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Disease rating system.

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Sweetingham, M. (1985), *Disease rating system.*. Department of Agriculture and Food, Western Australia, Perth. Report.

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Western Australian Department of Agriculture

EXPERIMENTAL SUMMARY 1985

M. Sweetingham
Plant Pathologist
Plant Research Division

1. Lupin hypocotyl rot trials
   85BA29 85BA30 85BA31 85NO54

2. Lupin root rot trials
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3. Lupin root disease survey - Moora District

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   82M26

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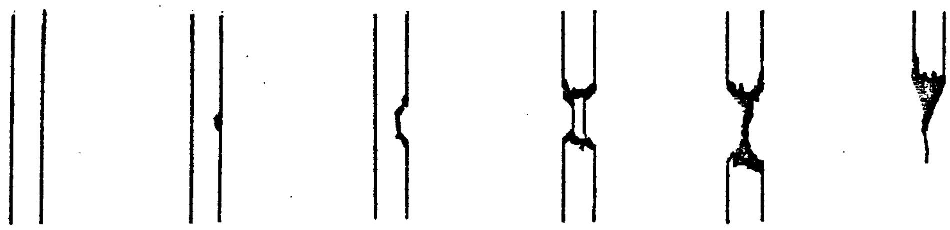
DISEASE RATING SYSTEM

1. LUPIN ROOT ROT:

The first six cm lengths of tap root are rated individually for lesion severity on a scale of 0 to 5 (0 = no lesion, 1 = shallow cortical necrosis, 2 = cortical necrosis as deep as the stele, 3 = cortex completely rotted, 4 = cortex completely rotted and stelar necrosis, 5 = lesion severing the root).



0 1 2 3 4 5

From this measurement the following root rot parameters are derived:

(a). Root Rot Incidence (0-100%) = percentage of plants with any root lesion.

(b). Lesion Score (0-6) = number of 1 cm segments with a lesion severity ≥1.

(c). Lesion Severity (0-5) = maximum lesion severity score of all 1 cm segments.

(d). Root Disease Index (0-5) = mean lesion severity score of all 1 cm segments.

2. LUPIN HYPOCOTYL ROT:

(a). Incidence (0-100%) = % of plants with any hypocotyl lesion.

(b). Lesion Severity (0-3): 0 (NIL) No lesion
1 (LOW) <25% crossectional area lesioned
2 (MODERATE) 25-75% " " "
3 (SEVERE) >75% " " "

1. LUPIN HYPOCOTYL ROT TRIALS

85BA29 - LUPIN HYPOCOTYL ROT: EFFECT OF SEEDING DEPTH

Rhizoctonia solani (ZG 3 and ZG 4) specifically attacks lupin hypocotyls and not roots. Shallow seeding reduces the length of hypocotyl exposed to Fungal attack and should reduce the incidence of disease and improve emergence.

The trial was conducted on the Badgingarra Research Station on a deep white sand. The trial was sown with 100 kg/ha CHITTICK using a tyned cone seeder into a moist seed bed on 30/5. Hypocotyl rot assessment and plant establishment counts were made 4 weeks after seeding.

Results and Conclusions

Deep sowing increases the incidence of hypocotyl rot, and decreases stand density and yield.

Table 1.1 The effect of seeding depth on lupin hypocotyl rot.

Depth of Seeding	HYPOCOTYL ROT Incidence %	HYPOCOTYL ROT Moderate + Severe %	STAND DENSITY (plants/m^2) 24/6	STAND DENSITY (plants/m^2) 26/9	Grain Yield (kg/ha)
2 cm	12.1	4.2	38.6	29.2	870
5 cm	27.3	12.7	32.2	25.1	729
10 cm	41.2	25.5	6.5	3.3	164
LSD 5%	5.2	5.3	3.6	2.3	78

85BA30 - RHIZOCTONIA HYPOCOTYL ROT: SEED TREATMENTS FOR LUPINS

The fungicides Rovral, Difolatan and Bavistin showed most promise in 1984 field and pot trials for the control of rhizoctonia hypocotyl rot of lupins. The fungus attacks lupins from pre-emergence until about the 6-8 leaf stage. Thus a seed dressing of a suitable fungicide could conceivably provide sufficient early protection from infection to reduce hypocotyl rot severity and improve plant establishment.

The trial was conducted at the Badgingarra Research Station on a deep white sand.

Fungicides were applied as a slurry at the rate of 2.5 g product per kg seed. The trial was sown with 100 kg/ha CHITTICK on 30/5. Hypocotyl rot assessment and plant establishment counts were performed 4 weeks after seeding.

Results and Conclusions

None of the fungicide treatments reduced hypocotyl rot severity or improved emergence or yield.

