Review

Mehrdad Alizadeh, Yalda Vasebi, Naser Safaie*

Microbial antagonists against plant pathogens in Iran: A review

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Abstract: The purpose of this article was to give a comprehensive review of the published research works on biological control of different fungal, bacterial, and nematode plant diseases in Iran from 1992 to 2018. Plant pathogens cause economical loss in many agricultural products in Iran. In an attempt to prevent these serious losses, chemical control measures have usually been applied to reduce diseases in farms, gardens, and greenhouses. In recent decades, using the biological control against plant diseases has been considered as a beneficial and alternative method to chemical control due to its potential in integrated plant disease management as well as the increasing yield in an eco-friendly manner. Based on the reported studies, various species of *Trichoderma*, *Pseudomonas*, and *Bacillus* were the most common biocontrol agents with the ability to control the wide range of plant pathogens in Iran from lab to the greenhouse and field conditions.

Keywords: biological control, *Trichoderma*, *Pseudomonas*, *Bacillus*

1 Introduction

Increasing human population in the world demands more food (70 to 100%) by 2050 to supply human needs (Godfray et al. 2010). Furthermore, different pests and diseases cause annual economic losses (20 to 40%) in agricultural products by decreasing the crop yield, destroying the quality, and pollution of products with toxic chemicals (Guo et al. 2013). Therefore, growers have generally concentrated on the intensive use of chemicals for the management of pests and diseases which induce several problems, including resistance to pesticides, hazardous effects on human health, loss of beneficial soil microorganisms, entrapment of residual toxic material in the food chain, and reduction in macro–microorganism biodiversity (Sindhu et al. 2016). These problems make enhanced attempts for developing eco-friendly microbe-based pesticides or biopesticides which use biological control agents (BCAs) as active ingredients and basically act different from common chemical pesticides (Sindhu et al. 2009).

Biological control, which attracted broad considerations in the past few decades, is defined as a bioeffector strategy that uses other living organisms for controlling insects, mites, weeds, and phytopathogens (Flint et al. 1998). Biocontrol agents either with antagonistic activities, or modifying effects on plant physiology and anatomy, mostly reduce the negative effects of pathogens. The advantages of beneficial microbes for associated plants are establishment of antagonistic microorganisms, prevention of phytopathogens, overall improvement of plant health, plant growth promotion, enhanced nutrient availability and uptake, and increased resistance to both biotic and abiotic stresses in the hosts (Vinale et al. 2014).

The first published studies on biological control of plant pathogens in Iran were presented in 1992. *Trichoderma* spp. and *Gliocladium* spp. were the first biocontrol agents applied against *Athelia rolfsii* (*Sclerotium rolfsii*), *Rhizoctonia solani*, and *Fusarium solani*, the causal agents of diseases on groundnut, bean, and apple, respectively (Asghari and Myee 1992; Bazgir et al. 1992; Karampour and Okhovat 1992). In the twenty-first century, with the improvement of biological control of plant pathogens throughout Iran, different biocontrol agents have been applied against the various pathogens in *vitro*, in greenhouse and field conditions. A large number of fungal and bacterial biocontrol agents have been found as the most important agents for plant disease management with identification of their role in plant pathogen management (Ramadan et al. 2016). *Trichoderma*, *Pseudomonas*, and *Bacillus* species have mostly been used for biological control of phytopathogens in Iran (Peyghami...
and Nishabouri 1998; Shahiri Tabarestani et al. 2000; Mostofizadeh-Ghalamfarsa et al. 2002; Niknejad-Kazempour et al. 2004a,b; Golzary et al. 2008b; Peighami-Ashnaei et al. 2009a,b; Ojaghian et al. 2010; Khalighi and Khodakaramian 2012; Naeimi and Zare 2013; Azizpour and Rouhrazi 2016; Karimi et al. 2016; Khaledi and Taheri 2016; Abdoli et al. 2018; Hosini et al. 2018; Zeynadini-Riseh et al. 2018).

Furthermore, because of increasing the stability of biological agents, the bioformulation progress has recently been evaluated in Iran (Karimi and Sadeghi 2015). The current study is a comprehensive review of applying fungal and bacterial antagonists for biological control of various plant diseases caused by fungal, bacterial, and nematodes in Iran during a period of 26 years.

2 Mechanisms of biocontrol agents for the management of phytopathogens

A key factor for attaining an effective prevention of phytopathogens in their hosts is the knowledge about their mechanism of action. Understanding the mechanisms in the biological control process can allow the establishment of favorable conditions in the interaction between phyto-pathogen and biocontrol agent that is important in performing a successful biological control strategy in a specific pathosystem (Handelsman and Stabb 1996). The microorganisms operating for biocontrol of phytopathogens have different modes of action (Nega 2014). In the present study, the most common mechanisms of interspecies antagonisms include direct antagonism, mixed-path antagonism, and indirect antagonism (Pal and McSpadden 2006; Parveen et al. 2016), which lead to biological control of plant pathogens, have been addressed. Microbial biocontrol agents take care of plants against pathogens via different modes. These agents could induce resistance or initial enhanced resistance against pathogens without direct confrontation with the phytopathogen. Also, competitions for nutrients and spaces are additional indirect interactions with phytopathogens (Köhl et al. 2019). These agents might directly interact with the pathogens using hyperparasitism (Ghorbanpour et al. 2018) or antibiotics (Raaijmakers and Mazzola 2012). Without these agents in soil and tissues of plants, the pathogens easily attack plants and could weaken or kill considered hosts (Figure 1). These modes will be discussed in the following sentences.

2.1 Parasitism

Mycoparasitism, direct parasitism or hyperparasitism, is the ability of fungal antagonistic agents to parasite other fungi

![Figure 1: Left: in the absence of antagonists, different pathogens especially fungi, bacteria, and nematodes can cause losses in plants. Over time, affected plants will show the weakness in the development and symptoms of diseases. Right: in the presence of antagonists with different biocontrol mechanisms, such as competition, parasitism, and antibiosis, the pathogens will not be able to progress in the host, and thus, the plant can grow and develop well rather than the absence of antagonists in soil and tissues of hosts.](image)
for utilizing them as food. Mycoparasitism causes either complete death of fungal propagules or destruction and lysis of their structure (Maloy 1993). Mycoparasitism depends upon the sequential occurrence of the following events: coming into close contact with fungal pathogen, mutual recognition between antagonist and pathogen, lytic enzyme secretion by antagonist, penetration into the host, active growth of antagonist into the host, and exit (Spadaro and Gullino 2004; Talibi et al. 2014). Various chemical compounds can be implicated in these processes, such as lectins, during the initial contact and recognition and cell wall-degrading enzymes (CWDEs), such as β-1,3-glucanases, chitinases, proteinases, and lipases, during the penetration process (Vos et al. 2015). Wisniewski et al. (1991) who studied biological control of Botrytis cinerea by yeast antagonist Meyerozyma guilliermondii (Pichia guilliermondii) demonstrated that lectin-like interaction resulted in firm attachment of antagonist’s cell to B. cinerea. Lysis of fungal cell wall also occurred due to the action of extracellular β-1,3-glucanase enzyme secreted by the antagonistic yeast. Trichoderma species are specific mycoparasitic fungi with the species of T. atroviride, T. virens, and T. reesei confirming that mycoparasitism is their ancestral lifestyle (Kubicek et al. 2011).

One of the main components in mycoparasitism event is CWDEs including endochitinases, β-1,3-glucanases, and proteases that are extracellular enzymes secreted by Trichoderma (Vos et al. 2015). After initial pathogen recognition by Trichoderma, hyphae wind around the pathogen’s hyphae by forming hook, the appressorium permeates into the pathogen cell, and chitin is broken down by enzymes such as chitinase and glucanase (Ghorbanpour et al. 2018). Subsequently, mycoparasitic’s hyphae release antibiotic compounds which penetrate the affected pathogen’s hyphae and resynthesize the host cell wall inhibited by these compounds (Toghueoa et al. 2016).

### 2.2 Antibiotic

Antibiotic is a secreting secondary metabolite with low molecular weight that is deleterious to the other microorganisms at low concentrations (Fravel 1988). The antibiotic produced by biocontrol agents decreases the disease symptoms as a main contributing mechanism particularly under soil conditions (Haas and Défago 2005). Some soilborne microorganisms, such as different strains of fluorescent Pseudomonas and Bacillus (Weller 1988) and Trichoderma species (Benitez et al. 2004), have appropriate features for biocontrol abilities. Furthermore, several strains of these species are able to promote plant growth and development as well as the disease prevention (Fernando et al. 2006; Arsenault and Filion 2017). The antibiotics at subinhibitory concentrations may inhibit the release of extracellular virulence factors and adherence mechanisms in bacteria (Kumar et al. 2008). Secondary metabolites can impress the community of soil microbial ecosystems in a variety of ways and levels (Abawi and Widmer 2000). The antibiotic production has been confirmed to be an important mechanism applied by microorganisms to manage a wide range of plant pathogens (McSpadden and Fravel 2002). Even at subinhibitory concentrations, antibiotics can create physiological changes in organisms. For instance, in Pseudomonas aeruginosa quinolone and macro-lide antibiotics can block cell signaling and production of virulence factors (Ulloa-Ogaz et al. 2015). Bacillus spp. produce enzymes, exotoxins, and metabolites with nematicidal activity (Engelbrecht et al. 2018). Although several rhizobacteria such as Pasteuria, Pseudomonas, and Streptomyces have nematicidal efficacy, the largest decrease in the hatching of Meloidogyne javanica eggs was found in Bacillus (74%) and Pseudomonas (54.77%) (Turatto et al. 2017). Furthermore, Bacillus spp. with antibiotic production are applied as antifungal antagonists for controlling postharvest diseases. Pyrrolnitrin antibiotic produced by Burkholderia cepacia has been used against Penicillium digitatum, B. cinerea, and Penicillium expansum pathogens. Similarly, syringomycin produced by Pseudomonas syringae was utilized to prevent citrus green mold and apple grey mold (Dukare et al. 2019). Alongside these beneficial microorganisms, Streptomyces spp. can help plants with antibiotic production against phytopathogens (Olanrewaju and Babalola 2019).

### 2.3 Cell wall degradation enzymes

Microorganisms which produce enzymes are able to hydrolyze chitin, proteins, cellulose, and hemicellulose and also may play a role in the suppression of plant pathogens. Chitin and β-1,3-glucans are major constituents of many fungal cell walls (Lam and Gaffney 1993). Trichoderma strains with antagonistic potential have been mainly characterized by their ability to secrete enzymes such as chitinases, glucanases, and proteases that hydrolyze the cell walls of pathogens (López-Mondéjar et al. 2011). Geraldine et al. (2013) reported that N-β-acetylglucosaminidase and β-1,3-glucanase are the key components of Trichoderma species action in biocontrol of Sclerotinia sclerotiorum in the field. Serratia marcescens which produces chitinases was found to
suppress the growth of Botrytis spp., R. solani, and Fusarium oxysporum (Ningaraju 2006).

### 2.4 Competition for available resources

Microorganisms’ challenge for available resources is named competition. For instance, when pine stumps were inoculated by spores Phlebiopsis gigantea (Phlebia gigantea), the spores prevent from Heterobasidion annosum infections. Considering that the pathogen is non-established on the pine, the severity of root rot disease could be decreased by the biocontrol agent (Cook and Baker 1983). Despite the possibility of existing antagonistic relationship (e.g., antibiosis) between the two fungi, the achievement of available resource sites may be the first mechanism in competition (Maloy 1993). Carbon sources such as glucose and fructose are one of the important action modes in yeasts Papillotrema laurentii (Cryptococcus laurentii) and Sporobolomyces roseus, which can control B. cinerea in decreasing its colonization and sporulation (Ghorbanpour et al. 2018). In the biological control of P. digitatum by Debaryomyces hansenii, competition plays an important role in obtaining nutrients in occupied sites (Droby et al. 1998). Furthermore, arbuscular mycorrhiza due to the creation of physiological and anatomical modifications can limit the progression of pathogen. These changes involve root lignification, creation of a thick cell wall using pectin, chitinase activation, and transfer of pathogenesis-related protein-1a to the infected area of root (Malik et al. 2016).

### 2.5 Siderophore

Low-molecular weight chelators with a very high and specific affinity for Fe(III) are called siderophores (Barbeau et al. 2002). Aerobic and facultative anaerobic microorganisms with the ability of siderophore production may have an important role in microorganism interactions (Haggag and Mohamed 2007). Siderophores have been known to play a significant role in phytopathogen prevention by several bacteria as BCAs which prevent the growth, development, and metabolic activity of phytopathogens by iron chelation (Haggag Wafaa et al. 2000). Different species of Trichoderma as biocontrol antagonists release more effective siderophores that chelate iron (Fe³⁺) and prevent growth and development of other fungal pathogens (Nahe et al. 2014). Iron competition can be a limiting factor in alkaline soils for microbial growth and development (Leong and Expert 1989). Siderophores produced by some bacteria, such as fluorescent pseudomonads, have very high dependency for iron, as a result, sequestering these limited resources from other microflora can inhibit their growth and development (Loper and Buyer 1991). In several studies, it has been reported that Pseudomonas fluorescens with siderophore biosynthesis plays an important role in the prevention of pathogen (Costa and Loper 1994). Rahnella aquatilis with siderophore production can inhibit B. cinerea and P. expansum postharvest pathogens (Calvo et al. 2007). The siderophore pulcherrimin produced by Metschinkowia pulcherrima and Monilinia fructicola yeasts was applied for biological control of postharvest apple pathogens B. cinerea, Alternaria alternata, and P. expansum (Saravanakumar et al. 2008). In particular, several species of Streptomyces detach iron by siderophore production in a way that some pathogens, owing to a lack of siderophore production, cannot take these ions for growth (Kloeper et al. 1980).

### 2.6 Induction of host resistance

Plant growth promoting rhizobacteria can protect plants against pathogens using induction of systemic resistance (ISR) (Sikora 1992). P. fluorescens with stimulating ISR can prevent the early penetration of Heteroderda schachtii to roots (Oostendorp and Sikora 1989). The ISR stimulation by Bacillus subtilis leads to the protection of cotton plants against Meloidogyne incognita and Meloidogyne arenaria. The ISR stimulation by Pseudomonas putida and S. marcescens inhibited cucumber Fusarium wilt caused by F. oxysporum f.sp. cucumerinum. The application of Pseudomonas sp. in plants leads to systematic protection against F. oxysporum f.sp. dianthi (David et al. 2018). Flavimonas oryzihabitanis, S. marcescens, and Bacillus pumilus have developed ISR against P. syringae pv. lachrymans (David et al. 2018). The direct promotion of plant growth by plant growth promoting bacteria through the production of phytohormones has been called phytostimulation (Bloomberg and Lugtenberg 2001). The enzyme 1-aminocyclopropane-1-carboxylate (ACC) deaminase is a phytostimulation that is the most studied one. Some bacterial endophytes producing ACC deaminase have been shown to enhance plant growth, such as Arthrobacter spp., Bacillus spp., P. putida, Rhodococcus spp. (Belimov et al. 2001; Sziderics et al. 2007), and Streptomyces spp. (Palaniyandhi et al. 2014; Jaemsaeng et al. 2018). The bacterial strains producing
other plant hormones, including indole-3-acetic acid (IAA), jasmonates, and abscisic acid, may also contribute to plant growth stimulation (Patten and Glick 2002; Forchetti et al. 2007). IAA is synthesized by different species of Streptomyces, such as S. violaceus, S. griseus, S. exfoliate, S. coelicolor, and S. lividans (Manulis et al. 1994). Also, IAA in S. atroviren activates growth promoting bacteria in groundnut and several crops (Reddy et al. 2016).

3 Reduction in the population of biocontrol agents

Phytopathogens may significantly alleviate the growth of biocontrol agents by using the nutrition resources within their occupied spaces more rapidly as well as by modifying their efficacy. This was found in several fungal root pathogens which can colonize the wheat rhizosphere despite the presence of P. fluorescens biocontrol agent (Mazzola and Cook 1991). Decline in the population of P. fluorescens occurs in the existence of some Pythium species. In this instance, infection by Pythium species leads to the limitation of the root surface which is available for P. fluorescens colonization and to the reduction of population of potential antagonists. Fedi et al. (1997) reported that a plant pathogenic P. ultimum with modification of gene expression of P. fluorescens tends to decrease biocontrol agent population. The competition in the rhizosphere for nutrients released from root wounds caused by P. ultimum was limited by the reduction of population size. Because of the importance of microbial community in number and diversity, competition and microorganism–microorganism interactions may also happen in phyllosphere (Vorholt 2012). On the other hand, existence of these microbial communities may also impress the efficacy of BCAs. Understanding the rhizosphere, phyllosphere, and endosphere microbial community structure and their interactions in these niches can contribute to the betterment of biocontrol (Bardin et al. 2015).

4 Improving the biocontrol agent effects

The use of combinations of BCAs may be a better method for developing biocontrol positive effects (Duffy and Weller 1995). Combined biocontrol agents with high level of biocontrol protection have been investigated for better efficacy and prevention of several phytopathogens (Mihajlović et al. 2017). It has been confirmed that natural prevention of Fusarium wilt in France (Châteaurenard soil) was related to the different mechanisms in which multiple microorganisms singly or together restricted the pathogen activation (Alabouvette et al. 1998). However, given that the application of biological control against soilborne pathogens will not be a good replacement of methyl bromide fumigation, these two methods could act together in integrated pest management (Akrami et al. 2011).

5 Biological control in Iran

A complete list of all pathogens and the antagonists used against them is provided in Table 1. Results showed that most studies were conducted in vitro and in greenhouse conditions, and a few cases were carried out in the farm condition in Iran. Bacterial strains belonging to 24 genera, Achromobacter, Acinetobacter, Azotobacter, Bacillus, Beauveria, Bradyrhizobium, Brochothrix, Burkholderia, Enterobacter, Erwina, Escherichia, Flavobacterium, Lactobacillus, Mesorhizobium, Pae nibacillus, Pantoea, Pasteuria, Pseudomonas, Rhizobium, Serratia, Sphingomonas, Stenotrophomonas, and Streptomyces, have been used in various studies. Also, fungal strains belonging to 27 genera, Acremonium, Alternaria, Arthrinium, Arthrobotrys, Aspergillus, Chaetomium, Cladobotryum, Coniothyrium, Embellisia, Fusarium, Gliocladium, Glomus, Hypsizygus, Lecythophora, Metarhizium, Paecilomyces, Penicillium, Periconia, Piriformospora, Pleurotus, Pythium, Scopulariopsis, Sebacina, Talaromyces, Trichoderma, Trichotheccium, and Verticillium, have been applied in Iranian studies against different plant pathogens. Also, strains of ten genera, Candida, Galactomycyes, Hanseniaspora, Metschnikowia, Meyerozyma, Pichia, Rhodotorula, Saccharomyces, Torulaspora, and Zygoascus, which belong to the yeast have been used for controlling the phytopathogens in Iran. The bacterial strains related to different species of Pseudomonas and Bacillus and fungal strains related to Trichoderma species had the greatest efficiency in biological control of different plant pathogens in Iran. These antagonists have been mostly used for biological control of fungi, bacteria, and nematodes, respectively.
| Pathogens | Host | Antagonists | Procedure | Ref. |
|-----------|------|-------------|-----------|-----|
| Rhizoctonia solani | Bean | Gliocladium sp. | In vitro | Bazgir et al. (1992) |
| Athelia rolfsii (Sclerotium rolfsii) | Groundnut | Trichoderma harzianum | Greenhouse | Asghari and Myee (1992) |
| Fusarium solani | Apple | T. koningii, T. viride, T. harzianum, and T. virens (Gliocladium virens) | Greenhouse | Karampour and Okhovat (1992) |
| Colletotrichum coccodes | Potato | Trichoderma spp. | In vitro | Okhovat et al. (1994) |
| R. solani | Rice | T. koningii, T. viride, T. harzianum, and T. virens | In vitro | Pourabdullah and Binesh (1994) |
| R. solani | Rice | Trichoderma sp. | In vitro | Izadyar and Padasht (1994) |
| Phytophthora erythroseptica | Potato | T. harzianum, T. viride, and T. koningii | In vitro | Zafari et al. (1994) |
| R. solani | Bean | T. viride, T. harzianum, and T. virens | Greenhouse | Bazgir et al. (1994a) |
| R. solani | Bean | T. viride, T. harzianum, and T. virens | Field | Bazgir et al. (1994b) |
| Scelotinia sclerotiorum | Eggplant | T. reesei, T. hamatum, T. longibrachiatum, T. koningii, T. viride, T. virens, and Gliocladium sp. | In vitro | Amir-Sadeghi et al. (1994) |
| Macrophomina sp. and Rhizoctonia sp. | Soybean | Bacillus subtilis | In vitro and greenhouse | Sanei and Ghobadi (1995) |
| Heterodera schachtii | Sugar beet | Paecilomyces farinosus | In vitro | Ahmadi et al. (1995a) |
| H. schachtii | Sugar beet | F. solani | In vitro | Ahmadi et al. (1995b) |
| H. schachtii | Sugar beet | Acremonium spp., Embellisia chlamydospora, Fusarium spp., P. lilacinus, Scopulariopsis brevicaulis, Verticillium chlamydosporium, and Verticillium lecanii | In vitro | Hojjat Jalali and Coosemans (1995) |
| Tilletia laevis | Cucumber | T. viride | Greenhouse | Peyghami and Babadoost (1996) |
| T. controversa | Wheat | T. viride | Greenhouse | Peyghami and Babadoost (1996) |
| F. solani | Chickpea | T. koningii, T. viride, T. harzianum, and T. virens | Greenhouse | Okhovat and Karampour (1996) |
| M. javanica | — | Pasteuria penetrans | Greenhouse | Damazdadeh et al. (1996) |
| M. javanica, M. incognita, and M. arenaria | — | P. penetrans | In vitro | Ameri et al. (1996) |
| Macrophomina phaseolina and R. solani | Soybean | B. subtilis | In vitro | Sanei and Ghobadi (1996) |
| H. schachtii | Sugar beet | E. chlamydospora, Acremonium spp., S. brevicaulis, P. lilacinus, Fusarium spp., V. chlamydosporium, and V. lecanii | In vitro | Hojjat-Jalali and Coosemans (1995) |
| Pythium ultimum | Chickpea | T. viride and T. virens | Field | Shahriria et al. (1996) |
| M. javanica | Tomato | P. lilacinus | Greenhouse | Fatemy (1996) |
| H. schachtii | Sugar beet | P. farinosus | In vitro | Ahmadi et al. (1996a) |
| H. schachtii | Sugar beet | F. solani | In vitro | Ahmadi et al. (1996b) |
| R. solani, Colletotrichum coccodes, and Pythophthora drechsliei | — | Trichoderma spp. and Gliocladium sp. | In vitro | Okhovat (1997) |
| H. schachtii | Beet | Paecilomyces fumosoroseus | Greenhouse | Fatemy and Ahmadian Yazdi (1997) |
| F. o. f.sp. cucumerinum | Cucumber | T. harzianum | Greenhouse | Peyghami and Nishabouri (1998) |
| Pathogens | Host        | Antagonists                                      | Procedure  | Ref.                                      |
|-----------|-------------|-------------------------------------------------|------------|-------------------------------------------|
| A. rolfsii (S. rolfsii) | Groundnut   | T. aureoviride, T. hamatum, T. longibrachiatum, T. harzianum, T. virens | In vitro   | Mirhosaini et al. (1998)                  |
| R. solani, Bipolaris sorokiniana, and Fusarium culmorum Ph. capsici | Wheat       | Penicillium polonicum                           | Greenhouse | Mansoori (1998)                          |
| P. ultimum | —           | Pythium oligandrum                              | In vitro   | Rahnama and Cooke (1998)                  |
| Pythium butleri | —           | Aspergillus niger                               | In vitro   | Rouhani and Safari 1998                  |
| Mauginiella scaettae | Date palm   | T. koningii and T. viride                       | Field      | Shetab-Booshehri et al. (1998)            |
| Xanthomonas translucens pv. cerealis | Wheat       | Pantoea agglomerans and Pseudomonas fluorescens | Greenhouse | Marefat and Rand Rahimian (1998)          |
| F. o. f.sp. lycopersici | Tomato     | T. harzianum and T. viride                      | Greenhouse | Niknejad et al. (2000)                   |
| Erwinia amylovora | Pear       | Erwinia herbicola and P. fluorescens            | In vitro, greenhouse, and field | Ahmadi et al. (2000)                     |
| S. sclerotiorum | Aubergine   | T. harzianum, T. virens, T. koningii, Trichoderma pseudokoningii, and Gliocladium deliquescent | In vitro and greenhouse | Omrani et al. (2000)                     |
| M. phaseolina | Soybean     | T. viride, T. koningii, and T. harzianum        | In vitro   | Ghaffarian et al. (2000)                  |
| R. solani | Rice        | T. viride, T. koningii, and T. harzianum        | Field      | Izadyar et al. (2000a)                   |
| Verticillium dahliae | Cotton     | Talaromyces flavus                             | In vitro and greenhouse | Naraghi et al. (2000)                   |
| V. dahliae | Cotton      | Pseudomonas sp. and Bacillus sp.                | In vitro   | Azad Disfani et al. (2000)               |
| R. solani | Sugar beet  | T. harzianum, T. viride, and T. virens          | In vitro and greenhouse | Shahiri Tabarestani et al. (2000)       |
| R. solani | Rice        | T. harzianum, T. viride, T. koningii, and T. virens | In vitro   | Izadyar et al. (2000b)                   |
| R. solani | Rice        | T. harzianum, T. viride, and T. virens          | In vitro and greenhouse | Niknejad-Kazempour et al. (2000)        |
| Neofusicoccum mangiferae | Citrus     | T. harzianum, T. virens, T. koningii, and T. longibrachiatum | In vitro   | Taheri et al. (2000)                     |
| S. sclerotiorum | Mulberry    | T. harzianum, T. viride, T. aureoviride, T. koningii, T. saturniporum, T. pseudokoningii, and T. longibrachiatum | In vitro   | Merat et al. (2000)                      |
| Fusarium spp., Sclerotium cepivorum, Pythium spp., and R. solani R. solani | Onion      | T. harzianum and T. viride                      | Greenhouse | Peyghami (2001)                          |
| Gaeumannomyces graminis var. tritici | Rice       | T. harzianum, T. viride, and T. virens          | In vitro and greenhouse | Niknejad Kazempour et al. (2002)        |
| F.avenaceum, F. graminearum, F. culmorum, F. moniliforme, F. oxysporum, F. solani, F. semitectum, F. sambucinum, F. proliferatum, and F. tricinctum | Wheat      | T. harzianum and T. viride                      | Greenhouse | Foroutan et al. (2002)                   |
| | Wheat      | P. fluorescens, P. syringae, P. putida, P. cichorii, P. aeruginosa, P. aureofaciens, and P. viridi flavia | In vitro   | Mostofizadeh-Ghalamfarsa et al. (2002)     |
Table 1: continued

