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Rhizoctonia bare patch of cereals and lupins

G C. Macnish

M W. Sweetingham

WHEAT RESEARCH COUNCIL
NEW PROJECT

PROJECT TITLE: RHIZOCTONIA BARE PATCH OF CEREALS AND LUPINS

RESEARCH OFFICERS: Dr G.C. MacNish
Dr M.W. Sweetingham

AIM OF PROJECT: To determine the stimuli for the formation of rhizoctonia patches in cereals and lupins

BRIEF SUMMARY

Rhizoctonia bare patch disease is now widespread in the Western Australian cereal belt and appears to be becoming more frequent in established areas and spreading to areas where it has not previously been recorded.

A considerable bank of knowledge about this disease is now available. For example, it has been shown that it is reduced by cultivation, deep ripping and use of nitrogen. However none of these treatments eliminate the disease and some are inappropriate especially for lupins. It is also known that the hyphae of the fungus (*Rhizoctonia solani*) are mainly confined to the top few centimetres of soil, that patch forming *Rhizoctonias* can be divided into at least three zymogram groups and that a given patch appears to be dominated by a single zymogram type. Despite this knowledge, the reason(s) for the formation of patches has not been discovered. It is not clear why some strains of *R. solani* colonize certain soils leading to the establishment of patches while outside these patches a range of other *Rhizoctonias* can be regularly isolated. If the underlying stimuli for patch formation could be discovered, new methods of control may be suggested.

In this project a detailed study of both physical and biological factors affecting patches will be made at locations where patches are known to exist. The study will continue throughout the year (rather than just in the growing season) to investigate whether the patch is an expression of an event or events prior to the commencement of the growing season. The investigations will be done in conjunction with a study of the effects of different farm management practices on the disease.

RHIZOCTONIA BARE PATCH OF CEREALS AND LUPINS

Background

Rhizoctonia bare patch is now widespread within Western Australia, having been recorded on all cereals and on a wide variety of other crops and pasture plants. The disease was first positively identified in Western Australia in 1971 on wheat and barley. Since 1971 it has been recorded on oats, cereal rye, triticale, medics, lupins, rapeseed and in grass and subterranean clover pastures (MacNish 1983b). Its wide host range prevents its control by crop rotation and makes this disease particularly difficult to control.

In the early 1970's spasmodic outbreaks of rhizoctonia bare patch were observed on the area of calcareous Mallee soils around Salmon Gums. Aerial photography in 1974 showed the disease was endemic on these soils. Estimates made in 1980 showed that total patch areas in some crops could be as much as 30 per cent of the paddock, but in most cases ranged from 6 to 12 per cent (MacNish 1986).

Close monitoring of rhizoctonia bare patch indicates it is an important disease on the calcareous Mallee soils around Salmon Gums and on the Esperance Downs sandplain areas (MacNish 1986). Although rhizoctonia bare patch is less important outside these areas, it appears to be becoming more frequently recorded probably due in part to the widespread adoption of reduced tillage practices. Its increasing frequency is causing considerable concern.

Wheat Research Council project entitled "Rhizoctonia root rot in cereal-grain legume and cereal-clover ley cropping systems" (DAW75W) is nearing termination. During the course of this project nine strains of the fungus *R. solani*, five strains of binucleate *Rhizoctonia* and one strain of *R. zeae* have been isolated from cereal or legume roots in the Western Australian wheatbelt and identified by their pectic zymograms (Table 1).

Table 1. Zymogram groups of <u>Rhizoctonia</u> spp. from the Western Australian wheatbelt

Zymogram group	Imperfect stage	No. nuclei	Perfect stage	Pathogenicity Wheat	Pathogenicity Lupins
ZG 1-1	R. solani	M	?	High	High
ZG 1-4	R. solani	M	n	High	High
ZG 2	R. solani	M	?	High	High
ZG 3	R. solani	M	Thanatephorus	Low*	High*
ZG 4	R. solani	M	Thanatephorus	Nil	High*
ZG 5	R. solani	M	?	Nil	Nil
ZG 6	R. solani	M	?	Low**	High**
ZG 9	R. solani	n	n	n	Medium**
ZG 10	R. solani	n	n	n	n
CZG 1	R. sp.	B	?	Low	Medium
CZG 2	R. sp.	B	Ceratobasidium	Nil	Low
CZG 3	R. sp.	B	?	Nil	Medium
CZG 4	R. sp.	B	Ceratobasidium	Nil	Low
CZG 5	R. sp.	B	Ceratobasidium	Nil	Nil
WZG 1	R. zeae	M	Waitea	Low	Medium

M multinucleate
B binucleate
n not tested
* coleoptile/hypocotyl rot
** coleoptile and root/hypocotyl and root rot

Although virulence and host range studies are incomplete, pot and field experiments have indicated that only the "bare patch" strains of R. solani (ZG 1-1, ZG 1-4 abd ZG 2) are important pathogens of wheat. By contrast lupins and possibly other legumes suffer serious disease by 'hypocotyl attacking' strains (ZG 3, ZG 4) and a 'root and hypocotyl attacking' strain (ZG 6) as well as the 'bare patch' strains.

This project indicates that further research on Rhizoctonia of cereals in Western Australia should concentrate on the bare patch disease; whereas with lupins further research is needed on the bare patch disease and the other diseases caused by several strains of Rhizoctonia. The latter are being addressed in a Grain Legume Research Council project.

Other work carried out in Western Australia has produced the following recommendations which give some control of rhizoctonia bare patch (MacNish 1986).

(1) Avoid using zero or minimum tillage in fields that have a history of rhizoctonia bare patch.