Table 1.2 The effect of fungicide seed treatments for rhizoctonia hypocotyl rot of lupins.

Treatment	Hypocotyl Rot Severity	Establishment (plants/m^2)	Grain Yield (kg/ha)
Nil	0.51	14.2	392
Rovral	0.30	13.0	401
Difolitan	0.52	14.0	368
Bavistin	0.48	12.2	365
LSD 5%	NS	NS	NS

85BA31 - LUPIN HYPOCOTYL ROT: EFFECT OF CULTIVATION

Cultivation (scarifying or deep ripping) dramatically reduces the incidence and severity of rhizoctonia patch disease of cereals and lupins caused by *Rhizoctonia solani* ZG 1 and ZG 2. This experiment aimed to determine whether cultivation would reduce rhizoctonia hypocotyl rot of lupins caused by *Rhizoctonia solani* ZG 3 and ZG 4.

The trial was conducted on the Badgingarra Research Station on a deep white sand. Scarifying and agrow plough treatments were performed after the break on 29/5 and the trial was sown on 30/5 with CHITTICK at 100 kg/ha.

Hypocotyl rot was assessed at 4 weeks and plant establishment counts taken at 4 and 16 weeks after seeding.

Results and Conclusions

The cultivation treatments slightly increased the incidence of hypocotyl rot but had no effect on plant establishment or yield. Cultivation treatments similarly caused a slight increase in hypocotyl rot in 85NO54.

Table 1.3 Effect of cultivation on rhizoctonia hypocotyl rot of lupins.

Treatment	HYPOCOTYL ROT Incidence %	HYPOCOTYL ROT Moderate + Severe %	STAND DENSITY (plants/m^2)	Grain Yield (kg/ha)
Direct Drill	23.0	8.5	21.8	396
Scarify	33.2	13.6	23.2	414
Deep Rip	31.4	12.3	21.2	365
LSD 5%	7.3	NS	NS	NS

85N054 - EFFECT OF SIMAZINE ON LUPIN HYPOCOTYL ROT

In 1984, several lupin crops on white and grey sands in the Northam district had extremely poor emergence. Both simazine toxicity and rhizoctonia hypocotyl rot appeared to be involved. The aim of this trial was to quantify the damage being caused by both Rhizoctonia and simazine and to determine if sublethal simazine damage increased the susceptibility of lupins to hypocotyl rot.

The trial was conducted on Mr B. McKay's property at Cunderdin on a grey sand over gravel. Cultivations were performed dry on 23/5 and sown with a disc drill on 5/6. Root disease assessment and plant establishment counts were taken 4 weeks after seeding.

Results and Conclusions

Owing to the dry start to the season, simazine was reduced to about half its normal activity and effectiveness. No simazine toxicity was detected at even the highest rate.

Both root rot and hypocotyl rot were observed at the site. Root lesions were cultured and found negative for Pleiochaeta. Both root and hypocotyl lesions gave rise to Rhizoctonia solani cultures which turned out to be a new zymogram group (ZG 6) capable of causing both root and hypocotyl lesions.

Simazine had no effect on root or hypocotyl rot but signicantly improved yield due to ryegrass control.

Cultivation treatments caused a slight increase in hypocotyl rot (see also 85BA31).

Table 1.4 Effect of simazine and cultivation on lupin root and hypocotyl rot.

Treatment	Root Disease Index	Hypocotyl Rot Severity	Plant Establishment (plants/m^2)	Grain Yield (kg/ha)
Direct Drill	0.41	0.10[a]	36	1073
Scarify	0.45	0.28[b]	29	1072
Plough	0.58	0.17[ab]	31	1167
Simazine 0	0.43	0.15	33	978[a]
Simazine 0.6	0.56	0.13	28	1044[ab]
Simazine 1.2	0.46	0.21	30	1090[bc]
Simazine 1.8	0.53	0.21	33	1162[cd]
Simazine 2.4	0.42	0.22	36	1244[d]

Means with different letter are significantly different by 5% LSD.

2. LUPIN ROOT ROT TRIALS

85WH31 - LUPIN ROOT ROT: EFFECT OF SEEDING DEPTH

Under ideal conditions, lupins prefer shallow seeding (2-3 cm). However, on soils with a history of Brown Leaf Spot it was hypothesized that shallow seeding would result in more severe Pleiochaeta root rot and poorer stand densities. Pleiochaeta spores are more concentrated in the top few cm of soil. Sowing deeper should theoretically put the roots below the zone of concentrated spores where they are less likely to become infected. Hypocotyls are not infected by Pleiochaeta.

The trial was conducted at the WHRS on a yellow loamy sand paddock which has been in a 1:1 wheat-lupin rotation for several cycles. The lupins in 1983 had moderate to severe levels of brown leaf spot.

