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REVIEW ON BIOLOGICAL CONTROL OF SOIL BORNE FUNGI IN VEGETABLE CROPS

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ABSTRACT : Biological control involves the use of beneficial organism, their gens, and/ or products, such as metabolites, that reduce the negative effect of plant pathogen and promote positive response by the plant. Disease suppression, a medicated by bio-control agents, is the consequences of the interactions between the plant, pathogen and microbial community. Mycoparasitism, spatial and nutrient competition, antibiosis by enzymes and secondary metabolites and induction of plant defense system are typical bio-control action of these fungi. Faster metabolic rates, anti-microbial metabolites and physiological conformation are key factors which chiefly contributes to antagonism. V.A. Mycorrhizae play major role in biological control of plant diseases owing to their capabilities of amelioration crop yields by multiple role as bio-pesticides and plant growth promotion.

Keywords : *Soil borne diseases, mycoparsitism, lysis, bacteria, mycoplasma.*

Soil supports richest number and kinds of microorganism interacting with each other and thus may modification or alteration in soil conditions greatly influence the microbial community and their activity in soil ecosystem. Soil physico-chemical and biological factors interact to provide rapidly changing ecological niches and microbial components fluctuate in response to change in soil condition (Cook and Baker, 8). There are large evidences that agricultural practices often favour antagonistic microorganism (Cook and Baker, 8) and therefore, biological control of plant pathogens could be possible through manipulation of soil condition. Soil organic matter also has a profound influence on microorganism in soil, particularly those, including some pathogen, saprophytic and obligate plant parasites.

During eighties several bio-agents available in nature have been tested against plant pathogen but *Trichoderma* and *Gliocladium* have gained maximum success and popularity. It is now well established that certain bio-agents have tremendous potential and can be exploited successfully in modern agriculture for control of plant diseases (Mukhopadhyay, 16). Recently several commercial products of *Trichoderma* like Antagon, Biocure, Bioderma, Dermapack, Trichofit and Trichosan in india and Binab-7, Azadderma, F-stop, Trichodermin, and Trichodex in abroad have appeared in the market (Joe, 10), which reveal that bioagents are becoming popular. The recognized type of antagonism are (i) Fungistasis or failure of propagule germination because of inhibition or competition for nutrients; (ii) antibiosis or production of toxic metabolites that reduce or prevent germination, invoke lysis or inhibit growth; (iii) Lysis dissolution of mycelia or survival structures; (iv) Inhibition by competition for nutrients, substrates and space and (v) Mycoparasitism and predation, the parasitic or predatory destruction of pathogen by other microorganisms.

Some principles or concepts on which biological control is based on :

1. Microorganisms occur in greater numbers and activity around the plant that at some distance.

2. Soil borne pathogen increases with repeated planting of susceptible crops and decreases when crop rotations are used.

3. Most soil borne pathogen are retarded or prevented when high amount of organic materials

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are added in sick soil, due to increased antagonism of the pathogens by microorganism stimulated by the amendments.

4. Spores of fungi remain mostly or entirely dormant in most or all soil unless stimulated to germinate by an external source of nutrients and energy.

Mechanisms and Process of Biological Control:

As there are numerous reports and reviews dealing with various aspect of biological control (Agarwal, 2) we intend to emphasize the role of non-pathogenic fungi and VA mycorrhizae in enhancing the biocontrol efficiency of myco-parasites in the integrated biocontrol of soil borne fungi.

Inspite of numerous reports on myco-parasitism and suppressive soils, biocontrol of soil borne fungi is not a practical reality and commercially feasible. Failure of biocontrol agents under field condition is attributed mainly to its inability to establish and occupy the new ecological niches to displace the pathogen. Mycoparasites are effective, only at high rate of inoculum and colonized effectively in sterile, fumigated or soil less mix in green house but not when applied to natural soil.

Suppressive soils :

Induction of soil suppressiveness to soil-borne fungi may provide a long-term plant protection. The phenomenon of disease suppression in soils is widespread and it may be natural supperssiveness associated with soil physical factors or it may be induced by agricultural practices of monoculture of susceptible crop. The most notable among the known suppressive soils are take-all decline. (Cook and Baker, 8).

The supperssiveness of soil to soil-borne fungi especially *Rhizoctonia solai* and *Pythium* spp. has been often attributed to native or introduced *Trichoderma* spp. Successive monoculture of radishes generated soil supperssiveness to *Rhizotonia solani.* Enhanced *T. harzianum* propagule density was closely accompanied by soil supperssiveness (Liu and Baker, 13). High propagule density of *Trichoderma* was found to be associated with naturally suppressive Colombian soils than the conductive soils due to acidic pH 5.1 which enhanced the propagation of fungi and *Trichoderma* in particular (Chung *et al.,* 7).

Mycoparasitism :

Mycoparasitism is an act where one fungus parasitizes on another. This term has been generally used with hyperparasitism, direct parasitism or inter fungus parasitism (Boosalis and Mankau, 4). The mycoparasitism includes different kinds of interaction, viz., coiling of hyphae, penetration, production of haustoria and lysis of the hyphae. In the narrow sense mycoparasitism could be taken to include only direct contact of the mycoparasitic fungus with the potential host.From practical point of view, however, the production of antagonistic metabolites which precedes the physical contact necessary to invasion of the mycelium of the potential host could reasonably be considered to constitute part of the essential reaction which leads to overt physical parasitism of the host.

There are a number of examples of fungi that parasitize plant pathogens (Lumsden, 14) of these only a few have been studied to any extent with the aim of biological control. Trichoderma and Gliocladium species probably have been studied to the greatest extent (Papavizas, 18). Other mycoparasites reported to have some potential for biocontrol are Chaetomium globosum, Conio-thyrium minitans, Laetisaria aravalia, Pythium nunn, Talaromyces flavus and Sporidesmium sclerotivorum (Adams, 1).

