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Sclerotium Stem Rot: A Threat to Groundnut Production

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Stem rot caused by *Sclerotium rolfsii* Sacc., is a necrotrophic soil-borne fungal pathogen infecting about more than 500 plant species worldwide including groundnut. Owing to its broad host range as well as worldwide distribution, its management through any single approach strategy is not effective. This article describes an approach of integrated disease management which proves to be effective against stem rot disease in groundnut.

Introduction

The cultivated groundnut (*Arachis hypogaea* L.) belongs to family *Fabaceae*, subfamily *Papilionaceae*. Groundnut is grown in nearly 100 countries. It occupied 21.7 million ha worldwide with a total production of 38.6 million tonnes during 2011 (FAOSTAT 2011). In India, it cultivated on 5.31million ha with production of 6.93 million tonne (Anonymous 2012). In India it is grown mainly in Gujarat, Maharashtra, Andhra Pradesh, Uttar Pradesh, Tamil Nadu, Rajasthan, Karnatka and Madhya Pradesh. The groundnut contains more protein (25-36 %) than meat, about two and a half times than in eggs, and far more than any other vegetable food except soybean and yeast. Groundnut seeds contain 46-52% oil content which is used for cooking purposes. It contains resveratrol, a polyphenol antioxidant, which has been found to have protective function against cancer, heart disease, degenerative nerve disease and viral infections. This signifies the importance of groundnut for human use and thus encourages for increasing its production and productivity. But there are several soil-borne fungal diseases affecting yield of groundnut, stem rot however, is most serious and wide spread under warm temperate and humid climate. Sclerotium stem rot is caused by *Sclerotium rolfsii* Sacc., a necrotropic soil-borne fungus causes disease on wide range of agricultural and horticultural crops including groundnut. Sclerotium stem rot, infecting about 500 plant species worldwide, causes considerable yield losses. Though this fungus is borne of both seed as well soil but soil-borne are more important in disease development. The pods, which are produced below the soil surface, come in contact with the fungi causing rotting of pods. This results in lowering of yield and quality of pods. Stem rot is also known as sclerotium blight, sclerotium rot, sclerotium wilt, southern blight, southern stem rot, root rot, white mould and pod rot.

Distribution and Economic Importance

It is widely distributed in tropics, subtropics and also in warm temperate regions of the world. In India, it is wide spread in almost all

the states especially in Gujarat, Maharashtra, Karnataka, Tamil Nadu and Andhra Pradesh. Irrigated groundnut crops grown in the post rainy and summer seasons in India are often infected by the pathogen. It is predominant especially in Vertisols and relatively less severe in sandy loam soils. The yield loss up to 75-80 per cent has been reported in New Mexico (Aycock 1966). Yield losses usually range from 10 to 25% in India, Thailand, Indonesia, Taiwan, and the Philippines but may reach 80% in severely infested fields (Mayee and Datar 1988). About 20-60% of pod yield reduction was observed due to pod rot in widely cultivated varieties, JL 24, KRG 1, Dh 40, TMV 2 in Karnataka and Andhra Pradesh (Anonymous 1992).

Disease Symptoms

The primary symptoms are browning and wilting of leaves and branches which are still attached with the plant. The fungus preferentially infects stem by forming a whitish mycelia mat around the stem, but it can also infect any part of the plant including root, leaf and pod. In heavy soils, fungus damages groundnut plants near the soil surface but in light soils it can reach upto pod level, causing severe damage to pegs and pods (Mehan and McDonald 1990). Infected pods are covered by mycelia usually rot. When bark is peeled off, the inner tissue shows a brown to yellow discoloration. Leaves of infected plants turn brown, dry and often remain attached to the dead stem. Drying or shrivelling of the affected branches ultimately lead to death of the complete plants after wilting.

Disease Cycle and Dissemination

The pathogen survives as a saprophyte on plant debris, even debris from non-host crops. Sclerotia survive well (3-4 years) at or near the soil surface but survive poorly when buried deep because the fungus has a high oxygen demand (Mehan et al. 1994). Infection starts from sclerotia that germinate eruptively in the presence of volatile compounds from decaying organic matter under warm and moist conditions. As warm and moist climatic conditions favour disease development. The fungus mycelia colonize plant debris or other organic matter before infecting living plant tissue. Any part of the groundnut plant that comes in contact with the soil is infected with fungus. In warm and high moisture condition, the occurrence of stem rot usually coincides with early stages of peg and pod development. Stem rot develops at all the growth stages (10-90 days) but disease development is slow in older (more than 40 days old) plants than the younger plants (Pande et al. 1994).

Management Practices

Crop rotation: Crop rotation, the successive planting of different crops in the same area is one of the oldest and most widespread cultural practices. It may also include a fallow period in which land is 'rested' from cultivation. Crop rotation improves soil fertility, moisture and texture and assists in weed and pathogen control. The most successful rotations employ intervals between susceptible crops which are longer than the known survival period of pathogens. Probably the most widely used rotations are

for the control of soil-borne pathogens of groundnut. Rotation of groundnut with non-susceptible crops such as corn, cotton, and wheat can greatly reduce stem rot incidence and severity (Wokocha 1988). Anecdotal information shows that crop rotation with sorghum, wheat, maize, cotton, onion and garlic may reduce the incidence of stem rot in groundnut.

