EFFECT OF TRICHODERMA IN ROOT COLONIZATION OF ARBUSCULAR MYCORRHIZAL FUNGI IN BRASICCA SPECIES

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ABSTRACT

It is well known that Brassica species act as non-host plants for arbuscular mycorrhizal fungi (AMF). Arbuscular mycorrhizal fungi (AMF) have the ability to setup association with maximum number of terrene plants, including species which has maximum benefit in agriculture. In this way the use of AMF as inoculants to profit plant growth and health. However, this symbiotic isn't a characteristic common to all or any plants, and therefore the incidence of root colonization varies depending on the plant species. Trichoderma species are non- pathogenic soil-borne (free living) fungi that colonize the roots of many plants as opportunistic, avirulent plant symbionts. Additionally, these fungi have been utilized in biotechnological applications and supply important benefits to agriculture, like their capability to protect crops against diseases and boost up crop productivity under field conditions. Trichoderma species are non-pathogenic soil borne fungi that colonize the roots of the many plants as opportunistic, avirulent plant symbionts. Additionally, these fungi have been exploited in biotechnological applications and supply important benefits to agriculture, like their ability to protect crops against disease and increase crop yield under field conditions. It is eminent that Trichoderma species have the potentiality of colonize the rhizosphere of the brassica species, nurturing growth and development in addition to systemic defenses. Brassicaceae plants has a growth in yield when arbuscular mycorrhizal fungi (AMF) and Trichoderma species are together applied to plants. Trichoderma harzianum species has the capability of colonizing the roots and the residence of AMF significantly produces the colonization of AMF in the roots.

INTRODUCTION

Arbuscular mycorrhizal fungi (AMF) are key components of soil microbiota form symbiotic alliance with the roots of most terrene plants, developing the nutritional status of their host and guarding it against several soil-borne plant pathogens (Smith et al., 1997; Harrison, 1999; Bi et al., 2007). The incidence and the effect of root colonization vary counting on the plant species and therefore the AMF (Jeffries and Barea, 2001); They're influenced by soil microorganisms and environmental factors (Azcón-Aguilar and Barea, 1992; Bowen and Rovira, 1999). Trichoderma sp. is a recurrent element of rhizosphere soil and has been noticed to suppress an excellent number of plant diseases (Chet, 1987; Harman and Lumsden, 1990; De Meyer et al., 1998; Elad, 2000; Howell, 2003). Some strains, also, are reported to colonize the basis surface, enhancing root growth and development, crop productivity, resistance to abiotic stresses, and therefore the uptake and use of nutrients (Ousley et al., 1994; Björkman et al., 1998; Harman and Björkman,1998; Rabeendran et al., 2000; Harman et al., 2004). Several reports have demonstrated that the interaction of those two groups of microorganisms could also be beneficial for both plant growth and disease control (Linderman, 1992; Barea et al., 1997; Saldajeno et al., 2008; Martínez-Medina et al., 2009a). A synergistic impact of some saprophytic fungi on Vesicular Arbuscular Mycorrhiza (VAM) spore germination and colonization has been rooted (Calvet et al., 1993; McAllister et al., 1996; Fracchia et al., 1998). for instance, it's been reported that some Trichoderma strains may show effect on VAM activity (Calvet et al., 1992, 1993; Brimner and Boland, 2003; Martinez et al., 2004; Martínez-Medina et al., 2009a). Volatile and soluble exudates generated by saprophytic fungi are involved in these effects (McAllisteret al., 1994, 1995; Fracchia et al., 1998). However, the outcome of the research on the interlinkage between soil saprophytic and VAM fungi differ widely, even when an equivalent species of saprophytic fungi is involved. for instance, Trichoderma harzianum has been found to own unsympathetic, neutral, and stimulating effects on VAM. Even more, the beneficial effect due to these interactions under controlled experimental conditions may not have same results in field experiments (Calvet et al., 1992; McAllister et al., 1997; Fracchia et al., 1998; Vázquez et al., 2000; Martinezet al., 2004). Arbuscular mycorrhizal fungi (AMF) that form symbiotic relationships with the roots of most terrestrial plants are known to enhance the nutritional status of their host and to guard plants against several soil-borne plant pathogens. during this way the utilization of AMF as inoculants to profit plant growth and health could contribute to a discount of the inputs of pesticides and other environmentally harmful chemical products currently required for good plant growth and health. However, this symbiotic association isn't a characteristic common to all or any plants, and therefore the incidence of root colonization varies counting on the plant species and the AMF. The use of AMF in sustainable agriculture requires selection of the accurate host amalgamation, contagious and efficiency being two of the standards for the appropriateness. A successful selection features a significant importance in certain plant species that show a probability to make this symbiosis. Species of Trichoderma, a non-pathogenic saprophyte, are reported to suppress fungal diseases during several crop plants. Some strains are ready to colonize the basis surface, causing changes in plant metabolism and inducing a localized or systemic resistance response. This root colonization by Trichoderma spp. frequently enhances root growth and development, crop productivity, resistance to abiotic stresses and therefore the uptake and use of nutrients.

