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Sources of Bacterial Spot Resistance in Japanese-Type Plum Cultivars[1]

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Abstract

This review compares the species composition of 18 bacterial spot (*Xanthomonas campestris* pv. *pruni*) resistant Japanese-type plum cultivars (*Prunus salicina* and hybrids) to that of 8 susceptible plum cultivars. *P. salicina* accounted for about 58% of the species in both the resistant and susceptible groups. *P. cerasifera* (22%), *P. angustifolia* (6%) and *P. munsoniana* (3%) were present only in the resistant cultivars. *P. americana* and *P. simonii* were in both groups but more commonly in the susceptible cultivars. Resistant cultivar releases from breeding programs at Alabama, Georgia, South Africa and Australia were compared for species composition. The level of *P. salicina* varied from 50-63%. *P. cerasifera* was most common in cultivars from Australia (31%) and Alabama (28%) and *P. angustifolia* was present only in cultivars from Georgia (13%) and Alabama (5%). Combination of germplasm from the 4 programs would capitalize on the different parent cultivars and species involved in each. *P. cerasifera*, *P. angustifolia* and possibly *P. salicina* are considered major sources of resistance to bacterial spot.

Additional Index Words: *Xanthomonas campestris* pv. *pruni*, plum breeding, *Prunus* species.

The number of *Prunus* species found in modern Japanese-type plum cultivars (*P. salicina* Lindl. and hybrids) influences many commercially important characteristics including resistance to bacterial spot [*Xanthomonas campestris* pv. *pruni* (Smith) Dye]. This paper examines the species composition of resistant and susceptible plum cultivars and the sources of resistance used in breeding.

Cultivars were classified as resistant or susceptible on the basis of their performance at the Granite Belt Horticultural Research Station (GBHRS), Applethorpe, Queensland, Australia and from release notices. Resistant cultivars were chosen from breeding programs at Auburn University, Alabama; United States Department of Agriculture (USDA), Byron, Georgia; GBHRS, Queensland, Australia; and Fruit & Fruit Technology Research Institute, Stellenbosch, South Africa all of which have bacterial spot resistance as a major objective. The remaining resistant cultivars 'Bruce' and 'Morris' were introduced in Texas and 'Wade' in South Carolina. Susceptible cultivars were chosen from germplasm bred by Luther Burbank; the Agricultural Experiment Station (AES), Davis, California; and the USDA, Fresno, California (Table 1). Published ancestries are not always correct (4) and the records concerning Burbank's original hybridizations and imported seedlings (upon which many of the modern cultivars are based) are vague (6). 'Beauty,' 'Barstow' and 'Mariposa' were assumed to be 100% *P. salicina* for the purpose of calculation of species content. Many of the species are represented by a single or a relatively small number of ancestral clones (3) and as such may not accurately reflect the general characteristics of the species. Conclusions on the contribution of these species are nevertheless important because they represent the bulk of the germplasm with which plum breeders are developing resistant cultivars.

P. salicina is present in all commercial cultivars, ranging from a low of 43.8% in 'Segundo' to highs of 75% in 'Queensland Bellerosa' and selection GB2-46 and 87.5% in 'Wade' (Table 1). Resistant and susceptible cultivars

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Table 1. Parents, species content and origin of bacterial spot resistant and susceptible plum cultivars.

