Metarhizium anisopliae (Metsch.) Sorokin
A biocontrol agent of coconut palm rhinoceros beetle

Murali Gopal[1], Alka Gupta[2] and B Sathiamma[3]

Central Plantation Crops Research Institute, Krishnapuram (Kerala) 690 533

An entomopathogen green fungus,* Metarhizium anisopliae, *saves damage of coconut palm by spraying 5 x 1^{11} spores/m^3 mycelia over the breeding sites of rhinoceros beetle. This fungus kills the grubs within 14–21 days when applied to the breeding sites of rhinocerose viz. farmyard manure, compost pits, and coir wastes dumps.

Key words: **Biological control,** *Cocos nucifera, Metarhizium anisopliae, Rhinoceroses*

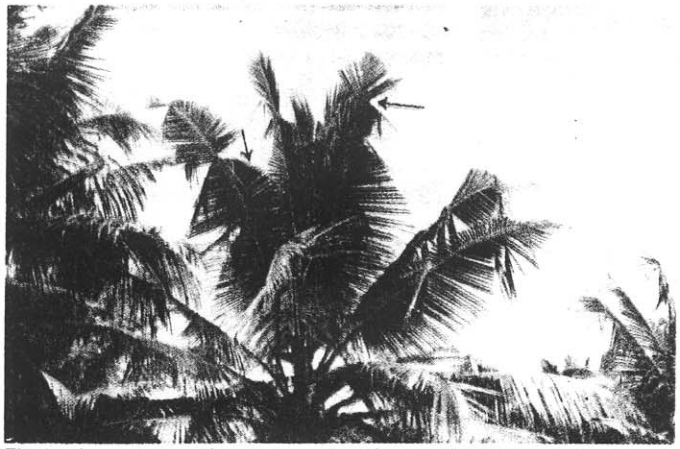

Fig.1. Appearance of the coconut palm attacked by the rhinoceros beetle. Note the 'V'- shaped cut patterns on the fronds (indicated by arrows).

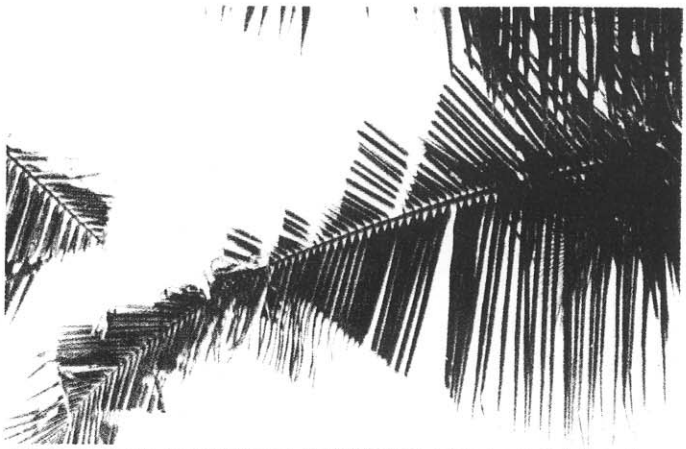

Fig.2. A single coconut frond exhibiting the typical geometric patterns made by the insect pest.

METARHIZIUM ANISOPLIAE (Metsch.), fungus, produces dark green conidial mass and hence it is called green muscardine fungus. This fungal entomopathogen produces 100 % and 38% mortality in the grubs and adults of rhinoceros beetle (*Oryctes rhinoceros*) respectively, in laboratory. In field, 75% mortality was observed on the grubs when optimum dose of pathogen is applied during the favourable conditions. *O. rhinoceros* adult damages the coconut palm by boring into the unopened fronds and spathes. This damage causes a 10 % loss in the economic yield of coconut production. The holes made by this pest serve as an entry point for the red weevil (*Rhynchophorus ferrugineus*), another dreaded pest of coconut palm and fungal pathogens which cause rotting of the tender tissues on the palm crown.

Fig.3. The point of attack on the coconut frond by the beetle breaks due to weakening of the petiole (indicated by arrow), which results in substantial loss of photosynthetic area.

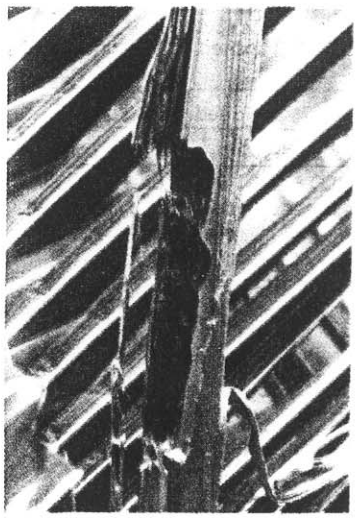

Fig.4. Newly emerging spindle chewed by the *Oryctes* sp. adult, which on opening exhibits the 'V'-shaped cuts.

