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Partial resistance to bacterial leafspot in pepper cultivar Hungarian Yellow

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Abstract

Field experiments were used to determine the resistance of *Capsicum annuum* L. cv. Hungarian Yellow to bacterial leaf spot (*Xanthomonas campestris* pv. *vesicatoria*). In separate trials leaf fall was correlated (r^2=0.62, 0.8 and 0.9) with yield (t/ha) and provided a measure of resistance. The cultivar Hungarian Yellow was partially resistant, having less leaf fall than red bell peppers. The resistance was evident in the hybrid; cv. Hungarian Yellow×cv. Northern Belle. This suggests selection of hybrid genotypes similar to the F_1 should be possible in backcross populations but further genetical studies are required to clarify this.

INTRODUCTION

Bacterial leaf spot (BLS) caused by *Xanthomonas campestris* pv. *vesicatoria* (Doidge 1920) Dye 1978 is a destructive disease of bell pepper (*Capsicum annuum* L.) in Queensland (Simmonds 1966; Hibberd and Gillespie 1982). At least two races of BLS occur naturally in Florida (Cook and Stall 1969, 1982). Only race 1 has been found here (A. M. Hibberd, pers. comm. 1987). Resistance to BLS has been identified in a number of accessions (Sowell 1960; Sowell and Dempsey 1977; Hibberd *et al.* 1979; Hibberd and Gillespie 1982).

The cultivar, Hungarian Yellow, is reported to be field tolerant to bacterial leaf spot (Hibberd *et al.* 1979). The origin of this tolerance is not known but the cultivar is not considered to carry genes *Bs1*, *Bs2* or *Bs3* (Hibberd *et al.* 1987; A. M. Hibberd pers. comm. 1987) which confer resistance through hypersensitivity. Tolerance implies an ability of a plant to sustain a substantial amount of disease with little or no effect on yield while resistance limits the development of the disease (Russell 1978). The degree of a cultivar's resistance or tolerance would influence its usefulness in a breeding programme. However, quantitative comparisons of the disease levels and yield of cv. Hungarian Yellow with those of other cultivars have not been reported. This paper reports these comparisons.

MATERIALS AND METHODS

In a preliminary field experiment, in Spring 1975 to compare cultivars and determine a method to measure resistance, 46 cultivars from the Redlands Research Station (RRS) collection were evaluated in ten plant plots as two replications. The standard commercial cultivar, Northern Belle (syn. Yolo Y) was included. The cultivar Hungarian Yellow also was included, because it has been reported to have field tolerance to BLS and also has the ability to set large numbers of fruit under widely varying weather conditions (Hibberd *et al.* 1979). The response of each cultivar to natural infection with bacterial leaf spot was determined 17 weeks after sowing, about one week before harvesting commenced.

In the second experiment in early spring 1977, the response of cvv. Hungarian Yellow, Canape, Sheba, Northern Belle, Florida VR-2 and the F_1 (Hungarian Yellow×Northern Belle) were compared within separate blocks of plants naturally infected, or plants spray-inoculated when 6 to 8 expanded leaves were present, with a bacterial leaf spot suspension supplied by Dr M. Moffett, (Department of Primary Industries, Indooroopilly). The BLS was most likely race 1, as race 2 has not been reported in Queensland (A. M. Hibberd, pers. comm. 1987). Each regime of infection consisted of three replicates of 15 plants of each cultivar. The cultivars had been chosen following the first experiment as likely to give a range of reactions when infected with BLS. The number of leaves, expressed as a percentage, having BLS lesions and/or having fallen was visually estimated on each of five plants in each plot 18 weeks after sowing. This was one week before harvest. All 15 plants were harvested. Where fewer plants occurred in a plot marketable yields were adjusted by covariate analyses. Leaf fall was assumed to be due to BLS and thus the leaf spot estimate included both leaf fall, and leaves with lesions. Size of lesion was not estimated. Plants were grown using standard cultural practices.

Data were subjected to analysis of variance and where the *F*-test was significant means were compared using a *t*-test. Correlations were calculated using mean values.

RESULTS AND DISCUSSION

Cultivars differed in the severity of leaf symptoms, leaf fall and yield in both experiments (Tables 1 and 2). In the first experiment yield (t/ha), was moderately well predicted by leaf fall (r^2=0.62, P<0.01). In the second experiment similar correlations were also high (r^2=0.9 and 0.8 (P<0.05) for inoculated and naturally infected plants, respectively. This suggests leaf fall may be a suitable indication of resistance or tolerance. In the first experiment cv. Hungarian Yellow had less BLS (P<0.05) than only six cultivars and higher yields (P<0.05) than 15 cultivars, however, on the basis of leaf fall it was one of the most resistant cultivars. In the second experiment, when assessed on leaf spot, leaf fall or yield, cv. Hungarian Yellow was more resistant than the bell peppers, cvv. Northern Belle and Florida VR-2 irrespective of the method of infection (Table 2). Although cv. Hungarian Yellow had the lowest values for leaf spot and leaf fall these were, with one exception, not significantly different (P<0.05) from those of cvv. Sheba and Canape. The latter is a F_1 hybrid. Following inoculation, leaf fall on cv. Sheba was higher than cv. Hungarian Yellow (Table 2). The lower incidence of leaf spot compared with that on bell peppers indicates that in fact cv. Hungarian Yellow has higher resistance to BLS. Cultivar Hungarian Yellow is widely adapted (Hibberd *et al.* 1979), the performance of cvv. Sheba and Canape in Queensland is not well known but all appear to be potential sources of resistance to BLS. Because of the greater leaf fall (Table 2), cv. Sheba is the least desirable source of resistance to BLS.

