1975

1975 Field experiments and cereal disease surveys

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WESTERN AUSTRALIAN DEPARTMENT OF AGRICULTURE

SUMMARY OF 1975 FIELD EXPERIMENTS AND CEREAL DISEASE SURVEYS WITH ADVISERS

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1. Septoria disease of wheat
2. Fungicide seed dressing on lupins
3. Cereal Disease survey

Title: Effect of variety and sowing date on yield and infection of wheat by Septoria spp.

Location: Badgingarra R.S.

Soil Type: Sand over gravel.

History: Ex pasture, 1973, cropped to Lupins.

Introduction:

Experimentation using fungicides had shown that large differences in yield of wheat could be associated with relatively small differences in the level and timing of upper canopy leaf damage at Badgingarra, where the principal species involved was *Septoria nodorum* - glume blotch. In the absence of economical control by fungicides or suitable resistance, an alternative means of reducing yield loss could be by use of disease escape, i.e. the avoidance of excessive leaf damage. It is probable that cv. Kondut which has found some favour in the West Midlands escapes excessive damage by being late maturing. Conversely, it might also be possible to escape excessive damage by the use of early maturing cultivars -

(a) by sowing these cultivars late, and

(b) by exploiting their faster maturation rate to increase the chance of escaping some period of the (discontinuous) epidemic (a period of rainfall is necessary for infection).

A small experiment in 1974, testing some 14 early maturing selections indicated that some had yielded better than expected from previous tests chiefly in non-disease situations and so in 1975 three of these were compared with 'control' varieties Kondut, Darkan and Gamenya at four sowing dates.

Methods:

Six wheat cvs., Darkan, Gamenya, Kondut and three early maturing selections, were sown in 0.01 ha plots at four sowing dates - May 1, 15, June 1 and June 15. A split plot design was used with sowing dates as main plots. There were three replications. Wheat was sown with 65 kg/ha^{-1} super and urea.

Assessment of Septoria infection began at flag leaf emergence on the first sowing.

Results:

Germination was rapid at each sowing date (May 1, 15, June 1, 15) and the desired separation of growth stages was achieved. Weed control was uneven however, with sowing dates 2 and particularly 3 badly affected by capeweed. A dry August slowed growth in all plots but had no effect on grain setting. Late rains produced favourable moisture conditions for all sowings during grain development.

Conditions were (unusually) unsuitable for Septoria infection until August and consequently the first record of infection levels was not begun until August 13. At this time Gamenya was at growth stage 13-14 (H. Fisher's scale) and early maturing varieties at growth stage 20 in the first sown plots.

Subsequent records of infection were made on August 28, September 17, October 2 and 24, 1975. By September 17 it was evident that the three experiments would be severely affected by take-all and this disease was eventually responsible for loss of up to 75% of the plants in some plots. First and Second sowings appeared to be more severely affected. The distribution and extent of take-all damage in this experiment made yields obtained quite unreliable.