[1,2] *Scientist (Microbiology);*
[3] *Retired Senior Scientist (Entomology), Regional Station, Kayangulam.*

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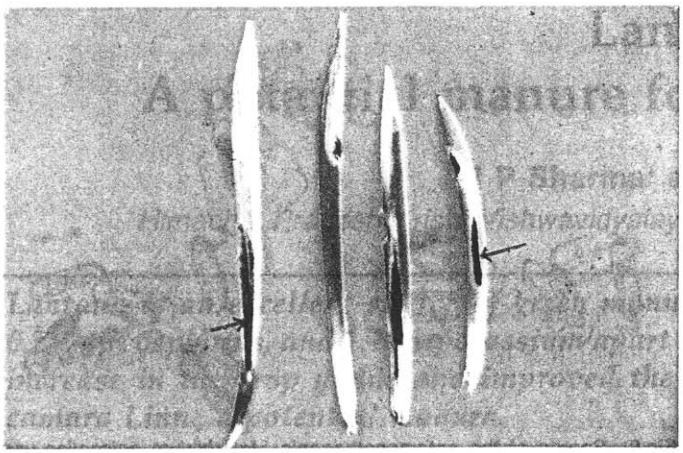


Fig. 5. The spathes damaged by the pest (indicated by arrows) leads to partial to total loss of the nuts in those inflorescences.

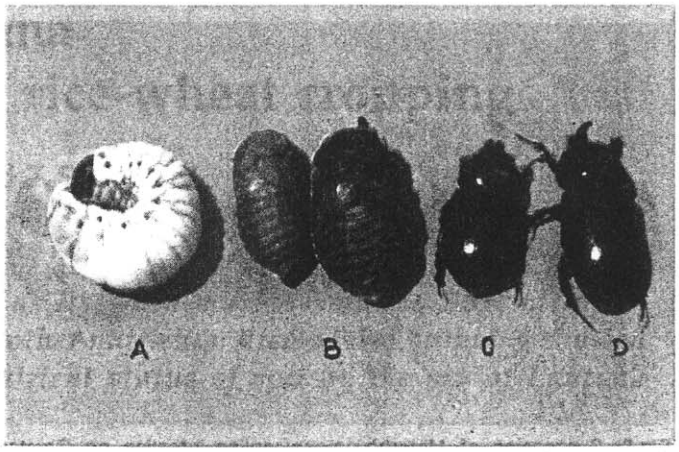


Fig. 6. Different life stages of *Oryctes rhinoceros* beetle : grub (a), pupae (b) and adults, female (c) and male (d). The adult is the damage inflicting stage.

MYCOLOGY

The fungus gains entry through membranous joints of cuticle of *Oryctes* grubs (host) by mechanical and enzymatic action. The studies carried out at this Regional Station showed that high humidity (92 % RH) and moderate temperature (27°–28°C) are favourable for the establishment of this pathogen in the host. The grubs after infection by the fungus, become sluggish, lose appetite, get mummified and even-tually die. Some white powdery fungal colonies appear initially at all the joints of the integument. After 7–10 days, white colonies become green, and finally the whole grub becomes black and decomposes with in 15–20 days after infection. Production of toxins like destruxins, desmethy-ldestruxin and swainsonine inside the host by the pathogen is believed to cause the death. All stages of *Oryctes rhinoceros* except the eggs are mycosed. The first instar larva is most susceptible and dies with in 10–12 days. Second and third instar larvae take infection in about 2 weeks. The adults also succumb to the infection, but are relatively less susceptible because of their hard integument.