| Pathogens                     | Host                | Antagonists                                      | Procedure         | Ref.                           |
|-------------------------------|---------------------|-------------------------------------------------|-------------------|-------------------------------|
| *G. graminis var. tritici*    | Wheat               | *Pseudomonas* spp.                              | *In vitro* and    | Sedaghatfar et al. (2002)     |
|                               |                     |                                                 | greenhouse        |                               |
| *G. graminis var. tritici*    | Wheat               | *T. harzianum* and *T. viride*                  | *In vitro* and    | Foroutan et al. (2002)        |
|                               |                     |                                                 | greenhouse        |                               |
| *F. graminearum, F. moniliforme, F. nygamai, F. oxysporum, F. proliferatum, F. sambucinum, F. semitectum, F. solani, and F. tricinctum* | Wheat               | *Pseudomonas* spp.                              | *In vitro*        | Mostofizadeh-Ghalamfarsa et al. (2002) |
| *F. oxysporum*                | Melon               | *Streptomyces* sp., *T. harzianum,*             | *In vitro* and    | Ashrafizadeh et al. (2002)    |
|                               |                     | *T. viride,* and *T. virens*                    | greenhouse        |                               |
| *M. javanica*                 | Tomato              | *P. lilacinus*                                  | Greenhouse        | Pakniat and Banihashemi (2002) |
| *Ph. drechsleri*              | Cucurbit            | *Streptomyces* sp.                              | *In vitro*        | Heidari Faroughi et al. (2002) |
| *F. graminearum*              | Wheat               | *Streptomyces* sp., *Pseudomonas* sp., and       | *In vitro*        | Norouzian et al. (2002)       |
|                               |                     | *Bacillus* sp.                                  |                   |                               |
| *Sclerotinia minor*           | Sunflower           | *T. harzianum,*                                 | *In vitro*        | Abdollahzadeh et al. (2003)   |
|                               |                     | *T. viride,* and *T. virens*                    |                   |                               |
| *Ph. drechsleri*              | Cantaloupe          | *T. harzianum,*                                 | Greenhouse        | Heidari Faroughi et al. (2004) |
|                               |                     | *T. viride,* and *T. virens*                    |                   |                               |
| *Tilletia indica*             | Wheat               | *T. longibrachiatum,*                           | Greenhouse        | Beeazar and Torabi (2004)      |
|                               |                     | *T. harzianum,*                                 |                   |                               |
| *F. o. f.sp. ciceri*          | Chickpea            | *T. longibrachiatum*                            | Greenhouse        | Karimi et al. (2004a)         |
| *F. o. f.sp. ciceri*          | Chickpea            | *Bacillus* sp.                                  | *In vitro*        | Karimi et al. (2004b)         |
| *F. o. f.sp. dianthi*         | Carnation           | *P. fluorescens* and *Bacillus* sp.             | Greenhouse        | Karimi et al. (2004c)         |
| *R. solani*                   | Chickpea            | *T. harzianum,*                                 | Greenhouse        | Mohammadi et al. (2004)       |
|                               |                     | *T. viride,* and *T. virens*                    |                   |                               |
| *B. sorokiniana*              | Wheat               | *B. subtilis,*                                   | Greenhouse        | Mohammadi et al. (2004)       |
|                               |                     | *P. fluorescens,* and *Bacillus* pumilus         |                   |                               |
| *M. phaseolina*               | Soybean             | *T. harzianum*                                  | Greenhouse        | Barari et al. (2004)          |
| *Armillaria mellea*           | —                   | *Cladobotryum polyapore,*                       | *In vitro*        | Asef and Mohammadi-Gholtapeh (2004) |
|                               |                     | *C. varium,*                                     |                   |                               |
|                               |                     | *C. dendroides,*                                 |                   |                               |
|                               |                     | *C. verticillatum*                               |                   |                               |
| *T. laevis*                   | Wheat               | *B. subtilis*                                   | Greenhouse        | Khodaygan et al. (2004)       |
| *B. sorokiniana*              | Wheat               | *Trichoderma* sp. and *Streptomyces* sp.        | Greenhouse        | Salehpour et al. (2004)       |
| *R. solani*                   | Rice                | *P. fluorescens*                                | Field and         | Niknejad-Kazempour (2004)     |
|                               |                     |                                                 | greenhouse        |                               |
| *F. moniliforme*              | Rice                | *P. fluorescens*                                | *In vitro*        | Niknejad-Kazempour et al. (2004) |
| *R. solani*                   | Rice                | *Bacillus* cereus and *P. fluorescens*          | *In vitro*        | Sajjadi et al. (2004)         |
| *Pyricularia grisea*          | Rice                | *Bacillus megaterium,*                          | Field             | Padasht-Dehkaei et al. (2004)  |
|                               |                     | *B. subtilis,*                                   |                   |                               |
|                               |                     | *Bacillus circulans,*                            |                   |                               |
|                               |                     | *P. fluorescens*                                 |                   |                               |
| *F. oxysporum*                | Onion               | *B. cereus,* *B. subtilis,* and *P. fluorescens*| Field             | Saberi-Riseh et al. (2004)    |
| *Ph. citrophthora*            | Pistachio           | *P. fluorescens*                                | Field             | Saberi-Riseh et al. (2004)    |
| *P. ultimum*                  | Cucumber            | *B. subtilis,* *Trichoderma* sp., and *P.        | Greenhouse        | Taghinasab et al. (2004)      |
|                               |                     | fluorescens*                                    |                   |                               |
| *F. oxysporum*                | Basal               | *B. cereus* and *P. fluorescens*                | Greenhouse and    | Ramezani-Baghmishezad et al. (2004) |
|                               |                     |                                                 | field             |                               |
| Pathogens | Host | Antagonists | Procedure | Ref. |
|-----------|------|-------------|-----------|-----|
| S. sclerotiorum | Rapeseed | Bacillus spp. | In vitro | Akbari-Kiarodi et al. (2004) |
| R. solani | Cotton | Bacillus sp. and P. fluorescens | In vitro and greenhouse | Heydari et al. (2004) |
| Gibberella fujikuroi | Rice | T. viride, T. harzianum, Bacillus sp., B. subtilis, and B. circulans | In vitro and greenhouse | Padasht Dehkaei et al. (2004) |
| Xanthomonas axonopodis pv. citri | Citrus | P. fluorescens and P. putida | In vitro and greenhouse | Khodakaramian (2004) |
| F. oxysporum | Chickpea | B. subtilis and P. fluorescens | In vitro and greenhouse | Jamali et al. (2004) |
| R. solani | Sugar beet | B. subtilis | In vitro and greenhouse | Mohamiri et al. (2005) |
| B. sorokiniana | Wheat | B. subtilis and P. fluorescens | In vitro and greenhouse | Behboudi et al. (2005) |
| Ph. capsici | Pepper | T. viride, T. kaningii, T. harzianum, and T. vires | In vitro and greenhouse | Akbari et al. (2005a,b) |
| S. sclerotiorum | Rapeseed | B. cereus, B. subtilis, and P. fluorescens | In vitro | Foroutan et al. (2005) |
| F. graminearum | Wheat | P. aeruginosa, B. subtilis, and P. fluorescens | Greenhouse | Shahidi Bonjar and Aghighi (2005) |
| V. dahlieae | — | Streptomyces plicatus and Frankia sp. | In vitro | Khazzam et al. (2005) |
| Pseudomonas talaasii | Agaricus bisporus | P. fluorescens | In vitro and greenhouse | Soltani et al. (2006) |
| R. solani, F. oxysporum, F. solani, and C. cocodes | Potato | T. harzianum | Greenhouse and field | Fazeli et al. (2006) |
| S. sclerotiorum | Sunflower | T. harzianum, T. viride, and T. vires | In vitro | Abdollahzadeh et al. (2006) |
| M. javanica and M. incognita | Pistachio | M. penetrans | Greenhouse | Karimipourfard and Damadzadeh (2006) |
| R. solani, F. oxysporum, F. solani and Lasiodiplodia sp. | Mulberry | P. fluorescens and Bacillus spp. | In vitro | Niknejad-Kazempour et al. (2006) |
| Ph. cactorum | Apple | P. fluorescens and B. subtilis | Greenhouse | Farzaneh et al. (2006) |
| F. o. f.sp. tuberosi | Potato | P. fluorescens | Greenhouse | Khorasani-Aghazadeh et al. (2006) |
| R. solani | Common bean | Burkholderia cepacia | Greenhouse | Ahmadzadeh et al. (2006b) |
| Ascochyta rabiei | Chickpea | T. harzianum | Greenhouse | Bahrami et al. (2006) |
| F. graminearum | Wheat | Streptomyces sp., P. fluorescens, and B. subtilis | In vitro and greenhouse | Nourozian et al. (2006) |
| Bipolaris spicifera | Wheat | Bacillus sp. and P. fluorescens | Greenhouse | Behboudi et al. (2006) |
| R. solani | Bean | P. fluorescens | Greenhouse | Afsharmanesh et al. (2006) |
| M. phaseolina, R. solani, Ph. nicotianae var. parasitica, Pythium sp., and Fusarium sp. | Soybean, pistachio, bean, pepper, and cucumber | Pseudomonas spp. | In vitro | Ahmadzadeh et al. (2006a) |
| V. dahlieae | Cucumber | B. subtilis, P. fluorescens, and B. pumilus | Greenhouse | Ahmadiifar et al. (2006) |
| R. solani | Rice | P. fluorescens | In vitro | Kazemzadeh et al. (2006) |
| T. laevis | Wheat | P. putida and P. fluorescens | Greenhouse | Khodaeygan et al. (2006) |
| Ph. sojae | Soybean | Pseudomonas spp. | Greenhouse | Zearjarad et al. (2006) |
| R. solani | Rice | B. cereus, B. subtilis, and P. fluorescens | Greenhouse | Sajadi et al. (2006) |
Table 1: continued

| Pathogens                  | Host            | Antagonists                                      | Procedure             | Ref.               |
|----------------------------|-----------------|--------------------------------------------------|-----------------------|--------------------|
| *M. phaseolina*            | Eggplant        | *T. hamatum*, *T. harzianum*, *T. polysporum*,   | *In vitro* and        | Ramezan (2008)     |
|                            |                 | *T. viride*                                      | field                 |                    |
| *M. javanica*              | Tomato          | *T. harzianum*                                   | *In vitro*            | Golzary et al.     |
| *A. mellea*                | Fruit trees     | *T. harzianum*                                   | *In vitro*            | Asef et al. (2008) |
| *Penicillium digitatum*    | Orange          | *Pseudomonas* spp.                               | *In vitro*            | Zamani et al.      |
| *P. digitatum*             | Orange          | *P. agglomerans*                                 | *In vitro*            | Zamani et al.      |
| *F. o. f.sp. tuberosa*     | Potato          | *Brevibacillus brevis*, *B. subtilis*, and        | *Greenhouse*          | Khorasani et al.   |
|                            |                 | *P. fluorescens*                                 |                       | (2008)             |
| *Colletotrichum gloeosporioides* | Citrus        | *B. subtilis*                                    | *In vitro*            | Salari et al.      |
| *Penicillium expansum*     | Apple           | *T. viride*                                      | *Greenhouse*          | Tabe-Bordbar et al.|
| *Aspergillus flavus*       | Pistachio       | *B. subtilis*, *B. licheniformis*, *B. cereus*,  | *In vitro*            | Haghdeldi et al.   |
|                            |                 | *P. fluorescens*                                 |                       | (2008a, b)         |
| *M. javanica*              | Tomato          | *P. fluorescens*                                 | *Greenhouse*          | Mokhtari et al.    |
| *M. javanica*              | Tomato          | *P. fluorescens*                                 | *In vitro*            | Golzary et al.     |
| *Magnaporthe salvinii*     | Rice            | *P. fluorescens*                                 | *In vitro*            | Ahmaddeh et al.    |
| *F. oxysporum*             | Potato          | *P. putida*, *P. fluorescens*, and *P. aeruginosa*| *Field*               | Ommati et al.      |
| *P. digitatum*             | Citrus          | *T. viride*, *P. fluorescens*, and *B. subtilis*  | *In vitro*            | Zamani et al.      |
| Pathogens                          | Host           | Antagonists                                                                 | Procedure          | Ref.                                  |
|-----------------------------------|----------------|------------------------------------------------------------------------------|--------------------|---------------------------------------|
| F. solani and P. ultimum          | —              | B. subtilis                                                                 | In vitro           | Selselehazkeri et al. (2008)          |
| R. solani                         | Sugar beet     | T. harzianum and T. viride                                                   | Field              | Safaee et al. (2008)                  |
| R. solani                         | Sugar beet     | P. oligandrum                                                               | In vitro and greenhouse | Salari et al. (2008b)                |
| R. solani                         | Canola         | P. fluorescens, B. cepacia, B. subtilis, and Streptomyces sp. (P. viridescens, T. virens, T. orientalis, and T. atro) | In vitro and greenhouse | Sarani et al. (2008a)                |
| Penicillium solitum                | Apple          | T. harzianum, T. harzianum, and T. virens                                   | In vitro greenhouse | Tabe Bordbar et al. (2008a)          |
| O. novo-ulmi                       | Elm            | B. subtilis                                                                 | In vitro           | Iragi et al. 2008                     |
| R. solani                         | Rice           | T. atro, T. harzianum, and T. virens                                        | In vitro           | Khalili and Sadravi (2008)            |
| Botrytis mali                      | Apple          | Candida membranifaciens                                                     | In vitro greenhouse | Alavifard et al. (2008a)              |
| Botrytis cinerea                   | Apple          | C. membranifaciens, Rhodotorula mucilaginosa, and Meyerozyma guilliermondii(P. guilliermondii) | In vitro and greenhouse | Alavifard et al. (2008b)              |
| P. expansum                        | Apple          | C. membranifaciens                                                          | In vitro greenhouse | Gholamnejad et al. (2008)             |
| S. sclerotiorum                    | Potato         | T. ceramicum, T. koningii, T. koningiopsis, T. virens, T. viridescens, T. orientalis, and T. atro | In vitro greenhouse | Ojaghian et al. (2008)                |
| G. graminis and M. phaseolina      | —              | Piriformospora indica and Sebacina vermifera                                | In vitro           | Abbaszadeh and Mohammadi Goltapeh (2008a)          |
| M. phaseolina                      | Soybean        | T. harzianum, T. viride, P. indica, and S. vermifera                         | In vitro greenhouse and field | Abbaszadeh and Mohammadi Goltapeh (2008b)          |
| Pyricularia oryzae                  | Rice           | Streptomyces spp.                                                           | In vitro greenhouse | Ebrahimi-Zarandi et al. (2008)         |
| P. expansum                        | Apple          | P. fluorescens                                                             | In vitro greenhouse | Khazaee et al. (2008)                  |
| Ph. nicotianae                     | —              | P. fluorescens                                                             | In vitro greenhouse | Nazerian et al. (2008)                |
| S. sclerotiorum                    | Canola         | B. subtilis                                                                | In vitro           | Nasrolah Nejad and Rahnama (2008)      |
| P. syringae pv. tomato             | Tomato         | P. fluorescens                                                             | In vitro           | Mousavi et al. (2008a)                |
| Clavibacter michiganensis subsp.   | Tomato         | P. fluorescens                                                             | In vitro           | Mousavi et al. (2008b)                |
| E. amylovora                       | Pear           | P. fluorescens and Pantoea sp.                                             | In vitro           | Mirzaie et al. (2008)                 |
| M. phaseolina                      | Soybean        | T. harzianum                                                               | In vitro           | Montazernia et al. (2008)             |
| S. sclerotiorum                    | Canola         | P. fluorescens and B. subtilis                                             | In vitro greenhouse | MansouriPou et al. (2008)             |
| G. graminis var. tritici           | Wheat          | Azotobacter isolates                                                       | In vitro           | Maghsodloo et al. (2008)              |
| B. cinerea                         | Apple          | B. subtilis, Pichia membranifaciens, and Candida guilliermondii             | In vitro greenhouse | Zangoie et al. (2008)                 |
| X. axonopodis pv. citri            | Citrus         | P. fluorescens                                                             | Greenhouse         | Khodakaramian et al. (2008)           |
Table 1: continued

| Pathogens                        | Host                          | Antagonists                                      | Procedure       | Ref.                        |
|----------------------------------|-------------------------------|-------------------------------------------------|-----------------|-----------------------------|
| F. graminearum, R. solani AG4,   | Wheat, sugar                  | T. hamatum, T. harzianum, T. virinens, and Trichoderma sp. | In vitro       | Hajieghrari et al. (2008)  |
| R. solani AG5, M. phaseolina,    | beet, potato, soyabean, and   |                                                 |                 |                             |
| Ph. cactorum                      | apple                         |                                                 |                 |                             |
| G. graminis var. tritici         | Wheat                         | T. koningiopsis, T. brevicompactum, and T. viridescens | Greenhouse      | Zafari et al. (2008)       |
| M. javanica                      | Tomato                        | T. harzianum                                    | In vitro and   | Maleki Ziyarati et al. (2009) |
| M. phaseolina                    | Melon                         | P. fluorescens and P. putida                    | In vitro and   | Kheiri et al. (2009)       |
| H. schachtii                     | Sugar beet                    | T. harzianum and T. virinens                    | In vitro and   | Mahdikhani Moghadam et al. (2009) |
| S. sclerotiorum                  | Canola                        | T. harzianum and T. virinens                    | In vitro       | Nasrolah Nejad et al. (2009) |
| M. javanica                      | Tomato                        | T. koningi, T. brevicompactum, T. harzianum, and T. virinens | Greenhouse     | Ziarati et al. (2009)      |
| T. laevis                        | Wheat                         |                                                 | Field          | Mehrabi Koshki et al. (2009) |
| R. solani                        | Common bean                   | P. fluorescens                                  | Greenhouse     | Ahmadzadeh and Tehrani (2009) |
| B. cinerea                       | Apple                         | P. fluorescens and B. subtilis                  | Greenhouse     | Peighami-Ashnaei et al. (2009a) |
| S. sclerotiorum                  | Sunflower                     | P. fluorescens                                  | Greenhouse     | Ashofteh et al. (2009)     |
| Xanthomonas campestris pv.       | Cotton                        | P. aeruginosa                                   | Greenhouse     | Falahzadeh-Mamaghan et al. (2009) |
| malvacearum                      |                               |                                                 |                 |                             |
| R. solani                        | Bean                          | B. subtilis and P. fluorescens                  | In vitro       | Peighami-Ashnaei et al. (2009b) |
| R. solani                        | Common bean                   | B. cepacia                                      | In vitro and   | Ahmadzadeh et al. (2009)   |
| P. expansum                      | Apple                         | Saccharomyces cerevisiae                        | In vitro       | Gholamnejad et al. (2009)  |
| H. schachtii                     | Sugar beet                    | Pleurotus ostreatus, P. sajor-caju, P. florida, | In vitro and   | Palizi et al. (2009)       |
|                                 |                               | P. flabellatus, P. eryngii, and Hypsizygus ulmarius | greenhouse     |                             |
| P. expansum                      | Apple                         | R. mucilaginos and M. guilliermondii            | In vitro       | Gholamnejad et al. (2009)  |
| V. dahliae                       | Cotton                        | Glomus etunicatum, G. intraradices, and G. versiforme | Greenhouse     | Norouzi et al. (2009)      |
| Meloidogyne spp.                 | Faba bean                     | Paecilomyces lilacinus                          | Greenhouse     | Boromand et al. (2010)     |
| F. oxysporum, R. solani, M.      | Pseudomonas sp.                |                                                 | In vitro and   | Golpayegani et al. (2010)  |
| phaseolina, and Pythium sp.      |                               |                                                 | greenhouse     |                             |
| R. solani                        | Rice                          | T. harzianum, T. atroviride, and T. virinens    | In vitro,      | Naeimi et al. (2010)       |
|                                 |                               |                                                 | greenhouse, and field |                             |
| Phytophthora sojae                | —                             | T. virinens, T. orientalis, T. brevicompactum, | In vitro       | Ayoubi et al. (2010)       |
|                                 |                               | T. atroviride, T. ceramicum and T. asperellum   |                 |                             |
| B. sorokiniana                   | Wheat                         | P. fluorescens                                  | In vitro and   | Ranjarb Sistani et al. (2010) |
|                                 |                               |                                                 | greenhouse     |                             |
| G. fujikuroi                     | Rice                          | T. harzianum and T. virinens                    | In vitro and   | Roodgar et al. (2010)      |
|                                 |                               |                                                 | greenhouse     |                             |
| Pythium aphanidermatum            | Cucumber                      | B. subtilis and B. licheniformis                | In vitro and   | Safari Asl et al. (2010)   |
|                                 |                               |                                                 | greenhouse     |                             |
Table 1: continued

