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EXPERIMENTS IN THE CONTROL OF BACTERIAL WILT OF TOMATOES IN SOUTH-EASTERN QUEENSLAND.

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SUMMARY.

1. Under the conditions of the experiment, treatment of the soil with sulphur to produce a pH value of 4, followed by the addition of lime to restore the pH value to 5, failed to give efficient control of bacterial wilt in tomatoes.

2. Varietal trials on infested soil showed that Break o' Day, which is widely grown locally, was very susceptible to the disease. Strains of another Australian variety, Sensation, and several varieties introduced from the United States of America, showed promise of possessing some degree of resistance.

INTRODUCTION.

Bacterial wilt of tomatoes, caused by *Xanthomonas solanacearum* (E.F.Sm.) Dowson, is most apparent in south-eastern Queensland during February and March, i.e., in the latter half of summer. Growers wishing to obtain an early autumn crop, which commands good prices on the local market, commence planting in January, and it is this crop which is often seriously affected by the disease.

The problem of control was approached from two angles, viz., soil treatment to eliminate the causal bacteria, and the selection of varieties or strains resistant to the disease. The work was interrupted owing to war service, but it is considered that the results obtained, and particularly the data on the degree of resistance of the different varieties, may be of use to other workers on this problem.

SOIL TREATMENT.

The soil treatments given followed the principle of the experiments of A. H. Eddins in Florida (Eddins, 1936, 1938, 1939). This worker applied sulphur to the soil at a rate estimated to be sufficient to reduce the final pH value to 4 or slightly less; the soil was then allowed to stand for a period of time,

after which it was limed to restore the pH value to approximately 5. In the successful Florida experiments, the sulphur was applied about midsummer and the ground lime approximately five months later. No mention was made in Eddin's papers of the time at which the field was planted, but probably it would be in the following spring, several months after liming. The period of high acidity during the five months which elapsed between the application of sulphur and liming was apparently sufficient to destroy, or to render non-virulent, the causal organism, as Eddins had considerable success in the control of bacterial wilt in potatoes, egg plant and tomatoes.

To follow Eddins' seasonal procedure in south-eastern Queensland would mean applying the sulphur in January and the lime in June. However, because of the local cropping programme it was considered that it would be more convenient if the sulphur was applied in autumn to early winter and the lime in midsummer, and the plants put out into the field about a month after liming.

Two areas known to be infected with *X. solanacearum* were treated in the above fashion for two years in succession. For convenience of discussion, the areas will be designated A and B. The soil in area A was a clay loam of a dark grey-brown to dark-brown colour, while that in area B was a sandy loam to loam of a light red-brown colour. The initial pH values for the two areas varied from 5·9 to 6·1 and 5·2 to 5·4 respectively, and sulphur at the rate of 2,850 lb. and 1,520 lb. per acre was required in the first season to reduce the pH value to approximately 4. To raise the pH value to 5, hydrated lime was later applied at the rate of 2,620 lb. and 1,750 lb. per acre respectively to A and B. The same plots were again sulphured and limed in the following season; the pH values were 5·1–5·5 and 4·7–4·8 for areas A and B respectively prior to sulphuring, and consequently less sulphur was required than in the first season. On area A the experiment was laid out as six randomized blocks and on area B as four randomized blocks. In the 1938-39 trials, Break o' Day variety only was used, but in the 1939-40 trials a number of varieties was planted in order to obtain some lead on varietal resistance to bacterial wilt.

There was a period of $3\frac{1}{2}$ months between sulphuring and liming in the 1938-39 season and of 7 months in 1939-40. However, in both seasons and on both areas the actual period for which the pH values were approximately 4 was only a month, as a very small drop in pH values took place during the winter months.

The only result obtained from the soil treatments was a delay in the rate of incidence of the disease on the sulphured and limed plots. There was a final mortality of practically 100 per cent. in all plots of Break o' Day before even the earliest maturing fruit could be harvested. This is in accord with the results reported by Eddins (1938) for sulphur applications made in the autumn or winter. A trial providing for summer application of sulphur was commenced but was abandoned because of war conditions.

VARIETAL RESISTANCE.

The first indication in Queensland that a variety might be relatively resistant to the strains of *X. solanacearum* present here was afforded by the growing of several rows of the variety Sensation adjacent to a badly infected crop of Break o' Day on one of the experiment plots in the summer of 1938-39. In order to pursue this aspect of the investigation further, the 1939-40 soil treatment experiments were planted with a number of varieties. From this preliminary experiment, it was evident that Break o' Day is very susceptible to the disease. Though there was not sufficient evidence from which to draw any definite conclusions, the varieties Sensation, Australian Earliana, Marvana and Rutgers showed indications of possessing some resistance to bacterial wilt.

