Sunseed Desert Technology

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Sunseed's Mycorrhizal Project 2003-09

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Dr. J M Barea of El Zaidin CSIC Research Centre, Granada gave frequent advice and encouragement, including training at El Zaidin for Alzena, Donald and Fay.
How it began:
Sunseed set up its base in Almeria to research ways of countering desertification and living sustainably in a semi-arid environment. Our first tree trials were not very successful, so we consulted Dr Barea of Granada, a soil microbiologist and expert on desertification.
We learned that:
- In healthy soils most plants have a symbiotic relationship with mycorrhizal fungi. These act as extensions of the plants' roots, and help the plants' nutrition and water relations. This is specially important in arid and semi-arid conditions.
- In areas where the natural vegetation is destroyed or over-exploited, the mycorrhizal fungi die out too or become very depleted, and attempts to re-establish the trees or other vegetation that formerly grew there often fail.
- Cultivation can also have an adverse effect on the fungi.
- The topsoil of nearby forest areas or undisturbed thickets or trees is likely to harbour healthy populations of mycorrhizal fungi. This soil can be collected, pot-cultured to multiply the fungi, and then used to inoculate tree or shrub seedlings – these can then be outplanted complete with their below-ground partners, which should multiply as the tree grows.

We have since found that many crops also benefit from mycorrhizal inoculation. The fungi are not used up by the crop, they multiply with it, so the challenge is to manage the land in a way which enables the fungi to survive and to benefit succeeding crops.
The simple mycorrhizal procedure we have adopted is that advocated by R C Munro and colleagues (1999) "A low-cost method of mycorrhizal inoculation improves growth of Acacia tortilis seedlings in the nursery", in Forest Ecology and Management 113, 51-59.
** Download leaflet – 'MYCORRHIZAL INOCULATIONS: A simple technique for improving the success of plants in arid zones' here:
MYCORRHIZAL INOCULATIONS.pdf

"Friendly Fungi" in Sunseed's Gardens

In 2004, Zena Wilmot was producing and using this simple mycorrhizal inoculum in the tree nursery, and had the idea of applying it to maize. After 16 weeks on a dryland terrace, the inoculated plants were on average 10 cm taller than the uninoculated control plants.
Zena's successor, Fay Tuffen, followed this up in 2005-6 with a comprehensive set of production trials on the irrigated garden terraces, using most of the vegetables commonly grown at Sunseed. In eleven of these trials, the inoculated plants yielded a heavier crop; the results with carrots, courgettes, onions, peas and broad beans were particularly striking, with the inoculated crop double the weight of the uninoculated controls. Cherry tomatoes and sweetcorn also benefited from inoculation. Plum tomatoes benefited in one trial but not in another. In contrast, inoculated potatoes were less productive than their uninoculated controls in two

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separate trials. All these trials were quite small scale, and we would not claim that the results are definitive, but taken together they suggest strongly that this simple mycorrhizal procedure can offer substantial benefit to vegetable growers.

How does it work?

In undisturbed natural soil environments, mycorrhizal fungi are the normal symbiotic partners of most plants, but they do not react well to disturbance, so cultivated soils can become depleted of these useful organisms. Inoculation aims to restore these “friendly fungi”, which are a key component of a healthy soil ecosystem. These fungi are sometimes described as “biofertilisers”, but it important to realise that they are not themselves nutrients, they help the plant to access mineral nutrients, particularly phosphate. They also help the plant to cope with drought, and to resist pathogens. In return, they take some of the sugars which the plant produces by photosynthesis. They are not used up when the crop plants flourish; on the contrary, they multiply when their host plants are active.

When the host plants are harvested, the fungi will seek out alternative host plants, if there are any, otherwise they will become dormant. Where water is available all year, and climate permits, it is best to re-plant/re-sow land as soon as the preceding crop is harvested. This should make best use of the improved mycorrhizal potential that inoculation has brought about.

Factors which favour maintenance of a healthy mycorrhizal population (much of this is of course normal organic principle):

- Rotation of crop species,
- Companion planting, e.g. combinations like maize and beans, is particularly propitious for a healthy soil,
- Maintain soil organic matter content and nutrient levels with compost and manure, but avoid heavy fertiliser application; mycorrhizal fungi function best in natural soil conditions,
- Leguminous or grassy green manures maintain mycorrhizal activity in between vegetable crops,
- Mycorrhizal fungi may function better with traditional crop varieties than new high yield cultivars (probably developed in high artificial nutrient levels),
- Minimize soil disturbance (obviously cultivation is sometimes necessary, and mycorrhizal populations do recover afterwards, but it is a set-back for them),
- Brassicas and the beet family do not associate with mycorrhizal fungi, so a crop of these involves a set-back for the mycorrhizal population, and the following crop may need to be inoculated.

** Download leaflet - 'A simple method for making your own mycorrhizal inoculum' here:

A SIMPLE METHOD FOR MAKING YOUR OWN MYCORRHIZAL INOCULUM.pdf

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Summary report on the tree/shrub work of the Mycorrhizal Project 2003-9

What we hoped to achieve: conclusive evidence, from trials in a variety of locations, that the method aided the re-establishment of indigenous trees/shrubs on degraded dryland. The method would then be promoted by publication and lobbying of bigger development organizations.

We have not reached this objective.

- In Tanzania, we have only managed small trials, which do not carry statistical weight, though they were very successful, and the Sunseed Tanzania Trust continue to promote the method in village and school tree nurseries.

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FIELD TRIALS AND EXTENSION WORK IN TANZANIA.pdf

- Large scale trials were set up in Burkina Faso, but were badly damaged by rabbits or rats. The mean stem collar diameter of mycorrhizal seedlings was greater in most cases, suggesting that the plants must have been bigger before they were grazed off, but this cannot be regarded as conclusive evidence.

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- The most scientifically rigorous trial of the whole project was Zena's Retama Trial at SDT. Inoculation conferred a clear growth benefit; the non-mycorrhizal group suffered marked transplant shock, and never caught up. But an extra control group which were given live natural retama soil instead of our pot-cultured inoculum, grew almost as well as the inoculated group! This trial also provided evidence that both the inoculum and the natural soil also transmitted other important soil microorganisms, as well as the mycorrhizal fungi. This is a very important finding.

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- A small trial in Morocco supported Zena's Retama findings, (a) that inoculation reduced transplant shock, and (b) natural soil can also be very beneficial.

- 30 cm deep biodegradable growtubes were trialled in Morocco. We have had these specially produced for dryland species with very rapid taproot development, and they should facilitate the development and transplantation of seedlings with intact root systems. Preliminary trials showed a better survival rate for growtube seedlings than seedlings grown in standard plastic tree-bags, but it has not yet been possible to run a large scale trial.

But the three main findings need to be made known:

(1) This technique has the potential to transfer, not only locally adapted mycorrhizal fungi but also other key microorganisms, and indeed a total intact soil ecosystem. This broader aspect may be more important than we had realised.

(2) In some cases, particularly legumes, there can be special benefit from e.g. culturing retama soil for use with retama seedlings.

(3) If inoculum is not available, soil from natural, undisturbed vegetation can also be effective. People do not know this – cultivated soil or peat-based composts do not have the same properties.