| Pathogens                        | Host      | Antagonists                                                                 | Procedure          | Ref.                          |
|----------------------------------|-----------|-----------------------------------------------------------------------------|--------------------|-------------------------------|
| B. cinerea                       | Tomato    | T. harzianum, T. arundinaceum, T. viridescens, T. atroviride, and T. koningii | In vitro and      | Eivazi et al. (2010)          |
| P. expansum                      | Apple     | B. subtilis                                                                | In vitro and      | Emadi et al. (2010)           |
| Phytophthora drechsleri          | Cantaloupe| Pseudomonas fluorescens, P. putida and P. aeruginosa                        | In vitro and      | Tabarraie et al. (2010)       |
| P. expansum                      | Apple     | R. mucilaginosa                                                            | In vitro and      | Golamnejad et al. (2010)      |
| Penicillium italicum             | Orange    | M. guilliermondii                                                          | In vitro and      | Ghasemi Sardareh et al. (2010)|
| Verticillium albo-atrum          | Tomato    | T. flavus                                                                  | In vitro and      | Naraghi et al. (2010)         |
| F. o. f.sp. ciceri               | Chickpea  | B. subtilis, P. aeruginosa, and P. putida                                  | In vitro          | Karimik Amini et al. (2010)   |
| B. sorokiniana                   | Wheat     | Glomus fasciculatum and B. subtilis                                       | Greenhouse        | Hashemi Alizade et al. (2010) |
| F. o. f.sp. radicis-cucumerinum  | Cucumber  | B. subtilis                                                                | Greenhouse        | Yousefi et al. (2010)         |
| S. sclerotiorum                  | Potato    | T. ceramicum, T. koningii, T. koningiopsis, T. viridescens, T. virens, and Coniothyrium minitans | In vitro          | Ojaghian et al. (2010)        |
| Sclerotinia sclerotiorum         | Sunflower | Pseudomonas fluorescens                                                    | In vitro and      | Khezri et al. (2010)          |
| Sclerotium cepivorum             | Garlic    | Bacillus spp.                                                               | In vitro          | Babaei Nasir et al. (2010)    |
| Fusarium oxysporum f.sp. gladioli | Garlic    | Trichoderma spp.                                                           | In vitro          | Bagheri et al. (2010)         |
| F. oxysporum and F. solani       | Chickpea  | T. harzianum and T. asprellum                                              | In vitro and      | Akrami and Ibrahime (2010)    |
| M. phaseolina                    | Sunflower | B. subtilis                                                                | In vitro and      | Iraqi and Rahnama (2011)       |
| R. solani                        | Canola    | B. cepacia                                                                 | In vitro and      | Sarani et al. (2010)          |
| P. carotovorum                   | Potato    | P. putida, P. aeruginosa, and P. fluorescens                               | Field             | Khodakaramian and Zafari (2010)|
| X. axonopodis pv. citri          | Citrus    | P. fluorescens, P. viridiflava, and P. syringae                            | In vitro          | Montakhabi et al. (2010)      |
| G. graminis var. tritici         | Wheat     | B. subtilis, B. pumilus, P. fluorescens, P. putida, P. aeruginosa, and Chromobacteria sp. | In vitro and      | Babaepoor et al. (2011)       |
| Phoma lingam                     | Rapeseed  | B. subtilis and T. koningii                                                | In vitro and      | Panjehke et al. (2011)        |
| H. schachtii                     | Sugar beet| T. harzianum, T. virens, and B. subtilis                                   | Field             | Mahidkhani Moghadam and Rouhani (2011)|
| F. oxysporum                     | Lentil    | P. fluorescens                                                             | Greenhouse        | Akrami et al. (2011)          |
| F. culmorum                      | —         | B. subtilis                                                                | Greenhouse        | Khezri et al. (2011)          |
| S. sclerotiorum                  | Sunflower | P. fluorescens                                                             | Greenhouse        | Heidari-Tajabadi et al. (2011) |
| P. italicum and P. digitatum     | Citrus    | P. syringae and Candida famata                                             | Greenhouse        | Nasrollahi Omran et al. (2011)|
| G. graminis var. tritici         | Wheat     | P. fluorescens                                                             | Greenhouse        | Bagheri et al. (2011)         |
| P. expansum                      | Apple     | R. mucilaginosa                                                            | In vitro          | Gholamnejad et al. (2011)     |
| Phytophthora parasitica and Ph. citrophthora | Pistachio | Streptomyces sp.                                                           | In vitro and      | Salari et al. (2011)          |
| Pathogens          | Host       | Antagonists                                      | Procedure                | Ref.                              |
|-------------------|------------|--------------------------------------------------|--------------------------|-----------------------------------|
| *Ph. drechsleri*  | Sugar beet | *T. asperellum, T. atroviride, T. harzianum,* and *T. virens* | Greenhouse               | Moayedi and Mostowfizadeh-Ghalamfarsa (2011) |
| *M. javanica*     | Olive      | *P. fluorescens and P. putida*                   | Greenhouse               | Khalighi and Khodakaramian (2012)   |
| *Fusarium solani* | Potato     | *T. brevicapectum, T. longibrachiatum,* and *T. asperellum* | *In vitro and greenhouse* | Ommati and Zaker (2012)            |
| *M. javanica*     | Tomato     | *T. harzianum*                                   | Greenhouse               | Naserinasab et al. (2012)          |
| *P. carotovorum*  | Potato     | *Pseudomonas spp.*                               | *In vitro and greenhouse*| Ghods-Alavi et al. (2012)          |
| *P. grisea*       | Rice       | *T. harzianum*                                   | Greenhouse               | Raeesi et al. (2012a)              |
| *B. cinerea*      | —          | *T. harzianum*                                   | *In vitro and greenhouse*| Raeesi et al. (2012b)              |
| *R. solani*       | Rice       | *P. fluorescens and P. aeruginosa*               | *In vitro and greenhouse*| Kazemzadeh et al. (2012)           |
| *Ph. sojae*       | Soybean    | *Bradyrhizobium japonicum,* *T. spirale,* *T. orientale,* and *T. brevicapectum* | *In vitro and greenhouse*| Ayoubi et al. (2012)               |
| *P. aphanidermatum*| Cucumber   | *T. longibrachiatum* and *T. atroviride*         | Greenhouse               | Ale Aghae et al. (2012)            |
| *Ph. parasitica*  | Citrus     | *Streptomyces sp.*                               | *In vitro and greenhouse*| Sadeghi (2012)                     |
| *F. o. f.sp. lycopersici* | Tomato       | *Streptomyces sp.*                               | *In vitro*               | Fadaei et al. (2012)               |
| *F. solani f.sp. pisi* | Chickpea   | *T. harzianum* and *T. viride*                   | *In vitro and greenhouse*| Afrousheh et al. (2012a)           |
| *Fusarium subglutinans* | Cucumber      | *Streptomyces spp.*                             | *In vitro*               | Sadeghi and Hatami (2012)           |
| *F. solani f.sp. pisi* | Pea        | *T. harzianum and T. viride*                     | *In vitro and greenhouse*| Afrousheh et al. (2012b)           |
| *Phytophthora sojae* | Soybean   | *T. orientals,* *T. brevicapectum,* and *T. spirale* and *Bradyrhizobium japonicum* | *In vitro and greenhouse*| Najmeh et al. (2012)               |
| *Rosellinia necatrix* | —        | *T. flavus*                                     | *In vitro*               | Masudi and Shahidi (2012)           |
| *P. aphanidermatum* | Cucumber   | *T. virens,* *T. harzianum,* and *T. atroviride* | *In vitro and greenhouse*| Hosseyni et al. (2012a)            |
| *R. solani,* *M. phaseolina,* *F. graminearum,* and *S. sclerotiorum* | —        | *T. virens*                                     | *In vitro*               | Soofi et al. (2012)                |
| *Bipolaris australiensis* and *B. cinerea* | Saffron | *T. virens,* *T. harzianum,* and *T. koningii* | *In vitro*               | Roohabadi et al. (2012)            |
| *F. graminearum*  | Wheat      | *T. harzianum* and *T. virens*                   | Field                   | Baghani et al. (2012)              |
| *F. o. f.sp. radicis-cucumerinum* | Cucumber | *T. harzianum*                                   | *In vitro and greenhouse*| Javanshir Javid et al. (2012)       |
| *Monosporascus cannonballus* | Muskmelon | *T. atroviride,* *T. harzianum,* and *T. virens* | *In vitro and greenhouse*| Keshavarzi et al. (2012a)          |
| *F. graminearum*  | Wheat      | *T. harzianum* and *T. virens*                   | Field                   | Baghani et al. (2012)              |
| *R. solani* and *F. solani f.sp. tuberosae* | Sugar beet | *P. putida*                                     | *In vitro*               | Nazari et al. (2012)               |
| *Alternaria alternata* | Potato   | *T. viride,* *T. orientalis,* *T. arundinaceum,* and *T. harzianum* | *In vitro and greenhouse*| Nasiri et al. (2012)               |
| *P. aphanidermatum* | Cucumber   | *Bacillus sp. and B. subtilis*                   | Greenhouse               | Hosseyni et al. (2012b)            |
| Pathogens | Host | Antagonists | Procedure | Ref. |
|-----------|------|-------------|-----------|-----|
| F. solani and R. solani | — | Streptomyces sp. | In vitro | Vasebi and Dehnad (2012) |
| B. cinerea | Apple | Hanseniaspora occidentalis | In vitro | Azadrooh et al. (2012) |
| A. flavus | Pistachio | T. harzianum and T. longibrachiatum | In vitro | Chegini et al. (2012) |
| M. cannonballus | Cucumis melon | T. harzianum, T. virens, T. atrobriride, and Chaetomium globosum | In vitro | Keshavarzi et al. (2012b) |
| M. javanica | — | Penicillium griseofulvum, Penicillium chrysogenum, and Penicillium coprophilum | In vitro | Karkhaneh et al. (2012) |
| V. albo-atrum, F. oxysporum, and R. solani | Potato | T. flavus | In vitro | Naraghi et al. (2012a) |
| R. solani | Common bean | Streptomyces microflavus | In vitro and greenhouse | Moazenian et al. (2012b) |
| A. flavus | Pistachio | T. harzianum and T. koningii | In vitro | Kahnooji et al. (2012) |
| Ph. drechleri | Pistachio | T. harzianum | In vitro | Mirkhani et al. (2012) |
| Ph. drechleri | Pistachio | T. harzianum | Greenhouse | Alipoor Moghadam et al. (2012) |
| Paecilomyces variotii | Pistachio | Streptomyces spp. | In vitro | Ansari et al. (2012) |
| P. tolaasii | A. bisporus | Pseudomonas reactants, Bacillus sp., and P. fluorescens | In vitro | Tajalipour et al. (2012) |
| V. albo-atrum | Potato | T. flavus | Greenhouse | Naraghi et al. (2012b) |
| B. oryzae | Rice | T. harzianum, T. atrobriride, and T. virens | Greenhouse | Khalili et al. (2012) |
| F. solani | Bean | T. harzianum and T. viride | In vitro and greenhouse | Khodaei et al. (2012) |
| F. solani, R. solani, F. oxysporum, Pestalotiopsis spp., C. gloeosporioides, and P. digitatum | Citrus | Streptomyces sp. | In vitro | Noorizadeh et al. (2012) |
| P. italicum | Orange | Pichia kluveri | In vitro | Ghasemi Sardareh et al. (2012) |
| R. solani | Sugar beet | T. harzianum | In vitro | Ghanbari et al. (2012) |
| P. expansum | Apple | Torulaspora delbrueckii | In vitro | Ebrahimii et al. (2012a,b) |
| Magnaporthe oryzae | Rice | T. harzianum, T. atrobriride, and T. virens | In vitro | Javadi et al. (2012) |
| F. graminearum | Wheat | P. fluorescens, E. herbicola, B. subtilis, and B. cereus | In vitro and greenhouse | Alimi et al. (2012) |
| S. sclerotiorum | Bean | B. subtilis subsp. spizizenii and Streptomyces acrmycin | In vitro and greenhouse | Gholami et al. (2012) |
| S. sclerotiorum | Cucumber | Bacillus sp. | In vitro | Rostami et al. (2012) |
| G. graminis var. tritici | Wheat | P. fluorescens | In vitro and greenhouse | Lagzian et al. (2012) |
| F. oxysporum | Cucurbit | T. harzianum and T. longibrachiatum | In vitro | Abdolahy and Parsaiany (2012) |
| F. solani | Cucurbit | T. koningii | In vitro | Abdolahy and Parsaiany (2012) |
| V. dahliae | Pistachio | T. harzianum and T. koningii | In vitro | Jamdar et al. (2012) |
| Pratylenchus loossi | Tea | B. subtilis | In vitro | Rahamandeh et al. (2012) |
| M. javanica | Cucumber | P. fluorescens, B. subtilis, and Pantoa sp. | Greenhouse | Majzoob et al. (2012) |
| Meloidogyne javanica | Tomato | Arthrobotrys oligospora and Paecilomyces lilacinus | Greenhouse | Jamshidnejad et al. (2012) |
| B. cinerea | Strawberry | Trichoderma spp. | In vitro and greenhouse | Naeimi and Zare (2013) |
Table 1: continued

| Pathogens                       | Host               | Antagonists                                                                 | Procedure                  | Ref.                        |
|---------------------------------|--------------------|----------------------------------------------------------------------------|----------------------------|-----------------------------|
| P. aphanidermatum               | Sugar beet         | Trichoderma erinaceum, T. koningii, T. longibrachiatum, and T. harzianum   | Greenhouse                 | Abdollahi et al. (2013)     |
| Fusarium oxysporum f. sp. tuberosi | Potato             | Trichoderma virens and Trichoderma asperellum                            | In vitro and greenhouse   | Ommati et al. (2013)        |
| B. sorokiniana                  | Wheat              | G. fasciculatum and P. fluorescens                                         | Greenhouse                 | Hashemi Alizadeh et al. (2013) |
| Tylennchulus semipenetans       | Citrus             | F. solani, F. oxysporum, P. lilacinus, Cladosporium cladosporioloides, and Acremonium strictum | Greenhouse                 | Chavoshisani et al. (2013)  |
| Aspergillus flavus              | Pistachio          | Trichoderma harzianum and Trichoderma longibrachiatum                     | In vitro                   | Chegini et al. (2013)       |
| M. javanica                     | Tomato             | Glomus mosseae and G. intraradices                                         | Greenhouse                 | Golzari et al. (2013)       |
| A. flavus                       | Pistachio          | B. subtilis subsp. subtilis, B. atrophaeus, B. tequilensis, B. subtilis subsp. spizizenii, Streptomyces cyaneofuscatas, S. flavofuscus, S. parvus, and S. acrimycin | In vitro and greenhouse   | Gholami et al. (2013)       |
| Colletotrichum lindemuthianum   | Bean               | B. subtilis subsp. subtilis, B. atrophaeus, B. tequilensis, B. subtilis subsp. spizizenii, Streptomyces cyaneofuscatas, S. flavofuscus, S. parvus, and S. acrimycin | In vitro and greenhouse   | Gholami et al. (2013)       |
| P. aphanidermatum               | Tarragon           | T. asperelloides                                                          | In vitro                   | Pakdaman et al. (2013)      |
| E. amylovara                     | Apple, pear, and quince | P. fluorescens, P. agglomerans, P. putida, and Serratia marcescens        | Field                      | Gerami et al. (2013)        |
| F. culmorum                     | Wheat              | Pseudomonas spp.                                                          | Greenhouse                 | Madloo et al. (2013)        |
| P. loosi                        | Tea                | P. fluorescens                                                            | In vitro                   | Rahanandeh et al. (2013)    |
| V. dahliae                      | Cotton             | B. subtilis, Bacillus coagulans, Bacillus polymyxa, and P. fluorescens     | Greenhouse                 | Mansoori et al. (2013)      |
| F. graminearum                  | Wheat              | T. harzianum and T. viride                                                | Field                      | Foroutan (2013)             |
| M. phaseolina                   | Soybean            | P. agglomerans, Bacillus sp., and T. harzianum                            | In vitro and greenhouse    | Vasebi et al. (2013)        |
| Ph. drechsleri                  | Cucumber           | P. fluorescens                                                            | In vitro and greenhouse    | Ghafelebashi et al. (2014)  |
| B. cinerea                      | Apple              | B. subtilis, C. membranifaciens and M. guilliermondii                    | In vitro and greenhouse    | Zanguei et al. (2014)       |
| M. oryzae                       | Rice               | T. harzianum, T. atroviride, and T. virens                               | In vitro and greenhouse    | Javadi et al. (2014)        |
| F. solani f. sp. pisi           | Pea                | G. mosseae and G. intraradices                                             | Greenhouse                 | Soharabhi et al. (2014)     |
| F. o. f. sp. lycopersici        | Tomato             | T. harzianum and T. virens                                                | Greenhouse                 | Jalali (2014)               |
| P. talaassii                    | Mushroom           | P. reactants, P. putida, P. fluorescens, and B. subtilis                   | In vitro and greenhouse    | Tajalipour et al. (2014)    |
| M. javanica                     | Tomato             | P. fluorescens                                                            | In vitro                   | Bagheri et al. (2014)       |
| A. flavus                       | Pistachio          | B. subtilis                                                               | In vitro                   | Afsharmanesh et al. (2014)  |
| P. digitatum                    | Citrus             | B. subtilis, Rhizobium rubi, and P. digitatum                             | In vitro                   | Mohammadi et al. (2014)     |
| Cercospora beticola             | Sugar beet         | Bacillus sp., Enterobacter sp., and Enterobacter sp.                      | In vitro and greenhouse    | Mousavi Mirak (2014)        |
| Pathogens                        | Host                  | Antagonists                     | Procedure                  | Ref.                                      |
|---------------------------------|-----------------------|---------------------------------|----------------------------|-------------------------------------------|
| M. phaseolina                    | Soybean               | T. harzianum                    | In vitro and greenhouse    | Vasebi et al. (2015)                      |
| R. solani                       | Tomato                | Trichoderma spp.                | In vitro and greenhouse    | Kavari et al. (2015)                      |
| P. drechsleri                    | Cucumber              | T. harzianum                    | In vitro and greenhouse    | Delkhah and Behboudi (2015)               |
| M. javanica                      | Tomato                | T. harzianum and P. fluorescens | Greenhouse                 | Mohammadi and Ghanbari (2015)            |
| M. javanica                      | Tomato                | Metarhizium anisopliae and T. harzianum | Greenhouse                 | Mahdizadeh-Deharagi et al. (2015)        |
| F. graminearum                   | Wheat                 | P. fluorescens                  | Greenhouse                 | Akbari-Moghadam et al. (2015)            |
| P. aphanidermatum                | Cucumber              | P. fluorescens                  | Greenhouse                 | Shahbazi et al. (2015)                   |
| G. graminis var. triticus        | Wheat                 | Trichoderma spp. and T. flavus | In vitro                   | Heidazadeh and Baghaee-Ravari (2015)     |
| S. cepivorum                     | Garlic                | T. asperellum, T. harzianum, and T. flavus | Greenhouse                 | Bashiri et al. (2015)                    |
| F. solani, R. solani, and F. oxysporum | Bean            | Pseudomonas sp. and Bacillus sp. | In vitro and greenhouse    | Faraji et al. (2015)                      |
| R. solani                       | Cotton                | P. fluorescens                  | Greenhouse                 | Abdollahipour et al. (2015)              |
| F. o. f.sp. lycopersici          | Tomato                | B. pumilus                      | Greenhouse                 | Heidazadeh and Baghaee-Ravari (2015)     |
| Meloidogyne spp.                 | Kiwifruit             | Pseudomonas chlororaphis        | Greenhouse                 | Bashiri et al. (2015)                    |
| Fusarium solani, Rhizoctonia solani, and Fusarium oxysporum | Bean            | Pseudomonas sp. and Bacillus sp. | In vitro and greenhouse    | Faraji et al. (2015)                      |
| V. dahiae                        | Pistachio             | T. harzianum                    | Greenhouse                 | Fotoohiyan et al. (2015)                 |
| P. aphanidermatum                | Cucumber              | G. mosseae                      | Greenhouse                 | Hosseini et al. (2016)                   |
| F. oxysporum                     | Tomato                | P. fluorescens                  | Greenhouse                 | Jamali et al. (2016)                      |
| B. cinerea, C. cladosporioides, and Aspergillus tubingensis | Grape    | T. harzianum and T. hamatum | In vitro                   | Davari and Ezaeei (2016)                |
| B. cinerea                       | Strawberry            | B. subtilis and B. licheniformis | Greenhouse                 | Amini et al. (2016)                      |
| Mycosphaerella rabiei            | Chickpea              | T. atroviride, T. virens, and T. atroviride | Greenhouse                 | Naghed et al. (2016)                     |
| A. alternata, Alternaria dumosa, Alteranaria tenuissima, Alternaria mimicula, Alternaria tomaticola, and C. cladosporioides | Tomato    | T. harzianum and T. virens | Greenhouse                 | Beydaghi et al. (2016)                  |
### Table 1: continued

