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Coconut basal stem rot is manageable

Of the different treatments imposed, basal application of *T. viride* gives significant results. The mixture of 50g of *T. viride* talc formulation + 5 kg of neem cake as basal application per palm per year is most effective and none of the palms treated with this method shows symptoms even after 3 years. Overall yield performance of field after treatment imposition is good. Nut yield per acre before treatment imposition is recorded as 700, whereas that after treatment imposition is 1000.

DISEASES are one of the important factors impeding the coconut cultivation in Andhra Pradesh, Tamil Nadu and Karnataka. Basal stem rot, stem bleeding, bud rot, leaf blight and root (wilt) are major diseases. Among them, basal stem rot caused by *Ganoderma applanatum* and *Ganoderma lucidum* is most fatal disease, resulting in death of affected palms. The genus *Ganoderma* is particularly diverse in the tropics where it affects the plantation crops such as oil palm, coconut, rubber, betel nut, tea and forest trees. Occurrence of both the species as the causal organism of basal stem rot of coconut has been reported and there is a wider variation among isolates of *Ganoderma* collected from various.

The basal stem not is severe disease in lighter soils such as red and sandy soils near to the river and sea coasts. However in recent years, the disease is spreading to coconut palms of black soils such as paddy field bunds, fish pond bunds etc. East Godavari, West Godavari, Srikakulam, Vijayanagaram and Visakhapatnam are major coconut-growing districts, contributing to approximately 95% of the total coconut cultivation in Andhra Pradesh. Among these districts, East Godavari recorded maximum mean per cent disease incidence of 13.8, followed by Srikakulam (13.7) and West Godavari (11.4) during the last five years. Mean per cent incidence of 7.2 is recorded in Vijayanagaram district. Village-wise disease incidence in three districts ranges from 0 to 30.5% in the surveyed districts.

In Karnataka, it is severe in Hassan, Chikkamagalur, Tumkur and Shimoga districts. Hassan district recorded maximum BSR incidence of 7.46 per cent, followed by Chikkamagalur (7.36%) and Tumkur district (6.32%). Village-wise disease incidence in these three districts ranges from 1 to 21%. The survey results from 2005 reveals that incidence of BSR are increasing year after year in dry tracts of southern Karnataka. In Tamil Nadu, disease is more prominent in Thanjavur, Thiruvarur and Nagapattinam districts. It is maximum in Thanjavur district with a mean incidence of 6.5% followed by Nagapattinam (3.0%) and Thiruvarur (1.2%) districts.

Symptoms of coconut rot (*above* and *below*)

Symptomatology

The disease first starts in the root system. Initially, a few roots get infected and rot. Decay and death of fine roots is first underground symptom of the disease. Discoloration and extensive rotting of root system are observed which are characteristics of disease. The rotting proceeds towards the bole. Cortical tissues disintegrate and the stele turns brown. In severely diseased palms, more than 70 per cent root rotting is observed. Exudation of reddish brown viscous fluid from basal portions of stem is the first visible symptom. The bleeding patches begin from the base and extend up to 3 meters upwards as disease progresses. Occasionally, some infected palms do not show bleeding symptoms. Sporophores of *Ganoderma*

lucidum appear at the base of affected trunk in palms prior to wilting or just after the death of palm. The leaflets exhibit wilting symptoms and outer one or two whorls of leaves turn yellow. Later, they exhibit light to moderate browning followed by drooping and drying. As the disease advances, remaining leaves also droop down in quick succession and the spindle alone remains