Benefits of mycorrhizae: Mycorrhizae are symbiotic associations, formed between plants and soil fungi that play a vital role in sustainable crop production and soil fertility. Demand for Vesicular Arbuscular Mycorrhiza (VAM) fungi propagation for agriculture is increasing due to the promotion of plant health, soil fertility, and soil aggregates stability. It benefits the plants by promoting the uptake of water and nutrients. They also have the potential to boost systemic plant responses to natural habitat and biotic conditions. Arbuscular mycorrhizal fungi (AMF) that form symbiotic relationships with the roots of most plants are known to improve the nutritional status of their host and to guars plants against several soil borne plant pathogens. Vesicular Arbuscular Mycorrhiza (VAM) are generated by aseptate mycelial fungi and are presumed due to the two modeled structures vesicles and arbuscules found in roots with type of infection. Vesicular Arbuscular Mycorrhiza (VAM) fungi helps the plants to seize nutrients such as phosphorus and micronutrients from the soil. It is believed that the event of the VAM symbiosis played a supreme role within the primary colonization of the land by plants and in evolution of the vascular plants (Brundrett, 2004). it's been said that it is quicker to list the plants that don't form mycorrhizae than those that do (Harley and Smith, 1983). The mycorrhizal symbiosis may be a foundation to the productivity and variety of natural plant ecosystems (Jeffries et al., 2003). The symbiosis may be a highly evolved mutualistic relationship found between fungi and plants, the most prevalent plant symbiosis known (Simon et al., 1993); and as a result, VAM symbiosis is found in additional than 80% of tracheophyte families of today (Schüßler et al., 2001). The symbionts are formed by the majority of the vascular flowering plants and are found in ecosystems throughout the planet. Generally, the symbionts trade nutrients, and therefore the arbuscular mycorrhizal (AM) fungus obtains carbon from the plant while providing the plant with an additional supply of phosphorus (as phosphate). While much research has focused on nutrient exchange, the VAM symbiosis is associated with a range of additional benefits for the plant including the acquisition of other mineral nutrients, such as nitrogen, phosphorus and resistance to a variety of stresses such as drought, soil/root borne pathogens, salts, heavy metals and soil stability. Consequently, the VAM symbiosis is of tremendous significance to life on this planet, in both natural and agricultural ecosystems (Smith and skim, 1997). The tremendous advances in research on mycorrhizal physiology and ecology over the past 40years have led to a greater understanding of the multiple roles of VAM within the ecosystem. It is very much perceived that diverse mycorrhizal types have shifting abilities to get to natural and inorganic types of supplements in soil (Smith and Read, 2008; Lambers et al., 2008; Read and Perez-Moreno, 2003). Ecto-and ericoid mycorrhizas are normal for plants that develop on natural soils, and it is presently grounded that the exercises of the parasites assemble N (and presumably additionally P) from natural structures in this manner modifying the wellspring of N available to the plant symbionts (for example Peruse furthermore, Perez-Moreno, 2003). Conversely, arbuscular mycorrhizas are normal for plants developing on mineral soils, where inorganic N and P sources are predominant. Arbuscular mycorrhizas are shaped by individuals from the parasitic phylum Glomeromycota (Schüßler et al., 2001). Albeit just a little part of plant species have really been inspected, it is accepted that most of plant species are possibly equipped for framing arbuscular mycorrhizas (e.g.Wang and Qui, 2006).This advantageous interaction is inarguably the most well-known and broad root advantageous interaction, and we limit our conversation in this paper generally to this sort of mycorrhiza. AM growths are committing symbionts furthermore, acquire all their natural carbon (C) necessities from their plant accomplices. In outcome their exercises are not restricted by natural C substrates in soil, just like the case for some free-living microorganisms counting those engaged with supplement cycling. The beneficial interaction is regularly mutualistic dependent on trade of C from the plant and P conveyed by the growths (Smith and Smith, 2011). Different advantages incorporate resistance of microorganisms and improved water relations (Newsham et al., 1995; Sikes et al., 2010). AM parasites may in this way tweak biological system strength to abiotic (for example supplement insufficiency, water pressure, temperature stress e Garrido et al., 2010; Bunn et al., 2009) and biotic burdens (for example plant microorganisms, herbivory - Koricheva et al., 2009; Shah et al., 2008) and could subsequently be significant biological system drivers. AM affiliations are normal for plant types of a moderate successional stage when the sum of N that has been immobilized in the natural litter layer is little (Smith and Read, 2008) and tropical biomes.

