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Developing clovers for disease and insect resistance

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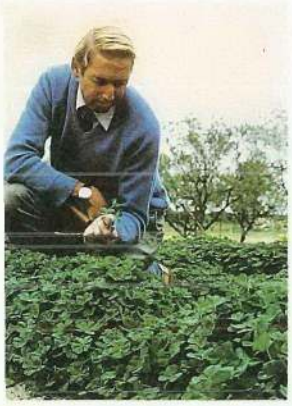

■ Dr. C. M. Francis checks one of the varieties being screened for disease resistance.

Most of the new subterranean clover varieties released to farmers in recent years are more resistant to disease and/or insects than the old varieties they have replaced. The varieties Esperance, Meteora, Larisa and Trikkala all have more resistance to clover scorch* ***(Kabatiella caulivora)*** *than varieties such as Woogenellup, Yarloop and Seaton Park. Also they are all more tolerant of root rot diseases than the highly susceptible Mt Barker, Woogenellup and Yarloop varieties.*

This improved resistance has resulted from the Department of Agriculture's massive disease and insect resistance screening programme, largely funded by the Australian Wool Corporation. Today more than 1 000 clover selections are tested annually for resistance to clover scorch, 100 to 150 for root rot resistance, and more than 200 for resistance to bluegreen aphid (B.G.A.). The Department's research staff intend to expand this screening programme in 1983 to include resistance to red-legged earth mite.

The screening programme has at its disposal more than 6 000 defined varieties of subterranean clover, forming the National collection which is based at the Western Australian Department of Agriculture. This programme services all southern states of Australia by direct input into the National Subterranean Clover Breeding and Improvement Programme. Disease and insect susceptibility is common in many of the commercial sub. clover cultivars and is considered to be a major cause of pasture deterioration in higher rainfall areas of Western Australia, South Australia, Victoria, and New South Wales. Therefore results from this screening programme are of value throughout southern Australia.

*In this article "resistance" is used in the broadest sense to include escape and field tolerance mechanisms.

Clover scorch

Screening sub. clover selections for resistance to clover scorch disease *(Kabatiella caulivora)* started in 1972. Since then more than 7 500 selections have been tested. Many of these are crossbred clovers derived from crosses between selections identified earlier in the programme as possessing resistance to clover scorch.

In earlier years all overseas clover introductions and most crossbreds were tested. Now, because of increasing numbers, only selected clovers are being tested. Clovers possessing high oestrogen levels, excessively late maturity, or other serious disadvantages are now excluded from the clover scorch programme.

A number of sub. clovers possessing resistance to clover scorch have been identified and have been used extensively as parents in crossbreeding . . . for example Daliak . . . or, like Meteora, have been developed as varieties. Several of the overseas collections have a high level of resistance to clover scorch, in particular those from Southern Italy and Sardinia. More than 300 introductions have now been identified as possessing resistance to clover scorch.

Enough success has been achieved in this programme to make us confident that all clovers released for commercial use in clover scorch susceptible areas of southern Australia in future will possess adequate levels of resistance to clover scorch.

Root rot

Screening for root rot resistance in sub. clover started in 1975, first in glasshouse conditions and later in the field. Since then clovers originally selected for their high level of resistance to clover scorch have also been tested for root rot resistance. More than 500 introductions and crossbreds have been tested and a wide range of resistance has been observed. However, no fully resistant clovers have been identified yet although many tolerant lines are present including all the recently released medium and high rainfall varieties.

reference to the performance of the same varieties unstressed by aphids. Table 1 shows the commercial sub. clover varieties ranked according to aphid resistance tested under these conditions. Later trials included control boxes so that a comparison of dry matter yield with and without aphid damage also could be made. Table 2 summarises the results of these trials.

It is clear from these results that all commercial sub. clover varieties are affected by BGA to some degree. It is also clear that the vast majority of the breeding lines tested so far suffer reduced dry matter yield under aphid attack. However, many of the clovers tested performed much better than the highly susceptible commercial varieties Daliak, Woogenellup, and the yanninicum group of clovers... Yarloop, Trikkala, Larisa and Meteora.

These susceptibility trials use seedling sub. clovers under controlled conditions. They are designed to identify breeding lines with a genetic basis for aphid resistance. The performance of these lines under field conditions is complicated by an enormous range of environmental and behavioural influences which might modify their response to aphid attack. Field testing of the more promising lines is a lengthy and complex procedure.

Table 1—Plant damage on sub. clovers caused by BGA

Comparison of seedling and vegetative plant screening. Ratings of effects on plants 0 = no effect; 5 = all plants dead.

Variety	Seedling rating	Vegetative plant rating
Dwalganup	2.0	2.2
Nungarin	2.8	2.6
Bacchus Marsh	2.8	3.0
Mt Barker	2.8	3.2
Clare	2.8	3.2
Tallarook	2.2	3.4
Northam	3.2	3.2
Geraldton	3.4	3.2
Nangeela	3.0	3.6
Seaton Park	3.6	3.4
Meteora	3.8	3.6
Dinninup	—	3.8
Esperance	4.2	3.8
Woogenellup	4.2	4.0
Trikkala	4.6	3.8
Larisa	5.0	4.0
Daliak	4.7	4.8
Yarloop	5.0	4.8

Table 2—Productivity loss through BGA attack in 108 sub. clover breeding lines

Reduction in dry-matter yield—average of 120 plants %	Number of lines	
	(spp. yanninicum)	(spp. subterraneum)
0	1	1
1 to 10	2	0
11 to 20	4	2
21 to 30	9	3
31 to 40	16	9
41 to 50	17	10
51 to 60	4	11
61 to 70	3	10
71 to 80	0	6

■ Some of the varieties in the Department's screening trials.

The highly variable nature of root rot in the field, even over a short distance, means that several test sites and replications are needed to identify tolerant or resistant lines. This increases the research work load so much that in 1982 approximately 20,000 plants were examined and assessed so that the root rot susceptibility of 135 selections could be determined.

Bluegreen aphid

Experiments to determine bluegreen aphid susceptibility in commercial and breeding lines of sub. clover started in Western Australia in 1980. Since then, some 500 genotypes have been tested.

Early trials compared the damage between varieties under heavy aphid attack without