Cultivar	Origin[a]	Parents	Species content (%)[b]					
			SAL	CER	ANG	AM	SIM	MUN
Resistant								
AU Producer	AL	Bruce x Santa Rosa	50	0	12.5	12.5	12.5	12.5
AU Roadside	AL	Ozark Premier x Methley	62.5	37.5	0	0	0	0
Bruce	TX	(SAL x ANG) x Excelsior	50	0	25	0	0	25
Crimson	AL	Bruce x Methley	50	25	12.5	0	0	12.5
Explorer	GA	Queen Ann x Santa Rosa	50	0	0	25	25	0
GB2-46	A	Burbank x Skuse Seedling	75	25	0	0	0	0
Harry Pickstone	SAF	Gaviota x (Methley X Wickson)	50	12.5	0	25	12.5	0
Homeside	AL	Methley x Ozark Premier	62.5	37.5	0	0	0	0
Morris	TX	Methley self-pollinated	50	50	0	0	0	0
Purple	AL	Methley x Ozark Premier	62.5	37.5	0	0	0	0
Queensland Bellerosa	A	Burbank x Santa Rosa	75	0	0	12.5	12.5	0
Queensland Earlisweet	A	Early Jewel x Early Gem	50	50	0	0	0	0
Reubennel	SAF	Gaviota x (Methley x Wickson)	50	12.5	0	25	12.5	0
Robusto	GA	(Queen Ann x Barstow) x BY7-335	56.3	6.2	25	6.2	6.2	0
Rubysweet	GA	Mariposa x Morris	75	25	0	0	0	0
Segundo	GA	(Queen Ann x Santa Rosa) x BY7-335	43.8	6.2	25	12.5	12.5	0
Wade	SC	Beauty x Ozark Premier	87.5	12.5	0	0	0	0
Wilson	A	CER x SAL	50	50	0	0	0	0
Susceptible								
Beauty	LB	SAL	100	0	0	0	0	0
Blackamber	CA	Friar x Queen Rosa	50	0	0	31.2	18.8	0
Eldorado	CA	SAL x SIM	50	0	0	0	50	0
Friar	CA	Gaviota x Nubiana	50	0	0	37.5	12.5	0
Laroda	CA	Gaviota x Santa Rosa	50	0	0	37.5	12.5	0
Nubiana	CA	Gaviota x Eldorado	50	0	0	25	25	0
Queen Rosa	CA	Queen Ann x Santa Rosa	50	0	0	25	25	0
Santa Rosa	LB	complex hybrid	50	0	0	25	25	0

[a] A = Applethorpe, Queensland, Australia; AL = Auburn University, Alabama; CA = USDA, Fresno and AES, Davis California; GA = USDA, Byron, Georgia; LB = Luther Burbank; SAF = Stellenbosch, South Africa; SC = Clemson, South Carolina origin (2); and TX = Texas origin (1, 2).
[b] AM = *Prunus americana;* ANG = *P. angustifolia;* CER = *P. cerasifera;* MUN = *P. munsoniana;* SAL = *P. salicina;* and SIM = *P. simonii.*

have about the same level of *P. salicina* (58%) but differ in their content of other species (Figure 1). Susceptible cultivars contain higher proportions of *P. simonii* Carr. and *P. americana* Marsh. and none of *P. cerasifera* Ehr., *P. angustifolia* Marsh. or *P. munsoniana* Wight and Hedr. *P. americana* and *P. simonii* have been incorporated into the susceptible plums through 'Eldorado' (*P. salicina* x *P. simonii*), 'Santa Rosa' (complex hybrid of *P. salicina, P. simonii* and *P. americana*) and 'Gaviota' (*P. salicina* x *P. americana*) and it seems likely that both species have contributed to susceptibility. Popenoe (9) suggested that susceptibility to bacterial stem cankers was derived from *P. simonii* and both 'Eldorado' and 'Gaviota' have been reported as transmitting susceptibility to bacterial spot to their progeny (7, 8). These and many other California cultivars have been used extensively as parents because of their high fruit quality, specifically attractive skin color, large size and firm flesh.

