Biological control mechanisms

Fungi *Trichoderma* spp. It possesses many mechanisms that affect its path in fungi Plant pathogens can be divided into two main axes:

A- Direct biological control : Include

1- Direct parasitism

Direct parasitism by *Trichoderma* spp. includes direct attack against other fungi This process is complex and includes identification of host fungus and then attack and penetration and then kill the host fungus, The mechanism involved in the analysis of enzymes for the fungal mycelium Which are Protease, Lipase and Esterase.

Trichoderma spp. can recognize the presence of host fungus in its biological environment by sensitizing the products of cell wall decomposition as a result of action of CWDEs Cell – Wall Degrading Enzymes Such as Chitinases, Proteases and Glucanases , a small amount of the enzyme Exochitnases is released into its biological environment. When the enzyme breaks the walls of the other fungi, it produces several substances, including Oligomers, which continue to stimulate the production of exochitinases, Then *Trichoderma* spp begins direct parasitism on his host.

2- Antibiosis

It occurs by the chemical compounds produced and released in the periphery by the *Trichoderma* spp. Which affect pathogens. The anticholinergic agents of Trichoderma are Harzianic acid, Aalamethicins, Richolin.

3- Competition for food sources

Nutrients determine the numerical density of microorganisms, so competition for limited nutrients is one of the most important means of biological control against plant pathogens. The relationship of pathogenic fungi to plant roots depends on the numerical density of the disease and its reduction is one of the priorities in determining this relationship and the fungus *Trichoderma* spp. has highly competitive nutrients for high growth, development and reproduction, as well as the production of a large number of spores that enable him to control the space around the roots of the plant and a positive reflection on the growth of these plants

4- Inhibition of pathogenic enzymes

Fungal biocontrol causes the inhibition of the pathogen enzymes responsible for its ability pathogenesis of the plant they are the enzymes that break down the host's host cells and cause infection including the Srineprotase enzyme inhibitor of Pectolytic, Ketinolytic, and Cellulytic cellulose-producing enzymes that play a major role in the analysis of host cell walls.

5- Production of Lytic Enzymes

Trichoderma spp. Produce of many Lytic Enzymes Which analyze the cell walls of other fungi Called Cell-Wall-Degrading Enzymes (CWDEs).

B- Indirect biological control : Include

1. Promote plant growth

The production of plant growth regulators by *T. harzianum* stimulates the growth of plant roots the fungus increases the secretion of these substances at the ends of the roots.

2- Stimulate resistance in plants

Resistance is stimulated in plants grown in soil have fungi *Trichoderma* spp. as follows:

I- Induced Resistance

Resistance Induced in plants as a factor or substance if they are exposed to or have a living cellular system, but with a small concentration, this system starts by building or increasing the concentration of certain substances. Inducers are usually biotic or abiotic (chemical) agents that lead to plant resistance to a wide range of pathogens. Chemical inducers are **organic** such as tannic acid and salicylic acid, **minerals** such as phosphates and cobalt salts, or as **natural** as plant hormones .The following patterns of induced resistance can be identified:

A- Induced localized resistance

Localized Resistance induced occurs in a region close to the induction zone and is the result of toxic changes, such as the accumulation of Phytoalexin defense materials, phenol oxidation and hypersensitivity response.

B- Systemic induced resistance

These include induction of defensive responses to plants at the level of tissue systems and organs and to stimulate synthetic chemical defense mechanisms in parts of the plant far from the site of infection

1-Defense-Related Proteins

These proteins, especially those related to Pathogenesis-Related Proteins (PR Proteins) and induced by the Elicitor-induced factor, are caused by infection with the proteins already present in the plant and are classified into fourteen groups.

2- Lignin synthesis and compounds derived from Lignin

Phenyl alanine ammonia lyase is activated by a biological or non-biotic agent by building the lignin primers and other ring compounds, which are themselves toxic to pathogens such as phytoalxin compounds.

3- Defensive response to changes in plant metabolism

Including several changes in the pathway of metabolism of some compounds, leading to the activity of some enzymes and the accumulation of many compounds, many of which have been known against microorganisms, including Benzoic Acid, Salicylic Acid, Jasminic Acid and Ethylene.