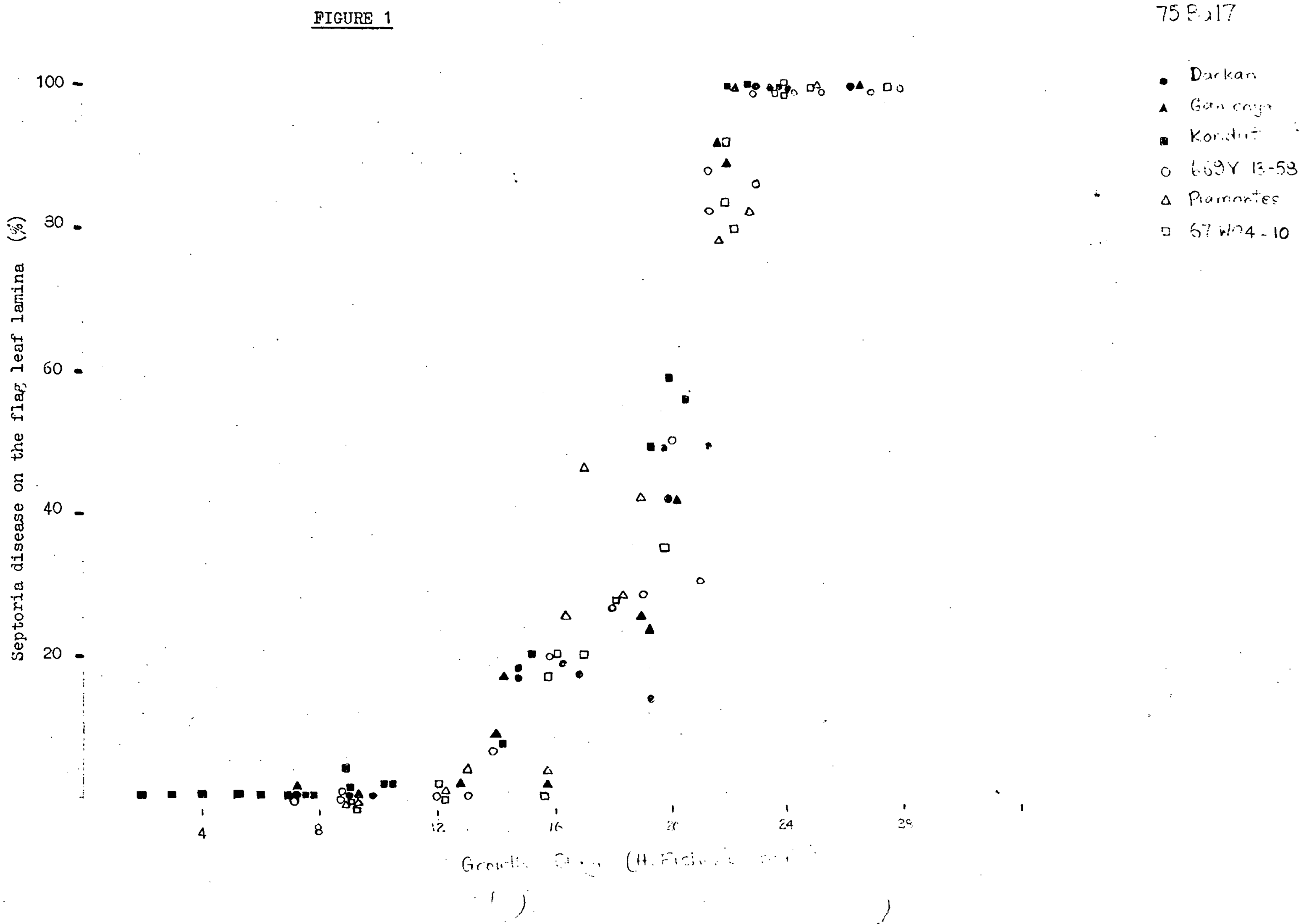
Results:

Figure 1 shows the development of damage attributable to Septoria on flag leaf laminas adjusted for crop development for each cultivar. The date has not yet been analysed but it seems unlikely that there is any difference in disease development when the cultivars are compared in this manner. This would indicate either no difference in resistance between them or that any difference was sufficiently short-lived for it to have escaped detection. The mean score of around 75% of leaf area lost at stage 22 would be comparable with severe epidemics experienced previously at Badgingarra. With partial control of Septoria using fungicides in these conditions, yield increases of 50-100% have been obtained.

Yields and 1,000 grain weights are shown in Table 1. As mentioned previously it is considered that no reliance can be placed on yield data but bearing in mind that 1,000 grain weight is the main yield factor affected by Septoria it would appear that considerable tolerance or escape from the effects of disease has been demonstrated by certain varieties.

However, this was no associated with early maturity particularly, nor was there a significant cv. x sowing date interaction - early maturing varieties performed relatively no better at late sowing dates than early. It is possible that the extended rains of 1975 may have affected this result. It is also possible (but unlikely) that grain weight differences betweens cvs. have also been affected to some extent by take-all, since large seeds cvs. would have been sown at lower rates and take-all has been shown to be somewhat less severe on thinly sown crops.

FIGURE 1



75 B17
Septoria disease on the flag leaf lamina (%)
100
80
60
40
20
4
8
12
16
20
24
Darkan
Piamontes
67 W04 - 10

TABLE 1 75BA17

Mean yield (tonnes/ha) and grain weight (g/1000 grains) for cvs. and sowing dates

8	MAY 1						MAY 15					
	D	G	K	EM1	EM2	EM3	D	G	K	EM1	EM2	EM3
Yield	1.78	1.56	1.02	1.52	1.17	1.14	1.62	1.33	7.3	1.29	1.05	1.04
Grain wt.	38.7	27.6	33.6	35.0	30.5	26.9	42.2	29.8	34.3	35.9	31.6	26.7

