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DEPARTMENT OF AGRICULTURE
WESTERN AUSTRALIA

1975 - EXPERIMENTAL SUMMARY

CLOVER SCORCH
(February 1976)

D.L. Chatel
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Plant Research Division

This report covers the three major clover scorch activities for the year :

- A) The tolerance screening at Denmark.
- B) The dry matter production in the second year of a mowing trial, in which clovers with and without scorch were compared the previous year.
- C) A summary of the first four years of a disease incidence survey - and an examination of some meteorological factors in relation to disease development.

The first two were done jointly with Dr C.M. Francis.

A) SCREENING TRIAL

Summary:

Two hundred and eighty eight clovers were screened in the field for tolerance to the disease. Once again all clovers showed symptoms of infections to varying degrees.

The disease was slower than usual in developing. However, the most susceptible clover, Yarloop - and many of the unknowns being tested for the first time developed serious effects and many of them had completely collapsed by late September.

The varieties included because of their apparent tolerance in earlier years again stood out as promising, particularly 47308D, N2674 and Williams C.

Most of the cross bred material proved very good.

Methods and Results :

The varieties tested included: 43 that were apparently tolerant in other years: 51 crosses between Midland B and Daliak; 11 Daliak x Bacchus Marsh crosses; 18 Daliak x Toodyay C crosses; 15 (Mt Helena x Nangeela) x Daliak crosses; 13 varieties from various collections that had not been tested previously; 131 varieties from North Africa, Spain and Portugal, largely collected by J.S. Gladstones.

Triplicate plots of six control varieties were sown, viz: Mt Barker, Daliak, Woogenellup, Yarloop, Y26 and Toodyay C.

The plots were established at Denmark Research Station on newly cleared land (Jarrah). The soil type was sand over gravel/coffee rock. Fertilizer, plot layout were the same as used in previous years (see W.A. Dept Agric. Tech. Bulletin No. 25). All plots were topdressed with manganese sulphate (two occasions) and potash (one) during the growing season.

A comparison of the rainfall for the Station between 1974 and 1975 is presented in Table 1.

...../2.

TABLE 1

Rainfall pattern at Denmark Research Station in 1974 and 1975 (mm)

(figures in parentheses are the number of rainy days)

Month	1974	1975
January	28.7 (7)	17.1 (9)
February	25.1 (9)	10.9 (8)
March	26.8 (10)	18.6 (13)
April	64.1 (14)	121.0 (18)
May	117.8 (20)	130.5 (21)
June	81.3 (23)	88.8 (21)
July	177.9 (27)	194.7 (30)
August	102.6 (25)	105.6 (25)
September	47.6 (19)	83.8 (24)
October	96.0 (17)	85.2 (21)
November	53.0 (13)	25.9 (12)
December	13.2 (7)	4.1 (3)
Totals	834 (191)	886 (205)

TABLE 2

The most tolerant clovers in the 1975 screening trials*
(rated 0 = no disease to 10 = death)

Variety	Disease rating	Variety	Disease rating
13243	0	47300A	2-2.5
Williams C	"	47309D	"
GS 058.12	"	47302B	"
39327 YB	1-1.5	Parkerville B	"
47299A	"	Boyup Brook	"
Daliak	"	47301	"
Toodyay C	"	GM 122.9	"
Guildford D	2-2.5	GS 058.7	"
14218	"	GS 058.15	"
47308D	"	GS 058.16	"
47308C	"	GS 072.2	"
N2674	"	GS 163.2	"
26225	"	GS 042.1.8	"
Williams D	"	47267A	3
Toodyay E	"	47299A	"
47267 F	"	47299D	"
47299 B	"	47300C	"
47309 A	"	47283	"
47308 B	"	47298	"
14217 A	"	47300D	"
47278 A	"	47271B	"
47278 B	"	ACD 12	"
Toodyay D	"	Marradong	"
		47277B	"
		14198	"
		GPO42.4	"
		GS036.1	"
		GS072.1	"
		GS042.2.10	"
		GS042.3.12	"
		GS052.1	"
		GT018.1.14	"

*Excluding the crosses.
only 10 of the 95 crosses
had a maximum rating in
excess of 3.5

Table 2 (continued)

Excluding the crosses only ten of the 95 crosses had a maximum rating in excess of 3.5

A list of the most tolerant clovers is presented in Table 2. It can be seen that many of the varieties showed very little sign of damage (ratings from 0-3). Many of the clovers (mainly crosses) with an 0 rating had very small lesions that were not considered to be caused by Kabatiella at the time of rating. However, the disease organism was isolated from all of a number of petioles typical of these clovers, and we are assuming, at this stage, that all of the 0 rated clovers had scorch, but of no agronomic significance.