| Pathogens                        | Host                                      | Antagonists                                      | Procedure                     | Ref.                                    |
|----------------------------------|-------------------------------------------|--------------------------------------------------|-------------------------------|-----------------------------------------|
| *M. javanica*                    | Tomato                                    | *G. mosseae*                                     | Greenhouse                    | Azami-Sardooie et al. (2016)            |
| F. o. f.sp. *lycopersici*        | Tomato                                    | *T. harzianum*                                   | *In vitro and greenhouse*     | Barari (2016)                           |
| *M. phaseolina, R. solani,*      | Melon, melon, canola, and wheat           | *T. harzianum*                                   | *In vitro*                    | Abbasi et al. (2016)                    |
| *S. sclerotiorum,*               |                                           |                                                  |                               |                                         |
| *F. graminearum*                 |                                           |                                                  |                               |                                         |
| *M. phaseolina*                  | Soybean                                   | *T. harzianum*                                   | Greenhouse                    | Khalili et al. (2016)                   |
| *F. solani* f.sp. *pisi*         | Chickpea                                  | *Streptomyces antibioticus*                      | *In vitro*                    | Azizpour and Rouhrazy (2016)            |
| *A. rabiei*                      | Chickpea                                  | *P. putida, P. fluorescens,* *Mesorhizobium ciceri,* and *Burkholderia multivarans* | *In vitro*                    |                                         |
| *R. solani*                      | Sugar beet                                | *Bacillus amyloliquefaciens,* *B. pumilus,* and *Bacillus siamensis* | *In vitro*                    | Karimi et al. (2016)                    |
| F. o. f.sp. *lycopersici*        | Tomato                                    | *B. subtilis and P. fluorescens*                 | *In vitro and greenhouse*     | Jalali et al. (2016)                    |
| *A. flavus*                      | Pistachio                                  | *B. subtilis*                                    | *In vitro*                    | Farzaneh et al. (2016)                  |
| *Penicillium crustosum*          | Grape                                     | *Pichia membraneaefaciens*                       | *In vitro*                    | Ranjbar Chaharborj et al. (2016)        |
| *A. tubingenisis*                |                                           |                                                  |                               |                                         |
| *S. sclerotiorum*                | Cucumber                                  | *Pseudomonas spp.,* *Stenotrophomonas spp., and* *Flavobacterium spp.* | *In vitro and greenhouse*     | Bagheri et al. (2016)                   |
| *P. aphanidermatum*              |                                           |                                                  |                               |                                         |
| *X. translucens pv. cerealis*    | Wheat                                     | *Pseudomonas spp.*                               | Greenhouse and *in vitro*     | Fallahzadeh-Mamaghani et al. (2016)    |
| *F. o. f.sp. cucumerinum*        | Cucumber                                  | *T. flavus*                                      | Greenhouse                    | Shahriri et al. (2016)                  |
| *M. javanica*                    | Tomato                                    | *T. harzianum*                                   | Greenhouse                    | Heidari and Ola (2016)                  |
| *Agrobacterium tumefaciens*      | Tobacco                                   | *B. subtilis*                                    | Greenhouse                    | Nazari et al. (2016)                    |
| *R. solanacearum*                | Potato                                    | *P. fluorescens*                                 | *In vitro*                    | Hasani and Khodakaramian (2016)         |
| *G. graminis var. tritici*       | Wheat                                     | *B. subtilis*                                    | *In vitro and greenhouse*     | Khezri and Manafi (2016)                |
| *F. solani* f.sp. *phaseoli*     | Bean                                      | *T. hamatum and P. fluorescens*                  | *In vitro and greenhouse*     | Shabestari (2016)                       |
| *V. dahliae*                     | Tomato                                    | *B. subtilis,* *B. pumilus,* *B. atrophaeus,* and *Bacillus thuringiensis* | *In vitro*                    | Safdarpour and Khodakaramian (2016)     |
| *E. amylovara*                   | Apple                                     | *P. agglomerans*                                 | *In vitro*                    | Firouzian Bandpey and Rahimian (2016)   |
| *F. oxysporum*                   | —                                         | *T. harzianum,* *T. koningii,* and *T. virens*   | *In vitro*                    | Habibi and Rahnama (2016)               |
| *F. oxysporum* f.sp. *lycopersici* and *M. javanica* | Tomato                                   | *G. mosseae*                                     | *In vitro*                    | Amirafzali et al. (2016)               |
| *Diplodia bulgarica*             | Apple                                     | *Arthrinium arundinis,* *Arthrinium saccharicola,* *Periconia sp.,* *Penicillium sp.,* *Aspergillus persii,* *C. globosum,* *Chaetomium sp.,* *Trichothecium roseum,* *A. tenuissima,* and *Altermaria infectoria* | *In vitro*                    | Alijani et al. (2016)                   |
| *R. necatrix*                    | Apple                                     | *B. siamensis* and *B. pumilus*                  | *In vitro*                    | Binandeh et al. (2016)                  |
| *F. oxysporum*                   | Cucumber                                  | *T. harzianum*                                   | *In vitro*                    | Akhlaghi et al. (2016)                  |
| *P. aphanidermatum*              | Cucumber                                  | *B. cereus,* *B. licheniformis,* and *Bacillus endophyticus* | *In vitro*                    | Rezaei et al. (2016)                    |
| Pathogens          | Host       | Antagonists                                      | Procedure                  | Ref.                        |
|--------------------|------------|--------------------------------------------------|----------------------------|-----------------------------|
| R. solani          | Wheat      | T. citrinoviride                                 | In vitro and greenhouse    | Sharify et al. (2016a)      |
| R. solani          | Wheat      | T. asperellum                                    | In vitro and greenhouse    | Sharify et al. (2016b)      |
| P. talaasii        | A. bisporus| Brochothrix thermosphaacta and Bacillus mycoides | In vitro                   | Aslani et al. (2016)        |
| B. cinerea         | Grape      | T. harzianum and C. membranifaciens              | In vitro                   | Kasfi et al. (2016a)        |
| A. niger           | Grape      | T. harzianum and C. membranifaciens              | In vitro                   | Kasfi et al. (2016b)        |
| H. schachtii       | Sugar beet | T. harzianum, Thalaromyces flavus, F. solani, and | Greenhouse                 | Shirazi et al. (2016)       |
|                    |            | V. chlamydosporium                               |                            |                             |
| M. phaseolina      | Mungbean   | T. harzianum, T. reesei, A. niger, and B. subtilis | Greenhouse                 | Shahid and Khan (2016)      |
| Curvularia lunata  | Wheat      | Achromobacter xylosoxidans                       | In vitro                   | Bagheri and Ahmadsadegh (2016) |
| and Bipolaris      |            |                                                  |                            |                             |
| sarokiniana        |            |                                                  |                            |                             |
| R. solani          | Tomato     | Beauveria bassiana                              | Greenhouse                 | Azadi et al. (2016)         |
| Bipolaris victoriae| Rice       | T. harzianum, A. tenuissima, Fusarium verticilliodies, Alternaria citri, A. infectioria, and Preussia sp. | Greenhouse                 | Safari Motlagh and Mohmadian (2016) |
| M. javanica        | Tomato     | P. fluorescens                                  | Greenhouse                 | Tanha et al. (2016)         |
| M. javanica        | Tomato     | Talaromyces flavus and T. harzianum             | Greenhouse                 | Abootorabi and Naraghi (2016) |
| F. solani and F. oxysporum | Chickpea | T. harzianum, T. asperellum, and T. virenens | Field                      | Khomeini et al. (2016)      |
| M. phaseolina      | Soybean    | T. harzianum                                    | Greenhouse                 | Khaledi and Taheri (2016)   |
| C. beticola        | Sugar beet | Bacillus sp., Paenibacillus sp., Pseudomonas sp., and Enterobacter sp. | In vitro and greenhouse    | Arzanlou et al. (2016)      |
| M. phaseolina      | Soybean    | T. harzianum, T. asperellum, and Trichoderma virens | Greenhouse                 | Barari and Foroutan (2016)  |
| M. phaseolina      | Soybean    | T. harzianum and T. atroviride                   | In vitro and greenhouse    | Kia and Rahnama (2016)      |
| F. o. f.sp. dianthi| Carnation  | T. harzianum                                    | In vitro                   | Kermajany et al. (2017)     |
| V. dahliei         | Pistachio  | T. harzianum                                    | Greenhouse                 | Fotoohiyan et al. (2017)    |
| F. verticilliodies,| —          | Lactobacillus fermentum, Lactobacillus plantarum, Lactobacillus paralimentaris, Lactobacillus pentoos, Lactobacillus buchneri, and Sporalactobacillus inae | In vitro and field         | Kharazian et al. (2017)     |
| P. aphanidermatum, |            |                                                  |                            |                             |
| Penicillium sp., and V. dahliei |          |                                                  |                            |                             |
| Rhizoctonia solani | Sugar beet | Bacillus subtilis                                | In vitro and greenhouse    | Ahmadzadeh et al. (2017)    |
| Macrophomina phaseolina | Soybean | Trichoderma harzianum, Trichoderma reesei and Trichoderma atroviride | In vitro and greenhouse    | Alamdar Lou et al. (2017)   |
| F. oxysporum, X. campestris, and E. amylovora | —         | Streptomyces sp.                                 | In vitro                   | Shams and Shahnnavaz (2017)  |
| M. javanica        | Cucumber   | Pseudomonas rhodesiae and Acinetobacter sp.       | In vitro and greenhouse    | Amini et al. (2017)         |

| Table 1: continued |
| Pathogens                        | Host         | Antagonists                                                                 | Procedure            | Ref.                        |
|---------------------------------|--------------|------------------------------------------------------------------------------|----------------------|-----------------------------|
| *C. michiganensis* subsp.       | Alfalfa      | *B. subtilis*, *Pseudomonas* sp., *Escherichia coli*, *Sphingomonas* paucimobilis, and *Paenibacillus glycanilyticus* | In vitro and greenhouse | Omidi Nasab and Khodakaramian (2017) |
| *P. loosi*                      | Tea          | *P. lilacinus*                                                               | Greenhouse           | Yahyavi Azad et al. (2017)  |
| *P. syringae* pv. syringae      | Oak          | *Pseudomonas protegens*, *Stenotrophomonas maltophilia*, and *Bacillus firmus* | In vitro             | Tashi-Oshnoei et al. (2017) |
| *F. o. f.sp. radicis lycopersici* | Tomato       | *Streptomyces carpaticus*                                                   | In vitro and greenhouse | Zahed and Behbudi (2017)     |
| *A. niger* and *A. flavus*      | —            | *B. cereus*                                                                 | In vitro             | Motamedi et al. (2017)      |
| *Xanthomonas oryzae* pv. oryzae | Rice         | *Bacillus* sp., *B. subtilis*, *P. putida*, and *Enterobacter* sp.          | Greenhouse           | Yousefi et al. (2018)       |
| *R. solani*                     | Common bean  | *B. pumilus*, *T. harzianum*, and *Rhizaphogus intraradices*                | Greenhouse           | Nasir Hussein et al. (2018) |
| *P. syringae* pv. syringae and  | Pistachio     | *Pantoea brenneri*, *P. protegens*, *S. maltophilia*, *Bacillus anthracis*, *B. pumilus*, and *Serratia plymuthica* | Greenhouse           | Etminani and Harighi (2018) |
| *P. talaasii*                   |              |                                                                              |                      |                             |
| *M. incognita*                  | Pistachio     | *P. fluorescens*, *B. cereus*, and *B. subtilis*                            | Greenhouse           | Zeynadini-Riseh et al. (2018) |
| *Fusarium pseudograminearum*    | Wheat         | *P. fluorescens*, *B. subtilis*, and *Streptomyces* sp.                     | In vitro and greenhouse | Norouzian et al. (2018)    |
| *V. dahliae*                    | Tomato        | *Bacillus* sp., *Pseudomonas* sp., and *Enterobacter* sp.                   | In vitro             | Zendehdel et al. (2018)     |
| *H. schachtii*                  | Sugar beet    | *T. harzianum*, *Talaromyces flavus*, *F. solani*, and *Pochonia chlamydosporium* | Greenhouse           | Hosini et al. (2018)        |
| *F. oxysporum*                  | Cucumber      | *T. harzianum* and *T. atroviride*                                          | In vitro             | Eini et al. (2018)          |
| *P. carotovorum* subsp.         | Potato        | *Bacillus* sp.                                                              | In vitro             | Nosratii (2018)             |
| *carotovorum*                   |              |                                                                              |                      | Abdoli et al. (2018)        |
| *S. sclerotiorum*               | Cucumber      | *Streptomyces albidoflavus*                                                  | In vitro and greenhouse | Eini et al. (2018)          |
| *P. loosi*                      | Tea           | *P. lilacinus* and *Clonostachys rosea*                                     | Greenhouse           | Yahyavi Azad et al. (2018)  |
| *M. phaseolina*                 | Melon         | *B. amylo UEFA*                                                             | Greenhouse           | Bakhshi et al. (2018)       |
| *S. sclerotiorum*               | Cucumber      | *S. albidoflavus*                                                           | In vitro and greenhouse | Zahed and Behbudi (2018)    |
| *F. o. f.sp. radicis lycopersici* | Tomato       | *Streptomyces* spp.                                                         | In vitro and greenhouse | Vafaie et al. (2018)        |
| *F. oxysporum*                  | Cucumber      | *P. fluorescens*                                                            | Greenhouse           | Saberi-Riseh and Fathi (2018) |
| *B. cinerea*                    | Cucumber      | *Pichia galeiformis*, *Galactomyces candidum*, *M. guilliermondii*, *S. cerevisiae*, *Zygomyces meyerae*, *Pichia* sp., *Candida parapsilosis*, *Metschnikowia* sp., *Candida boidinii*, *Lecythophora* sp., and *Candida catenulata* | In vitro             | Gharaei et al. (2018)       |
6 Future perspectives

The climate changes and the growing human population with enhancing food demands have been considered as risks to food security in Iran. Different beneficial population of microbes can positively affect agricultural farms, such as pollutant degradation, productivity, and decrease in disease and pest. Maintaining and improving the performance of these microbes can increase agricultural products in different geographical area of Iran with various climates. More studies are needed to reach these aims in Iran. We need to engineer microbes in different parts and various population of plants. We can use beneficial microbes as bioformulation or other methods of treatments on plants. Since the roots are in contact with soil and rhizosphere has high biodiversity, these are the most important parts in plants for engineering the microbes. Therefore, soil improvement with beneficial microorganisms will be able to help farmers and agricultural ecosystems in the future years.

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References

[1] Abawi GS, Widmer TL. Impact of soil health management practices on soilborne pathogens, nematodes and root disease of vegetable crops. Appl Soil Ecol. 2000;15:37–47.
[2] Abbas S, Safae N, Shams-baksh M, Shahbazi S. Biocontrol activities of gamma induced mutants of Trichoderma harzianum against some soilborne fungal pathogens and their DNA fingerprinting. Iran J Biotechnol. 2016;14(4):260–9.
[3] Abbaszadeh F, Mohammadi-Goltapeh E. Biocontrol of the charcoal rot of soybean (Macrophomina phaseolina) by members of the Sebacinales and Trichoderma species under greenhouse and field conditions. 18th Iranian Plant Protection Congress; 2008a. p. 267.
[4] Abbaszadeh F, Mohammadi-Goltapeh E. Determination of suitable conditions for the axenic culture mycorrhizal fungi (Piiriformospora indica and Sebacina vermifera) and to study the antagonistic ability of these fungi in vitro condition, 18th Iranian Plant Protection Congress; 2008b. p. 362.
[5] Abdolahi M, Parsaian M. Study on antagonistic efficacy of Trichoderma isolates on cucumber root rot. 20th Iranian Plant Protection Congress; 2012. p. 338.
[6] Abdoli F, Fallahzadeh Mamaghani V, Shirzad A. Screening of biofilm forming rhizobacteria of field crops for biological control of Pectobacterium carotovorum subsp. carotovorum the causal agent of potato soft rot. Biol Control Pests Plant Dis. 2018;7(1):75–84.
[7] Abdollahi M, Ommati F, Zaker M. Efficacy of some native Trichoderma isolates in biological control of Pythium aphanidermatum the causal agent of sugar beet root rot under greenhouse condition. Biocontrol Plant Prot. 2013;1(1):41–52.
[8] Abdollahipour FZ, Akbar Shirzad A, Hamid Mohammadi H. Evaluation of biocontrol of Rhizoctonia solani in cotton by Pseudomonas fluorescens isolates. Biol Control Pests Plant Dis. 2015;4(1).
[9] Abdollahzadeh J, Mohammadi Goltapeh E, Rouhani H. Evaluation of antagonistic effect of Trichoderma species in biological control of causal agent of crown and root rot of sunflower (Sclerotinia minor) in vitro. J Agric Sci. 2003;13(2):13–23.
[10] Abdollahzadeh J, Mohammadi GE, Rouhani H. Investigation on biocontrol of crown and root rot of sunflower (Sclerotinia sclerotiorum) by Trichoderma species in laboratory condition. J Agric Sci. 2006;12(1):43–56.
[11] Abootorabi E, Naraghi L. Biological control of tomato root knot nematode Meloidogyne javanica by Talaromyces flavus and Trichoderma harzianum in the greenhouse conditions. Biocontrol Plant Prot. 2016;4(2):1–9.
[12] Afrousheh M, Mohammadi H, Shokoohi E. Effect of Trichoderma viride and Trichoderma harzianum on chickpea root rot caused by Fusarium solani f. sp pisi. 20th Iranian Plant Protection Congress; 2012a. p. 286.
[13] Afrousheh M, Mohammadi H, Shokoohi E. Evaluation of Trichoderma viride and Trichoderma harzianum as biocontrol agents against pea root rot disease caused by Fusarium solani f sp pisi. 20th Iranian Plant Protection Congress; 2012b. p. 255.
[14] Afsharmanesh H, Ahmadzadeh M, Sharifi-Tehrani A. Biocontrol of Rhizoctonia solani the causal agent of bean damping-off by fluorescent pseudomonads. Commun Agric Appl Biol Sci. 2006;71(3):1021–29.
[15] Afsharmanesh H, Ahmadzadeh M, Javan-Nikkhah M, Behboudi K. Improvement in biocontrol activity of Bacillus subtilis UTB1 against Aspergillus flavus using gamma-irradiation. Crop Prot. 2014;60:83–92.
[16] Afsharmanesh H, Ahmadzadeh M, Majdabadi A, Motamedi F, Behboudi K, Javan-Nikkhah M. Enhancement of biosurfactants and biofilm production after gamma irradiation-induced mutagenesis of Bacillus subtilis UTB1 a biocontrol agent of Aspergillus flavus. Arch Phytopathol Plant Prot. 2013;46(15):1874–84.
[17] Aghighi S, Shahidi Bonjar GH, Naghizadeh M, Rashid Farrokhi P, Banitashemi Z, Heydarnajad J, et al. Bioactivity of Iranian native strains of Streptomyces plicatus and Frankia sp. against pistachio olive potato and cotton isolates of Verticillium dahliae. 17th Iranian Plant Protection Congress; 2006. p. 468.
[18] Ahmadzadeh M, Shahrkohi A, Rahimian H, Behboudi K. Isolation of Bacillus subtilis strains from Iran and their biocontrol effect against Rhizoctonia solani AG3-2 damping off of sugar beet in vitro and greenhouse Scinzer. J Agric Biol Sci. 2017;3(1):5–10.
[19] Ahmadzadeh M, Farzaneh M, Javan-Nikkhah M. Biological control of Magnaporthe salvinii the causal agent of stem rot of rice by fluorescent Pseudomonads. 18th Iranian Plant Protection Congress; 2008. p. 291.
[20] Ahmadi A, Sedaghat M, Saroukhani E, Khoshkham S. The evaluation of efficacy of biocontrol strains of Erwinia herbicola and Pseudomonas fluorescens against pear fire blight disease. 14th Iranian Plant Protection Congress; 2000. p. 140.

[21] Ahmadi AR, Hedjaroude CA, Sharifi-Tehrani A, Kheiri A, Akarani A. First report on isolation and identification of Paecilomyces farinosus from Heterodera schachtii and its antagonistic effects on the eggs in Iran. 12th Iranian Plant Protection Congress; 1996a. p. 354.

[22] Ahmadi AR, Hedjaroude CA, Sharifi-Tehrani A, Kheiri A, Akarani A. Isolation of Fusarium solani from the sugar beet cyst nematode (Heterodera schachtii) and antagonistic evaluation on the eggs in vitro. 12th Iranian Plant Protection Congress; 1996b. p. 355.

[23] Ahmadifar F, Roustaei A, Shahriari D. Biological control of Rhizoctonia solani Kuhn casual agent of common bean damping-off through Burkholderia cepacia (ex Burk) Yabuchi. Iran J Plant Prot Sci. 2009;39(1):81–90.

[24] Ahmadzadeh M, Nabizadeh M. Biological control of Rhizoctonia solani Kuhn casual agent of common bean damping-off through Burkholderia cepacia (ex Burk) Yabuchi. Iran J Plant Prot Sci. 2009;39(1):81–90.

[25] Ahmadzadeh M, Tehrani AS. Evaluation of fluorescent pseudomonads for plant growth promotion antifungal and inhibition of germination of the causal agent of white mold in oilseed rape. Plant Dis. 2005b;41:102–14.

[26] Ahmadzadeh M, Afsharmanesh H, Javan-Nikkhah M, Sharifi-Tehrani A. Identification of some molecular traits in fluorescent pseudomonads with antifungal activity. Iran J Biotechnol. 2006a;4(4):245–53.

[27] Ahmadzadeh M, Sharifi-Tehrani A, Naizadeh M. Biological control of Rhizoctonia solani causal agent of common bean damping-off Burkholderia cepacia. 17th Iranian Plant Protection Congress; 2006b. p. 144.

[28] Akbari KS, Niknejad KM, Elahinia SA, Khodaparast SA. Effect of antagonistic bacteria on Sclerotinia sclerotiorum the causal agent of white mold in oilseed rape. Iran J Plant Pathol. 2005a;41(3):307–28.

[29] Akbari KS, Niknezad KM, Elahinia SA, Khodaparast SA. Effect of antagonistic bacteria on Sclerotinia sclerotiorum the causal agent of white mold in oilseed rape. Plant Dis. 2005b;41:307–28.

[30] Akbari-Kiarodi SL, Niknejad-Kazampor M, elahinia SS. Antagonistic effects of four Bacillus spp. isolates on lysis and inhibition of germination of Sclerotinia sclerotiorum the causal agents of oilseed rape white mold disease. 16th Iranian Plant Protection Congress; 2004. p. 288.

[31] Akbari-Moghaddam E, Saberi-Riseh R, Khodayan P, Alaei H. Evaluate the control ability of Pseudomonas fluorescens strains on cucumber root rot disease. Biol Control Pests Plant Dis. 2015;41(2):77–88.

[32] Akhlaghi M, Moradzadeh Eskandari M, Rouhani H, Mahdikhani Moghaddam E. Evaluation of some native and commercial isolates of Trichoderma to control of cucumber Fusarium wilt. 22th Iranian Plant Protection Congress; 2016. p. 350.

[33] Akrami M, Goltzay H, Ahmadzadeh M. Evaluation of different combinations of Trichoderma species for controlling Fusarium rot of lentil. Afr J Biotechnol. 2011;10(14):2653–58.

[34] Akrami M, Ibrahimev A. Evaluation of different combination of Trichoderma species for controlling Fusarium rot of chickpea. J Crop Ecophysiology. 2010;4(2–1):75–83.

[35] Alabouvette C, Schippers B, Lemanceau P, Bakker PAHM. Biological control of Fusarium wilt. In: Boland GJ, Kuykendall LD, editors. Plant-microbe interactions and biological control. New York NY: Marcel Dekker; 1998. p. 15–36.

[36] Alamdarlou RM, Idin Hasanabei A, Mirabadi AZ, Foroozan F. Evaluation of the efficacy of Trichoderma isolates in the biological control of soybean charcoal rot disease in the laboratory and greenhouse conditions. Biocontrol Plant Prot. 2017;5(1):71–80.

[37] Alavifard FS, Etebarian HR, Sahebany N, Aminian H. Biological control of grey mould of apple by isolates Candida membranifaciens, Rhodotorula mucilaginosa and Pichia guilliermondii. 18th Iranian Plant Protection Congress; 2008a. p. 339.

[38] Alavifard F, Etebarian HR, Sahebany N, Aminian H. Control of grey mould of apple by Candida membranifaciens and induction of defense responses at 20°C. 18th Iranian Plant Protection Congress; 2008b. p. 338.

[39] Ale Aghaei SH, Shahriari D, Torabi M. Evaluation of the effect of Trichoderma spp. isolates on biological control of Pythium aphanidermatum the causal agent of cucumber damping-off and seed rot in laboratory and greenhouse. 20th Iranian Plant Protection Congress; 2012. p. 252.

[40] Alijani M, Manafi Shabestarzi M, Ghostra Y. Biocontrol effects of endophytic fungi isolated from apple trees against Diplodia bulgarica the causal agent of apple canker disease. 22th Iranian Plant Protection Congress; 2016. p. 339.

[41] Alimi M, Soleimani MJ, Taghinasab Darzi M. Characterization and application of microbial antagonists for control of Fusarium head blight of wheat caused by Fusarium graminearum using single and mixture strain of antagonistic bacteria on resistance and susceptible cultivars African. J Microbiol Res. 2012;6(2):326–33.

[42] Alimi M, Soleymani M, Rahimian H, Mohajer A. Application of antagonistic bacteria for controlling Fusarium head blight of wheat caused by Fusarium graminearum on semi-resistance and susceptible cultivars in greenhouse and field conditions. J Agric Sci Nat Resour. 2006;13(5):102–1014.

[43] Alipoor Moghadam M, Moradi M, Sedaghati E, Khodayan P. Identification of Trichoderma species and investigation on their effects on the crown and root rot of pistachio seedlings in Kerman province. 20th Iranian Plant Protection Congress; 2012. p. 295.

[44] Ameri M, Kheiri A, Damadzadeh M, Rahimian H. An investigation on the efficiency of Pasteuria penetrans for control of root-knot nematodes (Meloidogyne javanica). 12th Iranian Plant Protection Congress; 1996. p. 379.