8	JUNE 1						JUNE 15					
	D	G	K	EM1	EM2	EM3	D	G	K	EM1	EM2	EM3
Yield	1.27	1.21	1.08	1.30	1.05	1.11	0.81	0.97	0.84	0.98	0.86	0.81
Grain wt.	41.6	29.7	36.9	39.0	34.0	31.9	35.9	27.3	31.5	34.3	31.6	29.1

	Darkan	Gamenya	Kondut	EMI (669 Y 13.58)	EM2 (Piamentes)	EM3 (67 W 04.10)	
ield	1.37	1.27	0.92	1.27	1.03	1.03	
rain wt.	39.7	28.6	34.1	36.2	31.9	28.7	S.E. ± 0.997

	Sowing 1	Sowing 2	Sowing 3	Sowing 4	
ield	1.37	1.18	1.17	0.88	
rain wt.	32.1	33.5	35.5	31.1	N.S.

as below :

TABLE 4 Estimated mean percentage yield loss assuming % damage ≡ 0.44% yield loss

		A > 450 mm	B 325-450 mm	C < 325 mm
Wheat	? Water stress etc.	8.8	18.2	32.4
	Septoria	16.1	13.9	3.0
	Total	24.9%	32.1%	35.4%
Barley	? Water stress etc.	14.9	28.1	33.0
	Scald	13.8	5.8	3.6
	Total	28.7%	33.9%	36.6%

Since a score for the entire barley flag leaf has been used, damage to barley may be underestimated. Similarly, because Septoria nodorum also affects the glumes, losses from infections with S. nodorum may also be underestimated.

Incubation of sample flag and second leaves under near ultra-violet light allowed identification of Septoria present on wheat samples. From sporulation on these leaves an estimate of the proportion of tissue affected by S. nodorum and S. tritici was inferred. Each pathogen was rated as absent (0), occasional (1), sparse (2), moderate (3) or attributed to Septoria was then apportioned according to the ratio of sporulation scores.

Septoria was successfully detected on only 23 specimens after incubation, thus the figures given below are determined on data from just over half the trials :

TABLE 5 Mean percentage loss of photosynthetic area (Flag leaf) attributable to Septoria infection

			S. tritici	S. nodorum	Total
Area	A	> 425 mm	20.1	16.8	36.9
	B	425 - 325	11.5	21.5	33.0
	C	< 325	3.0	3.0	6.0
Zone	1	North	0	29.0	29.0
	2	N. Central	0	35.8	35.8
	3	Central	18.0	0	18.0
	4	S. Central	19.8	6.0	25.8
	5	South	32.4	3.7	36.1

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However, it will be noticed that the totals here show favourable agreement with those obtained from 36 trials as shown in the main table. The most noticeable features are the tendency for S. tritici to decrease rapidly with rainfall, while S. nodorum remains at a high level in the middle rainfall area and the almost complete reversal of distribution from north to south. This confirms the trend of previous years.

Occurrence of other foliage diseases on wheat was negligible but there was a relatively high incidence of whiteheads considering the small size of the samples. Whiteheads were recorded from 11 sites and appeared to be unduly numerous (4 out of 30) at Gairdner River, Jerramungup and Yuna. At Chowerup the incidence was very high - 18 out of 30 plants were affected. It is also likely that many more (if not most) samples would have been affected to some extent this year. Barley yellow dwarf disease was noted at two sites and wind-damage (death of flag lamina by fracture near the axil) at four.

With barley, the only other disease of consequence was net blotch which was present in small amounts at two of the six sites which grew Beecher. The most severely affected was Yuna where damage reached 32%. In this trial Clipper was also affected (8%) and scald was absent. Since Clipper is quite resistant to net blotch and has been virtually unaffected by mildew in commercial crops in Western Australia until now it is likely that the incidence recorded is unrepresentative of disease in the commercial crop (Beecher still occupies a large fraction of the barley area sown). In fact any survey of crops cannot really estimate the distribution and preponderance of a disease - only its effect on current varieties. Diseases with alternative hosts or extremely long lived resting structures can thus reassert themselves in the commercial crops with a change to susceptibility either by a change in variety or the evolution of a new pathotype and even by some change in agronomic practice.

CEREAL FOLIAGE DISEASE SURVEY

Samples from Mr H. Fisher's cereal variety trials (10 main tillers from each replication) collected by Wheat & Sheep Division's country office staff were rated for disease during September and October. Samples were collected, firstly at or about 100 days and, secondly, when grain development was at the milky-ripe stage (22 on H. Fisher's Development Scale), the date for this collection being determined from the first samples. Necrosis and chlorosis was rated on L. flag and second youngest leaf laminas at first sampling and on ear and flag lamina for wheat, flag lamina and sheath for barley and flag lamina for oats at second sampling. The proportion of non-functional tissue affected by disease or diseases was then estimated with dead tissue unaccounted for by disease ascribed to water stress and possibly N deficiency (which would also include stress caused by root-rot).