Benefits of Trichoderma: Trichoderma (teleomorph Hypocrea) may be a fungal genus found in many ecosystems. Trichoderma spp. can reduce the intensity of plant diseases by suppressing plant pathogens within the soil through their highly potent antagonistic and myco parasitic activity. Moreover, as revealed by research in recent times, some Trichoderma strains can interconnect directly with roots, increasing plant developing ability, resistance to disease and liberality to abiotic stresses. Different soil-borne bacteria and fungi are ready to colonize plant roots and should have beneficial effects on the plant. Besides the classic mycorrhizal fungi and Rhizobium bacteria, other plant-growth encouraging rhizobacteria (PGPR) and fungi like Trichoderma spp. and Piriformospora indica can reviving plant growth by suppressing plant diseases (Van Wees et al., 2008). These micro-organisms can form endophytic associations and interact with other microbes within the rhizosphere, thereby influencing disease protection, plant growth and yield. Trichoderma (teleomorph Hypocrea) may be a fungal genus found in many ecosystems. Some strains have the power to scale back the severity of plant diseases by inhibiting plant pathogens, mainly within the soil or on plant roots, through their high antagonistic and myco parasitic potential (Viterbo & Horwitz, 2010). The current relative genome sequence analysis of two recognized biocontrol species – Trichoderma atroviride and Trichoderma virens – has afforded us a far better understanding of how mycoparasitism arose during a common Trichoderma ancestor as a lifestyle of the genus (Kubicek et al., 2011). The presence of fungal prey and therefore the availability of root-derived nutrients may be major attractors for the ancestors of Trichoderma to determine themselves within the rhizosphere and to facilitate the evolution of positive interconnection with plants (Druzhinina et al., 2011). The control of a broad range of plant pathogens, including fungi, oomycetes, bacterial and viral diseases, through elicitation by Trichoderma of ISR or localized resistance has been reported (Harman et al., 2004). Some Trichoderma rhizosphere-competent strains are shown to possess direct effects on plants, increasing their growth potential and nutrient uptake, fertilizer use efficiency, percentage and rate of seed germination, and stimulation of plant guarding against biotic and abiotic damage (Shoresh et al., 2010). Trichoderma strains are found in many root ecosystems. Similarly, to things with mycorrhizae, the highly hydrated polysaccharides of the root-secreted mucigel layer and consequently the mono- and disaccharides excreted by plant roots into the rhizosphere promote growth of the fungi. it's been noticed that plant-derived sucrose is a major resource supplied to Trichoderma cells to facilitate root colonization, the coordination of defense mechanisms, and increased rate of leaf photosynthesis (Vargas et al., 2009). Strains ready to promote plant growth and supply protection against infections must be ready to colonize plant roots. Colonization involves a capability to acknowledge and cling to roots, penetrate the plant, and withstand toxic metabolites generated by the plant in response to invasion. In Trichoderma, adherence to the basis surface can be mediated by hydrophobins, which are small hydrophobic proteins of the outermost cell membrane layer that coat the fungal cell surface, and expansion like proteins associated with cell membrane development.

