyllody and leaf spots are also becoming serious. The symptomatology, causal organisms and control measures of major diseases are outlined in this paper and future lines of work suggested.

Key words: black pepper, control measures, diseases, *Piper nigrum.*

Introduction

Although 17 diseases are recorded in black pepper (*Piper nigrum* L.), *Phytophthora* foot rot and slow decline cause severe economic losses. New diseases like stunted disease and anthracnose also affect production. In nurseries, *Phytophthora* rot causes high mortality of cuttings. At times this fungus is inadvertently carried from diseased areas to healthy areas through planting material. When the feeder roots are damaged by *Phytophthora capsici,* it results in slow decline. Such vines survive for more than one season although with reduced canopy. In recent years stunted disease or little leaf disease and anthracnose are on the increase. The symptoms, causes and possible control measures of these diseases are described.

Nursery diseases

Black pepper is propagated through stem cuttings and three types of cuttings are generally used. In the first type, orthotropic terminal shoots are taken from the top of growing vines and planted directly before rooting during rainy season. In the second method, runner shoots which are produced at the base of the vine during rainy season are collected, cut into bits having 2-3 nodes and planted in polybags for rooting, and these are later planted in the field. In some places, the runner shoots are kept coiled around the base of the vine on wooden stakes so as to avoid contact of these shoots with soil. These are used during the next season for rapid propagation. In the third method, cuttings taken from runners are allowed to grow on split bamboos filled with coir dust

and soil mixture. As the nodes come in contact with soil, roots are produced. Later the vine is cut at internodes so as to get single nodes with a leaf and roots (Sivaraman 1991; Ramadasan 1992). These are planted in polythene bags filled with soil and are later planted in the field. Thus the production of single nodded rooted cuttings are done throughout the year. As the conditions in the nursery are uniform and congenial throughout, several disease problems persist.

Phytophthora *infection*

During rainy season, black, water soaked lesions with a characteristic fimbriate advancing margins appear on leaves which later enlarge to cover all over the lamina and spreads to the stem. This is caused by the fungus *P. capsici.* If runner shoots are collected from a foot rot affected plantation, the severity of the disease is more. At times the pathogen is carried from the field with the runner shoots in the form of incipient infections on the roots or passively through the adhering soil particles (Sarma *et al.* 1988 a). As the conditions in the nursery are favourable, the pathogen multiplies and infects the developing roots and causes root rot. This could be prevented by collecting runner shoots from healthy gardens and by removing the soil particles adhering to the cuttings by washing in water and treating with fungicide. The cuttings may be sprayed with Bordeaux mixture (1%) at fortnightly intervals during rainy season (Sarma, Ramachandran & Anandaraj 1988; Ramachandran, Sarma & Anandaraj 1988).

Leaf rot and blights

These are caused by *Rhizoctonia solani, Pythium* sp. and *Colletotrichum* sp. In case of *R. solani,* greyish spots develop on the leaves and the infected leaves remain attached to one another. *Colletotrichum* spots are characterized by a yellowish halo surrounding the necrotic spots. These diseases can be prevented by collecting runner shoots from healthy gardens and by spraying Bordeaux mixture (1%). Phytosanitation plays an important role in reducing the inoculum build up. The affected vines should be removed and destroyed (Mammootty, Abi Cheeran & Peethambaran 1980; Mammootty & Sukumara Pillay 1981). Basal wilt caused by *Sclerotium rolfsii* causes the death of vines as the basal part of the vine is affected. Regular prophylactic measures suggested for other nursery diseases keep the plants healthy.

Diseases in plantations

Phytophthora *disease*

The fungus *P. capsici* infects all parts of the vine. The severity of the disease depends upon the plant part affected and the extent of damage (Anandaraj, Ramachandran & Sarma 1991). If the collar of the vine is affected the vine is killed within a few days and hence the term quick wilt. However, if the infection is confined to feeder roots, it leads to slow decline (Anandaraj, Sarma & Ramachandran 1994).