[45] Amini J, Faizi S, Mirzaei S. Biological control of gray mold of three cultivar of strawberry using Bacillus strains. Biol Control Pests Plant iseseas. 2016;5(1):13–23.

[46] Amini F, Mahdikhani-Moghaddam E, Baghaee-Ravari S. Efficiency of cucumber endophytic bacteria on Meloidogyne javanica control under lab and greenhouse conditions. Biol Control Pests Plant esDisea. 2017;6(1):83–92.

[47] Amirafzali M, Fekrat F, Azami-Sardooei Z. Investigation of the effects of vermi- compost and Glomus mosseae on Fusarium
Rhizoctonia disease on tomato. Acta Biol Szeged. 2016;60(2):119–27.

[62] Azadrooh M, Aminian H, Erebani HR, Sahebani N. Studies on effect of combination sodium carbonate and yeast Hanseniaspora occidentalis M46 in control of Apple fruit gray mold caused by Botrytis cinerea. 20th Iranian Plant Protection Congress; 2012. p. 273.

[63] Azami-Sardooie Z, Nasirpour R, Fekrat F, Alizadeh H. Use of Brassica oleracea tissue and Glomus mosseae for controlling of Meloidogyne javanica on tomato plant. Biol Control Pest Dis. 2016;6(1):41–51.

[64] Azizpour N, Rouhaz K. Isolation and Characterization of Rhizosphere Bacteria for the Biocontrol of the Ascochyta rabiei in Iran. Adv Plants Agric Res. 2016;3(4):104.

[65] Babaei Nasir S, Amini J, Soleimani Pari MJ, Harighi B. Biocontrol of garlic white rot disease (Sclerotium cepivorum) by using bacterial antagonistic strains of Bacillus species in In Vitro. 19th Iranian Plant Protection Congress; 2010. p. 809.

[66] Babaeipoor E, Mirzaei S, Danesh YR, Arjim A, Chaichi M. Evaluation of some antagonistic bacteria in biological control of Gaeumannomyces graminis var. tritici causal agent of wheat take-all disease in Iran. Afr J Microbiol Res. 2011;5(9):5165–73.

[67] Baghani F, Rahnama K, Aghajani MA, Dehghan MA. Parasitization of Fusarium graminearum by Trichoderma isolates after spraying wheat spikes in the field conditions. 20th Iranian Plant Protection Congress; 2012. p. 268.

[68] Bagheri F, Rohani H, Felahati Rastegar M, Saberi Rish RA. Investigation on Phase Variation Phenomenon in Fluorescent Pseudomonads and their Effect on Control of Gaeumannomyces graminis var. tritici Causal Agent of Take-all Disease. Iran J Plant Prot Sci. 2011;42(2):199–208.

[69] Bagheri N, Ahmadzadeh M. First report of Achromobacter xylosoxidans on wheat rhizosphere in Iran and its biocontrol activity. Sci Agriculturae. 2016;16(1):36–42.

[70] Bagheri N, Ahmadzadeh M, Heydari R. Effects of Pseudomonas fluorescens strain UTPF5 on the mobility mortality and hatching of root-knot nematode Meloidogyne javanica. Arch Phytopathol Plant Prot. 2014;47(6):744–52.

[71] Bagheri S, Alizadeh H, Azadvar H, Amirijmiani A. Evaluation of biocontrol characteristics of antagonistic bacteria isolated from cucumber rhizosphere against Sclerotinia sclerotiorum and Pythium aphanidermatum. Iran J Plant Prot Sci. 2016;47(2):325–40.

[72] Bagheri J, Elahinia SA, Niknejad M, Pedramfar H, Bayar H. Biological control of vascular wilt and corm rot of gladiola (Fusarium oxysporum f.sp. gladioli) with Trichoderma isolates in vitro. 19th Iranian Plant Protection Congress; 2010. p. 812.

[73] Bahrami B, Afshari-Azad H, Hassanzadeh N. Possibility of biological control of Ascochyta rabiei the causal agent of chickpea blight disease using antagonistic microorganisms. 17th Iranian Plant Protection Congress; 2006. p. 126.

[74] Bakhshi E, Safaie N, Shamsbakhsh M. Bacillus amyloliquefaciens as a biocontrol agent improves the management of charcoal root rot in melon. J Agric Sci Technol. 2018;20(3):597–607.

[75] Barari H. Biocontrol of tomato Fusarium wilt by Trichoderma species under in vitro and in vivo Conditions. Cercetari Agronomice Moldova. 2016;49(1):91–98.
Barari H, Foroutan A. Biocontrol of soybean charcoal root rot disease by using *Trichoderma* spp. Cercetari Agronomice Moldova. 2016;49(2):41–51.

Barari H, Alami V, Foroutan A, Dalili A. Biocontrol of soybean charcoal root rot disease using antagonistic fungi in laboratory and greenhouse. 16th Iranian Plant Protection Congress; 2004. p. 282.

Barari H, Rayatpanah S, Dalili A, Oladi M. Study of the efficiency of three strains of *Trichoderma harzianum* on charcoal rot of soybean in field conditions in Mazandaran province. 21th Iranian Plant Protection Congress; 2014. p. 113.

Barbeau K, Zhang G, Live DH, Butler A. Petrobactin, a marine bacterium *Marinobacter hydrocarbonoclasticus*. J Am Chem Soc. 2002;124(3):378–9.

Bardin M, Ajouz S, Comby M, Lopez-Ferber M, Graillot B, Siegwart M, et al. Is the efficiency of biological control against plant diseases likely to be more durable than that of chemical pesticides. Front Plant Sci. 2015;27(6):566.

Bashiri S, Llop P, Davino M, Golmohammadi M, Scuderi G. Efficacy of *Pseudomonas chlororaphis* subsp. aureofaciens SH2 and *Pseudomonas fluorescens* RH43 isolates against root-knot nematodes (*Meloidogyne* spp.) in kiwifruit *XENZA*. 2015. p. 8.

Bazgir A, Rouhani H, Okhovat M. The investigation of *Giocladium sp.* effect on *Rhizoctonia solani* the causal agent of seedling death and bean seed rot. 10th Iranian Plant Protection Congress; 1992. p. 108.

Bazgir E, Rouhani H, Okhovat M, Karimi A. Comparative efficiency of chemical vs biological control of *Rhizoctonia* disease of bean under field conditions. 11th Iranian Plant Protection Congress; 1994a. p. 141.

Bazgir E, Okhovat M, Sharifi A, Rouhani H. A comparative of chemical and biological control of *Rhizoctonia* disease in bean in greenhouse. 11th Iranian Plant Protection Congress; 1994b. p. 140.

Beeazar A, Torabi M. Study of the effectiveness of antagonistic *Trichoderma* in biological control of wheat carnal bunt (*Tilletia indica*) in vitro and in vivo. 16th Iranian Plant Protection Congress; 2004. p. 32.

Behboudi K, Sharifi-Tehrani A, Hedjaroude GA, Zad J. Study on antagonistic properties of *Trichoderma viride* against *Phytophthora capsici* the causal agent of pepper damping-off. 13th Iranian Plant Protection Congress; 1998. p. 180.

Behboudi K, Sharifi TA, Hejaroud GA, Zad S. Antagonistic effects of *Trichoderma* species on *Phytophthora capsici* the causal agent of pepper root and crown rot. Plant iseseasesD. 2005;41:342–65.

Behdani M, Roustae A, Etebarian HR, Khodakaramian. Biological control of root rot of wheat (*Bipolaris spicifera*) by antagonistic strains of *Bacillus* and *Pseudomonas*. 17th Iranian Plant Protection Congress; 2006. p. 12.

Behnam S, Ahmadzadeh M, Sharifi Tehrani A, Hedjaroude GA, Farzaneh M. Biological control of *Sclerotinia sclerotiorum* (Lib) de Bary the causal agent of white mold by *Pseudomonas* species on canola petals. Commun Agric Appl Biol Sci. 2007;72(4):993–6.

Belimov AA, Safroanova VI, Sergeyeva TA, Egorova TN, Matveyeva VA, Tsyganov VE, et al. Characterization of plant growth promoting rhizobacteria isolated from polluted soils and containing 1-aminocyclopropane-1-carboxylate deaminase. Can J Microbiol. 2001;47(7):642–52.

Benítez R, Rincón AM, Limón MC, Codón AC. Biocontrol mechanisms of *Trichoderma* strains. Int Microbiology. 2004;7:249–60.

Beydaghi M, Panjejheh N, Rezaei R. Identification fungal causing leaf spot on tomato and biological control by the antagonists isolated from the rhizosphere of tomato in Sistan. Biol Control Pests Plant Dis. 2016;6(1):23–39.

Binandeh N, Safaei N, Khelghatibana F. Antagonistic activity of two *Bacillus* species against apple white root fungus in vitro. 22th Iranian Plant Protection Congress; 2016. p. 349.

Bloomberg GV, Lugtenberg BJ. Molecular basis of plant growth promotion and biocontrol by rhizobacteria. Curr OpPlant Biol. 2001;4:343–50.

Boromand G, Fatemy S, Rezaee S. Evaluation of biocontrol of root knot nematode (*Meloidogyne* spp.) by *Paecilomyces lilacinus* fungus. 19th Iranian Plant Protection Congress; 2010. p. 808.

Calvo J, Calvete V, de Orellano ME, Benuzzi D, de Tosetti MIS. Biological control of postharvest spoilage caused by *Penicillium expansum* and *Botrytis cinerea* in apple by using the bacterium *Rahnella aquatilis*. Int J Food Microbiology. 2007;113:251–7.

Chavoshisani M, Jamali S, Taheiri H, Khodaparast SA. Bioinhibition of citrus nematode *Tylenchulus semipenetans* by antagonistic fungi under greenhouse condition. J Plant Prot. 2013;27(3):376–8.

Chegini S, Behboudi K, Javan-Nikkah M, Farzaneh M. Study of *Trichoderma* isolates against mycelial growth and AF81 produced by *Aspergillus flavus* on pistachio nuts. Biol Control Pests Plant Dis. 2013;2(2):71–79.

Cook RJ, Baker KF. The Nature and Practice of Biological Control of Plant Pathogens. St Paul MN: American Phytopathological Society; 1983. p. 539.

Costa JM, Loper JE. Characterization of siderophore production by the biological control agent *Entrobacter cloacae*. MPMI. 1994;7:440–8.

Dadjoo H, Khodakaramian G, Rooh Razi K. The endophytic bacterium of potato *Paeinibacillus polymyxa* as biocontrol agent of *Rhizoctonia solanacearum*. 21th Iranian Plant Protection Congress; 2014. p. 94.

Damadzadeh M, Samavatin H, Ansarpour B, Gowen S. Control of *Meloidogyne javanica* by *Pasteuria penetrans* in greenhouse. 12th Iranian Plant Protection Congress; 1996. p. 167.

Danaei M, Baghizadeh A, Pourseyedi S, Amini J, Yaghoobi MM. Biological control of plant fungal diseases using volatile substances of *Streptomyces griseus*. Eur J Exp Biol. 2014;4(1):334–9.

Davari M, Ezaei R. Study on the effects of four medicinal plant essential oils and two *Trichoderma* species on biocontrol of grape fruit rot fungi. Biol Control Pests Plant iseseasesD. 2016;5(1):1–12.

David BV, Chandrasehar G, Selvam PN. *Pseudomonas fluorescens*: a plant-growth-promoting rhizobacterium (PGPR) with potential role in biocontrol of pests of crops.
In Crop improvement through microbial biotechnology. Elsevier; 2018. pp. 221–43.

[106] Delkhah Z, Behboudi K. Production and application of *Trichoderma harzianum* Tr6 for controlling of damping-off caused by *Phytophthora drechsleri* and its effect on the growth promotion of cucumber. Biol Control Pests Plant Dis. 2015;3(2):97–104.

[107] Derakhshan A, Safaie N, Alizadeh A. Investigating effect of epiphytic bacteria in biocontrol of wheat head blight on Tagen and Falat cultivars in vivo. 19th Iranian Plant Protection Congress; 2010. p. 840.

[108] Droby S, Cohen L, Daus A, Weiss B, Horev B, Chalutz E, et al. Commercial testing of Aspire: a yeast preparation for the biological control of postharvest decay of citrus. Biol Control. 1998;12(2):97–101.

[109] Duffy BK, Weller DM. Use of *Gaeumannomyces graminis* var. *graminis* alone and in combination with fluorescent *Pseudomonas* spp. to suppress take-all of wheat. Plant Dis. 1995;79:907–11.

[110] Dukare AS, Paul S, Nambi VE, Gupta RK, Singh R, Sharma K, et al. Exploitation of microbial antagonists for the control of postharvest diseases of fruits: a review. Crit Rev Food Sci Nutr. 2019;59(9):1448–513.

[111] Ebrahimi L, Etebarian HR, Aminian HA, Sahebani NA. Biological control of apple blue mould with *Metschnikowia pulcherima* and assessment of total phenolic content and peroxidase activity. 20th Iranian Plant Protection Congress; 2012a. p. 298.

[112] Ebrahimi L, Etebarian HR, Aminian HA. Control of apple blue mold with *Torulaspora delbrueckii* alone and with silicon in storage condition. 20th Iranian Plant Protection Congress; 2012b. p. 306.

[113] Ebrahimi-Zarandi M, Shahidi Bonjar GH, Padash Dehkaeio F, Ayatollahi Moosavi SA, Aghighi S. Biological control of rice blast by use of *Streptomyces* spp. 18th Iranian Plant Protection Congress; 2008. p. 351.

[114] Eini S, Behbodi K, Purbabaei AA, Zahed MJ. Biological control of *Sclerotinia sclerotiorum* the causal agent of cucumber white stem rot by rhizosphere actinobacteria. Biol Control Pests Plant Dis. 2018;7(1):33–45.

[115] Eivazi A, Soleimani MJ, Zafari D. Biological control of tomato stem canker disease caused by *Botrytis cinerea* using *Trichoderma* isolates. 19th Iranian Plant Protection Congress; 2010. p. 876.

[116] Emadi A, Etebarian HR, Aminian H, Sahebani N, Alizadeh Aliabadi A. In vitro and in vivo biological control of blue mold of apple fruit by *Bacillus subtilis*. 19th Iranian Plant Protection Congress; 2010. p. 878.

[117] Engelbrecht G, Horak I, Jansen van Rensburg PJ, Claassens S. *Bacillus*-based biofortication: development modes of action and commercialization. Biocontrol Sci Technol. 2018;28(7):629–53.

[118] Etebarian H, Mohammadiar M, Alizadeh H, Zareei SA. Biological control of barley covered smut by bacterial antagonists. Appl Entomol Phytopathology. 2007;74(2):81–91.

[119] Etebarian HR. Evaluation of *Trichoderma* isolates for biological control of charcoal stem rot in melon caused by *Macrophomina phaseolina*. J Agric Sci Technol. 2006;8:243–50.

[120] Etminani F, Harighi B. Isolation and identification of endophytic bacteria with plant growth promoting activity and biocontrol potential from wild pistachio trees. Plant Pathol J. 2018;34(3):208.

[121] Fadaei Sh, Shahidi Bonjar GH, Aminae MM, Negarestani MR. Evaluation of physiological characteristic of some Actinomycetes isolated from agricultural soils of Kerman Fars and Hormogzan Provinces for production of chitinase protease lipase and amylase enzymes. 20th Iranian Plant Protection Congress; 2012. p. 254.

[122] Falahzadeh-Mamaghani V, Alizadeh Aliabadi A, Shirzad A. Screening of fluorescent pseudomonads based on production of siderophore and induction of plant ethylene production for induction of systemic resistance against wheat bacterial leaf streak. Iran J Plant Prot Sci. 2016;47(2):277–92.

[123] Falahzadeh-Mamaghani V, Ahmadzadeh M, Sharifi R. Screening systemic resistance-inducing fluorescent pseudomonads for control of bacterial blight of cotton caused by *Xanthomonas campestris pv. malvacearum*. J Plant Pathol. 2009;91(3):663–7.

[124] Faraji A, Roghayhe Hemmatti R, Marefat A. Biological control of major fungal causal agent of root and crown rot of bean in Zanjan province with antagonistic bacteria. Iran J Plant Prot Sci. 2015;46(2):317–29.

[125] Farzaneh M, Sharifi-Tehrani A, Ahmadzadeh M, Zad J. Effect of some antagonistic bacteria in the control of *Phytophthora cactorum* the casual agent of root and crown rot on apple trees. 17th Iranian Plant Protection Congress; 2006. p. 338.

[126] Farzaneh M, Sharifi-Tehrani A, Ahmadzadeh M, Zad J. Biocontrol of *Phytophthora cactorum* the causal agent of root and crown rot on apple (*Malus domestica*) by formulated Pseudomonas fluorescens. Commun Agric Appl Biol Sci. 2007;72(4):891–900.

[127] Farzaneh M, Shi ZQ, Ahmadzadeh M, Hu LB, Ghassempour A. Inhibition of the *Aspergillus flavus* growth and Aflatoxin B1 contamination on pistachio nut by Fengycin and Surfactin-producing *Bacillus subtilis* UTBSBP. Plant Pathol J. 2016;32(3):209.

[128] Fatemy S, Ahmadian Yazdi A. Isolation and introduction of *Pseudomonas fluorescens* from beet cyst nematodes, *Heterodera schachtii*. Sugerbeet. 1997;13(1):63–70.

[129] Fatemy S. Evaluation of *Pseudomonas ilicinus* as a biocontrol agent of *Meloidogyne javanica* on tomato. 12th Iranian Plant Protection Congress; 1996. p. 173.

[130] Fedi S, Tola E, Moenne-Loccoz Y, Dowling DN, Smith LM, O’Gara F. Evidence for signaling between the phytopathogenic fungus *Pythium ultimum* and *Pseudomonas fluorescens* F113: pultimum represses the expression of genes in *Pseudomonas fluorescens* F113 resulting in altered ecological fitness. Appl Environ Microbiol. 1997;63:4261–66.

[131] Fernando WGD, Nakkeeran S, Zhang Y. Biosynthesis of antibiotics by PGPR and its relation in biocontrol of plant diseases. In: Siddiqui ZA, editor. PGPR: Biocontrol and Antibiotics by PGPR and its relation in biocontrol of plant diseases. Dordrecht/Netherlands: Springer; 2006. p. 67–109.

[132] Firouzian Bandpey S, Rahimian H. Identification of *Pantoea agglomerans* and evaluation of its antagonistic activities against *Erwinia amylovora* the causative agent of fire blight of pome fruits in Mazandaran. 22th Iranian Plant Protection Congress; 2016. p. 315.
Ghasemi Sardareh R, Etebarian HR, Vasebi Y. Control of blue mold of orange fruit by *Penicillium expansum*. J Res Plant Pathol. 2011;4(1):28–36.

Ghorbanpour M, Omidiar M, Abbasszadeh-Dahaji P, Omidvar R, Kariman K. Mechanisms underlying the protective effects of beneficial fungi against plant diseases. Biol Control. 2010;4(2):283–92.

Golzary H, Panjehkeh N, Salari S, Sedaghati Khoravi E, Rejali F. Effects of mycorrhizal fungi (*Glomus mosseae* and *Glomus intraradices*) on root-knot nematode (*Meloidogyne javanica*) on tomato. Biol Control Pests Plant Dis. 2013;12(1):211–9.

Golzary H, Ahmadzadeh M, Panjekneh N, Salari S, Sedaghati Khoravi E. Evaluation of *Trichoderma harzianum* isolates for biological control of *Meloidogyne javanica* in in vitro. 18th Iranian Plant Protection Congress; 2008a. p. 280.

Golzary H, Ahmadzadeh M, Panjekneh N, Salari S, Sedaghati Khoravi E. Biological control of *Meloidogyne javanica* by Iranian strains of fluorescent Pseudomonads in vitro. 18th Iranian Plant Protection Congress; 2008b. p. 378.
editor. Bacteria in Agrobiology: Disease Management. Berlin/Heidelberg: Springer Verlag; 2013. p. 473–85.

[164] Haas D, Défago G. Biological control of soil-borne pathogens by fluorescent Pseudomonads. Nat Rev Microbiology. 2005;3:307–19.

[165] Habibi R, Rahnama K. Morphological and molecular identification of Trichoderma species based on rDNA ITS sequences from cucurbits field of Iran and study their antagonistic properties. 22th Iranian Plant Protection Congress; 2016. p. 324.

[166] Haggag Wafaa M, Abo SA, Seder. Influence of iron sources and siderophores producing Pseudomonas fluorescens on crown rot disease incidence and seed contamination of peanut with pathogenic Aspergillus Egyptian. J Phytopathology. 2000;28:1–16.

[167] Haggag WM, Mohamed HAA. Biotechnological aspects of microorganisms used in plant biological control. Am-Eurasian J. Sustain Agric. 2007;1(1):7–12.

[168] Haghdel M, Taghavi SM, Mohammadi AH. Study of antagonistic effect isolated bacteria of pistachio nuts on toxigenic Aspergillus flavus. 18th Iranian Plant Protection Congress; 2008a. p. 252.

[169] Haghdel M, Taghavi SM, Mohammadi AH. Study of antagonistic effect isolated bacteria of pistachio nuts on toxigenic Aspergillus flavus. 18th Iranian Plant Protection Congress; 2008b. p. 333.

[170] Hajieghbali R, Torabi-Gligou M, Mohammadi MR, Davari M. Biological potential of some Iranian Trichoderma isolates in the control of soil borne plant pathogenic fungi. Afr J Biotechnol. 2008;7(8).

[171] Handelsman J, Stabb K. Biocontrol of soilborne plant pathogens. Plant Cell. 1996;8:1855–69.

[172] Hasani E, Khodakaramian G. Assessment of the antagonistic activity of fluorescent pseudomonads isolated from potato rhizosphere towardsRalstonia solanacearum. 22th Iranian Plant Protection Congress; 2016. p. 274.

[173] Hashemi Alizadeh SK, Rouhani H, Tarighi S. Study of interaction between mycorrhizal Glomus fasciculatum and Bacillus subtilis on control of common root rot of wheat by Bipolaris sorokiniana. 19th Iranian Plant Protection Congress; 2010. p. 925.

[174] Hashemi Alizadeh SG, Rouhani H, Tarighi S. study of interaction between mycorrhiza Glomus fasciculatum and Pseudomonas fluorescens on control of common root rot of wheat caused by Bipolaris sorokiniana. J Plant Prot. 2013;27(2):142–8.

[175] Heidari Faroughi S, Etebarian HR, Zamanizadeh HR. Evaluation of Trichoderma isolates for biological control of Phytophthora drechsleri in greenhouse. Entomol Phytopathol. 2004;72(2):113–34.

[176] Heidari F, olive M. Study on the separate and integrated application of the fungus Trichoderma harzianum i2375 and Vermicompost in Control of Root-knot Nematode Meloidogyne javanica on Tomato. 22th Iranian Plant Protection Congress; 2016. p. 271.

[177] Heidari-Tajabadi F, Ahmadzadeh M, Moinizadeh A, Khezri M. Influence of some culture media on antifungal activity of Pseudomonas fluorescens UTFP61 against the Sclerotinia sclerotiorum. Afr J Agric Res. 2011;6(30):6340–47.

[178] Heidarzadeh N, Baghaee-Ravari S. Application of Bacillus pumilus as a potential biocontrol agent of Fusarium wilt of tomato. Arch Phytopathol Plant Prot. 2015;48(13–16):841–9.

[179] Heidari Faroughi S, Etebarian HR, Zamanizadeh HR. Evaluation of Streptomyces isolates for biological control of cucurbit wilt. 15th Iranian Plant Protection Congress; 2002. p. 110.