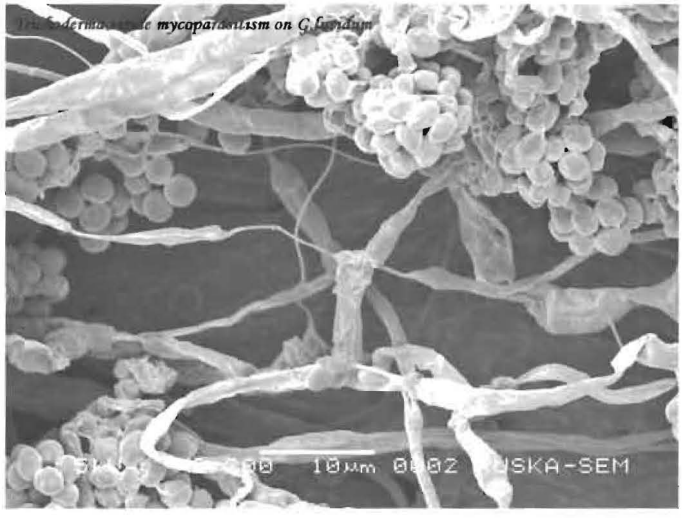
Production of new leaves is delayed. Leaves break off near the base along the midrib. The affected bud emits a foul smell and in advanced stages, the crown is blown off leaving the decapitated stem and in the later stages normal development of flowers and bunches are arrested. The leaves droop down resulting in hanging down of the subtended bunches this leads to button shedding and barren nuts. Most of the palms bear profusely, just prior to and at the time of initiation of symptoms.

Redgram as and indicator plant

Bengal gram as an indicator plant

Epidemiology and Disease Forecasting

The pathogen is fungal in nature and transmits by means of soil, water and air. It persists for longer periods in soil by producing various resting stages such as melanised mycelium, basidiospores and pseudosclerotia. The disease is mostly prevalent in sandy soils and where coconut gardens are raised under rainfed conditions. Lack of soil moisture in summer months, presence of infected stumps in garden, injury to roots and non-adoption of recommended cultural practices are favorable for the disease spread. Correlation studies between weather factors and spread of basal stem rot disease for the period from 2000 to 2012 indicated that number of rainy days, rainfall and evening relative humidity have significantly negative relationship with vertical spread of basal stem rot disease in coconut.



Scanning electron microscopic view on mechanism of action of *Trichoderma* spp. on *Ganoderma* spp.

Varietal Screening

Forty-six coconut accessions were screened for identifying resistance against basal stem rot disease in Andhra Pradesh but all of them were found susceptible to the disease.

Early Detection of Basal Stem Rot

Studies at Ambajipet, Andhra Pradesh on thirteen plant species, the pathogen of basal stem rot disease, *Ganoderma* species, could able to infect red gram and bengal gram plants. The pathogen was re isolated from the above said indicator plants. Red gram plant showed typical bark splitting symptom within three months, whereas the Bengal gram plants showed infection at the basal stem region and withering and yellowing of the older leaves within two months period. Sesbania and Eucalyptus plants also show infection by the pathogen and the symptoms are oozing of reddish brown to black liquid from the stem region. Bengal gram plant was also proved as indicator plant from Arsikere, Karnataka.

Biological and Chemical Control

Studies on biological control measures against BSR from the three states confirmed the importance of bioagents, *Trichoderma viride* and *Pseudomonas fluorescens* against *Ganoderma* species. *T. viride, T. harzianum* and *T. hamatum* are found to have complete suppression on pathogen under *in vitro* conditions. Volatile and non- volatile metabolites of the three *Trichoderma* species were tested against the *Ganoderma* species and the results were found promising. *Pseudomonas fluorescens* also inhibited the growth of both the *Ganoderma* species. Neem cake and farmyard manure are found to support the growth of the bioagents, *Trichoderma* and *Pseudomonas* under *in vivo* conditions.