There are three types of foot rot. In infections spreading through runner shoots or the roots of the upper tier closer to soil surface, lead to sudden death, whereas infection through roots of lower tier, foliar yellowing preceeds death of vines. Whereas, when the infection is confined to root system it results in slow decline (Anandaraj & Sarma 1994 a & b). The affected vines show yellowing, defoliation and reduc-

tion in canopy size. Such vines survive for more than one year after infection (Anandaraj, Sarma & Ramachandran 1994). Feeder root damage by *P. capsici, Radopholus similis* and *Meloidogyne incognita* either alone or in various combinations results in slow decline (Anandaraj, Ramana & Sarma 1994). All the aerial parts of the vine are susceptible to the disease and runner shoots, leaves, spikes and branches are affected. If branches are affected the portion above the point of infection dries up.

Phytophthora infection in black pepper is weather dependent and is polycyclic and polyetic. The inoculum is carried from one season to another. The aerial spread is rapid when weather conditions are favourable. A temperature of 23-29°C, relative humidity of 81-99%, daily rainfall of 15.8 - 23.0 mm and sunshine of 3.5 h/day favour aerial spread (Ramachandran *et al.* 1988; Ramachandran Sarma & Anandaraj 1990). The tender runner shoots and branches take up infection and spread to other parts of the vine and also to adjacent vines through rain splashes (Ramachandran *et al.* 1988; Ramachandran, Sarma & Anandaraj 1990). The activity of the fungus is confined to the South West monsoon period when there is high relative humidity, high soil moisture, lower temperature, and reduced sunshine hours. The fungus remains dormant as resting spores in infected plant debris and also as latent infection in underground plant parts. Maximum vegetative growth of the vine also occurs during the same period. As soon as pre-monsoon showers are received the vine starts producing feeder roots, foliage and runner shoots. Maximum feeder root production and new flushing occur during July. Thus ideal conditions for multiplication of the pathogen and production of most susceptible tissues of the vine occur at the same time making control measures rather difficult.

Anthracnose

The fungus *C. gloeosporioides* affects young leaves, spikes and berries. On young leaves and spikes it appears as small brown specks surrounded by a yellow halo. In severe form defoliation and spike shedding occurs. Cracks develop on the berries due to infection by the fungus, thus reducing the quality of the produce besides damaging the berry.

Phyllody

This disease was noticed in parts of Wynad in Kerala, a major black pepper growing district. The spikes are converted into leaf like structures instead of normal flowers. The causal organism is suspected to be Mycoplasma like organisms (MLO). Although the vines are not killed, the production of berries is hampered (Sarma *et al.* 1988 b).

Stunted disease

The affected vines show stunted growth and the productivity is gradually reduced. The leaves show mottling, reduction in size, narrowing of lamina and reduction in internodal length. Because of these symptoms this disease was earlier referred to as little leaf disease (Sarma *et al.* 1988 b). Epidemiological studies showed that it is graft transmissible and cross inoculation tests have shown positive indication of viral etiology. ELISA tests also have shown that the disease is caused by a virus, tentatively identified as CMV banana race.

Integrated disease management

The following are the management strategies suggested for major diseases of black pepper.

Avoidance of disease

Black pepper being vegetatively propagated, collection of ideal planting material is the first step in disease management. Healthy planting material should be collected from disease free areas. In case of viral disease the pathogen is systemic and is actively carried in propagating units. Similarly, in case of fungal diseases especially in *Phytophthora,* the pathogen is passively carried either through soil particles adhering to or in the form of latent infection on the roots of runner shoots.

Phytosanitation

Reduction of initial inoculum and removing the source of inoculum are important steps in disease management. For diseases which could be controlled by chemicals or otherwise the infected vines must be removed and destroyed. Vines affected with stunted disease and vines killed due to foot rot or vines showing declining symptoms must be uprooted and burned. Foot rot incidence is found to cluster around previously infected vines. Hence reduction of initial source of inoculum is one of the important steps in disease management.

Cultural practices

Minimum tillage: *P. capsici* spreads through soil water and soil splashes. Clean cultivation favours rapid spread through splashing of soil inoculum. Presence of grass cover prevents splashing of soil containing the pathogen. It is suggested to keep the soil around the basin covered with mulch and have a grass cover in the interspaces to prevent the rapid spread of inoculum. Minimum tillage concept is an essenial component of cultural practices. Any disturbance to the base of the vine that results in root damage would further aggravate the disease.

