Cordyceps SPECIES AS A BIO-CONTROL AGENT AGAINST COCONUT ROOT GRUB, Leucopholis coneophora BURM
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ABSTRACT
Indiscriminate use of synthetic chemical pesticides affected the stability of agro- ecosystems which resulted in pesticide hazards viz., human health problems, environmental pollution, pesticide resistance, pest resurgence, secondary pest outbreak, etc. The demand for eco-friendly methods leads to the exploration of naturally occurring bio-control agents for pest control. Entomopathogenic fungi are important among all the biological control agents due to its broad host range, route of pathogenicity and its ability to control sap sucking pests and insects with chewing mouthparts. Cordyceps is a genus of ascomycete fungi (Sac Fungi) that are endoparasitoids, mainly on insects and other arthropods (they are thus entomopathogenic fungi) a few are parasitic on other fungi. Some species of the fungus viz. C. wuyishanensis and C. mauolanoides were obtained from nymphs of cicada and dung beetle pupa, respectively. C. mauolanensis infects Coleopteran larvae. Several species of Cordyceps are considered to be medicinal mushrooms in classical Asian pharmacology, such as that of traditional Chinese and Tibetan medicines. Studies on C. sinensis indicate that the fungus may improve liver function, reduce cholesterol, adjust protein metabolism, inhibit lung carcinoma and treat aging disorders. Coconut root grub (Leucopholis coneophora Burm) is a serious pest of coconut found in sandy loam tracts of Kerala and Karnataka. This polyphagous pest damages the roots of coconut palms and other crops. Since, it is a soil inhabiting pest, chemical control is not advisable and hence search for a promising bio-control agent is a thrust in this field. Natural incidence of Cordyceps (DMRO-526) has been found on coconut root grub. Studies on artificial cultivation and inoculation of the fungus will help to develop potential entomopathogenic fungi for controlling coconut root grub and also we can use the grub for growing these medicinal fungi.

Key Words: Eco-friendly, Biological control, Cordyceps species, Root grub, Medicinal properties, Integrated pest management

INTRODUCTION
Root grubs belonging to the family Scarabaeidae of order Coleoptera are considered as National Pests are also called white grubs. Out of 1500 species recorded from India, 40 species are reported serious pests on economically important agricultural and horticultural crops in different parts of the country. White grubs attacking coconut (Leucopholis coneophora) are mostly found in sandy loam tracts of Kerala and Karnataka. It damages the roots of the crops. In seedlings, it tunnels into the bole and collar region, results in drying up of spindle leaf followed by gradual death of seedlings. In mature trees, continuous feeding on roots, results in yellowing of leaves, tapering of crown, premature nut fall, delayed flowering, retardation of growth and reduced yield. It has an annual life cycle with a grub period of 8 months. Peak grub population is observed from September to October. Adult beetles emerge out of the soil after pre monsoon showers in May-June during sunset hours. To combat this pests usually insecticides are recommended. Prolonged dumping of chemical not only causes soil pollution but also has deleterious effect on soil fauna and flora. Bio-control agents against...
coconut root grubs are not much popular. So there is a need to develop an effective bio-control agent for controlling these pests. Biological control is an important part of IPM. Extensive use of synthetic chemical pesticides had lead to insecticide resistance to chemical pesticides. The resulting environmental pollution, adverse effects on human health and other organisms and the demand for reduced chemical inputs in agriculture have provided an impetus to the development of alternative forms of pest control. Entomopathogenic fungi are important among all the bio-control agents due to its broad host range, route of pathogenicity and its ability to control sap sucking pests as well as pests with chewing mouth parts. The spores of many species of the anamorphic entomopathogenic fungi can be mass produced on a variety of culture media and so are suitable for development as biopesticides. They have a range of desirable characteristics including safety to people, compatibility with other natural enemies and a lack of toxic residues. They also provide persistent control by multiplying in the pest population. Cordyceps is a genus of ascomycete fungi (Sac Fungi) which includes about 400 identified species and many get to be described. All Cordyceps species are endoparasitoids, mainly on insects and other arthropods (they are thus entomopathogenic fungi) a few are parasitic on other fungi. Entomopathogenic fungi Cordyceps is found to be infecting these grubs. The fungi multiplied in PDA media when applied to grub, had shown mycelia growth over the insect body. Studies on artificial cultivation and inoculation of the fungus will help to develop a potential entomopathogenic fungi for controlling coconut root grub which also has medicinal properties which we can exploit for human health science.