(2) Apply nitrogen to cereals at 15 to 25 $kgha^{-1}$ on areas where rhizoctonia bare patch is known to be a problem. (This is not applicable to lupins.)

(3) Barley is more susceptible to rhizoctonia bare patch than wheat, and oats is least susceptible. In problem areas oats might be sown in preference to wheat or barley.

(4) Deep ripping reduces rhizoctonia bare patch.

Although these practices reduce rhizoctonia bare patch they do not eliminate it. Research on control appears to have reached an impass. Before more progress can be achieved, a better understanding of the aetiology of this disease is required.

A brief review of current knowledge of this disease is given below (numbers refer to references):

- Rhizoctonia bare patch is reduced by cultivation (4,7,10,15,20,22,23,28,29)
- Patch is reduced by deep ripping (7)
- Patch is reduced by nitrogen (6,15)
- Patches can expand between seasons (14)
- Patches can be present for one or two seasons and then completely disappear (14)
- Patches tend to be clustered (3,14)
- Patches are often elongated in the direction of sowing (9, 14)
- Mixing soil removed from patches reduces rhizoctonia root rot (5,8)
- Soil removed from patches, mixed and then compressed regains some of its ability to support root rot (12)
- Most of the R. solani hyphae in cereal soils are in the top 7.5 cm of the soil (3)
- The bulk of the organic debris colonized by R. solani is in the top 5 cm of soil (25)
- Most of root damage caused by R. solani in patch soil is in the top 5 cm of soil (17)
- Freshly killed grass roots appear to carry more R. solani inoculum than grass killed prior to a short fallow (27)
- Most of the R. solani isolates from within patches are the multinucleate type (19,26)
- Binuculeate forms are scattered both inside and outside patches (19)
- Multinucleate patch forming types can be divided into at least three zymogram groups (24,31)
- Multinucleate types within individual patches appear to be dominated by a single zymogram group (19).

Although this information has gradually accumulated, the stimuli for the formation of patches is still unknown. The spatial distribution of patches in paddocks has also not been explained satisfactorily.

Daniels (1963) suggested that patches were caused by a localized increase in the virulence of R. solani. De Beer (1965) concluded that virulent R. solani is distributed widely in infested fields and that its concentration in patches is due to the fungus reacting to a localized but unknown stimulus. Baker and Cook (1974) proposed that expansion of patches could be due to 'receding antagonist populations rather than from advancing pathogens' but this hypothesis has not been confirmed.

MacNish (1985a) proposed that within an infested paddock there is a balance of soil factors suppressive or conducive to rhizoctonia patch and that seasonal factors and local effects within a paddock can alter this balance. If for example there are foci of *R. solani* scattered throughout the field and the soil around many of these foci becomes highly conducive, large severe patches would appear, while if the soil was less conducive moderate patches might be expected. If there was a shift towards suppressiveness, fewer foci would survive in conducive soil and consequently smaller patches would appear (often in clusters). In highly suppressive areas there would be few or no patches.

Objectives

The objective of this project is to determine the stimuli for rhizoctonia bare patch formation and to use this information as the basis for developing control measures.

Supplementary objectives are:

1. To establish detailed maps of physical and biological factors within patch areas and correlate these with the establishment of patches.

2. To establish mini-plots within areas likely to be affected by patches and to apply treatments to these plots and determine the effect of the treatments on patch formation.

3. To establish patch incidence on the Esperance Downs Research Station and correlate these data with the detailed management histories of the various fields on the station.

4. To survey patches in other regions of the cereal belt and to establish the strains of *R. solani* involved (using PAGE) and their relative importance as patch forming types.

Outline of proposed project

Over the next three years it is proposed that there be two approaches to this problem. Firstly, a detailed study of both physical and biological factors will be undertaken at several sites where there is a known rhizoctonia bare patch problem. There are already several sites where quite detailed patch histories have been established. At these sites it is planned to undertake by intensive sampling, a detailed analysis of physical and biological factors including:

distribution of organic matter
distribution of organic matter colonized by *R. solani*
distribution of *R. solani* hyphae
distribution of zymogram groups
patterns of soil suppressiveness and conduciveness
patterns of soil wetting
patterns of soil compaction
patterns of soil moisture distribution
distribution of proven antagonistic fungi (e.g. *Trichoderma* spp).

Maps could then be established and related to rhizoctonia bare patch maps. Thus it may be possible to establish a link between disease expression and one or more of the above factors. The study will continue throughout the season (rather than just in the growing season) in case the patch is an expression of some event that took place prior to the commencement of the growing season.

The second approach will be to establish mini-plots within sites where patches are likely to appear. For several reasons these plots need to be established prior to the opening of the season. Firstly some treatments would be difficult to establish once crops are sown. Secondly, and more importantly, the establishment of mini-plots within patches (i.e. about 5 or 6 weeks after sowing when patches become clearly defined) has not been successful in the past. Presumably the conditions required for patch establishment have changed by this time. A range of treatments including applications of fungicides, fumigants, herbicides, wetting agents, soil mixing, soil compaction, etc. will be applied to these plots. The effect of application of such treatments on the formation or disappearance of rhizoctonia bare patch will be studied.

A third part of this project will be investigations of different farm management practices on the disease. Although there is a major patch problem on the Esperance Down Research, there are considerable differences in the susceptibility of the various fields to bare patch incidence. Efforts will be made to link these differences with the detailed field histories that are available on the research station.

Patches in other regions of the cereal belt will be surveyed to establish the strains of R. solani involved (using PAGE) and to determine their relative importance to the formation of patches in different parts of the cereal belt.

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