Trichoderma hamatum hyperparasitic on Rhizoctonia solani protected pea and radish seeds from infection when applied as seed dresser and inclusion of chitin further improved control of seeding diseases in greenhouse condition (Harman *et al.,* 12), lsolates of *T. knoingii* and *T. harzianum* protected seed rots of pea in soil naturally infested with the pathogen, *Pythium* spp. (Hadar *et al.,* 11).

Coniothyrium minitans is a potential mycoparasite against Sclerotinia spp. Application of *C. minitans* inoculum to soil have been reported to reduce the survival of sclerotia of *Sclerotinia sclerotiorum* (Cael *et al.,* 6). The ability of C. minitans to parasitize sclerotia of *Sclerotinia sclerotiorum* inside host plant root and stems as well as those on root surface of infected sunflower plants was demonstrated that up to 65% of sclerotia of *S. trifoliorum* were destroyed in field soil by application of pycnidal dust preparation of *C. minitans* (Turner and Tribe, 22).

Lysis :

Lysis is the complete or potential destruction of a cell by enzymes. Two types of lysis, viz., endolysis and exolysis have been distinguished. Endolysis or autolysis is the breakdown of the cytoplasm of a cell by the cell's own enzymes following death, which may be caused by nutrient starvation or by antibiotics or other toxins. Endolysis usually does not involve destruction of cell wall. Exolysis or heterolysis is the destruction of a cell by the enzymes of another organism. Typically, exolysis is the destruction of the wall of an organism by chitinases, cellulases etc. and these results in the death of the attacked cell. In exolysis death is caused by the lysis, but in endolysis death is the cause of the cell's own lysis. There could sometimes be overlapping, if an organism produces the cell wall degrading enzymes as well as antibiotic and toxins to cause endo- and exolysis both and it is difficult to know which precedes the other. Elad *et al.* (9) mentioned that *T. hamatum* was attached to the host *S. rolfsii* or *R. solani* by hyphal coil, hooks or appressoria and caused lysis of host cells. *Trichoderma hamatum* caused lysis of *Drechlera sorokinina* mycelium by tightly coiling around the host pathogen. (Mandal, 15).

Antibiotics :

The toxins produced by an organism killing another organism at very low concentration (less than10 ppm) are called antibiotic. These should be distinguished from other products of the attacking organisms such as hydrogen ions which may change pH or ethanol. These are required at much higher concentration to act. True antibiotics are the most studied mechanisms of antagonism between microorganisms. It is possible to isolate antibiotic producing organisms from leaves and other plant parts, but they are most common in soils. The antibiotics may have a significant role in biological control as these cause cell death.

The first knowledge of toxic metabolites production by species of *Trichoderma* and Gliocladium was largely expressed by Weindling (23) who showed the production of an antifungal metabolite by *Trichoderma lignorium,* later stated be *Gliocladium fimbriatum*. The metabolite was named as gliotoxin. A second fungistatic antibiotic viridin was shown to produced by *Trichoderma viride* (Brian and Mc-Gowan, 5). *Trichodermin* (from *T. viride* and *T. polysporum*) and gliovirin (from *G. virens*) are other antibiotics isolated from these fungi.

Bacteria:

Bacillus species are the promising biocontrol agents as they produce endospores that are tolerant to heat and desiccation. Seed treatment with *B. subtilis* successfully controlled diseases in peanut and onion. *Pseudommnas* species are more favoured in biocontrol as they are efficient root colonizers enhancing the yield considerably in potato, sugarbeet and radish. *Bacillus subtilis,* antagonism to *Sclerotinia sclerotiorum,* can be demonstrated by marked inhibition zone which develop in dual culture or by inhibition of sclerotial germination (Singh *et al.,* 20).When applied as soil amendments, Bacillus subtilis significantly reduced the development of Sclerotinia blight of brinjal under green house condition (Singh, 19).

Siderophores :

A particular form of nutrient competition involving iron has been proposed as a mechanism of biological control. They can be competition for ferric ion by the production of siderophores. These are low molecular weight, high affinity iron (III) chelators than transport iron in the cells. Direct correlation was observed between siderophore production by various fluorescent pseudomonads and their inhibition of chlamydospore germination in soil. Disease was suppressed more strongly by the highly fluorescent sidrerophore producers than by other isolates (Sneh *et al.,* 21).

Mycorrhizae :

VA mycorrhizal fungi have the potential to increase plant growth and vigour under a number of stress conditions like nutrient defficiency and soil-borne fungi. Recently several workers reviewed the effect of VA mycorrhizal fungi on root diseases (Agarwal, 2) and microbial interaction in the mycorhizosphere (Bagyaraj, 3). He further suggested screening several species or isolates to select an effective isolate and to use several mycorrhizal fungi together against various cultivars of the host.

Four ectomycorrhizal fungi were tested with six common root pathogens and found *Suillus brevipes* inhibiting all the root pathogen. The ectomycorrhizal fungus, Laccaria bicolor (Syn. Laccaria laccata) provided temporary or partial protection against *Fusarium oxysporum* infection in Douglas- fir under controlled and field condition (Natarajan and Govindasamy, 17). This mycorrhizal fungus also protected roots of Pinus against *Cylindrocarpon destructans, F. moniliforme* and *Rhizoctonia solani.*

Several species of Glomus are implicated in the reduction of root diseases viz., *G. fasciculatum* controlling pea root rot caused by *Aphanomyces euteiches; G. intraradices* in the control of crown and root rot of tomato incited by *F. oxysporum* f. sp. *radicis-lycopersici* while *G. mosseae* protected tomato plants against *Erwinia caratovora.*

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