Coming to grips with Eradu-patch of lupins

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Investigations by Bill MacLeod and Mark Sweetingham have confirmed that Eradu-patch of lupins is caused by a previously undescribed fungal pathogen. They have developed strategies to minimise the spread of patches but choices are limited for control in lupin crops.

Eradu-patch has only recently been identified as a new root disease of lupins. It was initially seen on the Eradu sandplain east of Geraldton in Western Australia’s northern wheatbelt. In 1994 it was seen in about 100 lupin crops in the Geraldton area and as far south as Bruce Rock.

Eradu-patch was initially thought to be rhizoctonia bare patch, a disease of cereal and legume crops and pastures, because its appearance in lupin crops is so similar. It became clear that this was not the case when paddocks that had large numbers of patches in the lupin phase of a rotation had no patches in the wheat phase.

Eradu-patch appears as roughly circular patches of stunted plants. There is a clearly defined edge between the stunted plants in the patch and healthy crop outside.

**Appearance of the disease**

Eradu-patch produces circular patches of stunted plants. Patches range in size from 0.5 m up to 10 m or more in diameter and have sharply defined edges. The most severely stunted plants are usually nearest the outside of the patch. Larger patches may develop a ‘doughnut’ appearance where a ring of stunted plants surrounds a circle of apparently healthy plants.

At a high density patches may coalesce to large irregular shaped areas of stunted plants.

The appearance of Eradu-patch in lupins is similar to that of rhizoctonia bare patch except that Eradu-patches usually have a ‘doughnut’ appearance, which is less common for rhizoctonia bare patch.

Eradu-patch is caused by a non-sporing white basidiomycete fungus which is related to the fungi that cause ‘fairy rings’ in lawns and pastures. The fungus may be a *Rhizoctonia* species, possibly related to the type that form mychorryzal associations with native orchids.

 Plants removed from Eradu-patches have lateral roots that are pinched off by a brown rot. Lesions on the tap root usually appear as brown staining and stripping of the outer layer from the root. The hypocotyl (below ground stem) is not affected, but lateral roots arising from the hypocotyl are usually rotted. In patches where stunting is severe, the tap root of up to half the plants may be rotted through by 12 weeks after sowing.
What plants are affected?

Eradu-patch affects all varieties of narrow-leaved lupins (*Lupinus angustifolius*). Erragulla, a variety of WA blue lupin (*Lupinus cosentinii*), is equally susceptible.

Other legumes, including peas, serradella, subterranean clover and medic, are not susceptible.

Of the cereals, barley is susceptible, cereal rye and oats are not, and wheat is only mildly affected.

Barley crops present fewer and less severe patches than lupin crops. Eradu-patch in barley appears as areas of depressed plant growth with indistinct edges. These patches may not be apparent until head emergence.

Common weeds appear to be unaffected by Eradu-patch.

Occurrence

The non-sporing white basidiomycete was first identified in 1990 at East Chapman Research Station and on three properties in the Allanooka and Casurinas localities in the Geraldton area.

It is now widespread throughout the 200,000 ha of Eradu sandplain in the northern wheatbelt. It has also been detected on properties near Wongan Hills, Badgingarra and Wubin. It has most likely been present in the Geraldton area for many years but was confused with rhizoctonia bare patch.

The Department of Agriculture conducted experiments on what were thought to be rhizoctonia patches at Mingenew in 1981. However, the patches did not respond to the treatments as expected for rhizoctonia patch but did respond as would be expected for Eradu-patch.

Eradu-patch has only been seen on sandy soils, but in a few cases these have been relatively shallow, gravelly sands. The disease could possibly occur on heavier soils but such sites cannot be identified until susceptible lupins are grown to enable the disease to become apparent.

In the eastern wheatbelt a lupin disease referred to locally as ‘Atkinson’s Patch’ was thought to be a different problem related to high levels of aluminium in the soil. It was first documented in 1988 and aerial surveys showed that it occurred as localised infections throughout hundreds of thousands of hectares of yellow earth soils. Surveys by Department of agriculture researchers Helen Tapscott and Bob French in 1990 dismissed aluminium as the probable cause. In 1994 we were able to demonstrate that the same basidiomycete fungus was associated with diseased lupin roots in ‘Atkinson’s patches’ at two locations in the Merredin district.