At the time of the first sampling almost all wheat showed signs of Septoria infection but samples with serious infection were few. The same was true of scald on barley with a strong tendency for severe Septoria and scald to occur at the same site. Few oat samples were free of Septoria infection but none could be described as seriously affected. Net blotch and mildew were virtually absent from barley samples but since Clipper is resistant to both diseases this is hardly surprising. Mildew was detected on lower leaves from Esperance Downs Research Station, the first indication of a race able to attack Clipper in the wheat belt of Western Australia. Net blotch was seen as a light infection on Beecher from Merredin Research Station and Salmon Gums, but was also present in trace amounts on Clipper from Yuna.

The percentage of damage (necrosis and chlorosis) attributed to various factors on the second samples is shown in the table. The amount of necrosis is very high by European or American experience but water stress (assuming that this diagnosis is correct) would probably be the major factor regularly limiting functional leaf area in the medium and low rainfall areas of Western Australia. It would seem less likely to be a factor in Europe or many parts of the U.S. and Canada.

Total disease loss was estimated at 8.8% of potential in "Losses from cereal diseases in Manitoba in 1971", Can. Plant Dis. Surv. 1972, 52, 113-118. Leaf spotting diseases including Septoria avenae f. triticea accounted for a mean weighted percentage necrosis on the upper two leaves of 6%. No mention is made of necrosis unrelated to disease or to water stress. The Canadians used the data of James et al (Ann. appl. Biol. 1968, 273-288) relating scald to yield loss in barley and extrapolated the findings to all "leaf-spot" diseases on wheat, oats and barley in calculating losses. The relationship, derived from five field trials in South-West England, showed loss in yield as a percentage of an uninfected crop equivalent to approximately 0.67 of percentage damage to the flag or 0.5 of leaf 2 damage at growth stage 11.1 (Feekes-Large Scale). This means that 6% necrosis was assumed to account for a loss of 3.5% of potential. If the same relationship were used to extrapolate from my figures, then for wheat

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and barley, losses of potential yield would be :

TABLE 3 Estimated mean percentage yield loss assuming % damage ≡ 0.67% yield loss.

		A > 450 mm	B 325-450 mm	C < 325 mm
Wheat	? Water stress etc.	13.3	27.7	49.3
	Septoria	24.6	21.1	4.7
	Total	37.9	48.8	54.0
Barley	? Water stress etc.	22.7	42.7	50.2
	Scald	21.1	8.8	5.4
	Total	43.8	51.5	55.6

Some allowance would have to be made for the marginally later growth stage at which wheat and, particularly, barley samples were examined but it is still apparent that damage and potential loss caused by disease is enormous. It is possible that in Western Australia where water stress is an overriding factor, freedom from disease would merely result in increased stress damage but it is doubtful if this factor would negate the effect of disease entirely. Increased yields of 53.6, 11.7 and 10.3% following partial control of *Septoria nodorum* at Badgingarra in 1971, 1972 and 1973 supports the probability of large losses.

For Barley, control of scald (and some mildew) at Mr Barker from 1971-73 also produced large increases in yield. Since control of mildew alone produced little or no increase, results of scald and mildew control are assumed to be largely due to scald. With this assumption, percentage yield loss and percentage scald damage on the flag leaf lamina was plotted to give the relationship -

$$\hat{y} = 91.3383 - 0.276 x$$

$r = -0.619$ significant at $p \doteq < 0.01$. 50% loss of flag leaf lamina at growth stage 11.1 (≐ 22 H. Fisher's scale) was associated with a yield equal to 78% of the virtually disease free sprayed plots: percent scald damage was equivalent to 0.44 percent yield loss.

