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Biocontrol of plant diseases

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Abstract

Plants diseases are affecting on the quality and quantity of crops. The chemical pesticide can use to control the menace of crop disease. Chemical pesticide causes many environmental and health damage therefore biological agents are gaining importance to suppress of the plant diseases. Live organisms are utilization to control of the plant pathogens that use to suppress one or more pathogens and called to as biological control. Living organisms or products are used in the biocontrol of plant diseases that act to decrease the negative effect of pathogens.

Introduction

Several factors are affected on plant crops and the abundance of food such as diseases that act to decrease of quality and quantity of crops (Oerke, 2019). there are many various methods may be used to control or prevent plant diseases such as chemical pesticides, Therefore, this help to increase quality and quantity of plant crops. Pesticide may be caused environmental pollution and affect human health due to excessive use in agriculture, which has led to thinking of another method alternative to pesticide (Carvalho,2017). Biological control is used microbial antagonists to inhibition the pathogens and suppresses disease (Cook and Baker, 1983).

Define of Biological control

Biological control term is used in several various fields of biology, this term in plant pathology applies on microbial antagonists which use to suppress of the plant's diseases. The Biocontrol agent is meaning any microorganism use to suppress the pathogen agents. biocontrol depends on several agents such as source, and type of biological agents; in general, one or more organisms use in biocontrol to suppression of damaging activities. There are many ways to suppress plant diseases such as planting disease-resistant cultivars and use of rotations cultivars. Microbial inoculant is used managing soils by promoting the microbial activity that contributes to suppressing plant pathogens (Pal and Gardener, 2006).

Several mechanisms of biocontrol

There are many various mechanisms of biological control against plant disease pathogens (Kohl, et al., 2019). The mechanisms of biological control are mainly included of the following:

1- Antibiotic

Antibiotics are microbial material, toxin, has ability to poison or kill other microorganisms. These microorganisms can be produced an antibiotic that has an effect on anther microorganisms. Antibiotics have the ability to suppression plant diseases caused by microorganisms. In genetic analysis was studied the role of antibiotics in biocontrol, such as *P. fluorescens* strain can produce phenazine antibiotics that control take-all wheat due to *G. graminis* (Anand, *et al*., 2010)

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Bacillus cereus can produce Kanosamine, zwittermycin to help suppress different microbial competitors which cause disease to the plants (Choudhary and hohro, 2009). *Trichoderma* is one biocontrol agent that used against fungi diseases (Harman, 2005).

2- Competition

Competition is process indirect interaction by the physical occupation of a place or takes advantage of food whereby pathogens excluded (Lorito, *et al*.,1994). In general, food competition has a role in plant disease suppression through a decrease of a particular substance, the biocontrol agents have the ability to uptake the substance than the plant pathogens (Harman, and Nelson,1994). The best example of competition, iron has the ability to limiting microorganism growth in alkaline soils (Leong, and Expert, 1989). some types of microorganisms have the ability to produce siderophores that have the ability to affinities for iron ions, therefore isolate iron ions from other microbial and prevent the growth of these microorganisms such as *F. pseudomonads* (Loper and Buyer, 1991). Some studies indicate that increase uptake of iron by commensal microorganisms, contribute increase their ability to colonize the plant roots and also the displacement of the harmful organisms. Rhizosphere biocontrol agents are acting on protecting the plants by rapid colonization, thus lead to consuming completely nutrients so that prevent grow the pathogens (Van Dijk and Nelson,2000).