Soil solarization: Solarization involves laying clear plastic polyethylene mulch on moist soil. Solarization with polythene sheets increases the soil temperature by retaining the heat from the sun and kills or debilitates pests. Therefore solarization for 3-4 week in summer greatly reduces the survival ability of the pathogen and increases vulnerability of sclerotia to antagonists and can be adopted in areas where temperatures are high (above 43°C) and irrigation facilities are available (Mihail and Alcorn 1984). This practice has been found to significantly reduce incidence of stem rot and pod rot in groundnut.

Deep ploughing: As the fungus has high oxygen demand, the sclerotia survive very well at or near the soil surface but their survival decrease when buried in deep about 8-10 cm from soil surface. Deep ploughing of all undecayed organic matter and plant debris to at least 8-10 cm greatly reduced stem rot incidence in groundnut (Garren 1961).

Tillage: Tillage incorporates various types of organic matter including crop residues, green manure, volunteer crop plants and weeds plants into the soil. Tillage practices tend to have indirect effects on the spread of plant pathogens, although some forms of inoculum can be widely dispersed by implements. Tillage reduces populations of weeds and volunteer crop plants that harbour pathogens between crops. It also buries plant pathogens from the top soil into deeper layers of the soil where they cause less or no disease. This practice significantly reduces the stem rot incidence.

Water management: Groundnut is a rainfed crop generally requires 500 mm rainfall throughout the crop season to raise a healthy groundnut crop. Excessive irrigation at different stages of crop growth may promote soil-borne diseases resulting losses in yield. It was observed that incidence of stem rot was lower on raised beds than sowing on flat bed. Therefore, drainage system with proper arrangements should be made to reduce stem rot incidence in groundnut.

Organic manures: Soil with adequate organic matter can house uncountable numbers of organisms such as beneficial bacteria, fungi, nematodes, protozoa, arthropods and earth worms that deter harmful bacteria, fungi, nematodes and arthropods from attacking plants. These beneficial organisms also help to create a healthy plant that is able to resist pest attack. Addition of compost, oat or corn straw to soil can reduce disease incidence (Garren 1959), probably because of the release of toxic ammonia, or increases in populations of resident antagonistic soil microorganisms. Soil application of castor cake @ 750/ha in furrow before sowing reduces stem rot

incidence in groundnut (Anonymous 2008-09).

Biological control: Biological control has been proved to be a promising disease management technology especially against soil-borne plant pathogens. There are several soil fungi (*Trichoderma harzianum*, *T. viride, T. longibrachiatum)* bacteria (*Pseudomonas fluorescens, Bacillus subtilis*) and mycorrhizal fungi found to be highly antagonistic to *S. rolfsii* and other soil-borne pathogens of groundnut. *Trichoderma viride* Tv1 was the most effective isolate against *S. rolfsii* with 69.40% growth inhibition followed by *P. fluorescens* resulting in 64.40% inhibition. Among the organic amendments tested in greenhouse, mahua cake with *T. viride* each @ 5 g/kg of seed resulted in 3.75% stem rot incidence as against 39.98% in control (Karthikeyan et al. 2006). Seed treatment with *Trichoderma viride* or *T. harzianum* @ 10 g/kg seed and soil treatment @ 4 kg/ha with 250 kg castor cake helps in managing stem rot and other soil-borne diseases (Anonymous 2011). This showed a great potential for use of these microorganisms as biocontrol agents for controlling stem rot and other soil-borne pathogens.

Chemical control: Application of fungicides gives effective control of stem rot in groundnut. The effectiveness of fungicides use is dependent upon the method of application, time of application, optimum dose and weather factors. Stem rot is a seed and soil-borne disease so that it is important to treat the seed with vitavax @ 2 g/kg or tebuconazole @ 1.5 g/kg and spray tebuconazole @ 1 ml/l at 45 and 60 days after sowing for effective control of stem rot (Anonymous 2011). Application of tebuconazole 2 % DS @ 1g/kg seed before sowing provide excellent control of stem rot of groundnut (Gururaj, 2012).

Growing of resistant/tolerant cultivars: Sclerotium stem rot has wide host range, and is capable of producing several non-specific metabolites, oxalic acid and several cell wall degrading enzymes, it is logical to predict a low probability for success in finding useful levels of host resistance. This may be one of the reasons for the relatively low emphasis placed on breeding groundnuts for resistance to *S. rolfsii* (Mehan et al. 1994). At present there is no cultivars are known to be resistant to *S. rolfsii* in groundnut but some genotypes and breeding lines have been found to show lower than average susceptibility to stem rot under field conditions. Growing of tolerant groundnut varieties like GG 16 (JSP 39), Dh 8 and OG-52-1 may be found effective to stem rot under field conditions.

Conclusion

Stem rot is a major soil-borne disease of groundnut causing serious pod loss at harvest resulting great economic losses in groundnut growing countries including India. The emphasis should be given on an integrated management approach including crop rotation, sanitation, tillage practices, use of organic manure, soil solarization, water management, use of bio-control agents, growing of tolerant cultivars, use of

fungicides etc., for effective control of stem rot disease of groundnut.

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