Shade regulation : In order to ensure better light penetration and air circulation, shade regulation becomes an important cultural operation. Heavy shade during monsoon period would result in high humidity build up, a condition highly congenial for disease development. Lopping of branches of shade trees/standards during April-May is recommended.

Organic amendments

Soil amendments like neem cake, farm yard manure etc. favour growth of antagonistic microorganisms and reduce pathogen build up. Neem oil cake application has a dual role as it suppresses nematodes and *Phytophthora,* supporting saprophytic growth of antagonistic microflora, besides acting as a nutrient source for the vines.

Chemical control

Phytophthora foot rot, slow decline and anthracnose occur during rainy period. Due to heavy rains there is loss of chemicals by leaching and hence the need to use systemic fungicides. Two sprays with Bordeaux mixture (1%) during the monsoon period prevent aerial infection. To minimize the build up of soil inoculum, copper oxychloride (0.2%) @ 5-8 l/vine is recommended (Ramachandran, Sarma & Anandaraj 1991). Two systemic fungicides viz., Metalaxyl and Fosetyl Al were also found to be effective. Various formula-

tions of Metalaxyl and Phosphorus acid are available in market and were found to be effective under experimental conditions (Ramachandran, Sarma & Anandaraj 1991).

Biological control

Vesicular Arbuscular Mycorrhizae (VAM) are reported to enhance growth of several crop plants. In black pepper also several species of VAM were reported to enhance growth (George & Ghai 1987; Bopaiah & Khader 1989; Anandaraj & Sarma 1994 a). In black pepper, in addition to growth, VAM reduced the incidence of root rot caused by *P. capsici, R. similis* and *M. incognita* (Anandaraj, Ramana & Sarma 1992; 1993). In the field several species of *Trichoderma* and *Gliocladium virens* were antagonistic to *P. capsici.* Soil amendments such as neem cake promoted the growth of these antagonistic microflora. Field experiments have shown that incorporation of biocontrol agents in the field suppresses soil borne inoculum (Anandaraj & Sarma 1994 b). Incorporation of VAM in the form of infective propagules at nursery stage and also biocontrol agents grown on sorghum and coffee husk can be applied to suppress soil inoculum along with a foliar spray with Bordeaux mixture (1%) to protect the aerial parts.

Disease management strategies for nurseries

An integrated approach is to be followed from the nursery. Since healthy planting material is a prerequisite to raise a healthy plantation, production of healthy material is imperative.

Fumigation of nursery mixture

As discussed earlier, *P. capsici* and nematodes are soil inhabitants. The soil must first be made healthy by soil solarization. The method is simple and environmentally safe. After preparing the mixture it is moistened and covered with clear transparent polythene sheets and left in the sun. The temperature trapped inside kills all organisms. After a month the mixture is taken and used for raising cuttings.

Incorporation of VAM

At the time of planting cuttings, soil containing propagules of VAM is added to the bag at the rate of 100 cc per bag, which would contain approximately 1100 propagules.

Addition of biocontrol agents

Antagonistic fungi such as *Trichoderma* and *Gliocladium* are cultured on sorghum grains and added to each bag at the rate of 5g/bag, to produce disease free planting materials.

Future lines of work

The following lines of work are identified for developing an integrated disease management strategy which would minimize the crop loss caused by pathogens.

Large scale multiplication of VAM : VAM fungi being obligate symbionts, it is not possible to culture them on artificial medium; hence methods must be standardized to produce large scale inoculum.

Testing kits: Since virus diseases are on the increase it is necessary to develop an ELISA kit for testing the systemic presence of the virus causing stunted disease.

Developing disease resistant/tolerant lines : At present none of the cultivated varieties has resistance. Efforts to develop disease tolerant lines by

biotechnological methods have to be intensified.

Use of botanical pesticides : There are indications that certain plant products from neem, *Chromolaena odorata, Piper colubrinum* etc. have antifungal compounds suppressive to *P. capsici*. This has to be exploited and used as soil amendments.

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