Fate and behaviour of Trichoderma in the soil and effects on soil microflora

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Trichoderma spp. are ubiquitous fungi in soils in all climatic zones. In nature they are particularly present in forest litter and decaying wood (up to 3% of total fungal propagules in forest soils). They are commonly saprophytes, with the ability of attacking other fungi (mycoparasitism). Trichoderma strains have antagonistic activity against several soilborne pathogens and beneficial impacts in agricultural and forestry systems. The high ecological adaptability of members of the genus Trichoderma makes these species good candidates for the use in biocontrol applications in a variety of soils. Trichodermas can survive under and adapt to a wide range of environmental conditions: they commonly grow well at temperatures between 10 and 30 ℃, even a certain degree of correlation between species and environmental conditions exists. They also tolerate a wide range of pH levels, and can utilize a large number of carbon and nitrogen sources.

However, once they are introduced in soil, maintaining stable populations -so that antagonistic effects are sustained throughout the growing season - is a major challenge. The introduced Trichoderma strains usually decrease over time, mainly because of the antagonism of the resident microflora, to a level of 10-10^2 cfu/g. Some strains seem to be more persistent, however usually after one year they also reach the basal levels of native *Trichoderma* spp. Amendment of specific organic substrates supporting survival and enhancing colonization of soil may offer a solution. Substrates such as wheat bran, barley, and barks have been used to incorporate Trichoderma into soil with varying levels of effectiveness in prolonging. For example when rice is used as a carrier a concentration of 10^3 *T. atroviride* cfu /g of soil can be maintained after one year. Similar findings have obtained with *T. hamatum* in field plots to which compost was added. A certain degree of fungal migration patterns can be expected with surface application, however the concentration decreases in deeper soil. This behavior reflects the distribution of indigenous populations of *Trichoderma* spp. that are present at higher concentrations in the upper soil horizons and whose concentrations decrease at greater depths. Trichodermas are commonly found in the layer of soils explored by plant roots and almost absent at depth higher than 40 cm. Some isolates of *Trichoderma* spp. have the ability to colonize and grow in association with plant roots (rhizosphere competence). This behavior is an encouraging trait as concerns the fungus's use as a biocontrol agent of soil-borne diseases. If applied on soil surface Trichodermas can be found beyond the treated soil area (at distances of 2-4 m). This is commonly due to the movement of conidia on the soil surface after application. This dispersion is commonly limited and the fungus does not proliferate significantly without the addition of a substrate or carrier. When the colonization is successful, the introduced strain can become an integrant part of the local microbial community.

After the soil application of exogenous *Trichoderma* spp. we usually assist at a certain level of changes in resident microbial populations, however it does not significantly affect the fungal and bacterial soil community for a long time. At the moment no study has shown any detrimental effects over the long term on soil microbial population, even after high application dosages. The re-establishment of the community structure always took place within a few months throughout the soil profile. Similarly, when several single soil microbial species are analyzed, no relationships with the application of Trichodermas were discovered so far. Fungal and bacterial communities are usually more affected by agricultural practices, such as mechanical soil pressing and chemicals employment.