[180] Heydari A, Fatahi H, Zamanizadeh H, Hasan ZN, Naraghi L. Investigation on the possibility of using bacterial antagonists for biological control of cotton seedling damping-off in green house. Appl Entomol Phytopathol. 2004;72(1):51–68.

[181] Hojjat Jalali AA, Coosemans J. Antagonistic fungi of sugar beet cyst nematode of Iran. 12th Iranian Plant Protection Congress; 1995. p. 128.

[182] Hosini M, Mehdi Nasr Esfahani MN, Ghorbani M. Antagonistic effects of fungal isolates and two commercial bioproducts in the control of sugar beet cyst nematode Heterodera schachtii. Biocontrol Plant Prot. 2018;5(2):1–12.

[183] Hosseini Haji Abdal M, Rahimian H, Shahriri D, Sahebani N, Loffi M. The evaluation of Trichoderma atroviride and Trichoderma harzianum isolates in biological control of Cantaloup Fusarium wilt disease. 21th Iranian Plant Protection Congress; 2014a. p. 98.

[184] Hosseini Haji Abdal M, Rahimian H, Shahriri D, Sahebani N, Loffi M. Biological control of Cantaloup Fusarium wilt disease by Bacillus subtilis and investigation of total phenol amount and peroxidase enzyme changes. 21th Iranian Plant Protection Congress; 2014b. p. 95.

[185] Hosseini H, Panjekheh N, Alaei H. Effect of Glomus mosseae on cucumber damping off caused by Pythium under salinity stress. Biol Control Pests Plant Dis. 2016;5(2):139–49.

[186] Hosseyni H, Alaei H, Panjekheh N. The possibility of biological control of Pythium aphanidermatum the causal agent of cucumber damping off using Bacillus isolates under saline conditions. 20th Iranian Plant Protection Congress; 2012a. p. 271.

[187] Hosseyni H, Alaei H, Panjekheh N, Rostami F. Evaluation of Trichoderma isolates for biological control of cucumber damping off caused by Pythium aphanidermatum in vitro and in vivo. 20th Iranian Plant Protection Congress; 2012b. p. 258.

[188] Iraqi MM, Mostafa M, Rahnama K, Taghiniasab M. Evaluation of antagonistic activity of Bacillus subtilis isolates on Ophiostoma novo-ulmi causal agent of “Dutch Elm Disease” in vitro. 18th Iranian Plant Protection Congress; 2008. p. 326.

[189] Iraqi M, Rahnama K. Survey on Bacillus subtilis isolates for biological control of sunflower root rot caused by Macrophomina phaseolina (Tassi). Goid Sci J Agriculture. 2011;34(1):1–11.

[190] Iraqi MM, Rahnama K, Zafari D, Taghiniasab M. Investigating biological control of Ophiostoma novo-ulmi causal agent of Dutch Elm Disease by Trichoderma harzianum and T. virens in vitro. J Agric Sci Nat Resour. 2007;14(5):178–91.

[191] Izadyar M, Padash F. Antagonistic activity of some microorganisms against rice sheat blight. 11th Iranian Plant Protection Congress; 1994. p. 65.

[192] Izadyar M, Popushoi I, Rouhani H. Evaluation of antagonistic activity Trichoderma and Gloiocladium species on Rhizoctonia
solanii the causal agent of rice sheath blight in vitro. 14th Iranian Plant Protection Congress; 2000a. p. 247.

[193] Izadyar M, Popushoi I, Rouhani H. Evaluation of antagonistic activity of Trichoderma species and Gliocladium virens on Rhizoctonia solani causal agent of rice sheath blight on bean leaf. 14th Iranian Plant Protection Congress; 2000b. p. 35.

[194] Jaemsanag R, Jantasiuriyarat T, Thamchaipenet A. Molecular interaction of 1-aminocyclopropane-1-carboxylate deaminase (ACC–D) producing endophytic Streptomyces sp. GMKU 336 towards salt-stress resistance of Oryza sativa L. cv KDML105. Sci Rep. 2018;8(1):1950.

[195] Jalali S, Panjekhe M, Darvishnia M, Salari M, Salehi A. Biological control of Fusarium oxysporum f. sp. lycopersici by antagonistic bacteria Bacillus and Pseudomonas isolated from tomato rhizosphere in Lorestan province. Res Plant Pathol. 2016;4(1):67–78.

[196] Jalali S. Biological control of Fusarium oxysporum f.sp. lycopersici using antagonistic agents of tomato rhizosphere (Doctoral dissertation University of Zabol); 2014.

[197] Jamali F, Modarresi M, Bayat F. Biocontrol potential of Pseudomonas fluorescens strains producing 24diacetylphloroglucinol and hydrogen cyanide against tomato Fusarium wilt. Biol Control Plants. 2016;5(2):235–46.

[198] Jamali F, Sharifi-Tehrani A, Okhovat M, Zakeri Z. Study of the effect of some antagonistic bacteria against Fusarium oxysporum the causal agent of chickpea wilt in greenhouse and field condition. 17th Iranian Plant Protection Congress; 2004. p. 139.

[199] Jamdar Z, Mohammadi AH, Mohammadi S, Haghdel M. Study of antagonistic effect of isolated Trichoderma from soils of pistachio gardens on radial growth of Verticillium dahliae the causal agent of Verticillium wilt of pistachio. 20th Iranian Plant Protection Congress, 2012. p. 323.

[200] Jamshidejad V, Sahebany N, Etebarian HR. Biological control of root-knot nematode, Meloidogyne javanica, by Arthrobotrys oligospora and Paecilomyces lilacinus, and their effects on tomato development. The first national conference on agriculture in difficult environmental conditions. 2012. p. 1–5.

[201] Javadi L, Naemii S, Rezaei S, Khosravani V. Biological control of Magnaporthe oryzae the causal agent of rice blast disease with native Trichoderma strains in vitro. 20th Iranian Plant Protection Congress; 2012. p. 307.

[202] Javadi L, Naemii SH, Rezaei S, Vahid K. Biological control of rice blast disease with native Trichoderma isolates. J Biocontrol Plant Prot. 2014;2(1):1–15.

[203] Javanshir Javid K, Mahdijan S, Behboudi K, Alizadeh H. Biocontrol of cucumber Fusarium root and stem rot disease by Trichoderma isolates. 20th Iranian Plant Protection Congress; 2012. p. 263.

[204] Kahnooji H, Alaei H, Mohammadi AH, Haghdel M. Isolation and identification of Trichoderma species from soil of pistachio orchards in Rafsanjan and their evaluation for biological control of Aspergillus flavus. 20th Iranian Plant Protection Congress; 2012. p. 290.

[205] Karampour F, Okhovat M. Investigation on the effect of some isolates of Trichoderma and Gliocladium on the growth of Fusarium solanii at lab conditions. 10th Iranian Plant Protection Congress; 1992. p. 143.

[206] Karimi E, Rouhani H, Zafari DM, Khoda Karamian GH, Taghinasab M. Biological control of vascular wilt disease of carnation caused by Fusarium oxysporum fsp. dianthi by Bacillus and Pseudomonas strains isolated from rhizosphere of carnation. J Sci Technol Agric Nat Resour. 2007;11(4):309–19.

[207] Karimi E, Sadeghi A. Study on optimum growth condition and designing formulation for increasing shelf life of Streptomyces rimosus strain c-(2012) as biocontrol agent. Biol J Microorg. 2015;4(15):109–22.

[208] Karimi E, Rouhani H, Zafari D, Taghinasab M. Investigation on possible reason of reduced antagonistic potential of Trichoderma longibrachiatum chickpea root rot disease under greenhouse conditions. 16th Iranian Plant Protection Congress; 2004a. p. 185.

[209] Karimi E, Rouhani H, Zafari D, Khodakaramian Gh. Antagonistic activity of Bacillus and Pseudomonas fluorescens isolated from carnation rhizosphere against Fusarium oxysporum fsp. dianthi the causal agent of vascular rot of carnation in Mahallat. 16th Iranian Plant Protection Congress; 2004b. p. 456.

[210] Karimi E, Rouhani H, Zafari D, Khodakaramian Gh, Taghinasab M. Investigation on the antagonistic activity of Bacillus isolates from chickpea rhizosphere against Fusarium oxysporum f.sp. ciceri the causal agent of root rot of chickpea in Kermanshah province. 16th Iranian Plant Protection Congress; 2004c. p. 183.

[211] Karimi E, Safaie N, Shams-Baksh M, Mahmoudi B. Bacillus amyloliquefaciens SB14 from rhizosphere alleviates Rhizoctonia damping-off disease on sugar beet. Microbiol Res. 2016;192:221–30.

[212] Karimik Amini J, Harighi B, Bahrannnejad B, Behtoei H. Antagonistic activity of Bacillus and Pseudomonas isolates from the chickpea rhizosphere against Fusarium oxysporum f.sp. ciceri the causal agent of Fusarium wilt of chickpea in Kurdistan province. 19th Iranian Plant Protection Congress; 2010. p. 908.

[213] Karmipourfard H, Damadzadeh M. The effect of Pasteuria to control of Meloidogyne spp. on pistachio. 17th Iranian Plant Protection Congress; 2006. p. 375.

[214] Karkhaneeh R, MSheikhholeslami M, Hojat-Jaliali AA, Asadi Sardari A. Study on antagonistic effect of Penicillium spp. associated with females and egg masses of Meloidogyne javanica in vitro. 20th Iranian Plant Protection Congress; 2012. p. 277.

[215] Kasfi K, Taheri P, Jafarpour B, Tarighi S. Biological control of grey mould disease on grape caused by Botrytis cinerea using Trichoderma harzianum and Candida membranifaciens. 22th Iranian Plant Protection Congress; 2016a. p. 387.

[216] Kasfi K, Taheri P, Jafarpour B, Tarighi S. Biological control of Aspergillus niger the causal agent of black rot disease on grape using Trichoderma harzianum and Candida membranifaciens. 22th Iranian Plant Protection Congress; 2016b. p. 386.

[217] Kavari M, Mahdikhan Moghadam E, Rouhani H. Survey on chitinase production by several isolates of Trichoderma and its biological control effect on tomato root-knot nematode Meloidogyne javanica. J Plant Prot. 2015;29(1):123–33.

[218] Kazempour MN. Biological control of Rhizoctonia solani the causal agent of rice sheath blight by antagonistic bacteria in
greenhouse and field conditions. Plant Pathol J. 2004;3(2):88–96.

[219] Kazemzadeh M, Roustai A, Padashf, Khodakaramian Kh. Study of biological control of rice sheath blight caused by Rhizoctonia solani with some antagonist bacteria in the Guilan Province. J Plant Prot. 2012;26(1):44–54.

[220] Kazemzadeh M, Padashf, F, Rostai A. Effects of antibiotics antagonist bacterial isolated from rice paddy of the Guilan province on the Guilan province on the Rhizoctonia solani causal agent of rice sheath blight. J Agric Sci Nat Resour. 2006;12(6):146–53.

[221] Kermajany Z, Jamali Zavareh A, Fadaei Tehrani A. In vitro inhibitory effects of five strains of Trichoderma on the growth of Fusarium oxysporum f.sp. dianthi. Biol Control Pests Plant Dis. 2017;6(1):121–25.

[222] Keshavarzi S, Behboudi K, Sarpeleh A, Ahmadzade M. Potential of Trichoderma species for biocontrol of root rot and vine decline of Cucumis melo caused by Monosporascus cannonballus. 20th Iranian Plant Protection Congress; 2012a. p. 267.

[223] Keshavarzi S, Behboudi K, Sarpeleh A, Ahmadzade M. Induction of chitinase dependent resistance by Trichoderma virens strain IRAN 1101 C against Monosporascus cannonballus the causal agent of root rot and vine decline of muskmelon. 20th Iranian Plant Protection Congress; 2012b. p. 261.

[224] Khabbaz Jolfaei H, Mohammadi Goltapeh E, Rahimian HA. Isolation screening and evaluation of the efficacy of potentially antagonistic bacteria for the biocontrol of brown blotch disease of the cultivated mushroom Agaricus bisporus. Iran J Plant Pathol. 2005;41(4):543–59.

[225] Khaledi N, Taheri P. Biological control potential of Trichoderma harzianum fungi against soybean charcoal rot agent under experimental and greenhouse condition. 21th Iranian Plant Protection Congress; 2014. p. 74.

[226] Khaledi N, Taheri P. Biocontrol mechanisms of Trichoderma harzianum against soybean charcoal rot caused by Macrophomina phaseolina. J Plant Prot Res. 2016;56(1):21–31.

[227] Khalighi S, Khodakaramian G. Biocontrol of Meloidogyne javanica inducing olive root-knot under green-house conditions and by use of fluorescent Pseudomonads. Iran J Plant Prot Sci. 2012;43(2):323–32.

[228] Khalili E, Sadravim N, Naeimi SH, Khorasv V. Biological control of rice brown spot with native isolates of three Trichoderma species in greenhouse. 20th Iranian Plant Protection Congress; 2012a. p. 301.

[229] Khalili E, Javed MA, Huyop F, Rayatpanah S, Jamshidi S, Wahab RA. Evaluation of Trichoderma isolates as potential biological control agent against soybean charcoal rot disease caused by Macrophomina phaseolina. Biotechnological Equip. 2016;30(3): 479–88.

[230] Khalili E, Sadravim N, Naeimi S, Khorasv V. Biological control of rice brown spot with native isolates of three Trichoderma species. Braz J Microbiology. 2012b;43(1):297–305.

[231] Khalili E, Sadravim M. Biological control of rice sheath blight pathogen with three Trichoderma species isolates in vitro. 18th Iranian Plant Protection Congress; 2008. p. 334.

[232] Kharrazian ZA, Jouzani GS, Aghdasi M, Khorvash M, Zamani M, Mohammadzadeh H. Biocontrol potential of Lactobacillus strains isolated from corn silages against some plant pathogenic fungi. Biol Control. 2017;110: 33–43.

[233] Khazae FA, Etetsarian HR, Roustae A, Alizadeh-Alibad A. Potential biocontrol of Penicillium expansum in apple with some Pseudomonas fluorescens isolates. 18th Iranian Plant Protection Congress; 2008. p. 352.

[234] Kheiri A, Etebarian HR, Roustae A, Khodakaramian Gh, Aminin H. Study of possibility of biological control of charcoal rot on melon (Macrophomina phaseolina) by Pseudomonas fluorescens isolates. J Agric. 2009;11(1):35–46.

[235] Khezri M, Manafi Shabestari M. Biological control of wheat Take-all by native probiotic. Bacillus subtilis. 28th Iranian Plant Protection Congress; 2016. p. 288.

[236] Khezri M, Alizadeh M, Jouzani GS, Behboudi K, Ahangaran M, Mousivand M, et al. Characterization of some biofilm-forming Bacillus subtilis strains and evaluation of their biocontrol potential against Fusarium culmorum. J Plant Pathol. 2011;373–82.

[237] Khezri S, Alizadeh M, Shariri R, Ahangaran A. Screening of some isolates of Pseudomonas fluorescens against Sclerotinia sclerotiorum on sunflower. 19 th Iranian Plant Protection Congress; 2010. p. 830.

[238] Khodaemi M, Hemmati R, Rouhani H, Sarafraz Nikou F. Biological control of Fusarium root rot of bean using native Trichoderma isolates. 20th Iranian Plant Protection Congress; 2012; p. 302.

[239] Khodakaramian A, Heydari A, Balestra GM. Evaluation of Pseudomonads bacterial isolates in biological control of citrus bacterial canker disease. Int J Agric Res. 2008;3(4):268–72.

[240] Khodakaramian G, Zafari D. Identification of fluorescent pseudomonads isolated from potato rhizosphere and assessment of their antagonistic activity towards Pectobacterium carotovorum under field condition. Appl Entomol Phytopathol. 2010;77(2):1–18.

[241] Khodakaramian G. Characterization of fluorescent pseudomonads isolated from citrus phyllosphere in southern Iran and evaluation of their antagonistic activity against bacterial inducing citrus canker disease. Iran J Agric Sci. 2004;35(4):911–91.

[242] Khodaygan B, Etebarian HR, Khodakaramian G, Torabi M. Biological control of wheat common bunt (Tilletia laevis L10) by some bacterial antagonist. 16th Iranian Plant Protection Congress; 2004. p. 45.

[243] Khodaygan P, Etebarian HR, Khodakaramian G, Torabi M. Investigation of possibility of biocontrol of common covered smut disease in wheat by several isolates of Pseudomonas. Iran J Agric Sci. 2006;37(4):707–17.

[244] Khomeini K, Daneshjoo R, Nasr MR, Bakhtlir M. Biocontrol disease agents exposed to pathogens of chickpea by different combinations under field condition. Int Scholars J. 2016;2(2):28–32.

[245] Khorasani GA, Alizadeh A, Safaei N. Biological control of Fusarium wilt of potato using antagonistic strains of bacteria. Plant Dis. 2008;44(1):1–21.

[246] Khorasani-Aghazadeh A, Alizadeh A, Safaei N. Biological control of Fusarium oxysporum f.sp. tuberosi using antagonistic mutant and wild type bacteria. 17th Iranian Plant Protection Congress; 2006. p. 218.
[247] Khosravi M, Abdollahi M, Sadravi M. Effect of Metarhizium anisopliae and Trichoderma harzianum on root knot nematode Meloidogyne javanica. Biol Control Pests Plant. 2015;3(1):67–76.

[248] Khosro-Anjom E, Sharzei A, Sahebani N, Mohammadifar M. Biological control of Fusarium root rot of beans by Trichoderma harumatum and Pseudomonas fluorescens treatments. 22th Iranian Plant Protection Congress; 2016. p. 293.

[249] Kia Sh, Rahnama K. Study on the efficiency of Trichoderma isolates in controlling charcoal rot disease of soybean due to greenhouse conditions. Biocontrol Plant Prot. 2016;4(1):1–10.

[250] Kloepper JW, Leong J, Teintze M, Schrioth MN. Enhanced plant growth by siderophores produced by plant growth promoting rhizobacteria. Nature. 1980;286:885–86.

[251] Köhl J, Kolnaar R, Ravensberg WJ. Mode of action of microbial biological control agents against plant diseases: relevance to efficacy. Front Plant Sci. 2019;10:845.

[252] Kubicek CP, Herrera-Estrella A, Seidil-Seiboth V, Martinez DA, Druzhinina IS, Thon M. Comparative genome sequence analysis underscores mycoparasitism as the ancestral life style of Trichoderma. Genome Biol. 2011;12(4):40.

[253] Kumar A, Saini P, Shrivastava JN. Production of peptide antifungal antibiotic and biocontrol activity of Bacillus subtilis. Indian J Exp Biol. 2008;47:57–62.

[254] Lagzian A, Saberi-Riseh R, Khodayyan P, Sedaghati E, Dashi H. Isolation identification and screening for antifungal activity of fluorescent pseudomonads against Gaeumannomyces graminis var. tritici the causal agent of take-all. 20th Iranian Plant Protection Congress; 2012. p. 312.

[255] Lam ST, Gaffney TD. Biological activities of bacteria used in plant pathogen control. In: Chet I. editor. Biotechnology in Plant Disease Control. New York: John Wiley; 1993. p. 291–320.

[256] Leong SA, Expert D. Siderophores in plant pathogen interactions. In: Kosuge T, Nester EW, eds. Plant-Microbe Interactions Molecular and Genetic Perspectives. Vol 3. New York: McGraw-Hill; 1989. p. 62–83.

[257] Loper JE, Buyer JS. Siderophores in microbial interactions on plant surfaces. Mol Plant Microbe Interact. 1991;4:5–13.

[258] López-Mondéjar R, Ros M, Pascual JA. Mycoparasitism-related genes expression of Trichoderma harzianum isolates to evaluate their efficacy as biological control agent. Biol Control. 2011;56:59–66.

[259] Madloo PB, Behboudi K, Tohidfar M, Jouzani GS, Ahmadzadeh M. Response of some important Iranian wheat cultivars to Fusarium culmorum under genetic diversity of indigenous bio-control agent fluorescent Pseudomonas spp. Aust. J Crop Sci. 2013;7(7):1003.

[260] Maghsodloo R, Ghorbani-Nasrabadi R, Razavi SE, Ebrahimii T. Evaluation of antagonistic activity of Azoctobacter isolates on Gaeumannomyces graminis var. tritici causal agent of take-all disease in vitro. 18th Iranian Plant Protection Congress; 2008. p. 389.

[261] Mahdikhani Moghadam E, Rouhani H, Flahi Rastegar M. Biological control of sugar beet cyst forming nematode with Trichoderma under in vitro and greenhouse condition. J Water Soil Sci. 2009;13(48):301–12.

[262] Mahdikhani Moghadam E, Rouhani H. Effect of isolates of Trichoderma harzianum, T. virens and Bacillus subtilis for controlling Heterodera schachtii in field conditions. J Plant Prot. 2011;26(1):75–81.

[263] Mahdizadehnezhagh R, Heydari A, Zamanizadeh HR, Rezaee S, Nikan J. Biological control of garlic (Allium) white rot disease using antagonistic fungi-based bioformulations. J Plant Prot Res. 2015;55(2):136–41.

[264] Majzoob S, Kareag A, Taghavi M, Hamzehzargarhini H. Evaluation of rhizobacteria for antagonistic activity against root-knot nematode Meloidogyne javanica on cucumber under greenhouse condition. Iran J Plant Pathol. 2012;48(1):27–9.

[265] Maleki Ziyaraty H, Sahebani N, Rahnama K. Biological control of root- knot nematode Meloidogyne javanica by Trichoderma harzianum and the study of peroxidase activity changes in tomato. Iran J Plant Prot Sci. 2009;40(1):25–33.

[266] Malik RJ, Dixon MH, Bever JD. Mycorrhizal composition can predict foliar pathogen colonization in soybean. Biol Control. 2016;103:46–53.

[267] Maloy OC. Plant Disease Control: Principles and Practice. New York: John Wiley Sons Inc; 1993. p. 346.

[268] Mansoori B. Evaluation of antagonistic effects of Penicillium polonicum on a number of soil-borne of wheat under laboratory and greenhouse condition. 13th Iranian Plant Protection Congress; 1998. p. 51.

[269] Mansoori M, Heydari A, Hassanzadeh N, Rezae S, Naraghi L. Evaluation of Pseudomonas and Bacillus bacterial antagonists for biological control of cotton Verticillium wilt disease. J Plant Prot Res. 2013;53(2):154–7.

[270] Mansouri pour SM, Alizadeh A, Safaie N. Biological control of Sclerotinia stem rot of canola using wild type and derived antibiotic resistant bacterial antagonists. 18th Iranian Plant Protection Congress; 2008. p. 388.

[271] Manulis S, Epstein E, Shafir H, Lichter A, Barash I. Biosynthesis of indole-3-acetic acid via the indole-3-acetamide pathway in Streptomyces spp. Microbiology. 1994;140:1045–50.

[272] Marefat A, Rand Rahimian H. Identity and population dynamics of epiphytic bacteria of wheat in Mazandaran Tehran and Isfahan and preliminary studies on the antagonistic effects of representative strains on biological control of leaf streak caused by Xanthomonas translucens pv. cereolis. 13th Iranian Plant Protection Congress; 1998. p. 58.

[273] Masudi Sh, Shahidi GH. In vitro evaluation of antagonistic activity of Talaromyces flavus against Rosellinia necatrix the causal agent of white root rot disease. 20th Iranian Plant Protection Congress; 2012. p. 257.

[274] Mazza M, Cook RJ. Effects of fungal root pathogen on the population dynamics of biocontrol strains of fluorescent pseudomonads in the wheat rhizosphere. Appl Environ Microbiology. 1991;57(8):2171–78.

[275] McSpadden BB, Favel DR. Biological control of plant pathogens: research commercialization and application in the USA. Online. Plant Health Prog. 2002;3(1):1–18.

