Resistance to Gummy Stem Blight in Muskmelon

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Abstract. Resistance to gummy stem blight [*Didymella bryoniae* (Auersw.) Rehm] was evaluated in two accessions of *Cucumis melo* L., PI 266935 and PI 266934. Based on disease reaction scores and dry weights, PI 266934 possessed much greater resistance than PI 266935. The quality of resistance of PI 266934 was unaffected by the ranges of seedling ages and inoculum concentrations used. No melon cultivar, to our knowledge, is highly resistant to gummy stem blight in the field, and alternative sources of superior resistance are potentially useful for breeding.

Gummy stem blight (GSB) of muskmelon, caused by *Didymella bryoniae*, is a significant disease in all areas of extensive melon production in Australia. Annual production losses in the Riverland district of New South Wales are ≈30% of early season melons (J. Salvestrin, personal communication). In Queensland, disease severity in coastal production centers varies with rainfall, and may result in extensive crop losses. Higher incidence of GSB in the last decade is attributed to the widespread use of plastic mulch and trickle irrigation, which maintain a favorable microclimate for pathogen development (N. Meurant, personal communication).

Adequate control of GSB through fungicide applications is difficult during periods of

high humidity and rainfall, and under these conditions genetic resistance is a better alternative. Sowell et al. (1966) identified resistance to GSB in PI 140471, from which three cultivars with resistance were developed (Norton 1971, 1972; Norton et al., 1985). A dominant gene, *Mc*, in PI 140471 confers resistance to GSB (Prasad and Norton, 1967). The resistance in PI 140471, however, was inadequate during severe disease epidemics (Sowell, 1981). Two additional lines with resistance, PI 266935 and PI 436533, were identified in glasshouse and field tests (Sowell, 1981). Although the resistance of these two lines was similar to that of PI 140471, they provided a diversity of resistant germplasm for plant breeders to exploit.

Currently, to our knowledge, no melon cultivar is sufficiently resistant to GSB in the field, and alternative sources of resistance would be potentially useful. In this paper, we report a previously unidentified genotype with seedling resistance superior to PI 266935. We also discuss the effect of seedling age and inoculum concentration on this resistance, and

suggest a method for selecting plants with resistance from breeding populations.

Inoculum preparation. Isolates of *Didymella bryoniae* were acquired by excising small sections of crown lesions and plating on potato dextrose agar (PDA) containing 50 mg streptomycin sulfate/liter (S/PDA). Single-spore isolations were made, and cultures were freeze-dried. One single-spore culture, BRIP 3459, was used throughout these experiments. It had typical cultural characteristics, including development of all symptoms in inoculated melon plants. Spores were washed from 14-day-old cultures grown on S/PDA using sterile distilled water, and concentration was quantified with a hemocytometer.

Plant culture and inoculation. Seedlings were grown in 1 peat : 1 vermiculite mix (v/v), where they were inoculated by spraying both leaf surfaces with an atomized spore suspension. Following inoculation, seedlings were transplanted to 18-cm (2.3-liter) pots, three per pot, containing 1 peat : 1 sand (v/v) mix. Seedlings of inoculated and noninoculated (control) treatments were incubated for 4 days in a moist, 27 ± 2°C chamber, then transferred to open benches in a greenhouse. Each pot represented an experimental unit.

Disease assessment. Foliar symptoms were

Table 1. Ratings of foliar disease severity on seedlings of two ages for four melon cultivars inoculated with 1 × 10⁶ spores of *Didymella bryoniae*/ml.

Cultigen	Seedling age (days) at inoculation	
	29	44
Disease severity rating ^a		
Laguna	5.0	4.8
Planters Jumbo	1.2	1.0
PI 266935	1.5	0.7
PI 266934	0.3	0.3
LSD _{0.05} ^b	0.4	

^aDisease ratings were from 0 (no visible necrosis) to 5 (>80% leaf area necrosis).

^bLeast significant difference for *P* ≤ 0.05.

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Table 2. Dry weight per seedling of two ages for four melon cultigens inoculated with 1×10^6 spores of *Didymella bryoniae*/ml.

Cultigen	Seedling age (days)			
	29		44	
	Inoculated	Control	Inoculated	Control
	Dry wt (g)/seedling			
Laguna	0.35	0.57	0.60	0.85
Planters Jumbo	0.66	0.66	0.60	0.79
PI 266935	0.50	0.65	0.64	0.88
PI 266934	0.17	0.29	0.56	0.52
LSD _{0.05} ^z	0.15			

^zLeast significant difference for $P \leq 0.05$.

recorded for each seedling, using an index of necrotic tissue on the following 0 to 5 scale: 0) no infection visible; 1) $>0\% \leq 20\%$ leaf area necrotic; 2) $>20\% \leq 40\%$ leaf area necrotic; 3) $>40\% \leq 60\%$ leaf area necrotic; 4) $>60\% \leq 80\%$ leaf area necrotic; 5) $>80\%$ leaf area necrotic.