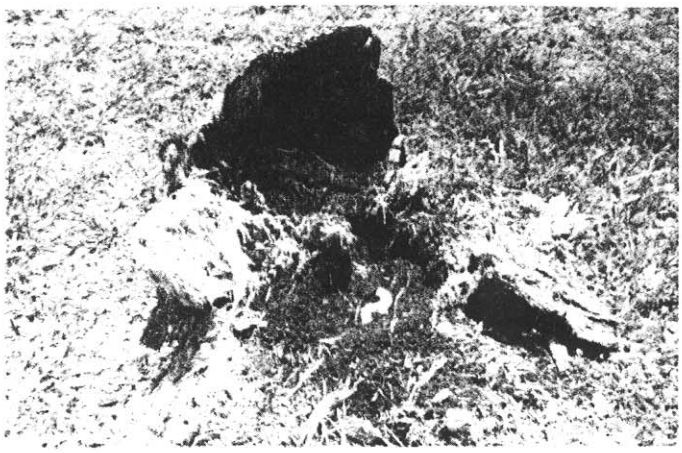
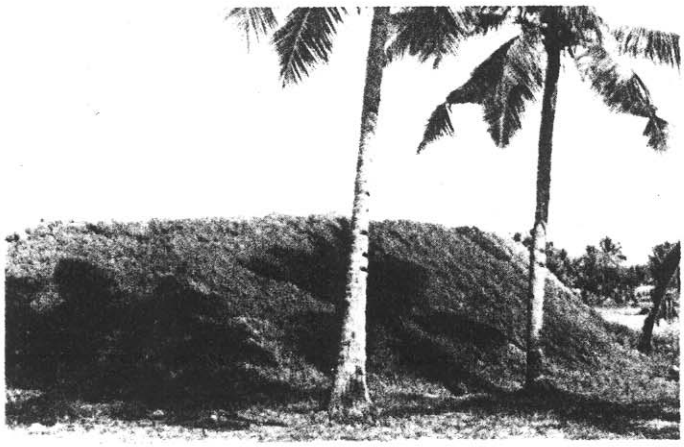
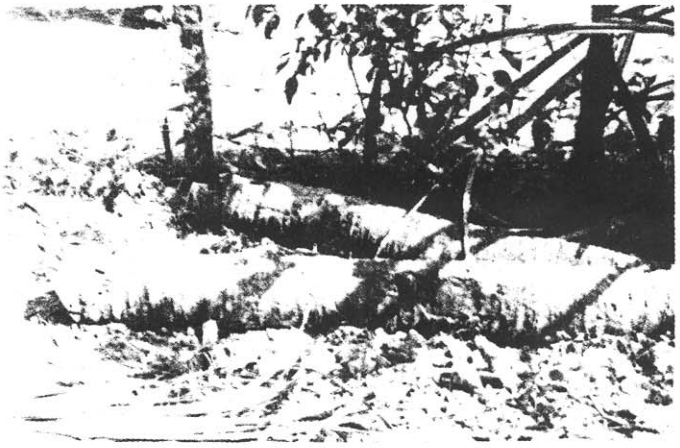


Fig. 7. This insect pest is a prolific breeder and prefers dead and lodged coconut stumps (a), cut and fallen logs, (b) and coir waste dumps, and (c) for its multiplication, in addition to farmyard manure, compost pits and other decaying organic debris.

Mass multiplication

Autoclaved, filter-sterilized or aseptically drawn out coconut water, an easily available agricultural by product from copra making





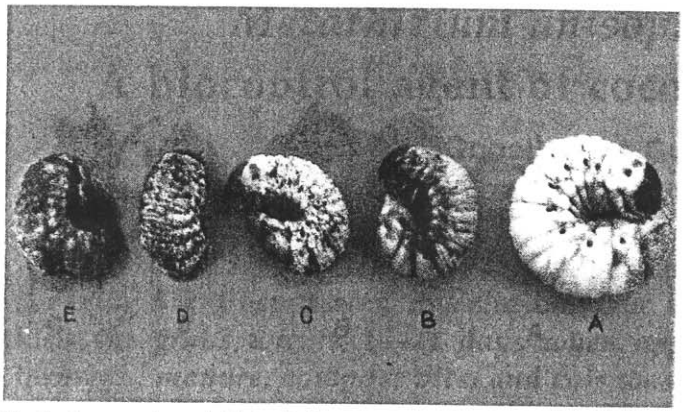


Fig.8. Succession of *Metarhizium anisopliae* infection on *Oryctes rhinoceros* grubs : healthy grub (a), dead and mummified grub (b), external whitish hyphal growth of the fungus (c), greenish spore production by the fungus (d) and finally decomposition of the host body (e).

Fig.9. Spores of the entomopathogenic *Metarhizium anisopliae* var. *major* [under the light microscope (oil immersion)].

industry, is a good liquid substrate for mass production of fungal spores. Solid media viz. cassava chips mixed with rice bran supplemented with urea or waste fish meal extract can also be used.

Field application

The entomopathogen is applied to the breeding sites of the rhinoceros beetle viz. farmyard manure, compost pits and coir waste dumps. About 5×10^{11} spores/m^3 can be sprayed or spread over the breeding sites of the rhinoceros beetle for effective management. The spores once applied retain their viability for more than 2 years in the breeding sites. The treatment is particularly effective during rainy season when humidity is high and temperature moderate. Peak occurrence of the adult beetles feeding on the palm crown is from June to August. The beetles visiting the breeding grounds for egg laying gets infected and the grubs emerging from the eggs also become susceptible to infection. This is one of the important component in the Integrated Pest Management (IPM) programme for the control of *Oryctes rhinoceros* beetle.

SUMMARY

Metarhizium anisopliae, a Deuteromycete also known as green muscardine fungus, is a well known entomopathogen. It is widely used for the control of rhinoceros beetle which does extensive damage to the coconut palm. The pest can be effectively controlled by spraying 5×10^{11} spores/ m^3 of the fungus over the breeding sites. The fungus kills the grubs in about 2–3 weeks time.