[276] Mehrabi Koshki M, Zafari DM, Rouhani H, Ghalandar M. Evaluation of effect of Trichoderma isolates mustard flour two biological commercial products in control of take-all disease. Agric Sci. 2007;17(3):197–208.

[277] Mehrabi Koshki M, Zafari D, Sharif Nabi B. Control of wheat common bunt by mustard flour Trichoderma isolates and biological materials. J Water Soil Sci. 2009;13(47):741–8.
[278] Merat A, Mihoseini SA, Rohani H. Study on antagonistic effect of Trichoderma spp. from Guilan province on Sclerotinia sclerotiorum causal agent of bud and twig die-back of mulberry trees. 14th Iranian Plant Protection Congress; 2000. p. 336.

[279] Mihajlović M, Rekanović E, Hrustić J, Grahovac M, Tanović B. Methods for management of soilborne plant pathogens. Pestic Fitomod. 2017;32(1):9–24.

[280] Mirhosaini S, Izadyar M, Rohani H. Study on the antagonistic activity of Trichoderma and Gilocladium species on Sclerotium rolfsii causal agent of stem rot of groundnut. 13th Iranian Plant Protection Congress; 1998. p. 109.

[281] Mirkhani F, Alaei M, Mohammadi A, Haghdel M, Kahanougi H. Identification of Trichoderma species isolated from soil of pistachio orchards in Iran and in vitro evaluation for biological control of Phytophthora drechsleri the causal agent of pistachio gummosis. 20th Iranian Plant Protection Congress; 2012. p. 291.

[282] Mirzaie M, Aminian H, Alizadeh A, Rustaei A, Gholamnejad J. The study of biological control of Erwinia amylovora the causal agent of pear fire blight by some antagonistic bacteria in Damavand. 18th Iranian Plant Protection Congress; 2008. p. 373.

[283] Moayedi G, Mostowfizadeh-Ghalamfarsa R. Antagonistic activities of Trichoderma spp. on Phytophthora root rot of sugar beet Iran. Agric Res. 2011;29(2):21–38.

[284] Moazzenian S, Aminian H, Etebarian HR, Sahebani N. Biological control of Phaseolus vulgaris damping-off caused by Rhizoctonia solani using Streptomycetes microfusus (S6) in greenhouse condition. 20th Iranian Plant Protection Congress; 2012a. p. 299.

[285] Moazzenian S, Aminian H, Etebarian HR, Ghasemi A, Sahebani N. Isolation and characterization of Streptomycetes microfusus (A3) and evaluation of antagonistic effects against Rhizoctonia solani the causal agent of common bean damping-off in vitro. 20th Iranian Plant Protection Congress; 2012b. p. 289.

[286] Mohammadi K, Etebaian HR, Rahimian H, Ghalandar M. Biological control of wheat (Bipolaris sorokiniana) by antagonistic bacteria isolated from wheat rhizosphere. 16th Iranian Plant Protection Congress; 2004. p. 37.

[287] Mohammadi K, Etebarian H, Rahimian H, Ghalandar M. Biological control of common root rot of wheat by antagonistic bacteria isolated from wheat rhizosphere. Iran J Plant Pathol. 2005;41(3):383–402.

[288] Mohammadi P, Kotan R, Tozlu E. The investigation of citrus green mold biological control with Penicillium digitatum agent by antagonistic bacteria. 21th Iranian Plant Protection Congress; 2014. p. 44.

[289] Mohammadi S, Ghanbari L. In vitro Antagonistic Mechanisms of Trichoderma spp. and Talaromyces flavus to Control Gaeumannomyces graminis var. tritici the causal agent of wheat take-all disease. Turkish J Agric-Food Sci Technol. 2015;3(8):629–34.

[290] Mohammadi S, Mansoori B, Zamani-Zahed HR, Heydari A. Biological control of Rhizoctonia solani the causal agent of wet root of chickpea in greenhouse conditions. 16th Iranian Plant Protection Congress; 2004a. p. 189.

[291] Mokhtari S, Navaz-allah Sahebani NA, Etebarian HR. Biological control of root-knot nematode (Meloidogyne javanica) by Pseudomonas fluorescens CHA0 and Trichoderma harzianum BI in tomato. Biol Control Pests Plant Dis. 2015;3(2):117–26.

[292] Mokhtari S, Montazeri R, Sahebani N, Etebarian HR. Study of Biological control and systemic induction of polyphenol oxidase and catalase enzymes activity in tomato plant infected with root-knot nematode by Pseudomonas fluorescens CHA0 antagonist. 18th Iranian Plant Protection Congress; 2008b. p. 262.

[293] Montakhbhi MK, Rahimian H, Falahati Rastegar M, Jafarpour B. In vitro investigation on biocontrol of Xanthomonas axonopodis pv. citri cause of citrus bacterial canker by citrus antagonistic bacteria. J Plant Prot. 2010;24(4):368–76.

[294] Montazernia B, Rahnama K, Barari H, Naemish SM. Evaluation of Trichoderma spp. isolated from soybean field against of Macrophomina phaseolina the causal agent of charcoal rot disease. 18th Iranian Plant Protection Congress; 2008. p. 379.

[295] Mostofizadeh-Ghalamfarsa R, Banihashemi Z, Taghavi SM. Antagonistic mechanisms of wheat rhizosphere fluorescens Pseudomonads and their inhibition on root pathogenic Fusarium species in Fars province. 15th Iranian Plant Protection Congress; 2002. p. 25.

[296] Motamedeh H, Zahedi E, Abadie AZM. Optimizing conditions for the production of antifungal agents using the native Bacillus cereus SB15 Feyz. J Kashan Univ Med Sci. 2017;21(1):9–18.

[297] Mousavi Mirak SS. The evaluation of inhibitory effect of in sugar beet rhizosphere antagonistic bacteria on the growth of Cercospora beticola fungi the causal agent of sugar beet cercospora leaf spot. 21th Iranian Plant Protection Congress; 2014. p. 48.

[298] Mousavi SA, Rahimiyah H, Zohour E, Nasrollah-Nejad S. Investigation of antagonistic effects of some strains Pseudomonas fluorescens on Clavibacter michiganensis subsp. michiganensis in vitro. 18th Iranian Plant Protection Congress; 2008a. p. 371.

[299] Mousavi SA, Rahimiyah H, Zohour E, Nasrollah-Nejad S. Investigation of antagonistic effects of some strains of Pseudomonas fluorescens on Xanthomonas campestris pv. tomato in vitro. 18th Iranian Plant Protection Congress; 2008b. p. 370.

[300] Naeimi S, Okhovvat SM, Javan-Nikkah M, Vágvölgyi C, Khorasvi V, Kredics L. Biological control of Rhizoctonia solani AG1-1A the causal agent of rice sheath blight with Trichoderma strains. Phytopathol Mediter. 2010;49(3):287–300.

[301] Naeimi Sh, Zare R. Evaluation of indigenous Trichoderma spp. isolates in biological control of Botrytis cinerea the causal agent of strawberry gray mold disease. J Biocontrol Plant Prot. 2013;2(5):55–74.

[302] Naghed H, Sadravi M, Kazemi S. Biological control of chickpea blight with some isolates of three species of Trichoderma. Biol Control Pests Plant Dis. 2016;51(1):123–7.

[303] Naher L, Yusuf UK, Ismail A, Hossain K. Trichoderma spp.: a biocontrol agent for sustainable management of plant diseases. Pak J Botany. 2014;46(4):1489–93.

[304] Najmeh A, Dostmorad ZA, Mansoureh M. Combination of Trichoderma species and Bradyrhizobium japonicum in...
control of *Phytophthora sojae* and soybean growth. J Crop Prot. 2012;1(1):67–79.

[305] Naraghi L, Heydari A, Afshari Azad H, Sharifi K. Antagonistic effects of *Talaromyces flavus* on some soil-borne pathogens of potato tomato and greenhouse cucumber. 20th Iranian Plant Protection Congress; 2012a. p. 278.

[306] Naraghi L, Heydari A, Karimi Roozbehani A, Ershad J. Isolation of *Talaromyces flavus* from cotton fields in Gorgan area and investigation of its antagonistic effects against *Verticillium dahliae* causal agent of cotton wilt. 14th Iranian Plant Protection Congress; 2000. p. 277.

[307] Naraghi L, Heydari A, Rezaee S, Razavi M. Biological control of wilt disease caused by *Verticillium albo-atrum* in potato tomato and greenhouse cucumber by *Talaromyces flavus*. 20th Iranian Plant Protection Congress; 2012b. p. 297.

[308] Naraghi L, Heydari A, Rezaee M, Razavi M, Jahanifar H. Biological control of tomato *Verticillium* wilt disease by *Talaromyces flavus*. 19th Iranian Plant Protection Congress; 2010. p. 920.

[309] Naserinasab F, Saheban N, Etebarian HR. Biological control of root knot nematode of tomato *Meloidogyne javanica* with *Trichoderma harzianum* BL and salicylic acid in greenhouse and an investigation of their effect on induction of phenolic compounds and total flavonoids on tomato. Iran J Plant Prot Sci. 2012;43(1):121–31.

[310] Nasir Hussein A, Abbasi S, Sharifi R, Jamali S. The effect of biocontrol agents consortia against *Rhizoctonia* root rot of common bean *Phaseolus vulgaris*. J Crop Prot. 2018;7(1):73–85.

[311] Nasiri M, Soleimani MJ, Zafari D. Study on possibility of using *Trichoderma* isolates on biocontrol of potato brown spot caused by *Alternaria alternata*. 20th Iranian Plant Protection Congress; 2012. p. 270.

[312] Nasrolah Nejad F, Rahnama K. Study of antagonistic effects of *Bacillus* bacterium on *Sclerotinia sclerotiorum* the causal agent of stem rot disease in canola. 18th Iranian Plant Protection Congress; 2008. p. 360.

[313] Nasrolah Nejad F, Rahnama K, Zafari D, Sadravi M, Nasrolah Nejad S, Vakili Zaraji Z. Study of antagonistic assessment of *Trichoderma* species on the causal agent of stem rot of canola. J Agric Sci Nat Resour. 2009;16(1b):1–11.

[314] Nasrollahi Omran A, Beighy Firooz Jaei F, Sangi M. Biological control of green and blue mold agents in oranges by citrus fruit epiphytic microbes in north of Iran. Plant Prot J. 2011;3(4):377–91.

[315] Nazari F, Momeni H, Rabani Nasab H. Antagonistic effects of *Pseudomonas putida* strains P5 and P13 formulated in biological fertilizers against *Rhizoctonia solani* (sugar beet root rot and seedling damping off) and *Fusarium oxysporum* f s tuberosi (*Fusarium dry* rot of potato). 20th Iranian Plant Protection Congress; 2012. p. 269.

[316] Nazari F, Safaei N, Soltani BM, Shams-Bakhsh M, Sharifi M. Study of flavonoids produced by *Bacillus subtilis* due to its biocontrol effect on *Agrobacterium tumefaciens* in tobacco plants. 22th Iranian Plant Protection Congress; 2016. p. 272.

[317] Nazerian E, Javadi S, Mirabolbathi M, Mohamadalian Y. Study on possibility of biocontrol on ornamental plants root rot caused by *Phytophthora* sp. 18th Iranian Plant Protection Congress; 2008. p. 358.

[318] Nego A. Review on concepts in biological control of plant pathogens. J Biol Agri Healthc. 2014;4(27):33–54.

[319] Niknejad Kazempour M, Pedramfar H, Elahinia SA. Effect of certain fungicides and isolates of antagonistic fungi on *Rhizoctonia solani* the causal agent of rice sheath blight. J Water Sci. 2002;6(4):151–58.

[320] Niknejad K, Sharifi-Tehrani A, Okhovat M. Effect of antagonistic fungi *Trichoderma* spp. on the control of *Fusarium* wilt of tomato caused *Fusarium oxysporum* f s p. *lycopersici* under greenhouse conditions. Iran J Agric Sci. 2000;31(1):31–37.

[321] Niknejad-Kazempour M, Pedramfar H, Elahinia SA. Effect of some fungicides and certain isolates antagonistic fungi to control rice sheath blight caused by *Rhizoctonia solani* under in vitro and greenhouse conditions. 14th Iranian Plant Protection Congress; 2000. p. 248.

[322] Niknejad-Kazempour M. Biological control of *Rhizoctonia solani* the causal agent of rice sheath blight with *Pseudomonas fluorescens* in greenhouse and field conditions. 16th Iranian Plant Protection Congress; 2004a. p. 88.

[323] Niknejad-Kazempour M, Anvary M, Elahinia E. Biological control of *Fusarium moniliform* the causal agent of collar and root rot of rice by antagonistic bacteria. 16th Iranian Plant Protection Congress; 2004b. p. 87.

[324] Niknejad-Kazempour M, hamran E, Merat A. Biological control of the causal agents of root rot of mulberry by antagonistic bacteria. 16th Iranian Plant Protection Congress; 2006. p. 347.

[325] Ningaraju TM. Cloning and characterization of chitinase gene/s from native isolates of Msc thesis *Serratia marcescens*. Dhawar; UAS; 2006. p. 144.

[326] Noorizadeh S, Golmohammadi M, Jamali S. Biological control of important citrus pathogenic fungi by some isolated actinomycetes from citrus rhizosphere. 20th Iranian Plant Protection Congress; 2012. p. 303.

[327] Norouzi K, Khara J, Ghosta Y. Effects of three *Glomus* species as biocontrol agents against *Verticillium*-induced wilt in cotton. J Plant Prot Res. 2009;49(2):185–9.

[328] Norouzian SJ, Etebarian HR, Khodakaramian G, Torabi M, Karimi N. Biological control of crown rot of wheat with *Pseudomonas fluorescens*, *Bacillus subtilis* and *Streptomyces* sp. 23th Iranian Plant Protection Congress; 2018. p. 877.

[329] Norouzian SJ, Etebarian HR, Khodakaramian G, Torabi M. Isolation and selection bacterial antagonists for biological control of *Fusarium graminearum*. 15th Iranian Plant Protection Congress; 2002. p. 179.

[330] Nosrati S. Investigation on The Ability of *Trichoderma* spp. existent in the soil of cucumber greenhouses of Yazd province to control *Fusarium* wilt agent in vitro condition. Biol Control Pest Plant Dis. 2018;7(1):99–102.

[331] Norouzian J, Etebarian HR, Khodakaramian G. Biological control of *Fusarium graminearum* on wheat by antagonistic bacteria *Songkianakarin*. J Sci Technol. 2006;28(1):29–38.

[332] Ojaghian SMR, Zafari D, Khodakaramian Gh. Biological control of *Sclerotinia sclerotiorum* the causal agent of potato white mold by different *Trichoderma* spp. and *Coniothyrium minitans*. J Agric Sci Sustain Prod. 2010;20(1):107–19.

[333] Ojaghian MR, Zafari D, Khodakaramian Gh. Biological control of *Sclerotinia sclerotiorum* the causal agent of potato white mold by different *Trichoderma* spp. and *Coniothyrium minitans*. J Agric Sci Sustain Prod. 2010;20(1):107–19.
mold in Hamedan province. 18th Iranian Plant Protection Congress; 2008. p. 345.

[334] Okhovat M. In vitro antagonistic effects of Trichoderma spp. on several soil-borne plant pathogenic fungi. J Sci Islamic Repub Iran. 1997;8(2):86–95.

[335] Okhovat M, Zafari DM, Karimi-Roosbahani AR, Rohani. Evaluation of antagonistic effects of Trichoderma on Colletotrichum coccodes isolated from potato. 11th Iranian Plant Protection Congress; 1994. p. 149.

[336] Okhovat M, Karampour F. Effect of some isolates of antagonistic fungi on the control of chickpea black root rot caused by Fusarium solani under greenhouse condition. Iran J Agric Sci. 1996;27(2):37–43.

[337] Olanrewaju OS, Babalola OO. Streptomycetes: implications and interactions in plant growth promotion. Appl Microbiol Biotechnol. 2019;103(3):1179–88.

[338] Omidi Nasab M, Khodakaramian G. Inhibition of alfalfa endophytic bacteria against Clavibacter michiganensis subsp. insidiosus causal agent of wilt disease in vitro and greenhouse conditions. Biocontrol Plant Prot. 2017;5(1):1–13.

[339] Ommati F, Khavaziand K, Akhyani A. A study on effect of Fluorescent Pseudomonads in controlling Fusarium wilt of potato in Semnan province. 18th Iranian Plant Protection Congress; 2008. p. 295.

[340] Ommati F, Zaker. In vitro and greenhouse evaluations of Trichoderma isolates for biological control of potato wilt disease (Fusarium solani). Arch Phytopathology Plant Protect. 2012;45(14):1715–23.

[341] Ommati F, Zaker M, Mohammadi A. Biological control of Fusarium wilt of potato (Fusarium oxysporum f. sp. tuberosi) by Trichoderma isolates under field condition and their effect on yield. J Crop Prot. 2013;2(4):435–42.

[342] Omrani Kh, Minassian V, Farokhnejad EJ. Biological control of Sclerotinia sclerotiorum (Lib) de Bary the causal agent of aubergine white mold. 14th Iranian Plant Protection Congress; 2000. p. 97.

[343] Oostendorp M, Sikora RA. Seed treatment with antagonistic rhizobacteria for the suppression of Heterodera schachtii early root infection of sugar beet. Rev de nematologie. 1989;12:77–83.

[344] Padasht Dehkaei F, Mansouri Jaijai SH, Rouhani H. Effects of paddy soil antagonist microorganisms of Guilan on the causal agent of rice bakanae disease. J Water Soil Sci. 2004;8(1):213–21.

[345] Padasht DF, Izdary M. Study On the biological control of rice blast disease in the field condition. J Agric Sci Nat Resour. 2007;13(6):84–92.

[346] Padasht-Dehkaei F, Popushoi I, Izdary M, Khodakaramian G. Biological control of rice blast disease in the field conditions. 16th Iranian Plant Protection Congress; 2004. p. 106.

[347] Pakdaman BS, Goltepeh EM, Soltani BM, Talebi AA, Nadeemoor M, Joanna SK, et al. Toward the quantification of confrontation (Dual Culture) test: a case study on the biological control of Pythium aphanidermatum with Trichoderma asperelloides. J Biofertil Biopesticides. 2013;4(2):137–41.

[348] Pakniet M, Banishahem Z. Biological control of root knot nematode (Meloidogyne javanica) by Paecilomyces lilacinus on tomato. 15th Iranian Plant Protection Congress; 2002. p. 107.

[349] Pal KK, McSpadden GB. Biological Control of Plant Pathogens. The Plant Health Instructor; 2006.

[350] Palaniuandi SA, Damodharan K, Yang SH, Suh JW. Streptomycetes sp. strain PGPA39 alleviates salt stress and promotes growth of ‘Micro Tom’ tomato plants. J Appl Microbiology. 2014;117(3):766–73.

[351] Palizi P, Goltapeh E, Pourjam E, Safaie N. Potential of oyster mushrooms for the biocontrol of sugar beet nematode (Heteroder a schachtii). J Plant Prot Res. 2009;49(1):27–34.

[352] Panjekheh N, Saberyan A, Afshari Azad H, Salari M. Biological control of Phoma lingam the causal agent of rapeseed blackleg by Trichoderma and Bacillus subtilis isolates. Iran J Plant Pathol. 2011;47(1):19–30.

[353] Parveen S, Wani AH, Bhat MY, Koka JA. Biological control of postharvest fungal rots of rosaceous fruits using microbial antagonists and plant extracts. Czech Mycology. 2016;98(1):41–66.

[354] Patten CL, Glick BR. Role of Pseudomonas putida indole-3acetic acid in development of the host plant root system. Appl Environ Microbiology. 2002;68(8):3795–801.

[355] Peighami-Asghaeei S, Sharifi-Tehrani A, Ahmadzadeh M, Behboudi K. Interaction of different media on production and biocontrol efficacy of Pseudomonas fluorescens P-35 and Bacillus subtilis B-3 against grey mould of apple. J Plant Pathol. 2009a;65–70.

[356] Peighami-Asghaeei S, Sharifi-Tehrani A, Ahmadzadeh M, Behboudi K. Screening of Pseudomonas and Bacillus isolates for potential biocontrol of the damping-off of bean (Phaseolus coccineus). Commun Agric Appl Biol Sci. 2009b;74(3):745–8.

[357] Peighamy-Asghaeei S, Sharifi-Tehrani A, Ahmadzadeh M, Behboudi K. Effect of carbon and nitrogen sources on growth and biological efficacy of Pseudomonas fluorescens and Bacillus subtilis against Rhizoctonia solani the causal agent of bean damping-off. Commun Agric Appl Biol Sci. 2007;72(4):951–6.

[358] Peyghami E, Babadoost M. Studying biological control of common and dwarf bunts of wheat. 12th Iranian Plant Protection Congress; 1996. p. 32.

[359] Peyghami E, Nishabouri MR. Studying biological control of cucumber Fusarium wilt by Trichoderma harzianum Rifai. 13th Iranian Plant Protection Congress; 1998. p. 178.

[360] Peyghami E. Antagonistic effects of several isolates of Trichoderma on fungi causing onion root rot East Azerbaijan Province Iran. J Agric Sci. 2001;32:747–55.

[361] Pourabadullah Sh, Binesh H. Biological control of rice sheat blight with antagonistic fungi. 11th Iranian Plant Protection Congress; 1994. p. 68.

[362] Pourmehdi Alamdarlou R, Zaman Mirabadi A, Fakharian S. Antagonistic effect of Coniothyrium minitans on the sclerotia of Sclerotinia sclerotiorum in Mazandaran province. 17th Iranian Plant Protection Congress; 2006. p. 469.

[363] Raaijmakers JM, Mazzola M. Diversity and natural functions of antibiotics produced by beneficial and plant pathogenic bacteria. Annu Rev Phytopathol. 2012;50:403–24.

[364] Raeesi H, Djavaheri M, Taghavi SM. Biocontrol effect of Trichoderma species on disease severity of Magnaporthe grisea. 20th Iranian Plant Protection Congress; 2012a. p. 250.

[365] Raeesi H, Djavaheri M, Taghavi SM. Biocontrol activity of T. harzianum against Botrytis cinerea in laboratory and
Rahanandeh H, Moshaiedy M. Potency evaluation of *Pseudomonas aeruginosa* and *Pseudomonas fluorescens* as biocontrol agents for root-knot nematodes in Iran. Int J Biosci. 2014;12:222–8.

Rahanandeh H, Khodakaramian G, Hassanzadeh N, Seraji A, Aghari SM. Evaluation of antagonistic *Pseudomonas* against root lesion nematode of tea. Int J Biosci. 2013;3(3):52–40.

Rahanandeh H, Khodakaramian G, Hassanzadeh N, Seraji A, Aghari SM, Tarang AR. Inhibition of tea root lesion nematode *Pratylenchus loosi* by rhizosphere bacteria. Online J Manag Syst. 2012;2(4):243–50.

Rahnama K, Cooke RC. Evaluation of mycoparasitism effect on oospores and sporangia of *Pythium ultimum* by *Pythium oligandrum*. 13th Iranian Plant Protection Congress; 1998. p. 302.

Ramadan EM, AbdelHafez AA, Hassan EA, Saber FM. Plant growth promoting rhizobacteria and their potential for biocontrol of phytopathogens. Afr J Microbiol Res. 2016;10:486–504.

Ramezani H. Biological control of root-rot of eggplant caused by *Macrophomina phaseolina* American-Eurasian. J Agric Environ Sci D. 2008;4:218–20.

Ramezani-Baghmishezad M, Sharifi-Tehrani A, Rohani H, Zakeri Z. Study on the effect of some antagonistic bacteria against *Fusarium oxysporum* the causal agent of basal and root rot in greenhouse and field conditions. 16th Iranian Plant Protection Congress; 2004. p. 239.