Effects of genotype, seedling age, and inoculum concentration. Two experiments were completed. One experiment compared four genotypes (Laguna, Planters Jumbo, PI 266935, and PI 266934). Seedlings were inoculated at each of two ages (29 and 44 days after sowing). Inoculum was applied at a concentration of 1×10^6 spores/ml. Disease severity was rated 6 days after inoculation, and seedlings were cut at the cotyledonary node to determine oven dry weights 7 days after inoculation.

The second experiment compared disease severity levels on two genotypes (Laguna and PI 266934) using three inoculum concentrations (0, 1×10^5 , and 1×10^6 spores/ml) and four seedling ages (11, 17, 25, and 32 days after sowing). Disease severity was rated, and seedlings were cut for dry-weight determinations 15 days after inoculation.

All treatments in both experiments were arranged in factorial combination in randomized block designs. There were two and four replications in the first and second experiments, respectively.

No disease developed on noninoculated seedlings of any genotype in either experi-

ment. The severity of visible necrosis on inoculated plants differed significantly among genotypes. PI 266934 seedlings were significantly less diseased than all others at each of two seedling ages (Table 1). Similarly, inoculated seedlings of all genotypes, except PI 266934, weighed significantly less than their noninoculated controls at age 44 days. This was also true for seedlings at 29 days, except Planters Jumbo (Table 2). Inoculated PI 266934 seedlings were not significantly different from their noninoculated controls.

Inoculated Laguna seedlings developed less disease when 32 days old than when 11 days old, and when inoculum concentration was low (1×10^5 spores/ml) rather than high, except at 11 days (Table 3). No significant disease developed on any inoculated PI 266934 plants. All inoculated Laguna seedlings weighed less than their controls, and seedlings inoculated with the high concentration weighed less than those treated with the low (Table 4), except at 32 days. Following inoculation, PI 266934 seedlings weighed less than their controls at 17 and 32 days, but not at 25 and 11 days. Weights of PI 266934 seedlings were similar for high and low inoculum concentrations.

The results confirmed the resistance of PI 266935 reported by Sowell (1981). However, foliar disease ratings of PI 266934 were significantly less than those for PI 266935 for both seedling ages (Table 1). Reductions in

dry weight following inoculation were significant for PI 266935, but not for PI 266934 (Table 2). These data suggest that the resistance of PI 266934 was conditioned by a different mechanism than that of PI 266935. The high resistance level to GSB in PI 266934 should be useful for breeding. Work is required to clarify the inheritance of this resistance and its relationship to previously identified genes (Prasad and Norton, 1967).

In general, this study revealed that PI 266934 maintained similar or marginally smaller dry weight after inoculation, whereas the other cultigens were substantially smaller. Although disease scores would be the primary selection criterion for resistance in a breeding population, dry-weight comparisons for a small number of lines could be a refinement that would enhance the efficiency of progeny testing. The expression of resistance would probably be modified by the choice of recurrent parent and the inheritance of resistance, but it is likely that resistant progenies would be distinguished by performance similar to that reported here.

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Table 3. Ratings of foliar disease severity on seedlings of four ages for two melon cultigens inoculated with two concentrations of *Didymella bryoniae*.

Inoculum concn (spores/ml)	Seedling age (days) at inoculation							
	11		17		25		32	
	Laguna	PI 266934	Laguna	PI 266934	Laguna	PI 266934	Laguna	PI 266934
	Disease severity rating ^a							
1×10^5	4.25	0	2.75	0	3.0	0	1.0	0
1×10^6	4.17	0.50	4.75	0.25	4.08	0	3.33	0
LSD _{0.05} ^y	0.76							

^aDisease ratings were from 0 (no visible necrosis) to 5 ($>80\%$ leaf area necrosis).

^yLeast significant difference for $P \leq 0.05$.

Table 4. Dry weight per seedling of two melon cultigens of four ages, noninoculated or inoculated with two concentrations of *Didymella bryoniae*.

Inoculum concn (spores/ml)	Seedling age (days)							
	11		17		25		32	
	Laguna	PI 266934	Laguna	PI 266934	Laguna	PI 266934	Laguna	PI 266934
	Dry wt (g)/seedling							
0	0.69	0.40	0.89	0.81	1.28	0.80	0.96	0.78
1×10^5	0.51	0.42	0.57	0.61	0.63	0.76	0.54	0.62
1×10^6	0.35	0.38	0.40	0.53	0.37	0.71	0.50	0.62
LSD _{0.05} ^z	0.16							

^zLeast significant difference for $P \leq 0.05$.