**AIMS AND OBJECTIVES**

To identify a potential naturally occurring microbial bio-control agent against root grubs in coconut. Explore suitable growing media for artificial culturing of these microbes and also study the effectiveness of these microbes against root grubs in coconut.

**MATERIAL AND METHODS**

A detailed field survey in various parts of Kasargod district of Kerala (India) were conducted to identify the naturally occurring potential bio-control microbial agents against root grubs in coconut. Collection, multiplication and identification of these naturally occurring bio-control agents by growing them in suitable growing media. Application of these fungal/microbial culture against the root grubs to find out whether it is effective or not.

**RESULTS AND DISCUSSION**

While conducting field survey/collection of root grubs to identify the natural microbial bio-control agents in various parts of Kasargod District of Kerala, fruiting bodies of the medicinal edible fungus Cordyceps were found on the third instar grubs of coconut root grub Lecopholis coneophora were obtained from Valiyaparamba grama panchayat. (Fig. 1 to Fig. 5) After infecting root grubs the fungus were found to be growing on the entire body of the third instar grubs and after death of the grub the entire body converted into hard sclerotia (Fig.6) and fruiting bodies were growing on the cephalic region of the grub (Fig.7). This fruiting bodies have an average length of 7cm. It was found that 80% of the grubs collected from 1 m² area of different locations from the field were infected with Cordyceps fungus. These fungus were isolated and cultured in ordinary PDA media. Cordyceps species are particularly abundant and diverse in humid temperature and tropical forests. Cordyceps militaris is parasitic on larvae and pupae of Lepidoptera. If the ascospores alight on the integument of susceptible larvae and pupae, germ tubes penetrate, possibly aided by their ability to hydrolyse chitin. After infection, cylindrical hyphal bodies appear in the haemocoel of pupa. The hyphal bodies increase by budding and the buds are distributed within the insect’s body. After death, mycelia growth follows and the body of the insect transformed into a sclerotium, from which the perithecial stromata later develop (Fig.8 to Fig.10) Cordyceps sp. Viz., C. sphingum, C. militaris, C. gracilis, C. aphondi and C. memorabilis are parasitic to Lepidopteran larvae. Fungus C.
militaris cultured in liquid shake can be potentially used for the biological control of forest Lepidoptera. Some species of the fungus viz., C. wuyishanensis and C. maolanoides were obtained from nymphs of cicada and dung beetle pupa, respectively. Cordyceps was also isolated from different species of ants. The fungus thus obtained were cultured in PDA media and the fungal culture were sent to Indian Mycological Research Institute, Solan, Himachal Pradesh and identified it as an edible fungus and got an accession no. DMRO-526. C. unilateralis was found to produce red naphthoquinones which possess anti-malarial activity and the fungus can be cultured on PDA media.

Fig. 1 : Search for Cordyceps

Fig. 2 : Cordyceps in nature

Fig. 3 : Cordyceps on plant

Fig. 4 : Cordyceps infecting a part of plant

Fig. 5 : Collection of Cordyceps

Fig. 6 : Cordyceps infected root grub
Several species of *Cordyceps* are considered to be medicinal mushroom in classical Asian pharmacologies, such as that of Traditional Chinese and Tibetan medicines. Submerged mycelium of *Cordyceps* comprises a unique complex of biologically active compounds including lipids, polysaccharides and phenolic compounds and has anti-tumour activity. Fungal mycelia of *C. sinensis* contain some polysaccharides that are responsible for their biological activity for which they are used as medicines. Studies on *C. sinensis* indicate that the fungus may improve liver function, reduce cholesterol, adjust protein metabolism, inhibit lung carcinoma and treat aging disorders. Some species are sources of biochemicals with interesting biological and pharmacological properties, like Cordycepin. The anamorph of *C. subsessilis* was the source of cyclosporine- a drug helpful in human organ transplants, as it suppresses the immune system.

**CONCLUSION**

*Cordyceps* (Accession No-DMRO526) is found to be a naturally occurring potential bio-control agent of coconut root grub (*Leucopholis coneophora*). Research work are going on for studying the effect of artificial cultured fungal inoculums on root grubs and also find out suitable growing media for the fungus. Various species of *Cordyceps* have different medicinal properties and is using for the treatment for cancer, kidney ailments, lung ailments, heart ailments, liver ailments, hypercholesteremia, male/female sexual disfunction, HIV/AIDS and have hypoglycaemic effect and thus the research gaining attention in that aspect also. Since it is an edible medicinal fungus, exploitation of root grubs for culturing these fungus also gaining much importance and thus we can change the pest status of root grubs to beneficial insects.
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