3- Parasitism

Parasitism mechanism uses as a biocontrol agent to kills or reduces the spread of the pathogen. Mycoparasites has a role in biological control (Tjamos *et al*., 2010). In general, mycoparasitism process is divided into four steps (Lo,1997) 1- chemotropic growth. Fungal control agents grow tropistically toward chemical stimuli which produce by target fungi. 2- Recognition: in this interaction may be involved the carbohydrate receptors found on the wall surface of the fungal control agents. 3- Attachment and fungi cell wall degradation: mycoparasites are growing either alongside the hyphae of the host or around hyphae and can able to produce enzymes that degrade the cell wall to attack the pathogen fungus. 4- The cell wall of the target fungus was penetrated by a biocontrol agent that produces appressoria-like structures (Sharma and Bhat, 2011). Many of the fungal parasites can attack sclerotia (C. minitans) or attack hyphae (P. oligandrum), some fungi have the ability to parasitize on the pathogens (Heydari and pessarakli, 2010). For example, Saccardo found that *S. filum* can parasite on *Puccinia* (rust fungi)(Sundheim and Tronsmo,1988), and also, notice *Ttichoderma* species can parasitize on *R .bactaticola* and *A. mellea* (Lo, *et al*., 1998).

4- Fungi cell wall degrading enzymes

Many biocontrol agents have the ability to produce enzymes that act to hydrolyze proteins, hemicellulose, chitin, and cellulose, thus help on suppression of plant pathogens. *S. marcescens* has the ability to produce chitinases that suppress the growth of *Fusarium oxysporum* and *Botrytis spp*. (Ningarju, 2006). Mathivanan et al. (1998) observed that *F. chlamydopsorum* strain has the ability to produce an endo-chitinase enzyme that acts to suppress the germination of the rust fungus. *Lysobacter* and *Myxobacteria* have the ability to produce lytic enzymes and also suppressing fungal pathogens of plants (Bull, *et al*., 2002).

5- Induction of systemic resistance of the host

plants respond to many stimuli either environmental stimuli such as (water, temperature, light, nutrient availability and gravity) or chemical stimuli produce by

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biological control agents, these stimuli have the ability to induce host defenses through biological chemical changes that enhance the resistance mechanisms of the plants against subsequent infection by pathogens microbial. Resistance may be local or systemic; these depended on several factors such as amount of the stimuli, type, and source. Systemic acquired resistance (SAR) is occurring by inoculating plants with chemical compounds (natural or synthetic), nonpathogenic microbial, or necrogenic pathogens (Bargabus, *et al*.,2003). Several compounds produce through Systemic acquired resistance after infection plant with the pathogen and also the synthesis of various proteins such as pathogenesis-related proteins. These proteins include different enzymes which act on invading cells. Some of the strains that colonize the root of the plant have been able to stimuli of plant defenses such as Pseudomonas sp. (Haas and Defago, 2005). In many instances, some diseases such as bacterial wilt (*E. tracheiphila*) and anthracnose (*C. lagenarium*) suppression by use inoculation with PGPR (plant growth-promoting rhizobacteria).

Commercialization of biocontrol

Application of biocontrol against the plant pathogenic and use commercial them has been slow due to variation efficacy under various environmental conditions (Fravel,2005). There are numerous biological control agents in the laboratory conditions and under greenhouse conditions act perform good but fail when applied in the field conditions. This recurring problem that can only be overcome by understanding the environment conditions which affect biological control agents (Wang et al., 2003). There are other problems to prevent the progress of the biocontrol as little investments in the development of commercially due to the cost of production, the test, and register and market them. biocontrol agents are produced in many various formulate either dry products form (dust, granules, wettable powders) or liquid products form (aqueous and oil). Biocontrol agents are produced by using a large tank containing liquid fermenters and also can control temperature, pH, and aeration inside the tank. Fermenters process can achieve high-quality, genetically stable, low-cost, and commercially useful products. Currently, these products are market to control plant diseases (Ardakani et al., 2009). Numerous additives such as inert carriers, UV radiation, wetting agents, and nutritional components are used with products to obtain desirable attributes. These additives may be useful to prolong the shelf-life (for least 6 months) of the product without any change.

A future vision

In the foreseeable future, biocontrol agents would not replace chemical pesticides therefore synthetic pesticides are used always due to the increasing world population must be increasing food production. In developed countries may be low in the use of synthetic pesticides and this leads to open avenues for the production of the microbial to satisfy markets. Most studies have a concentration on using a single antagonist, this similar to use pesticides. However, experimental evidence shows that this strategy is rarely achieved adequate and sustained control. A biological system is considered the best alternative.

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