Only four of the 43 clovers selected because of their tolerance in earlier screenings gave ratings of 4 or 5. The remainder showed mild symptoms only. Of these Guildford D, 47308D, Toodyay D, N2674 and Williams D looked very good.

The previously untested group included many from North Africa and Southern Europe. Very few of these showed any promise. The most tolerant were 47301 (which was very late maturing), GM122.9, GTO18.1, 14, GS058.15, GS072.2, GS163.2 and GSO42.1.8 - 042.3.12.

Most of the crossing material looks promising. Of particular interest is 210.10 (16.1) which is a Daliak x Bacchus March (F8) cross. It has inherited Daliak's tolerance and hard seededness but has maturity and growth characteristics close to Bacchus Marsh. This and other crosses, together with some of the tolerant selections, represent quite a collection of future commercial clovers.

The Daliak x Toodyay C crosses were disappointing. A number of them were worse than either parent in terms of tolerance to the disease.

B) MOWING TRIAL (74 D2) - SECOND YEAR

Some very useful information on the comparative yield of different clover varieties, with and without clover scorch, was obtained in 1974 (see 1974 summary).

Toodyay C established very poorly in the second year. Generally, differences in the 1974 seed yield were not reflected in the 1975 establishment.

The results of some agronomic measures done in 1975 are presented in Table 3. It can be seen that even by the end of May the disease was firmly established in some of the treatments; the worst affected being Yarloop, Y47, Woogenellup, Mt Barker and Larissa. By the end of July all these clovers had virtually completely collapsed. The early infection and ultimate near collapse of Mt Barker is very surprising. It is possible that this clover, which is classified as being able to escape the disease, just could not cope with the heavy spore load it presumably encountered at emergence. There must have been large numbers of spores on most of the plus Kabatiella plots, particularly as the plots were not grazed during the summer.

.... /4.

TABLE 3

The effect of clover scorch on seasonal production of subterranean clovers following clover scorch the previous year.

Host	Mean days to flowering	Disease 1974	Seed Yield 1974 kg/ha	Disease Rating 1975 May 28 July 30		Herbage production kg/ha						Seed Yield kg/ha
						June 27	Aug 7	Sept 9	Oct 4	Nov 21	Total to Nov 21	
Yarloop	111	+	280	6	10	340	-	-	-	-	340	104
		-	609	1	0	695	1000	1223	1015	-	3933	681
Mt Barker	139	+	445	4	9	355	-	-	-	-	355	132
		-	477	0	0	585	642	509	930	885	3551	511
Woogenellup	132	+	202	4	10	305	-	-	-	-	305	104
		-	475	0	0	470	459	804	841	-	2574	482
Toodyay C	132	+	517	0	0	600	-	-	-	-	600	321
		-	648	0	0	595	558	791	831	-	2775	362
Guildford D	120	+	384	0	2	525	585	585	1041	146	2882	472
		-	536	0	0	700	422	685	818	488	3113	553
Larissa	145	+	339	3	10	515	-	-	-	-	515	192
		-	492	0	0	910	763	931	1323	415	4342	489
39327YB	136	+	400	0	3	920	657	827	1115	816	4335	389
		-	528	0	0	585	822	1387	1122	405	4321	488
Trikkala	121	+	596	1	7	600	550	239	607	-	1996	544
		-	629	0	0	720	862	1045	891	-	3518	641
Y47	132	+	353	5	10	310	-	-	-	-	310	165
		-	544	0	0	685	676	1147	1107	386	4001	401

It is very interesting to note that the minus Kabatiella plots (those sprayed with Benlate in 1974) showed very little sign of disease again in 1975 (when not sprayed). The only variety to show symptoms was Yarloop - and it was very mild.

The big difference between the plus and minus scorch plots in disease development in the second year strongly suggests that there is little movement of spores from one plot to another, some being only one metre apart. (This assumes that the fungicide is no longer effective after summer-autumn).

The good performance of Guildford D and 39327YB, even on those plots on which scorch had been encouraged the previous year, is very encouraging. Toodyay C did not live up to its early promise. Apart from the seed viability problems it proved very susceptible to insect attack (caterpillars and perhaps slugs).