The trial was direct drilled with YANDEE lupins on 30/5 into a moist seed bed. Root rot assessment and plant establishment counts were made at 4 and 8 weeks after seeding. Nodulation and biological yield were assessed at 16 weeks.

Results and Conclusions

Deeper seeding resulted in lower levels of root rot and a 17% increase in plant establishment. No increase in grain yield would be expected when plant density was increased from 57 to 69 plants/m^2 as maximum yield is attained at about 40-45 plants/m^2.

(A 17% reduction in establishment from 40 to 33 plants/m^2 would result in approximately a 5% loss in grain yield.)

Table 2.1 The effect of seeding depth on lupin root rot.

Seeding Depth (cm)	Root Disease Index	Plant Establishment 8 weeks (plants/m^2)	Nodulation score	Biological yield per plant (g)	Grain yield kg/ha
1-2	11.8	56.9	3.97	2.98	1678
4	6.4	57.9	3.58	3.15	1640
7	4.4	68.6	3.41	2.79	1638
LSD 5%	3.3	3.9	NS	NS	NS

85WH32 - LUPIN ROOT ROT: EFFECT OF CULTIVATION

The concentration of Pleiochaeta spores is higher in the top few cm of soil. Cultivation may influence the distribution of spores down the soil profile and thus influence the amount of root rot and brown leaf spot.

The trial was conducted at the WHRS on a yellow loamy sand paddock which has been in a 1:1 wheat-lupin rotation for several cycles. Scarifying treatments were done on 30/5 prior to seeding with a disc drill (3 cm) into a moist seed bed. Root rot assessment, spore counts and plant establishment counts were made at 4 weeks after seeding.

There was no signficant effect of cultivation on emergence, root rot or grain yield. Spore counts showed that scarifying redistributes Pleiochaeta inoculum down the profile (Fig. 1) which would tend to increase root rot. There were very low levels of Brown Leaf Spot in this trial and no observable differences between treatments. There would be insufficient burial of inoculum by scarifying to significantly reduce spore splash and brown leaf spot infection.

Table 2.2 The effect of cultivation on lupin root rot.

Treatment	Emergence (plant/m^2)	Root Index	Grain Yield (kg/ha)
Direct Drill	72.8	6.5	1920
Scarify x 1	71.5	6.0	1959
Scarify x 2	67.8	7.4	1937
Scarify x 3	68.6	7.6	1913
LSD 5%	NS	NS	NS

85WH52: LUPIN BROWN LEAF SPOT/PLEIOCHEATA ROOT ROT RESISTANCE TEST

Glasshouse tests in 1983/84 indicated that differences exist between lupin breeding lines for resistance to Pleiochaeta root rot. Differences in brown leaf spot resistance have been observed in lupin breeding trials. This trial aimed to test the relative yield and disease resistance of selected lupin breeding lines under various level of disease pressure.

The trial, conducted in conjunction with Dr W. Cowling (PPD), tested 42 "varieties" in 5 x 1 m plots over three sites at WHRS (three replicates per site). Root rot was assessed approximately four weeks after seeding (brown leaf spot was also assessed but this data is still not available).

Results and Conclusions

The data analysed at present shows that real differences in resistance to Pleiochaeta root rot exist between breeding lines. Table 2.3 shows the mean root rot severity scores over three sites.

Table 2.3 Resistance of lupin varieties to Pleiochaeta root rot.

Variety	Root Rot Severity	Variety	Root Rot Severity
6	7.85 a	16	14.60 abcdefghi
34	7.93 a	33	15.11 abcdefghi
38	8.70 ab	40	15.44 abcdefghij
5	9.68 abc	2	15.63 abcdefghij
8	10.28 abcd	26	16.36 abcdefghij
10	10.35 abcd	3	16.64 abcdefghij
23	10.62 abcd	24	16.92 abcdefghij
ILLYARRIE	10.70 abcd	WANDOO	17.27 abcdefghij
17	10.93 abcde	11	17.34 abcdefghij
14	11.36 abcde	MARRI	17.59 abcdefghij
19	12.09 abcdef	12	18.16 bcdefghij
9	12.48 abcdef	35	18.43 cdefghij
4	12.93 abcdefg	CHITTICK	18.91 defghij
13	13.21 abcdefgh	37	19.53 defghij
31	13.73 abcdefgh	22	19.87 defghij
1	14.07 abcdefghi	36	20.28 efghij
30	14.12 abcdefghi	27	21.18 fghij
7	14.26 abcdefghi	UNICROP	22.36 ghij
15	14.27 abcdefghi	25	22.49 hij
18	14.35 abcdefghi	21	23.26 ij
YANDEE	14.51 abcdefghi	DANJA	24.58 j

Means with the same letter are not significantly different (5% Duncans Multiple Range Test).