Ranjbar Chaharborj S, Shirzad A, Arzanlou M. Evaluation of the biocontrol ability of *Pichia membranaefaciens* yeast against *Aspergillus tubingensis* and *Penicillium crustosum* causing bunch rot disease in grapes. Biol Control Pests Plant Dis. 2016;5(1):97–110.

Ranjbar Sistani S, Behboudi K, Sharifi Tehrani A, Razavi M, Ghasemi A. Biological control of common root rot of wheat by fluorescent pseudomonads isolated from wheat rhizosphere. 19th Iranian Plant Protection Congress; 2010. p. 841.

Reddy KRK, Jyothi G, Sowjanya Ch, Kusumamjali K, Malathi N, Subramaniam G. Editors. Plant Growth-Promoting Actinomycetes: mass production delivery systems and commercialization in plant growth promoting Actinobacteria. Singapore: Springer; 2016. p. 287–98.

Rezaei R, Alizadeh HR, Azadvar M, Salari K. Evaluation of *Bacillus* spp. isolates for biological control of *Pythium aphanidermatum* causal agent of cucumber damping-off. 22th Iranian Plant Protection Congress; 2016. p. 351.

Roodgar E, Foroutan A, Khorasv V, Eskandar IA, Naeimi Sh. Study on possibility of biological control of rice bakanane disease with *Trichoderma* isolates in Mazandaran province. 19th Iranian Plant Protection Congress; 2010. p. 844.

Roohabadi I, Rowhani H, Hamedi Kakhi A, Mahdikhan Moghadam E. The in vitro evaluation of Trichoderma isolates for biological control of *Bipolaris australiensis* and *Botrytis cinerea* the causal agents of saffron corm rot. 20th Iranian Plant Protection Congress; 2012. p. 260.

Rostami SH, Maleki M, Shahriyari D, Farzaneh M. Investigation of the effect of *Bacillus* sp. antagonistic isolates on biological control of *Sclerotinia sclerotiorum* cucumber stem rot in vitro. 20th Iranian Plant Protection Congress; 2012. p. 310.

Rouhani H, Safari M. Study on antagonistic effect of *Aspergillus niger* on *Pythium butleri*. 13th Iranian Plant Protection Congress; 1998. p. 301.

Saberi-Riseh R, Fathi F. Biocontrol of *Fusarium oxysporum* in cucumber by some antagonist bacteria under drought stress. J Crop Prot. 2018;7(4):375–85.

Saberi-Riseh R, Sharifi-Tehrani A, Hejardoun GH, Mohammadi M. Antagonistic effects of several bacteria on *Phytophthora citrophthora* the causal agent of gummosis (root and crown rot) of pistachio. 16th Iranian Plant Protection Congress; 2004. p. 381.

Sadeghi B, Hatami N. Evaluation of antifungal activity of Streptomycetes isolates against cucumber *Fusarium rot*. 20th Iranian Plant Protection Congress; 2012. p. 296.

Sadeghi B. Evaluation of Streptomycetes isolates for biological control of *Phytophthora parasitica* the causal agent of citrus root rot. 20th Iranian Plant Protection Congress; 2012. p. 253.

Sadeghi B, Hatami N. Screening biological activities of soil-borne *Streptomycetes* sp. against several phytopathogenic fungi. Arch Phytopathol Plant Prot. 2014;47(8):954–8.

Safaei D, Heydari A, Hesan A, Younesi H. Investigation of the possibility of biological control of sugar beet seedling damping-off and root rot disease in the field condition in Kermanshah province using Trichoderma *hazianum* and *T. viride*. 18th Iranian Plant Protection Congress; 2008. p. 308.

Safari Asl E, Rouhani H, Falahati Rastegar M. Study of antagonistic mechanisms of *Bacillus* spp. in biocontrol of cucumber root and foot rot caused by *Pythium aphanidermatum* in the Tonekabon fields. 19th Iranian Plant Protection Congress; 2010. p. 871.

Safar Motlagh MR, Mohammadian S. Biological control of rice brown spot disease caused by *Bipolaris victoriae* by some fungal isolates in the greenhouse and in vitro conditions. Biocontrol Plant Prot. 2016;3(2):11–25.

Safdarpour F, Khodakaramian G. Assessment of biocontrol ability of some tomato rhizosphere *Bacillus* spp. towards the causal agent of *Verticillium* wilts disease. 22th Iranian Plant Protection Congress; 2016. p. 303.

Sajjadi S, Hasan ZN, Bahrami M, Khosravi V. A possible approach to biocontrol of rice sheath blight with some antagonistic bacteria. J Agric Sci. 2006;12(1):201–213.

Sajjadi SA, Asemi H. Evaluation of biological control potential *Trichoderma* species against of tobacco collar rot in Mazandaran province. N Find Agriculture. 2008;2(3):253–70.

Sajjadi A, Hassanzadeh N, Bahrami M, Khosravi V. Studies the effects of some antagonistic bacteria against rice sheath blight on seed germination percentage and different rice growth stages. 16th Iranian Plant Protection Congress; 2004. p. 303.

Salari M, Hajan-Shahri M, Rohani H Farrokh F, Ravan S. Biological control of Rhizoctonia solani (AG6) damping-off of sugar beet with *Pythium oligandrum*. 18th Iranian Plant Protection Congress; 2008a. p. 312.

Salari M, Salehi Jouzani Gh, Panjeke N, Mohamadipour M, Mousivand M. Evaluation of biocontrol potential *Bacillus subtilis* strains producing surfactin against Citrus anthracnose. 18th Iranian Plant Protection Congress; 2008b. p. 250.

Salari M, Shahidi Bonjar GH, Sadeghi B, Panjeke N, Aminnaii MM, Shakery T. Investigation biological control two strains of antifungal actinomycetes against *Phytophthora*
parasitica and P. citrophthora in vitro and in vivo. Cond J Plant Prot. 2011;24(4):437–44.

[396] Salehpour M, Etebarian HR, Roustaii MA, Khodakaramian Gh, Aminian H. Biological control of Bipolaris sorokiniana causal agent of common root rot of wheat by Trichoderma spp. and Streptomyces spp. 16th Iranian Plant Protection Congress; 2004. p. 55.

[397] Samavat S, Heydari A, Zamanizadeh HR, Rezaee S, Aliabadi AA. A comparison between Pseudomonas aureofaciens (chlororaphis) and P. fluorescens in biological control of cotton seedling damping-off disease. J Plant Prot Res. 2016;54(2):115–21.

[398] Sanei SJ, Ghabadi A. Interaction of antagonistic and pathogens in biological control of soybean root rot. 12th Iranian Plant Protection Congress; 1996. p. 112.

[399] Sarani SA, Sharifi TA, Ahmadzadeh M, Javan NM. Biological control of canola rhizoctonia damping off by application of Burkholderia cepacia. Plant Prot (Sci J Agriculture). 2010;32(2):1–14.

[400] Sarani SH, Sharifi Tehrani A, Ahmadzadeh M, Javan Nikkhah M. Application of Fluorescent Pseudomonads in biological control of Rhizoctonia solani causal agent of Colza. JWSS-Isfahan Univ Technol. 2008a; 11(42):261–70.

[401] Sarani ShA, Sharifi Tehrani A, Ahmadzadeh M, Javan Nikkhah M. The study of correlation between antifungal metabolites production of antagonistic bacteria and biological control of Rhizoctonia solani the causal agent of canola damping-off. 18th Iranian Plant Protection Congress; 2008b. p. 314.

[402] Saravanakumar DA, Ciavarella D, Spadaro A, Garibaldi A, Selselehzakeri Sh, Akhavansepahi A, Rezapanah MR. An investigation on antifungal activity and compounds of S. plicatus strain MACH1 out competes Botrytis cinerea, Alternaria alternata and Penicillium expansum in apples through iron depletion Postharvest. Postharvest Biol Technol. 2008;49:121–28.

[403] Sedaghatfar A, Hassanzadeh N, Heydari A, Foroutan AR. Suppression of Take-all disease of wheat by bacterial isolates of in Pseudomonas spp. greenhouse condition. 15th Iranian Plant Protection Congress; 2002. p. 17.

[404] Selselehzakeri Sh, Akhavansepehi A, Rezapanah MR. An investigation on antifungal activity and compounds of Bacillus subtilis against some plant pathogenic fungi. 18th Iranian Plant Protection Congress; 2008. p. 299.

[405] Shahbazi H, Behboudi K, Nikkhah MJ, Ahmadzadeh M. Detection of hcnAB and phiD genes in fluorescent pseudomonads biological control agent of Fusarium graminearum and studying their ability to ectohyphosphere colonization of wheat. Biol Control Pests Plant Dis. 2015;4(2):143–55.

[406] Shahid S, Khan MR. Biological control of root-rot on mungbean plants incited by Macrophomina phaseolina through microbial antagonists. Plant Pathol J. 2016;15(2):27–39.

[407] Shahidi Bonjar GH, Aghighi S. Chitinolytic and microclicerotic static activity of Iranian strains of Streptomyces plicatus and Frankia sp. on olive isolate of Verticillium dahliae. Biotechnology. 2005;4(2):108–13.

[408] Shahidi Bonjar GH, Zamanian S, Aghighi S, Rahimian H, Masoumi H, Hoseini Pour A, et al. Antibacterial activity of Streptomyces corals strain 63 and S. plicatus strain 101 against Ralstonia solanacearum and Pectobacterium caroto- varum sub.ssp. carotovorum. 17th Iranian Plant Protection Congress; 2006. p. 467.

[409] Shahiri Tabarestani M, Flahati Rastegar M, Jafarpour B, Rohani H. Biological control of sugar beet Rhizoctonia root rot by Trichoderma, Gliocladium and Bacillus subtilis in vitro and in vivo. 14th Iranian Plant Protection Congress; 2000. p. 65.

[410] Shahiri TM, Falahati RM, Jafarpour B, Rouhani H. Investigation of antagonistic effect of Bacillus subtilis on biological control of sugar beet damping-off disease. J Sugarbeet. 2005;20(2):161–74.

[411] Shahriari D, Naraghi L, Sarpeleh A, Hydrae A, Afshari Azad H. Decrease in the incidence of cucumber Fusarium wilt in Varamin greenhouses using Talarymeces flavus. 22th Iranian Plant Protection Congress; 2016. p. 270.

[412] Shahriari D, Okhovat M, Rohani H. Biological control of P. ultimum the causal agent of chickpea seed-rot and damping-off by antagonistic fungi. 12th Iranian Plant Protection Congress; 1996. p. 147.

[413] Shams M, Shahnazav B. Evaluation of antimicrobial activity some of marine Streptomyces sp. against three plant pathogens. Biol Control Pests Plant Dis. 2017;6(1):73–82.

[414] Sharif-Tehrani A, Ahmadzadeh M, Sarani S, Farzaneh M. Powder formulation of Burkholderia cepacia for control of rape seed damping-off caused by Rhizoctonia solani. Commun Agric Appl Biol Sci. 2007;72(2):129–36.

[415] Sharify A, Sharzei A, Ramshini HA. Isolation and identification and evaluation of biological control potential of Trichoderma citrinoviride isolates against root and crown rot of wheat. 22th Iranian Plant Protection Congress; 2016a. p. 362.

[416] Sharify A, Sharzei A, Ramshini HA. Isolation and identification and evaluation of biological control potential of Trichoderma asperellum isolates against root and crown rot of wheat. 22th Iranian Plant Protection Congress; 2016b. p. 369.

[417] Shetab-Booshehri SM, Zad J, Hejaroud GHA, Okhovat M, Farokhinezhad R. The effects of several fungicides and antagonist fungi (Trichoderma spp.) on Maunginella scoetae Cav the causal agent of date palm inflorecence rot (Khamje). 13th Iranian Plant Protection Congress; 1998. p. 227.

[418] Shirazi K, NasrEsfahani M, Atabaki N, Mohsenzade Kermani A. Study of antagonistic effects of some fungi isolates and bioproducts in controlling sugar beet cyst nematode in the greenhouse. 22th Iranian Plant Protection Congress; 2016. p. 388.

[419] Sikora RA. Management of the antagonistic potential in agricultural ecosystems for the biological control of plant parasitic nematodes. Annu Rev Phytopathology. 1992;30:245–70.

[420] Sindhu SS, Sehrawat A, Sharma R, Daihii A. Biopesticides: use of rhizosphere bacteria for biological control of plant pathogens. Def Life Sci J. 2016;1(2):135–48.

[421] Sindhu SS, Rakshiya YS, Sahu G. Biological control of soil borne plant pathogens with rhizosphere bacteria. Pest Technol. 2009;3:10–21.

[422] Soharabi M, Mohammadi H, Mohammad AH. Effects of two arbuscular mycorrhizal fungi Glomus mossae and Glomus intraradices on pea root rot disease caused by Fusarium solani f.sp. pisi under greenhouse conditions. Biol Control Pests Plant Dis. 2014;2(2):129–37.

[423] Soltani H, Zafari D, Rouhani H. A study on biological control of the crown root and tuber fungal diseases of potato by Trichoderma harzianum under in-vivo and field condition in Hamadan. Agric Res. 2006;5(3):13–25.
[424] Soltanzadeh M, Soltani Nejad M, Shahidi Bonjag HR. Application of soil-borne actinomycetes for biological control against Fusarium wilt of chickpea (Cicer arietinum) caused by Fusarium solani. I. Phytopathology. 2016;364(11–12):967–78.

[425] Soofi S, Safaie N, Shahbazi S. Evaluation of antagonistic properties of Trichoderma viride mutants against some fungal plant pathogens. 20th Iranian Plant Protection Congress; 2012. p. 259.

[426] Spadaro D, Gullino ML. State of the art and future prospects of the biological control of postharvest citrus fungal plant pathogens. 20th Islamic International Plant Pathology Congress; 2016;96:8–12.

[427] Sziderics AH, Rasche F, Trognitz F, Sessitsch A, Wilhelm E. Tabe Bordbar E, Etebarian HR, Sahebany N, Rohani H. Biological control of apple blue mold by Trichoderma viride (T8) and inoculation of defense responses at 20°C. 18th Iranian Plant Protection Congress; 2008a. p. 251.

[428] Taheri H, Minassian V, Farrokhinejad R. Investigation on the possibility of biological and chemical control of citrus branch wilt disease by 16th Iranian Plant Protection Congress; 2004. p. 258.

[429] Taghinasab M, Roshani H. Control of control of blue mold of apple fruit by Trichoderma viride (T8) and inoculation of defense responses at 20°C. 18th Iranian Plant Protection Congress; 2008a. p. 251.

[430] Tabe-Bordbar F, Etebarian HR, Safaie N, Rohani H. Biological control of apple blue mold Penicillium solitum by Trichoderma isolates. 18th Iranian Plant Protection Congress; 2008b. p. 324.

[431] Tabe Bordbar E, Etebarian HR, Sahebany N, Rohani H. Biological control of apple blue mold Penicillium solitum by Trichoderma isolates. 18th Iranian Plant Protection Congress; 2008b. p. 324.

[432] Tehrani M, Nanassian V, Farrokhinejad R. Investigation on the possibility of biological and chemical control of citrus branch wilt disease by 16th Iranian Plant Protection Congress; 2004. p. 258.

[433] Tajalipour S, Hassanzadeh N, Khabbaz Jofaei H, Heydari A. Ghasemi A. Biological control of mushroom brown blotch disease using antagonistic bacteria. Biocontrol Sci Technol. 2014;24(4):473–84.

[434] Tajalipour Sh, Hassanzadeh N, Heydari A, Khabbab Jofaei H. Biological control of brown blotch disease of white button mushroom (Agaricus bisporus) by some antagonistic bacteria. 20th Iranian Plant Protection Congress; 2012. p. 300.

[435] Talibi I, Boubaker H, Bouyach EH, Ali Ben Aoumar A. Alternative methods for the control of postharvest citrus diseases. J Appl Microbiology. 2014;117(1):1–17.

[436] Tanha B, Bayat F, Jamali F, Saedi Zadeh AA. Evaluation of Pseudomonas fluorescens strains for biological control of root-srot nematode in some tomato cultivars. J Biocontrol Plant Prot. 2016;3(2):27–39.

[437] Tashiy-Oshnoi F, Harighe B, Abdollahzadeh J. Isolation and identification of endophytic bacteria with plant growth promoting and biocontrol potential from oak trees. For Pathol. 2017;47(5):12360.

[438] Toghueo RMK, Ekpe P, González IZ, de Aldanab BRV, Nanaa LW, Boyoma FF. Biocontrol and growth enhancement potential of two endophytic Trichoderma spp. from Terminalia catappa against the causative agent of Common Bean Root Rot (Fusarium solani). Biol Control. 2016;96:8–20.

[439] Turatto MF, Dourado FDS, Zilli JE, Botelho GR. Environmental microbiology: control potential of Meloidogyne javanica and Ditylenchus spp. Using fluorescent Pseudomonas and Bacillus spp. Braz J Microbiology. 2017;49(1):54–8.

[440] Ulloa-Ogaz AL, Muñoz-Castellanos LN, Nevárez-Moorillón GV. Biocontrol of phytopathogens: antibiotic production as mechanism of control the battle against microbial pathogens: basic science technological advances and educational programs. Spain: Formatex research center; 2015. p. 305–9.

[441] Vafaie A, Behboudi B, Jafarie A. Effect of Streptomyces isolates from tomato rhizosphere on Fusarium oxysporum f.sp. radicis-lycopersici. 23th Iranian Plant Protection Congress; 2018. p. 874.

[442] Vasebi Y, Alizadeh A, Safaie N. Pantoila aggregans ENA1 as a biocontrol agent of Macrophomina phaseolina and growth enhancer of soybean. J Crop Prot. 2015;4(1):43–57.

[443] Vasebi Y, Dehnad AR. Evaluation of antifungal potential of Streptomyces isolates based on molecular identification of chitinase-encoding gene. 20th Iranian Plant Protection Congress; 2012. p. 272.

[444] Vasebi Y, Safaie N, Alizadeh A. Biological control of soybean charcoal root rot disease using bacterial and fungal antagonists in vitro and greenhouse condition. J Crop Prot. 2013;2(2):139–50.

[445] Vinale F, Sivasithamparam K, Ghisalberti EL, Woo SL, Ngro M, Marra R, et al. Trichoderma secondary metabolites active on plants and fungal pathogens. Open Mycology J. 2014;8(Suppl-1):127–39.

[446] Vorholt JA. Microbial life in the phyllosphere. Nat Rev Microbiol. 2012;10:828–40.

[447] Vos CM, De Cremer K, Cammue BPA, De Coninck B. The toolbox of Trichoderma spp. in the biocontrol of Botrytis cinerea disease. Mol Plant Pathol. 2015;16:400–12.

[448] Wissmieski M, Biles C, Doby S, McLaughlin R, Wilson C, Chalutz E. Mode of action of the postharvest biocontrol yeast Pichia guilliermondii i characterization of attachment to Botrytis cinerea. Physiol Mol Plant Pathol. 1991;39(4):245–58.

[449] Yahyavi Azad A, Serajii A, Ali Akbar HJ, Safaei Chaeinkar S. The effect of several antagonistic fungi isolate on biological control of tea root lesion nematode (Pratylenchus loosi). Biol Control Pests Plant Dis. 2018;7(1):21–32.

[450] Yahyavi Azad A, Serajii A, Hojjat Jalali AA, Jamali S. Isolation of antagonistic fungi from tea plantation and study of their impact on tea root lesion nematode Pratylenchus looisi in laboratory. Biocontrol Plant Prot. 2017;5(1):81–91.

[451] Yousef H, Safaei N, Mirabolafathy M, Farvardeh L, Mahdavi V. The effect of Bacillus subtilis on cucumber root and stem rot caused by Fusarium oxysporum f.sp. radicis-cucumerinum. 19th Iranian Plant Protection Congress; 2010. p. 926.

[452] Yousefi H, Hassanzadeh N, Behboudi K, Firouzjahi FB. Identification and determination of characteristics of endophytes from rice plants and their role in biocontrol of bacterial blight caused by Xanthomonas oryzae pv. oryzae. Hellenic Plant Prot J. 2018;11(1):19–33.

[453] Zafar D, Koushey MM, Bazagir E. Biocontrol evaluation of wheat take-all disease by Trichoderma screened isolates. Afr J Biotechnol. 2008;7(20):3650–56.
[454] Zafari D, Rouhani H, Okhovat M, Hejaroud GhA. Biological control of *Phytophthora erythroseptica* by *Trichoderma* spp. 11th Iranian Plant Protection Congress; 1994. p. 156.

[455] Zahed MJ, Behbudi K. Assessment of *Streptomyces* isolates of tomato rhizosphere for biocontrol of *Fusarium oxysporum* f.sp. *radicis-lycopersici*. Biol Control Pests Plant Dis. 2017;6(2):173–85.

[456] Zahed MJ, Behbudi K. Biological control of *Sclerotinia sclerotiorum* (Lib De Bary) cause the cucumber white stem rot by rhizospheric Actinobacteria. Biol Control Pests Plant Dis. 2018;7(1):33–45.

[457] Zamani M, Sharifi TA, Ahmadzadeh M, Ali ZAAA, Farzaneh M. Biological Control of green mold of orange caused by *Penicillium digitatum* with bacterium *Pantoea agglomerans*. Iran J Agric Sci (J Agriculture). 2008a;39(2):345–52.

[458] Zamani M, Tehrani AS, Ahmadzadeh M, Behboudi K, Hosseininaveh V. Biological control of *Penicillium digitatum* on oranges using *Pseudomonas* spp. either alone or in combination with hot sodium bicarbonate dipping. Aust Plant Pathol. 2008b;37(6):605–8.

[459] Zamani M, Sharifi-Tehrani A, Ahmadzadeh M, Alizadeh-Aliabadi A. Biological control of citrus green mold using integrated application of some isolates of *Trichoderma* sp., *Pseudomonas fluorescens* and *Bacillus subtilis* under cold storage. 18th Iranian Plant Protection Congress; 2008c. p. 296.

[460] Zangoei E, Etebarian HR, Sahebani N. Biological control of apple gray mold by mixtures of *Bacillus subtilis* and yeast isolates. Afr J Food Sci. 2014;8(3):155–63.

[461] Zanguei E, Etebarian HR, Sahebani N, Alizadeh A. Improving biocontrol of gray mold disease of apple using a mixture of yeast isolates. Iran J Plant Prot Sci. 2010;41(2):361–72.

[462] Zebarjad A, Sharifi-Tehrani A, Hejaroud GHA, Mohammadi M. A study on the effect of several antagonistic bacteria on control of soybean damping-off disease caused by *Phytophthora sojae*. Iran J Agric Sci (J Agriculture). 2006;37(4):671–86.

[463] Zendehdel N, Hasanzadeh N, Beiki Firouzjahi N, Naeimi S. Isolation of tomato endophytic bacteria and evaluation of their biocontrol potential against *Verticillium dahliae*. 23th Iranian Plant Protection Congress; 2018. p. 880.

[464] Zeynadini-Riseh A, Mahdikhani-Moghadam E, Rouhani H, Moradi M, Saberi-Riseh R, Mohammadi A. Effect of some probiotic bacteria as biocontrol agents of *Meloidogyne incognita* and evaluation of biochemical changes of plant defense enzymes on two cultivars of Pistachio. J Agric Sci Technol. 2018;20(1):179–91.

[465] Ziarati HM, Roustaee A, Sahebani N, Etebarian HR, Aminian H. Study of biological control of root-knot nematode *Meloidogyne javanica* (Trube) Chitwood in tomato by *Trichoderma harzianum* Rifai in greenhouse and quantitative changes of phenolic compounds in plant. Seed Plant Prod J. 2009;25(3):261–74.