THE RELATIVE RESISTANCE OF SOME TOMATO VARIETIES TO BACTERIAL WILT (Bacterium solanacearum E. F. S.)

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BACTERIAL wilt (*Bacterium solanacearum* E.F.S.) is common in the tomato-growing areas of the wet zone of Ceylon.The disease is conspicuously absent in the Jaffna peninsula and in a large section of the dry zone. In the Kandy District, the disease is the major factor limiting tomato-growing and is particularly severe on alkaline soils overlying dolomitic limestone; these soils have an average pH value of 7·0—7·5 and values as high as 8·5 may sometimes be attained.

In Ceylon tomatoes are a peasants' crop, and control measures involving heavy and recurrent expenditure are not likely to find favour with cultivators of this type. With village crops, the production of disease-resistant varieties is the most desirable and, in many instances, the only feasible method of disease control. It is, however, realized that the promise of successful breeding against a pathogen so catholic in its tastes as *B. solanacearum* is less than with a specialized parasite with a limited host range.

The present communication presents the results of an exploratory experiment undertaken as part of a programme of tomato selection for resistance to bacterial wilt.

DESIGN OF EXPERIMENT

Eight varieties of tomato, *viz.*, Red Marhio Nos. 1 and 2, Break O' Day Nos. 1 and 2, Marvana, Pritchard, Marglobe and a strain of the local country tomato, were tested out for resistance to bacterial wilt during the *yala* season of 1938. All the varieties except the local strain were reputed to be

resistant to the wilt caused by *Fusarium lycopersici* Sacc.—a pathogen that has not hitherto been recorded in Ceylon. No varieties selected for resistance to bacterial wilt were available for trial. It was felt, however, that if the parasitic mechanism of the two pathogens were the same, a variety selected for resistance to fusarium wilt might exhibit some degree of resistance to bacterial wilt as well.

The trial was laid down in the form of an 8 by 8 Latin Square of 1/250 acre plots. Each plot consisted of 30 plants in 3 rows of 10, spaced 2½ feet between and within rows. The marginal plants of adjacent plots were separated by an interval of 3½ feet.

The experiment was laid down on a heavily and rather uniformly infested area at the Experiment Station, Peradeniya. A technique for producing artificial epiphytotics of bacterial wilt has not been developed, and it was necessary for the success of this and subsequent trials to secure uniformity of natural infestation. The bacterial inoculum was probably evenly distributed over the field by cultivation operations like ploughing and harrowing. The Latin Square design with very small plots and a high degree of replication, aimed at further reducing the error due to heterogeneity of soil infestation.

EXPERIMENTAL MATERIAL AND METHODS

Varieties of Tomato.—Information regarding the eight varieties included in the trial is presented in Table I (Boswell, 1937). Seed of the varieties Red Marhio 1 and 2, Break O'Day 1 and 2, Marvana and Pritchard, was kindly supplied by Mr. J. H. Simmonds, Senior Pathologist, Department of Agriculture and Stock, Queensland. Seed of the variety Marglobe was obtained from the Vegetable Seed Station, Tabbowa, and the seed of the local strain from Peradeniya.

Experimental Area.—The soil was a light, sandy loam with a low content of nutrient elements and of organic matter, and had a pH value of 6·5. During the *yala* season of 1937 the land had received applications of compost (five tons per acre) and of "Nicifos"* (¾ cwt. per acre), and had carried crops of tomatoes and brinjals (*Solanum melongena* L.). A severe outbreak of bacterial wilt resulted in complete failure of both these crops. The land was subsequently manured with "Nicifos" (one cwt. per acre) and sulphate of potash (½ cwt. per acre), and was planted with maize and garlic during *maha*, 1937, the area under maize receiving a further application of "Nicifos" (¾ cwt. per

* A proprietary mixture of monammonium phosphate with varying amounts of ammonium sulphate.


RECORDS OF INCIDENCE OF BACTERIAL WILT OF TOMATOES
21st JUNE
8th JULY
A : Red Marhio 1
B : Red Marhio 2
C : Break O'day 1
D : Break O'day 2
E : Marvana
F : Pritchard
G : Marglobe
H : Local Variety
REPRODUCED & PRINTED BY SURVEY DEPT. CEYLON. 7. 1. 35.

FIG. I.

acre), and that under garlic further applications of " Nicifos " (two cwt. per acre) and sulphate of potash (one and a half cwt. per acre). The land was subjected to the normal cultivation treatments. It was ploughed on March 26 prior to the planting of the experimental crop in the *yala* season of 1938, and compost was broadcast over the area at the rate of ten tons per acre on April 10. The land was subsequently harrowed and levelled during the first week of May.