Most of the plots badly affected by disease became very grassy during winter and this makes some comparisons very difficult. Some estimates of composition were made. However, apart from this complication, not all top material was recovered because of the heavy grazing by cattle (for reasons not clear to us) some days prior to the cut planned for late October. This was expected to be the highest yielding cut.

In the second year the Kabatiella - free plots of the susceptible clovers, Yarloop and Woogenellup, gave appreciably higher seed yields (Table 3) than their scorched counterparts. There was also a big difference between the two Mt Barker treatments. On the other hand there was relatively little difference between the corresponding treatments of Guildford D and 39327YB.

C) DISEASE INCIDENCE AND CLIMATE

- i) Disease incidence 1974.
The annual survey of disease incidence was again conducted by the various regional and district officers and results forwarded to me for compiling.

TABLE 4

Incidence of clover scorch disease in Western Australia during 1974.

District Office	No. Farms surveyed	Disease Rating*					
		1	2	3	4	5	6
Esperance	25	7 (28)	7 (28)	4 (16)	2 (8)	5 (20)	0
Denmark	10	2 (20)	6 (60)	2 (20)	0	0	0
Manjimup	28	6 (21)	10 (36)	5 (18)	5 (18)	2 (7)	0
Busselton	22	11 (50)	5 (23)	4 (18)	2 (9)	0	0
Margaret River	26	7 (27)	6 (23)	9 (35)	3 (11)	1 (4)	0
Bunbury	35	28 (80)	6 (17)	1 (3)	0	0	0
Harvey	25	23 (92)	2 (8)	0	0	0	0
	171	84 (49)	42 (25)	25 (15)	12 (7)	8 (5)	0

(Figures in parentheses are percentages)

- * 1. No clover scorch.
2. Trace of scorch. Insignificant.
3. One or two paddocks affected.
4. Most clover killed in some paddocks - but only traces in most paddocks.
5. Scorch bad in most paddocks.
6. Clover completely killed in most pasture paddocks.

The disease was much less severe in 1974 than the previous year, particularly in the Bunbury area, which had only 20 percent of farms affected in 1974 and 60 percent in 1973.

Table 5 shows the proportion of farms in each of the surveyed areas in which the disease was considered a serious problem. For this presentation I have combined categories 4, 5 and 6 (see footnote to Table 4).

TABLE 5

Farms on which clover scorch was a serious problem from 1971-1974 (%).

Location	1971	1972	1973	1974
Esperance	45	11	13	28
Denmark	40	0	30	0
Albany	44	24	-	-
Manjimup	6	3	16	25
Bridgetown	14	0	-	-
Busselton	7	7	23	9
Margaret River	38	41	37	15
Bunbury	17	3	12	0
Harvey	4	3	0	0
Total	24	11	17	12

- = not done

Table 6 shows the proportion of farms on which the disease was either not observed or was present in insignificant amounts (i.e. categories 1 and 2).

...../7.

TABLE 6

Farms on which clover scorch was either not present or largely noticable from 1971 - 1974 (%)

Location	1971	1972	1973	1974
Esperance	34	86	59	56
Denmark	10	80	50	80
Albany	51	48	-	-
Manjimup	74	66	57	57
Bridgetown	69	100	-	-
Busselton	72	72	62	73
Margaret River	47	47	48	50
Bunbury	66	94	77	97
Harvey	80	97	96	100
Total	57	76	65	74

- = not done

There are obvious problems here because many farmers may have difficulties with disease recognition. It should also be noted that the Denmark samples included only ten farms. The figures are of interest (for the record) but even if only 5 percent of farms were hardly affected by scorch, it would have to be considered a serious problem for those particular farmers.

ii) Climate and clover scorch

Observations of scorch in the field as early as 1972 strongly suggested that clover scorch development was enhanced by extended periods of mild temperature and drizzly rain. The longer the spring the worse the disease.

A puzzling question that continually arises is why are the clover dominant areas further from the coast (e.g. Williams, Narrogin, Kojonup) relatively free of serious scorch.

In order to examine those points we have started to look at some climatic factors.

Table 7 shows the number of rainy days in August, September and October.

TABLE 7

Rainy days in August, September and October in various locations.

Location	1970	1971	1972	1973	1974
Esperance	50	50	35	50	35
Denmark	63	74	54	61	60
Albany	56	70	54	62	55
Manjimup	55	73	53	63	49
Bridgetown	48	58	44	47	44
Busselton	43	60	45	54	41
Margaret River	-	74	35	66	51

No clear pattern emerges, however, it is clear that the worst year for scorch, 1971, was also the year that had the most rainy days in spring. Also, the next worst year 1973 had more wet days than either 1972 or 1974.