Scanning electron microscopic studies on mechanism of action of *Trichoderma* spp. on *Ganoderma* spp. visualized coiling of *Trichoderma* spp. around the hyphae of *Ganoderma* spp. sparsely in the initial stages and intensely at later stages, penetration of *Trichoderma* hyphae into the pathogen

Please turn to page 48

dioxide. Various steps involved in wine production are: i) extraction of juice; ii) detanning; iii) fermentation; iii) filtration and iv) ageing. Nine litres of wine can be obtained from 10 litres of cashew apple juice. The volatile acidity is below 0.07 per 100ml and aldehyde percentage ranges from 0.088-0.418. The quality of cashew apple wine is influenced by the clarifying agent used for clarification of cashew apple juice. The wine prepared from juice clarified with 1 per cent gelatin produces an appealing black colour, appreciable taste, aroma and sugar acid blend. Use of juice clarified using 0.4% Poly Vinyl Pyrollidone and later treating with 200 mg potassium meta bisulphite per litre of juice, though effective in reducing the tannin content, is not economic. Rice gruel, which is cheaper and easily available, can also be used for clarification of juice to prepare wine of satisfactory sensory quality.

Strain of wine yeast, *Saccharomyces cerevisiae* produces cashew apple wine of high alcohol content and low acidity. Jaggery is a better ameliorant than cane sugar in cashew wine preparation. Srilankan Cashew Corporation has standardized a method for production of semi sweet wine named as '*Cazholeena*' by adding wine yeast in the dry form to single strength fresh pulp for fermentation. It contains 11.4 per cent alcohol and 2 per cent sugar and free from volatile acids and turbidity.

Cashew Apple Residue

When bulk quantities of cashew apple is utilized for the manufacturing of soft drinks or fermented beverages on a commercial scale, considerable amount of cashew apple residue is obtained as waste. This fruit waste, which is highly perishable and seasonal, sometimes creates problems for disposal. Several techniques are available for the utilization of this waste by converting them into value added products. The cashew apple residue can be utilized after drying or without drying for the preparation of cattle feed, pig feed and poultry feed. The cashew apple is dried and powdered into a meal which can be used as bait for catching crustaceans. Cashew peel has protein (7.6 per cent), fat (12.3 per cent) and carbohydrate (59.2 per cent) is a good poultry feed and can also be used for the extraction of tannin. Apple residue could be effectively utilized for the production of vermicompost having a nutrient composition of N (1.69 per cent), P (0.44 per cent) and K (0.58 per cent). The residue, after extracting juice for fenni preparation, is used as fuel in liquor industry in Goa.

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Continued from page 38

Coconut basal...

species followed by replacement of its protoplasmic contents and finally lysis of *Ganoderma* mycelium. Under field conditions, two bioagents, *Trichoderma* spp. and *Pseudomonas fluorescens* are found effective in suppressing the growth of *Ganoderma* species.

Studies on management of BSR through bioagents, neem cake and root feeding of the chemical Hexaconazole (1%) @ 100ml/ palm, thrice in a year along with basal application of 5 kg neem cake and 50g of talc formulation of *Trichoderma* species is found as an effective method.

Integrated Disease Management

- Application of recommended dose of fertilizers to the coconut palms every year.
- Drip or basin method of irrigation is to be followed while irrigating the fields.
- Frequent watering or irrigation is to be applied to the palms especially during summer months.
- While irrigation, care should be taken to avoid flow of water from diseases trees to other healthy trees.
- Injury or damage to roots and pruning and cutting of the roots needs to be avoided.
- Raising and ploughing *in situ* of green manure crops like sunhemp and sesbania was followed for increasing the soil organic matter and antagonistic microflora.
- Sowing of indicator plants like red gram and Bengal gram seeds in the tree basins for symptom development thereby early detection of the disease can be identified.
- Red gram plants show bark splitting symptom and Bengal gram plants exhibits withering, yellowing and drying of lower set of leaves are the prominent symptoms developed by the indicator plants.
- Frequent observation and detection of the disease symptoms on coconut stem at early stage is utmost important in managing the disease by any measure.
- Uprooting and destruction of diseased and dead palms along with the roots.
- Application of 50g of *Trichoderma viride* in combination of 5kg of neem cake to the diseased plant as the curative measure once in every year.
- Application of the above said mixture at the rate of 1kg to all the healthy palms in the diseased garden as a prophylactic measure.
- Clean cultivation and cultural practices needs to be followed.

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