The red areas indicate where Eradu-patch has been confirmed in the Western Australian wheatbelt.
When patches were first noticed at East Chapman Research Station, they were thought to be rhizoctonia bare patch. Several unsuccessful attempts were made to reduce the severity of patches with deep cultivation, an established control measure for rhizoctonia bare patch. Rhizoctonia fungi were not detected by techniques developed for that purpose.

The breakthrough came when Bill MacLeod developed a technique developed for recovering fungi that are actively growing through the soil. Similar methods have been used for studying ‘fairy ring’ and similar fungi. This technique involves placing petri dishes of agar in the soil in such a manner that the agar is separated from the soil by an air gap of a few millimetres.

Sterile petri dishes containing agar were placed in freshly cut slots across the edge of patches. The slots were filled in to cover the petri dishes and left for four days. A non-sporing basidiomycete fungus was recovered by this method from inside patches but not outside.

Aerial view of a rotation experiment photographed in 1993. The area was sown to lupins in 1990 and left as uncultivated pasture in 1991. Three pairs of plots (1) were sown to cereals (barley on the right and wheat on the left) in 1992 and lupins in 1993. Two paired plots (2) were left as undisturbed pasture for a second year in 1992 and sown to lupins in 1993. The lupins are most uniform following two years of pasture and most severely patch-affected following one year of pasture and a barley crop.
Disease spread
The fungus appears to have a simple life cycle. Roots of young susceptible plants are infected by the fungus, lesions develop and more of the root is colonised. At the end of the season the plants 'hay-off' and the fungus survives the summer as dormant hyphae in colonised roots. After the break of the next season, active hyphae emerge from colonised roots to grow through the soil and infect roots of new hosts.

Spread is highly likely to occur by the movement of soil, which will contain roots and debris of infected plants, from existing patches. Pieces of contaminated plant material are equally likely to produce a patch in a lupin crop if moved during the cereal or lupin phase phase of the rotation.

Contaminated soil can be spread by cultivating machinery, either carried short distances attached to tines, or possibly longer distances sitting on structural members and other parts.

Control
The first step to controlling Eradu-patches is to quarantine the areas or paddocks that are currently affected. Allow a liberal buffer area around the patches where only a part of a paddock is to be quarantined. Any operation that could move soil (cultivation and seeding, for example) should be confined to the quarantined area and all soil removed from machinery before moving from the patch area.

Areas that are mildly affected by patch may be cropped in the chosen rotation.

For severely affected areas it may be best to avoid the symptoms of Eradu-patch by growing permanent pasture such as serradella because crop yields on such areas will be low. Growing pastures will also remove the risk of spreading the disease around the paddock and the farm.

The corner of this paddock, as indicated by dotted line, should be quarantined to limit the spread of Eradu-patch by preventing the movement of soil from this area to the remainder of the paddock and the rest of the farm.
This line of stunted plants is a long Eradu-patch produced by placing basidiomycete fungus (grown in the laboratory) into the soil in a single furrow at the start of the previous season.

The percentage of lupin crop affected by Eradu-patch and the grain yield for 1994. Longer periods of pasture reduced the area of patch within the crop and increased crop yield.

Unlike rhizoctonia bare patch, Eradu-patch is not controlled by deep cultivation such as ripping to a depth of 25 cm. In trial plots, mouldboard ploughing to completely invert the soil profile to a depth of 25 cm greatly reduced the severity of patches. However, we do not yet know whether this effect will last more than one season. It is also only practical for small areas.

Rotations in which paddocks are cropped every year spread the disease and do not reduce severity. Rotation with a pasture phase of two or more years can reduce severity and area of patches. The use of more productive and persistent pasture/species, such as serradella, may improve the grazing value of pasture in a rotation.

The most promising option for Eradu-patch affected areas is yellow lupins (Lupinus luteus). These have been shown to be resistant in field and glasshouse experiments. Yellow lupins could be used as an alternative to white lupins in a lupin:cereal rotation.

Eradu-patch disease is equally severe in all varieties of narrow-leaf lupins (Lupinus angustifolius). Yellow lupins (Lupinus luteus) are resistant as demonstrated by this severely affected strip of L. angustifolius flanked by healthy L. luteus.

Yellow lupins are being developed for wodjil sandplain soils but will perform well enough on good sandplain to be beneficial in sites with a high density of patches. The Department of Agriculture plans to have low alkaloid selections of yellow lupins available in 1997.

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