On all criteria evaluated the F_1 hybrid (Northern Belle×Hungarian Yellow) was more resistant than cv. Northern Belle and not significantly different from cv. Hungarian Yellow except in leaf spot incidence under natural infection. While this suggests that resistance to BLS in cv. Hungarian Yellow is controlled as a dominant character the actual (non-significant) values for yield, leaf fall and leaf spot (Table 2) suggest additive gene action may occur. Further studies to clarify the genetic control of this partial resistance are desirable. Methods of studying inheritance in combination with a breeding programme have been outlined by Bassett and Woods (1978). The large difference between the reactions of the F_1 and the susceptible parent suggests that if resistance is simply inherited

identification of heterozygous plants in segregating backcross populations should be possible and allow the transfer resistance from cv. Hungarian Yellow to bell peppers.

Table 1. Response of cultivars following natural infection with bacterial leaf spot

Cultivar	Leaf Spot* (%)	Leaf fall* (%)	Yield†
Burpee Fordhook	72	38	7.69 (8.1)
Golden Belle	74	39	8.05 (11.6)
Canape	66	39	8.63 (20.7)
Burpee Sunnybrook	76	42	7.93 (10.3)
Hungarian Yellow	70	42	8.67 (21.6)
Glory	73	42	7.54 (6.9)
Sweet Banana	65	45	8.75 (23.5)
Long Sweet Yellow	62	47	8.62 (20.5)
Sheba	84	48	7.92 (10.2)
Early Bountiful	76	53	8.22 (13.8)
Aconcagua	76	54	7.52 (6.8)
Long Green Sweet	79	55	7.90 (10.0)
Saitama Early	71	56	6.10 (1.6)
Pick-a-Peck	77	57	7.50 (6.7)
Jade	71	58	3.10 (0.1)
World Beater Thickwalled	70	59	5.93 (1.4)
Burpee Bellringer	72	59	3.01 (0.1)
Red Cherry Small	63	60	6.39 (2.2)
Burpee Tasty	73	61	7.52 (6.8)
Staddons Select	67	61	6.20 (1.8)
New Ace	72	62	6.79 (3.3)
Ace	76	62	7.30 (5.5)
Cubanelle	82	63	7.71 (8.3)
Calwonder 300	72	63	0 (0)
Grand Bell	72	64	0 (0)
Golden Calwonder	78	64	6.66 (3.0)
All Big	71	64	6.69 (3.0)
Miss Belle	78	66	6.48 (2.4)
Pimiento Select	74	66	7.26 (5.3)
Super Set 19	76	66	7.57 (7.2)
California Wonder	74	67	0 (0)
Earliest	74	67	3.52 (0.1)
Florida VR-2	79	67	2.80 (0.1)
Florida Giant	74	68	5.47 (0.9)
Cadice	75	68	3.37 (0.1)
Bell Boy	74	68	5.45 (0.9)
Titan	74	68	3.18 (0.1)
Midway	80	69	6.28 (2.0)
Northern Belle	73	69	5.56 (1.0)
Keystone Resistant Giant	76	70	2.90 (0.1)
Green Giant	80	70	0 (0)
Mercury	76	70	0 (0)
Market Giant	78	70	2.44 (0)
Emerald Giant	75	70	4.74 (0.4)
Yolo Wonder	82	70	2.44 (0)
Harris Early Giant	83	70	2.44 (0)
LSD P=0.05	9	14	3.87

* Estimated number of leaves affected 17 weeks after sowing as a percentage.

†Natural log transformation of kg/plot. Parenthesis encloses yield in t/ha.

This resistance is not complete but its incorporation into a bell pepper will likely result in useful reductions in the rate of disease progress through a crop. This would reduce losses from BLS epidemics.

Table 2. Response of selected cultivars following inoculation and natural infection with bacterial leaf spot

Cultivar	Inoculated			Natural infection		
	Leaf* spot	Leaf* fall	Yield (t/ha)	Leaf* spot	Leaf* fall	Yield (t/ha)
Hungarian Yellow	29	7	17.3	6	2	17.8
Canape	40	18	14.5	16	5	18.4
Northern Belle× Hungarian Yellow (F_1)	42	10	19.4	34	18	25.3
Sheba	56	40	7.6	31	10	16.8
Northern Belle	84	70	6.1	84	80	7.7
Florida VR-2	90	88	1.4	91	61	8.0
LSD P=0.05	39	21	5.3	26	27	7.2

* Estimated percentage (number) of leaves affected 18 weeks after sowing.

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