P. cerasifera is the second (after *P. salicina*) most common species in the resistant plums and accounts for 22% of the species content (Figure 1). The source of *P. cerasifera* varies with the breeding program. 'Methley' (*P. salicina* x *P. cerasifera*) and 'Ozark Premier' ('Burbank' x 'Methley') are the sources of resistance in the Georgia, Alabama, and South African breeding programs, whereas in Australia resistance has been obtained from early ripening cherry-plums such as 'Wilson,' 'Skuse Seedling,' 'Early Jewel' and 'Early Gem.' 'Wilson' has also been used as a source of resistance in South Africa but all the progeny were discarded in the F_1 due to small fruit size (8). A common fault with *P. cerasifera* is small fruit size, plums with greater than 50% *P. cerasifera* always have small size. The high levels of resistance of the Australian cherry-plum hybrids, such as 'Wilson,' and the frequent incorporation of 'Methley' in the background of resistant plums indicate the *P. cerasifera* is a major source of resistance to bacterial spot.

P. angustifolia is commonly found in the ancestry of resistant but not in susceptible plums and is considered to be a major source of resistance to bacterial spot (5). For example, 'Bruce' and selection BY7-335 ('Ozark Premier' x *P. angustifolia*) have been used at the Alabama and Georgia breeding programs (Table 1). The problem in breeding with *P. angustifolia* is small fruit size, lack of flesh firmness and poor flavor transmitted to progeny.

Some resistant cultivars such as 'Queensland Bellerosa' and 'Explorer' contain neither *P. cerasifera* nor *P.*

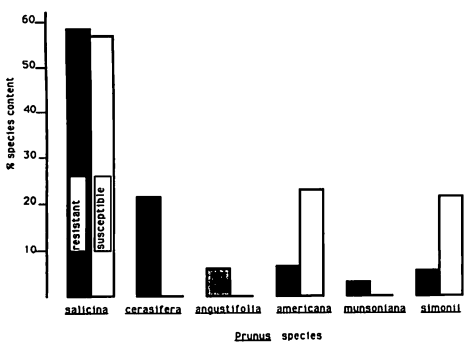


Figure 1. Average % species content in bacterial spot resistant and susceptible plums.

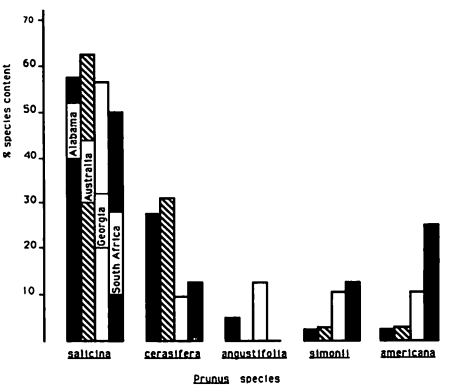


Figure 2. Comparison of species content of cultivars in Table 1 from breeding programs for bacterial spot resistance in Alabama, Australia, Georgia, and South Africa.

angustifolia (see Table 1) which indicates that there are other sources of bacterial spot resistance in the modern day cultivars, probably from *P. salicina*. It would be of interest to study a population of pure *P. salicina* to see what degree of resistance is available.

A comparison of the species content of the 4 programs breeding for bacterial spot resistance shows that while the levels of *P. salicina* are similar in all programs the level of other species varies considerably (Figure 2). *P. cerasifera* accounts for 31% and 28% of the species content for Australian and Alabama cultivars respectively, but is less common in the cultivars from Georgia and South Africa. *P. angustifolia*, native to the southeastern USA, accounts for 13% of the species content for Georgia cultivars and 5% for those from Alabama, but is absent in cultivars from Australia and South Africa. Alabama and Australian cultivars contain less *P. simonii* and *P. americana* than those from Georgia and South Africa due to the less frequent use of Californian cultivars which are the predominant source of these species (Table 1). Rapid advances in bacterial spot resistance are expected by combining germplasm from these 4 sources thus capitalizing on the different approaches that have been used in terms of parent cultivars and species.

Future breeding work for bacterial spot resistant plums requires a juggling of the various species so that sufficient resistance is obtained from *P. cerasifera, P. angustifolia* and possibly *P. salicina,* but with an improvement in fruit quality to be obtained predominantly from *p. salicina.*

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