If results from Mt Barker are taken as typical for barley in Western Australia and assumed to also indicate the effect of Septoria on wheat then the 1975 survey may indicate losses

TABLE 6 FOLIAGE DISEASES AND NECROSIS - 1975

Mean percentage loss of photosynthetic area
for Flag (wheat), Flag including sheath (barley) and Flag (oats)

	Rainfall Areas (mm)			Zones					
	(14) A >450	(14) B 325-450	(9) C < 325	(5) 1 North	(5) 2 N. Central	(8) 3 Central	(7) 4 S.Cental	(12) 5 South	
WHEAT									
? Water stress	19.9	41.4	73.6	55.0	23.4	31.1	49.1	35.1	
Septoria	36.7	31.5	7.0	27.0	32.2	19.0	20.9	27.3	
Total	56.6	72.9	80.6	82.0	55.6	50.1	70.0	62.4	
Growth stage	22.1	22.4	22.6	23.6	22.0	21.5	22.3	22.5	
Head Infection(0-4)*	1.04	0.93	0.29	1.70	0.92	0.46	0.50	0.74	
BARLEY									
? Water stress	33.9	63.8	74.9	55.0	23.4	31.1	49.1	35.1	
Scald	31.5	13.1	8.1*	2.0	17.2	15.4	22.4	24.2	
Total	65.4	76.9	83.0	57.0	40.6	46.5	71.5	59.3	
Growth stage	23.5	23.8	24.1	25.2	22.5	22.8	24.4	23.9	*6.4 from 1 site (L. Camm)
OATS									
Septoria	10.0	4.0	0.8	0	2.0	4.1	10.0	7.3	

* A 0-4 scale used to rate head infection.

TABLE 7 Cereal Foliage Disease Survey 1975

		Zone	Sowing (wheat) date	Wheat	Headscore (wheat) 0 - 4 Scale	Barley (Clipper)	Oats	Barley (Beecher)
1.	Beverley R.S.	B3	11/6	+ (19) 20 20	.3	+ (20) 38 38	18 0 0	
2.	Badgingarra	A2		(22) 50 50	1.6	(23) 53 53	20 5 5	
3.	Chapman	B1	17/6	-	-	-	-	
4.	Gibson	A5	17/6	(22) 58 23	1.1	(23) 52 52	(23)48 14	
5.	Merredin	C3	19/6	(21) 35 4	0	(23) 40 10		(22) 20 10 sc.
6.	Mt Barker	A5	14/5	(21) 87 87	1.0	(22) 62 62	(22)13 13	
7.	Newdegate	B4	4/6	(22) 52 52	1.4	(23) 72 29	(22)62 16	
8.	Salmon Gums	C5	16/5	(23) 100 5	0	(24) 95 5	(24)95 0	(25) 100 10 n.b.
9.	Wongan Hills	B2	9/6	(20) 33 33	.9	(21) 33 33	(20) 3 3	
10.	Woodgenellup	A5	18/6	(22) 84 42	1.0	(23) 52 36	(23)57 23	
11.	Chowerup	A5	5/6	(22) 90 10	0	(23) 60 36	(22)10 10	
12.	Neradup	A5	6/6	(22) 62 62	1.5	(23) 63 63	(23)17 17	
13.	W. Grass Patch	B5	28/5	(22) 83 8	0	(23) 88 0	(23)100 0	
14.	E. Salmon Gums	C5	26/5	(23) 95 0	.0	(24) 78 0	(23)75 0	(24) 67 0
15.	Mellewa	C1	11/6	(23) 98 18	.6	(25) 95 0	(25)90 0	
16.	Yuna	C1	13/6	(22) 50 30	1.2	(24) 75 8 n.b.	-	(24) 80 32 n.b.
17.	N. Mingenew	B1	23/6	(25) 67 33	2.0	(26) 85 10	(26)95 10 R.	
18.	Mingenew	B1	18/6	(25) 100 25	2.4	(27) 100 0	(26)100 5 R.	
19.	Gairdner River	A5		(23) 70 21	1.6	(26) 95 10	(26)100 10	10 10 R.
20.	Jerramungup	B5		(22) 40 40	1.5	(25) 100 0	(23)100 0	
21.	Ravensthorpe	B5		(22) 55 0	0	(23) 62 6	(22) 15 0	
22.	N. Kojonup	A4	21/5	(24) 100 60	1.3	(29) 100 0	(27)100 0	
23.	Borden	B5	27/5	(27) 100 30	1.2	(28) 100 20	(27)100 0	
24.	L. Camm	C4	21/5	(2[illegible]) 70 7	.8	(23) 7[illegible] 58	(22) 6 6	(23) 82 82 sc.

