Rotation

Nutrient availability

Mycorrhizal fungi enhances crop nutrient uptake

CSIRO Plant Industry scientist Megan Ryan explains the results of several paddock trials looking at the impact of canola on colonisation by naturally occurring mycorrhizal fungi and the possible impact on the following crop's nutrition and growth.

Despite farmer concerns, low levels of mycorrhizal fungal colonisation in crops grown after canola will not affect yields in south-east Australia, according to new research in New South Wales and Victoria.

But the results show high mycorrhizal fungal colonisation in wheat crops can enhance grain zinc concentrations, improving grain nutritional value.

Naturally-occurring arbuscular mycorrhizal fungi colonise the roots of most agricultural crops and pastures, with lupins and canola being the two exceptions. Mycorrhizal fungi form structures inside the root of host plants where nutrients collected from soil by the fungi are exchanged for plant photosynthate (carbon compounds the fungi can use for energy). The fungi collect nutrients using hyphae which spread out from the roots into surrounding soil. These hyphae are thinner than plant roots and can access nutrients from areas in the soil which roots cannot access.

In most crops, 10–80 per cent of root length is colonised by arbuscular mycorrhizal fungi. Colonisation is enhanced when soil phosphorus levels are low, when phosphorus fertilisers are not used and by minimal tillage and inclusion of host crops in the rotation.

Arbuscular mycorrhizal fungi are generally considered to be important in enhancing plant uptake of nutrients, particularly phosphorus and zinc, when soil nutrient levels are low.

For example, in southern Queensland, crops following long periods of bare fallow have low levels of colonisation. This is because during the fallow period there is no host plant for the fungi to obtain energy from, so the fungi are present as inactive inoculum (for example, spores). The viability of the inoculum declines over time. This poor colonisation has been associated with phosphorus and zinc deficiencies in crops (often known as long fallow disorder).

As *brassicas*, such as canola, do not host arbuscular mycorrhizal fungi they may have a similar effect to a long fallow on mycorrhizal fungi. As canola is now widely grown in Australia's southern wheatbelt, CSIRO Plant Industry assessed the impact of canola on colonisation by mycorrhizal fungi and the effects on nutrition and growth of the crops grown after canola in the rotation.

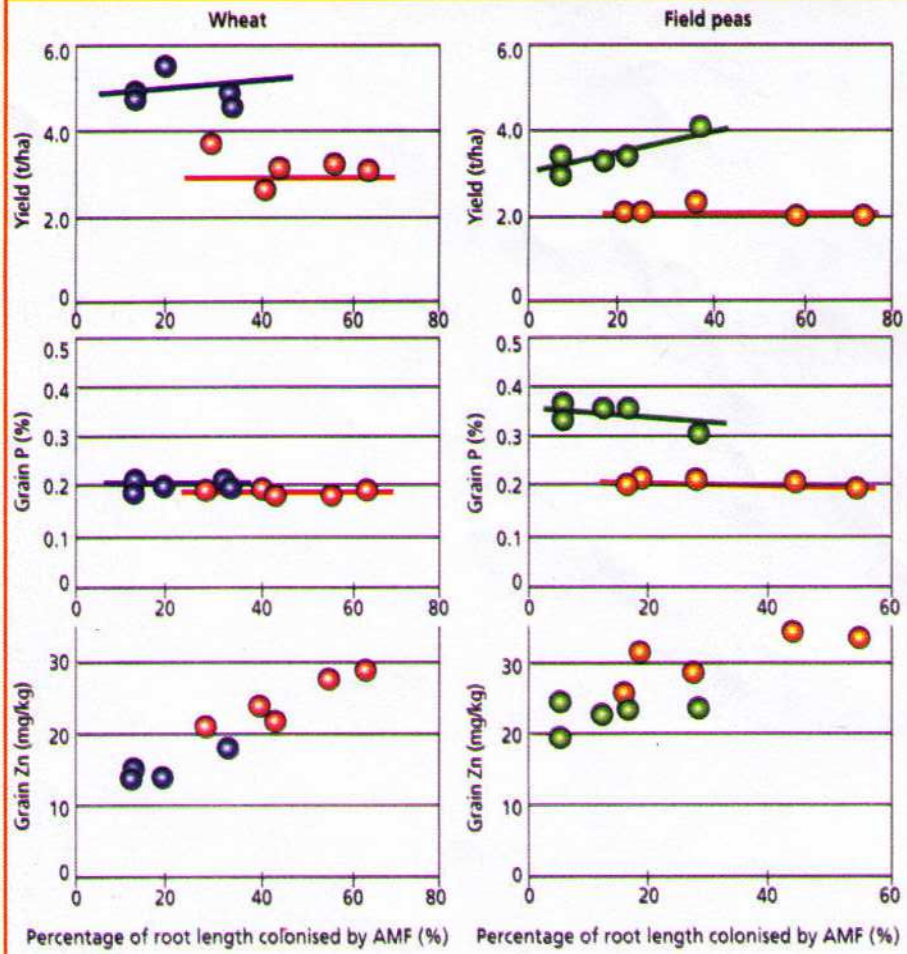
Paddock trials

A series of rotation field trials was carried out in southern NSW and the Wimmera in Victoria from 1998–2000. Mycorrhizal fungal colonisation, nutrition and growth of wheat grown after canola and wheat grown after host crops such as barley and pasture were assessed. Commercial fertiliser rates were applied.

In another paddock trial near Junee, NSW, wheat and field peas were sown after pasture and linola (to maintain inoculum) and canola and fallow (to deliberately decrease inoculum).

Crops received either no phosphorus fertiliser or 20 kilograms per hectare of phosphorus as superphosphate. Crop growth, nutrition and yield were assessed.

FIGURE 1 Relationship between mycorrhizal fungi levels and grain quality



Note: The figures show the relationship between arbuscular mycorrhizal fungi (AMF) colonisation levels and yield, grain phosphorus concentration and grain zinc concentration of wheat and field peas grown after pasture, linola, canola, chemical fallow and tillage fallow with (blue and green circles) and without (pink and orange circles) phosphorus fertiliser.

Source: CSIRO Plant Industry

in brief

- Arbuscular mycorrhizal fungi colonise the roots of most crops and pasture species and are considered important in enhancing plant uptake of nutrients, particularly phosphorus and zinc.
- As brassicas such as canola do not host mycorrhizal fungi, concerns have been raised they could be causing reduced yields in wheat grown after canola.
- New research shows crops grown after canola and fallow will have low mycorrhizal fungi levels. But this does not influence yield or phosphorus uptake in southern Australia.
- High mycorrhizal fungi levels may enhance grain zinc.