3. LUPIN ROOT ROT SURVEY - MOORA DISTRICT

This survey was conducted in conjunction with Mr D. Sawkins (Moora District Office) and aimed to:

(1) Compare the incidence and severity of root and leaf disease in lupin-wheat 1:1 and 1:2 rotations.

(2) Determine the relationship between pre-seeding *Pleiochaeta* soil inoculum levels and the incidence and severity of lupin root and leaf disease.

Results and Conclusions

Overall there were higher spore levels and root disease in the 1:1 compared to the 1:2 rotations despite large variations. Much of this variation is probably due to the frequency of lupin cultivation prior to 1982. Thus it is dangerous to conclude too much about the long term outcome of a 1:1 compared with a 1:2 rotation on this data because of the relatively few cycles of 1:2 completed by farmers in this district.

Table 3.1 Effect of crop rotation on lupin disease.

Rotation '82	'83	'84	'85	n	Spores/g Soil Mean	Range	Root Rot Severity Mean	Range	Brown Leaf Spot Defoliation Mean	Range
W	L	W	L	32	1050	30-3410	16.2	0.8-51.7	0.55	0.00-2.35
L	W	W	L	22	200	0-2155	8.2	0.9-15.1	0.33	0.00-3.45

n = Number of paddocks sampled.

There was a signficant correlation (r = 0.54) between soil spore levels and root rot severity although this correlation is probably not high enough to allow useful prediction of root rot severity in farmers paddocks. The very dry early growing conditions in certain areas in 1985 may have been responsible for increasing the variability in root rot severity and a more highly correlated relationship may exist between spore levels and root rot in a more 'normal' year.

There was no relationship between brown leaf spot severity and soil spore levels reflecting the far greater influence of environment compared to inoculum on the development of this disease.

It is likely that the frequency of rotation (i.e. 1:1 of 1:2) is not as important to the build up of soil inoculum as the occurrence of brown leaf spot epidemics in a particular paddock. Soil populations rise dramatically after a severe brown leaf spot epidemic which itself can be triggered by relatively low soil inoculum if environmental conditions are favourable.

4. COMMON ROOT ROT STUDIES

82M26 is a long term wheat-lupin rotation experiment which is monitored for root disease yearly. The trial is a split plot design (rotation - main plots, N rates - Sub-plots). The site has no take-all but moderate levels of common root rot (Cochliobolus sativus).

The trial was sampled at the soft dough stage and rated for common root rot using the method of Ledingham et al. (1973) Can. Plant Dis. Surv. 53: 113-122.

Table 4.1 The effect of rotation and nitrogen on yield components and common root rot severity 82M26.

Rotation	Plant wt (g)	Number Heads per plant	Head wt (g)	1000 seed wt (g)	Common Root Rot incidence (%)	Common Root Rot Severity (%)	Plot Grain Yield (kg/ha)
W W W W	2.26	1.10	1.23	39.12	71	45	1074
L W L W	2.59	1.19	1.41	38.98	65	32	1111
W L W W	2.55	1.19	1.40	41.32	61	33	1092
NH_4NO_3 (kg/ha)							
0	2.27[b]	1.11[b]	1.24[b]	39.94	58[b]	32	981[a]
300	2.66[a]	1.20[a]	1.45[a]	39.64	73[a]	43	1203[b]

Means with different letters are significantly different (Duncans 5%)

For each plot plants were separated into each disease severity category, bulked and the components of yield measured (Table 4.2).

Table 4.2 Yield components of plants in each common root rot severity category.

Root Rot Severity	Plant wt (g)	Number Heads per plant	Head wt (g)	1000 seed wt (g)
Nil	2.48[ab]	1.14[b]	1.18[a]	39.70[b]
Low	2.74[a]	1.94[a]	1.26[a]	41.02[a]
Moderate	2.68[a]	1.23[a]	1.19[a]	39.80[b]
Severe	2.35[b]	1.14[b]	1.12[b]	39.31[b]

Means with different letters are significantly different (Duncans 5%).

The most interesting trends were the lack of disease cleaning effect of the lupins and the increased disease incidence in the high nitrogen plots.

As observed in previous years at this site lupins give a poor disease cleaning effect.

There is a consistent reduction in yield parameters from low through moderate to severely affected plants. However, the plants with no infection were generally lower yielding than the low or moderately infected plants. This may reflect disease escape by plants with delayed germination.

The common root rot symptoms were measured on subcrown internodes. Damage on crown or seminal roots was not observed at the time of sampling (soft dough). The apparent reduction in all yield parameters with increasing disease severity suggests the disease has been hindering plant growth since early in the season.

FIG. 1 The effect of scarifying on soil spore population of *Pleiochaeta setosa*