Planting.—The nurseries were sown on April 12. Seedlings were transplanted to the experimental area, at the rate of one per hole, on May 27. Transplanting was late; the seedlings were six weeks old at the time of transplanting and had to be topped. The considerable root damage consequent on late transplanting, created conditions favourable for invasion by the wilt bacterium. Wilted plants were not removed. The land was periodically weeded. During the dry spell that occurred late in the season, the plants were watered by hand.

RESULTS

Records of the incidence of bacterial wilt on the experimental plots were made on June 21 and on July 8. These records are presented in Fig. 1; each solid black square in the figure represents a wilted plant. A gradient of infestation is evident in the direction of the long axis of the area, infestation being severest in plots at the centre and least in the end plots. There is, however, no marked " patchiness " in infestation.

An analysis of variance of the record of wilt incidence made on July 8, is given in Table 2. The value of F for varieties exceeds the one per cent. point and is hence indicative of a significant effect. In the following list the varieties are placed in descending order of resistance to bacterial wilt:—

1. Marvana.
2. Red Marhio 2.
3. Marglobe.
4. Pritchard.
5. Red Marhio 1.
6. Break O'Day 1
7. Break O'Day 2.
8. Local variety.

Marvana, Red Marhio 2 and Marglobe are significantly more resistant than all the other varieties. The differences between the varieties Marvana, Red Marhio 2 and Marglobe are not significant. There are also no significant differences in susceptibility between the varieties Pritchard, Red Marhio 1, Break O'Day 1 and 2 and the local variety.

TABLE I.

Name of Variety.	Parents.	Breeding method.	Characteristics.
A. Red Marhio 1 B. Red Marhio 2	—	—	Resistant to fusarium wilt
C. Break O'Day 1 D. Break O'Day 2	Marglobe x Marvana	hybridization	Resistant to fusarium wilt and nailhead rust; may be defined for most purposes as an early Marglobe
E. Marvana	Marvel x Earliana	do.	Early, resistant to fusarium wilt
F. Pritchard	Cooper Special x Marglobe	do.	Resistant to fusarium wilt, nailhead rust and cracking
G. Marglobe	Globe x Marvel	do.	Resistant to fusarium wilt and nailhead rust, susceptible to cracking
H. Local country tomato	—	—	—

TABLE 2.

Analysis of Variance of Record of Wilt Incidence made on July 8.

	D.F.	Sum of squares.	Variance	F	1 per cent. Point.
Rows	7	322·0	—	—	—
Columns	7	115·75	—	—	—
Varieties	7	348·75	49·82	4·2	<3·29
Error	42	495·5	11·797	—	—
Total	63	1,282·0			

Standard error : 3·43.
Co-efficient of variability : 18·5.

Mean Nos. of Wilted Plants per Plot.

Red Marhio 1	Red Marhio 2	Break O'Day 1	Break O'Day 2	Marvana.	Pritchard.	Marglobe.	Local variety.	Significant difference.
20	15	20·1	20·3	14·3	19·8	16	20·4	3·5

The mortality even in the least susceptible variety, *viz.*, Marvana, was just under 50 per cent. The percentage infection in the varieties Pritchard, Red Marhio 1, Break O'Day 1 and 2 and the local variety, was in the neighbourhood of 66 per cent.

It may be mentioned finally that the performance of these varieties must be investigated over several seasons before any generalization can be made regarding their resistance to bacterial wilt; a strain that exhibits an appreciable degree of resistance in one season may prove extremely susceptible in a later season.

SUMMARY

1. Eight varieties of tomato, *viz.*, Red Marhio 1 and 2, Break O'Day 1 and 2, Marvana and Pritchard from Queensland, Marglobe from Tabbowa, and a local variety from Peradeniya, were tested out for resistance to bacterial wilt on a heavily and a comparatively uniformly infested area at the Experiment Station, Peradeniya.

2. The varieties arranged themselves in the following descending order of wilt resistance; the symbol > represents a statistically significant difference and $\not>$ a difference not statistically significant:

Marvana $\not>$ Red Marhio 2 $\not>$ Marglobe > Pritchard $\not>$ Red Marhio 1 Break O'Day 1 $\not>$ Break O'Day 2 $\not>$ local variety.

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REFERENCES

Boswell, V. R., 1937—Improvement and genetics of tomatoes, peppers and eggplant. *U. S. D. A. Yearbook of Agriculture, 1937*, pp. 176–206.

Fisher, R. A., 1932—*Statistical methods for research workers, 4th edition*, London, Oliver and Boyd.

Snedecor, G. W., 1934—*Calculation and interpretation of analysis of variance and co-variance*. Collegiate Press, Inc. Ames, Iowa.