During the summer of 1940-41, the two blocks used previously for the investigation of soil treatments were planted to a variety trial without any further differential soil treatments. One area was planted with 10 varieties and strains, as four randomized blocks, and the other with 20 varieties as three randomized blocks. The arrangement of the blocks was such that the previous year's soil treatments did not invalidate the statistical analysis of the varietal experiment. Seedlings were planted in the field on January 28-29, 1941 and any misses were replaced on February 6 and 12. Growth was excellent over both plots until the appearance of the wilt.

Table 1.

VARIETAL RESISTANCE TO BACTERIAL WILT.
(Summary of Mean Index Values).

Variety.	Mean Index.	Significantly exceeds	
		5 per cent. level.	1 per cent. level.
1. Sensation No. 2	3·57	9–16	11–16
2. Sensation No. 1	3·13	11–16	12–16
3. Marvel	2·97	11–16	13–16
4. Sensation No. 3	2·77	11–16	13–16
5. Marvana No. 1	2·67	12–16	13–16
6. Marvana No. 2	2·57	13–16	14–16
7. Denisonia	2·40	13–16	16
8. Homer	2·37	13–16	16
9. Bowen Buckeye	2·30	13–16	16
10. Australian Earliana	2·27	13–16	16
11. Rutgers No. 1	1·50	..	..
12. Rutgers No. 2	1·40	..	..
13. Break o' Day No. 1	·93	..	..
14. Break o' Day No. 4	·83	..	..
15. Break o' Day No. 2	·80	..	..
16. Break o' Day No. 3	·60	..	..

Necessary difference for significance 5% level = 1·23 ;
1% level = 1·66.

As a rapid means of estimating wilt resistance, each plant was given a numerical value according to the following system:—

0 = a plant that is dead, or extremely stunted.

1 = a plant severely wilted, but still green.

2 = a plant with only one or two branches wilted.

3 = a plant with only one leaf or several leaflets showing wilt.

4 = a plant apparently healthy and of fair growth.

5 = a plant apparently healthy and of vigorous growth.

The results obtained from the two trials are given in Tables 1 and 2.

Table 2.

VARIETAL RESISTANCE TO BACTERIAL WILT.

(Summary of Mean Index Values).

Variety.	Mean Index.	Significantly exceeds	
		5 per cent. level.	1 per cent. level.
1. Sensation No. 1	3·87	8–20	11–20
2. Sensation No. 2	3·80	8–20	11–20
3. Sensation No. 3	3·60	11–20	13–20
4. Marvel	3·13	14–20	14–20
5. Carolina Cross No. 2	3·13	14–20	14–20
6. Louisana Pink No. 1	3·07	14–20	14–20
7. Bowen Buckeye	2·93	14–20	14–20
8. Prairiana	2·70	14–20	16–20
9. Louisana Pink No. 2	2·67	14–20	16–20
10. Marvana No. 1	2·63	14–20	17–20
11. Australian Earliana	2·27	17–20	19–20
12. Carolina Cross No. 1	2·23	17–20	20
13. Rutgers No. 1	2·13	17–20	20
14. Rutgers No. 2	1·40	..	..
15. *Lycopersicon pimpinellifolium*	1·33	..	..
16. Denisonia	1·23	..	..
17. Break o' Day No. 1	1·03	..	..
18. Break o' Day No. 4	·93	..	..
19. Break o' Day No. 2	·83	..	..
20. Break o' Day No. 3	·60	..	..

Necessary difference for significance 5% level = 1·06;
1% level = 1·41.

A progressive estimate of wilt values was made at weekly intervals and the estimates as made on April 4 and 8 were used for final comparisons and analysis. Each plant was given an individual value and from these a mean plot value was estimated.

DISCUSSION.

The extreme susceptibility of Break o' Day is apparent, while Sensation and Marvel gave quite encouraging results in both trials. Louisiana Pink No. 1 and Carolina Cross No. 2 also gave good results in the trials in which they were included.

Sensation is not, however, a good commercial variety, though it is a vigorous grower and the fruit externally has an excellent appearance. It has the disadvantages of requiring trellissing and pruning to assist development of fruit size and of possessing unsatisfactory internal fruit characteristics.

Louisiana Pink, Prairiana and the Carolina Cross were received from the North Carolina Agricultural Experiment Station, in January, 1940, and had already been selected for resistance to bacterial wilt in that State. The fruit type in these strains is a definite improvement on Sensation, but here also further improvement would have to be effected before the strains could take a place on the commercial market in Queensland.

Marvel was obtained from the United States Department of Agriculture; so far as is known it had not been selected for bacterial wilt resistance.

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