Reasons for brassica family susceptible to mycorrhiza: Non-mycorrhizal plant families include, broadly, two groups, occupying strongly contrasting habitats. One group comprises people who typically occur in disturbed habitats, where competition with other plants is low and soil phosphorus (P) availability is high; for instance, Amaranthaceae, Brassicaceae, Caryophyllaceae, Chenopodiaceae, Polygonaceae and Urticaceae (Harley & Harley 1987; Tester, Smith & Smith 1987; Francis & Read 1994; Olsson & Tyler 2004). We ask this group because the Brassicaceae type; these species lack specialized roots to access poorly available P. the advantages of a mycorrhizal habit within the nutrient-rich habitat of those species are presumably very low, thus providing a selective force against mycorrhization. The mechanisms which determine the non-host nature of plant species, preventing the establishment of a functional AM symbiosis, aren't known at the genetic lev-el. The absence of signals regulating morphogenic changes in AM fungal mycelium, either during pre-con-tact growth or at the basis surface, may explain the "im-munity" of non-host plants. Nevertheless, present knowledge of the sequence of fungal development leading to establishment of functional AM symbioses suggests that the non-host nature of plants lies in their inability to trigger expression of fungal genes involved in hyphal commitment to the symbiotic status.

How Trichoderma favours mycorrhizal colonization in brassica species: Trichoderma spp. can colonize root intercellular spaces. Trichoderma strains are found in many root biological systems. Also, to the circumstance with mycorrhizae, the exceptionally hydrated polysaccharides of the root-emitted mucigel layer and the mono-and disaccharides discharged by plant roots into the rhizosphere empower development of the parasites. It has been seen that plant-inferred sucrose is a significant asset given to Trichoderma cells to work with root colonization, the coordination of safeguard instruments, and expanded pace of leaf photosynthesis (Vargas et al., 2009). Solute carriers, for example, a di/tripeptide carrier and a permease/intracellular invertase framework engaged with the procurement of root exudates have been portrayed in Trichoderma (Vizcaı'no et al., 2006; Vargas et al., 2009). Strains ready to advance plant development and give security against diseases should have the option to colonize plant roots. Colonization includes a capacity to perceive and stick to roots, enter the plant, and withstand poisonous metabolites created by the plant in light of intrusion. In Trichoderma, adherence to the root surface can be interceded by hydrophobins, which are little hydrophobic proteins of the peripheral cell divider layer that coat the parasitic cell surface, and expansion-like proteins identified with cell divider advancement. Trichoderma aspirillum produces the class I hydrophobin TasHyd1, which has been appeared to help the colonization of plant roots, perhaps by upgrading its connection to the root surface and shielding the hyphal tips from plant protection compounds (Viterbo and Chet, 2006), and the swollenin TasSwo, an expansion-like protein with a cellulose-restricting space ready to perceive cellulose and change the plant cell divider engineering, working with root colonization (Brotman et al., 2008). Plant cell-divider corrupting catalysts are additionally engaged with dynamic root colonization, as happens with the endo polygalacturonase ThPG1 from Trichoderma harzianum (Mora'n-Diez et al., 2009).

CONCLUSION

The combined application of Vesicular Arbuscular Mycorrhiza (VAM) along with Trichoderma have a great impact on roots having mycorrhizal infections to roots of non- brassica species. Trichoderma colonizes the root rhizosphere zone which enables the Vesicular Arbuscular Mycorrhiza fungi to infect the roots of the brassica plants. The infection plays a great role in obtaining good yield and quality of crops. The VAM fungi helps in observing soil available phosphorous and micronutrients by the plants which make the fertilizer inputs less to the crops. Beside these Trichoderma is resistant against plant diseases and pathogens which cause damage to the crop so that it helps in reducing the use of agro chemicals on the crop which has a great impact on the environment. Several reports have demonstrated that the interaction of those two groups of microorganisms could also be beneficial for both plant growth and disease control the biofertilizers and bio fungicides combination has a great impact of reducing farm inputs and boosting the yield to the farmers which helps in obtaining maximum profit to the farmers.

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