Introduction

The need for new and useful compounds to provide protection and relief to crop plants from pests and thereby sustenance of food production for human consumption is ever growing. Plant diseases have been causing devastating effect on crop plants and human life since the human civilization evolved. Among fungi, bacteria, viruses and nematodes, inciting the plant disease, fungi cause the greatest damage to the crop plants. Several methods have now been developed to combat such plant diseases. However chemical pesticides remain very popular among farming community due to easy access and quick mode of action. Indiscriminate use of pesticides has created lot of problems like development of resistant strains in insects and plant pathogens, resurgence of pest species, direct toxicity to the applicator, destruction of parasites, predators, and other beneficial organisms, accumulation of pesticide residues in agricultural commodities, water, air and soil.

There is huge social apprehension towards the use of chemical due to its side effect on natural enemies, beneficial microbes and loss to biodiversity as well as human health hazards. Animals intended for human food absorb pesticides from residues in their feed, water or during direct/indirect exposure in the course of pest control (Aulakh et al., 2006). Pesticide poisoning causes more deaths than infectious diseases (Eddleston et al., 2002). In a study of pesticide poisoning in south India it has been found that two compounds, monocrotophos and endosulfan, accounted for majority of deaths, of which two-thirds of the patients were <30 years old (Srinivasrao et al., 2005). 86.3 % of the females are found to be suffering from the acute pesticide poisoning in the cotton growing areas as they assist in mixing concentrated chemicals and refilling spraying tanks (Mancini et al., 2005).

To cope up with the stated problems there is a need to develop ecologically sound, environmentally safe and economically viable methodologies for plant disease and pest management. Development of the safer and greener chemicals will aid a lot to achieve this goal. To achieve this goal, safer and greener chemicals needs to be developed.

Introduction

Most of the plant pathogens has life cycle of 2-6 days, so crop field requires rigorous monitoring for managing the diseases. Due to this major reason agricultural scientists are regularly trying to evolve disease resistant varieties, but due to higher reproduction rate and enhanced selective fitness of plant pathogens, new resistance breaking races are developing. To handle this superiority and selective fitness of the disease inciting agent, there is need to develop diverse kind of management strategies, which can fit into module of Integrated Disease Management (IDM).

Biopesticide based on chemical constituents of plant/plant products and compounds of microbial origin are emerging as strong component of sustainable crop protection strategies such as IDM. Compounds from microbes will be quite safer than using the microbe as biocontrol agent because microbial biocontrol agent may turn in to pathogenic. Single mutation in the avirulence gene of the biocontrol agent, its nutritional requirement and host preference are the possible causes of such conversion into pathogenic forms.

Endophytic fungi which live inside the plant and complete its part or whole life cycle inside plant, without causing any apparent disease symptom, offer great promises for crop protection along with their metabolite. They take nourishment from the plant and in turn provide protection from biotic and abiotic stress. There always exist balance between host plant and endophytic fungi, where fungi draw nutrition at slower rate than food synthesis and accumulation by plant.

Protection from pest and diseases is the most important advantage conferred by endophytes. Mechanism of action of these endophytic fungi includes killing of the pest and pathogen by parasitizing them and by producing secondary metabolites toxic to pests. Peramine an insecticidal alkaloid isolated from endophytic fungus of ryegrass (Rowan and Gaynor 1986) and cryptocin a fungicidal alkaloid isolated from endophytic fungus of *Trypterigium wilfordii* (Li et al. 2000). These isolated bioactive metabolites protect plant from insects and diseases of host as well as non-host plants. Other than the alkaloids there are other groups of metabolites viz. terpenoids, steroids, polyketides, peptides, lipids and polysaccharides, which have been isolated from endophytic fungi of terrestrial plants. Volatile organic compounds produced by *Muscedor albus* an endophytic fungus has proven to have fumigant activity and which can be used as replacement of ethyl bromide for management of storage grain pest (Strobel et al. 2001, Strobel 2006). Among several species of endophytic fungi known to produce bioactive metabolites common ones are- *Phomopsis, Alternaria, Chaetomium, Penicillium, Pestalotiopsis, Epichloe, Neotyphodium, Colletotrichum, Taxomyces* and *Xylaria*.
Apart from the pesticidal property endophytic fungi are known to provide thermotolerance to host plant (Redman et al. 2002) and are also prolific producers of plant growth hormones (Khan et al. 2008). Endophytes also produce metabolites of host origin and offers great advantage for easy and scale-up production of metabolites in per unit of input. Taxol is one such example (Stierle et al. 1993).

Looking at the situation and the opportunity, exploration of the endophytic fungi from Indian medicinal plant was undertaken in this study to find out endophytic fungi showing antifungal property against plant pathogenic fungi. Medicinal plants selected for the study include *Tylophora indica*, *Withania somnifera*, and *Jatropha curcas*. *Tylophora indica*, a medicinal plant of Asian origin, is known host of several metabolites having insecticidal property and medicinal property. *Withania somnifera* (Ashwagandha), a medicinal plant having wide range of activities including immunomodulatory, antioxidant, antistresser, and anticancer was studied for its endophytic fungi and effect of these endophytes and their extract on plant pathogenic fungi. *Jatropha curcas* L. (Euphorbiaceae) a promising energy crop is being extensively exploited for evolving biofuel technology. It is widely distributed in many parts of tropics and subtropics of the world and can be easily cultivated in low to high rainfall areas (Openshaw 2000) on saline and marshy land. Jatropha seed has good oil content (Augustus et al 2002). Leaf extract of Jatropha has been known to possess pesticidal activity against mosquito larvae (Karmegam et al, 1997). Kumar and Sharma (2008) described the insecticidal property of the oil and its extract against cotton bollworm, and on pests of pulses, potato and corn. Advantage with these plants are that they are seldom attacked by any insects and/or plant pathogenic fungi, and they thrive well in adverse climatic and edaphic conditions, which could be partially associated with the presence of endophytic fungi. For testing the antifungal activity of the endophytic fungi isolated from these plants, three plant pathogenic fungi of chickpea (*Cicer aeritinum*) viz. *Rhizoctonia solani*, *Fusarium oxysporum* and *Sclerotinia sclerotiorum* were selected. These are very common pathogen of several economically important crop plants belonging to of most of the families. *R. solani* and *F. oxysporum* are associated with root rot and wilt of crop plants, while *S. sclerotiorum* is known to cause stem rot and root rot of crop plants.

Following were the objectives of the study:

1. Isolation and characterization of endophytic fungi
2. Assessment of the antipathogenic activity of the endophytic fungi
3. Bioefficacy of the crude extract of fungal metabolites against important plant pathogens
4. Extraction and identification of the active fraction / active principles responsible for pesticidal activity