TABLE 8 Mean monthly minimum temperatures in 1971 and 1974

Location	May		June		July		August		September	
	'71	'74	'71	'74	'71	'74	'71	'74	'71	'74
Bridgetown	6.6	7.2	4.9	4.5	4.0	5.1	4.6	4.7	5.9	5.2
Kojonup	7.6	9.2	6.6	7.4	5.7	6.6	5.1	6.4	5.7	6.8
Narrogin	6.7	-	4.9	7.1	4.5	6.6	5.2	5.9	6.2	6.8
Esperance	8.3	9.0	7.1	6.6	5.8	6.6	6.3	5.9	6.8	6.6
Denmark	8.8	9.4	7.9	7.7	5.8	7.4	7.0	6.9	7.9	7.5
Albany	9.8	9.9	8.1	7.9	7.1	7.4	7.2	7.4	7.5	8.1
Manjimup	8.4	9.0	7.3	7.5	6.5	7.0	6.3	6.9	6.3	7.6
Busselton	8.8	9.1	8.0	8.5	8.1	8.8	7.6	9.1	8.6	9.0
Margaret River	9.6	10.5	8.4	8.7	8.6	9.2	7.6	8.4	8.1	7.9

TABLE 9 Mean maximum monthly temperatures in 1971 and 1974

Location	May		June		July		August		September	
	'71	'74	'71	'74	'71	'74	'71	'74	'71	'74
Bridgetown	18.5	18.4	17.2	17.8	16.6	15.2	15.5	16.8	16.3	19.5
Kojonup	17.1	16.6	15.6	15.5	14.7	13.7	13.5	14.9	15.1	17.6
Narrogin	17.6	-	15.8	15.5	14.9	13.8	14.1	15.2	15.7	18.0
Esperance	17.9	18.4	16.9	16.6	16.0	15.9	14.9	17.0	17.6	19.5
Denmark	18.6	19.0	17.6	18.4	16.3	16.2	15.2	16.8	16.2	18.7
Albany	17.9	18.2	17.3	17.3	16.3	15.5	14.8	16.1	16.5	17.8
Manjimup	16.7	16.7	15.7	16.1	14.9	13.6	13.4	15.0	15.1	17.8
Busselton	18.9	19.0	17.5	-	16.6	16.1	16.0	17.3	16.8	19.5
Margaret River	19.1	18.9	17.9	17.7	16.7	15.9	15.7	16.9	16.2	19.6

Tables 8 and 9 compare the mean maximum and minimum temperatures for May, June, July and August in 1971 (bad scorch year) and 1974 (mild scorch year). Although this data remains to be examined more fully, some points emerge:

- a) The bad scorch areas, e.g. Manjimup, Busselton, Albany, Denmark, Esperance usually had higher minimum temperatures than those areas in which scorch is either no problem (Kojonup, Narrogin) or a minor problem (Bridgetown).
- b) An examination of the minimum temperatures does not provide an explanation for the difference between 1971 and 1974 in disease severity.

- c) The higher maximum temperatures in August (and also September) in 1974 suggests that the higher temperatures may have arrested disease development in that year. It should be noted that there were also less rainy days in 1974 and 1971 for the same period.

The following tentative hypotheses are advanced to explain the regional differences in the distribution of clover scorch:

- a) The disease becomes established easily and develops seriously in those areas with mild winter temperatures and many rainy days, especially in spring; i.e. the south and southern coastal areas (note that most of the serious scorch in the Manjimup district is in the Northcliffe area - which is very close to the coast.
- b) The disease has not become serious in much of the Great Southern and other inland areas in which sub clover grows well because of the colder winter temperatures - and the higher likelihood of extended dryer periods in spring.
- c) The disease is not a problem in the northern areas because of a combination of warmer temperatures and less rainy days - in winter and spring.
- d) Occasional outbreaks in areas such as Badgingarra, Bannister and Kojonup, which are far removed from the bad scorch areas, indicates that the organism is spread over most of the sub clover areas. It also suggests that occasionally temperature and moisture conditions are conducive to disease development - but their relatively short duration means that the disease does not get the opportunity to spread seriously.

Climatic data needs to be fully examined in conjunction with aspects of disease infection, spread and spore survival before much more can be said about the distribution of the disease (in relation to location and time).