Contd..../2

TABLE 7 (CONTD)

		Zone	Sowing	Wheat				Headscore	Barley			Oats			Barley
25.	Kukerin	B4	29/5	(21)	58	17		.2	(21)	37	37	(21)	35	35	
26.	Bruce Rock	B3	4/6	(22)	88	0		0	(22)	83	0	(22)	48	0	
27.	Bencubbin	C2	29/5	(22)	100	5		.2	(23)	100	0	(23)	100	0	
28.	Moorine Rock	C3	21/5	(23)	83	0		0	(24)	100	0	(24)	87	0	(24) 97 0
29.	Dandaragan	A2	15/6	-				-	-			-			Lupins only
30.	W. Moora	A2	17/6	(22)	55	55		1.3				(20)	2	2	
31.	E. Wubin	C2	29/4	-				-	-			-			
32.	W. Narrogin	A4	22/5	(20)	32	10	22[BY]	0	(21)	33	33	(22)	27	19	8[BY]
33.	Wickepin	B4	6/6	(23)	100	0		.9	(27)	100	0	(26)	100	0	
34.	Hyden	C4	4/6	(24)	100	0		.2	(27)	100	0	(26)	100	0	
35.	Bolgart	A3	10/6	(22)	45	22		.1	(23)	72	0	(23)	48	5	
36.	Muresk	A3	21/5(?)	(22)	48	24		.9	(23)	63	31	(23)	42	0	
37.	Cunderdin	B3	6/6	(21)	25	25		1.6	(24)	95	10	(22)	43	2	41[BY]
38.	W. Dale	A3	23/5	(22)	57	57		.8	(23)	57	34	(22)	37	22	15[BY]
39.	N. Eneabba	A1	4/6	(23)	95	29		2.3	(24)	88	0	(24)	88	0	
40.	Waddi Forest	B2	11/6	(22)	60	18		.6	(23)	77	0	(23)	82	0	

+( ) Growth stage H. Fisher's scale ; total necrosis; Septoria or scald or Sept. avenae score.

* take-all induced senescence

sc. scald

n.b. net blotch

R. rust

BY B.Y.D.V.

Title: Effect of seed dressing on seedling death of lupins.

Location: Eradu and Boyup Brook

Introduction:

Considerable loss of stand had been experienced by some growers attempting to double crop Uniwhite lupins in 1972 and 1973. Some losses had also been experienced in first crop Uniharvest lupins. Preliminary investigations suggested species of *Pythium* and *Fusarium* as possible pathogens involved. With many other crops beneficial effects of seed dressing controlling pre and post emergence root-rots have been obtained where these fungal genera are known to cause problems.

Methods:

Seven fungicides (see Table 2) with either activity against a wide range of soil pathogens or good activity against the *Pythium*, *Phytophthora* group were chosen for trial. The fungicides were applied, using methocell to pellet the seed, at 3 g/kg except for Dexon which is known to be phytotoxic to legumes and which was used at 0.3 g/kg.

Exactly 100 seeds were sown in 1 x 2 m plots with 5 replications arranged as a randomized block design. Four weeks later germinating seedlings with two or more mature leaves were recorded. Six sites were sown, 3 near Eradu, 3 near Boyup Brook. Five sites were sown on land down to lupins in 1974 - 1 ex wheat.

Results:

Germination counts for 5 of the sites (1 site grazed by) are shown in Table 2 and it can be seen that no fungicide had any effect. Examination of root systems in the Eradu experiments showed that they were virtually unaffected by root rots. However, at Boyup Brook root-rotting was extensive and plants were less vigorous than those at Eradu. Isolations from root samples taken from all sites indicated that the most common fungi in the roots were *Pythium irregulare*, *Pythium acanthicum*, *Fusarium oxysporum* and *Pleiochaeta setosa*. Frequency of islation was similar for both sites except in the case of *Pleiochaeta* which was only rarely seen from Eradu.

Discussion:

It would appear that there is little need for a seed dressing on sites typical of those on the Eradu sand and also that none of the fungicides tried were of any use on the Boyup Brook sites. *Fusarium* and *Pythium* damage to seedlings appear to be more severe in cold soils in the U.S.A. and it is possible that temperature is the major factor here. The isolation of *Pleiochaeta* from roots does not appear to have been recorded previously.

LUPIN SEED DRESSING EXPERIMENTS

TABLE 2 - Mean numbers of Unicrop seedlings surviving 4 weeks after sowing (100 sown)

Treatment	Site	Nil	Dexon	Terrachlor S.X.	Captan	Thiram	Pyroxychlor	Difolatan	Daconil
Eradu	1	79	78	74	77	76	74	74	79
	2	75	77	73	70	72	77	73	72
	3	62	49	51	56	51	53	60	57
Boyup Brook	1	39	41	33	36	32	40	33	29
	2	65	62	53	64	59	66	58	61