

What Is An Ideal Truffle Infected Plant?

The fallacy of the percentage

Is a truffle infected plant that has 100% of its roots infected by the fungus better than one which has only 10%? The knee jerk reaction is "of course" but in reality the answer can only be "*possibly*". This is because percentages are ratios and not quantities. A truffle infected plant which has all of its 3 root tips infected with the truffle fungus is 100% infected but it is not one you might want to plant. This tree would certainly be small and its root system might be, for example, heavily infested with insects or nematodes that had destroyed the other root tips.

Another example might be a dormant plant in a large pot during winter with 100% of its 500 root tips infected by truffle. Would this be a better plant than the same plant a few weeks later in spring when its roots had begun growing rapidly? By this time there might be 5000 root tips present but still only the original 500 infected root tips because the fungus always lags behind the plant. And would a customer be sensible or justified to demand plants with 100% or even 30% infected roots in spring or early summer after root growth had resumed? Don't forget bud break generally occurs after resumption of root growth in spring.

What is best for the grower

The question that a customer should be asking is would it be safe to plant a 5000 root tip vigorous plant with 10% of its root tips infected. It would be no problem if the plants were going into an area where there are no competing fungi. Indeed, there would be no option but to plant rapidly growing plants in mid summer in the Waikato and Northland parts of New Zealand because to plant them in spring would be to risk losing upwards of 30% of plants from the ravages of the African black beetle (*Heteronychus arator*). Of course, the worst scenario would be to plant the same plants in an area where there were competing fungi already present in the prospective truffière and the soil pH had not been completely adjusted prior to planting. Then the competing fungi would have the best chance of establishing on the nonmycorrhizal portions of the root systems.

Prior to my leaving Crop & Food in 2004 I recommended that truffières were established in spring – Northland and Waikato excepted. So our plants were generally assessed in late autumn and winter when they were without leaves and the root systems were dormant. Rules were established as to what was an acceptable plant and what was not - standards that were laid down in the late 1980s and carried through for more than a decade. In contrast, if a nursery was to assess and distribute their plants in early spring I would expect it to have a different set of standards to those I adopted.

One way of ensuring a high percentage of infected root would be to raise plants in small containers such as Melfert bags or cells with slotted walls where the fungus would not have to grow far to exploit the whole of the potting mix. I am in favour of using such containers because they also limit the chances of roots spiralling when they hit the sides of the container and for other technical reasons. But only after experimenting over several years would it be possible to determine if, for example, Melfert bags were any better in the long run than say large plastic bags that allowed larger root systems to develop with patches of mycorrhizal infection spread throughout. Of course, a nurseryman might easily halt root growth in spring to maintain a high percentage infection by holding plants in a cool store, manipulating nutrient concentrations in the potting mix, or using chemical methods, but I am not convinced this would be wise or even ethical.

Because levels of infection can vary through the year; vary with different stages of plant growth and between containers; do not express the actual numbers of infected root tips; and can be manipulated, it is quite wrong to use percentages as the sole measure of how well plants are infected. Those who persist are doing a grave disservice to nurseries and creating concerns in the industry that may be unjustified. Notwithstanding this it is acceptable to use percentages as a way of comparing what proportion of all infections are of a particular species of truffle or competing mycorrhizal fungi.

Another questionable practice in Europe are nurseries that advertise their plants as *inoculated* (the fungus has been put on the roots) instead of *infected* (the fungus is actually growing on the roots). Similarly, great store has been placed by some nurseries on independent assessments done a year or

more ago on another batch of plants or perhaps one carried out using questionable methodology. This is covered in more detail in Taming the Truffle.

Contaminating fungi

Some common greenhouse mycorrhizal Ascomycetes can establish and perpetuate themselves in greenhouses. While some of these generally die out after outplanting, others like the AD fungus, which has recently been found on plants from a New Zealand nursery, are extremely tenacious and can completely dominate in the field. Consequently, nurseries might be justified in producing plants with modest levels of truffle infections on their plants and getting them into the field before they became infected with these greenhouse contaminants.

Incidentally, the AD fungus, *Tuber maculatum*, *Tuber brumale* and some other contaminants, cannot be clearly distinguished from the Périgord black truffle using just a low power microscope. This is illustrated in Taming the Truffle pages 91-95 and in the poster that can be obtained from Truffles & Mushrooms't free downloads page web site <http://www.trufflesandmushrooms.co.nz/page10.html> (Hall, I.R.; Zambonelli, A. 2008. Comparison of Périgord black and winter truffle mycorrhizas - 250k jpg file). Consequently, assessors who do not use both low and high power microscopes and rely on the belief they are looking at plants inoculated and infected only with a particular species of truffle, are taking a significant risk.

Are we shooting ourselves in the foot by going to extraordinary lengths to produce clean plants?

Some bacteria can be intimately associated with ectomycorrhizas, appear to aid the infection process and have been referred to as "mycorrhiza helper bacteria". Bacteria are also routinely found in truffles, can be involved in the suppression of competing ectomycorrhizal fungi and can have an antifungal activity against fungal contaminants in bianchetto truffles. Several ectomycorrhizal fungi are also regularly found associated with other fungi. For example, the mushrooms *Suillus bovinus* and *Rhizopogon* are often associated with *Gomphidius roseus*. So it could be that some soil bacteria and fungi could benefit the plant/Périgord black truffle relationship.

Prior to 1990 there were 11 known truffières in New Zealand and all came from the Ministry of Agriculture and Fisheries' nursery at Invermay at a time when plants were raised in specially treated soil rather than potting mix. Three of these truffières in the coolest part of the country have never produced while 100% of the others did. So is it possible that beneficial bacteria and fungi could have been present on these plants that were not on those produced in later years? Anything is possible and things may not be as we might first believe.

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