

Susceptibility of potato cultivars and germplasm lines to powdery scab in New Zealand

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Potato cultivars and breeding lines have been assessed for their susceptibility to powdery scab in field trials over 20 consecutive growing seasons (1991/92 to 2010/11). The trials were carried out at The New Zealand Institute for Plant & Food Research Limited farm, Lincoln, Canterbury, New Zealand. Each cultivar/line (see accompanying table) was tested in at least two of these growing seasons.

Methods: The trials were carried out in soil inoculated with macerated potato tubers which were severely infected with powdery scab. The trials were planted early in each growing season (mid-September), and regularly irrigated during crop growth, especially during and immediately after tuber initiation. This ensured that cool, moist soil conditions prevailed to encourage powdery scab development. In each trial (each season), plots consisted of 1.5 m rows containing five seed tubers of each cultivar/line, hand-planted at 0.3 m spacings, with 0.75 m spacing between plots. Each trial was of randomised complete block design (six replicates). In early March, tubers in the plots were hand-dug and all tubers heavier than 30 g were harvested. They were washed free of soil and assessed for powdery scab severity using a 0–3 severity scale (0 = nil infection, 1 = less than 5% of tuber surface area infected, 2 = 5–25% surface area infected, 3 = greater than 25% surface area infected).

Analysis of variance was used to estimate mean tuber severity scores for each cultivar/line, and the mean scores from each trial were scaled linearly so that those of two standard cultivars, ‘Gladiator’ and ‘Iwa’ (which were included in all of the annual trials), were assigned the scores 0.15 and 1.50 respectively (their mean scores over the first four annual trials). This adjusted for seasonal differences in powdery scab severity. All cultivars (except the standards) that were tested in two or more growing seasons were then included in an analysis to estimate a mean severity score for each cultivar. A generalised linear model was used, with a binomial error structure to allow for smaller score variances for the very resistant and very susceptible cultivars. Estimated cultivar mean severity scores were further linearly scaled giving scores for ‘Gladiator’ and ‘Iwa’ of 8.8 and 5.0 respectively. This additional scaling gave high scores to highly resistant cultivars and low scores to susceptible cultivars (9 = almost complete resistance, 1 = all tubers heavily infected with powdery scab).

Results: The accompanying table (overleaf) lists the scaled average powdery scab severity scores for tubers of 133 cultivars and 18 breeding lines. The cultivars and lines formed a continuum of susceptibility to the disease from very resistant to very susceptible. They have been arbitrarily categorised as ‘very resistant’ (scaled average severity score > 8.0), ‘moderately resistant’ (score 7.0–7.9), ‘moderately susceptible’ (score 6.0–6.9) and ‘very susceptible’ (score < 5.9). This categorisation classified 18% of the cultivars/lines as very resistant, 27% as moderately resistant, 28% as moderately susceptible and 26% as very susceptible.

Discussion: This comprehensive and continuing evaluation of the susceptibility of New Zealand-available potato cultivars to powdery scab provides growers with information to assist management of the disease. They can either choose cultivars that are resistant to powdery scab, or where susceptible cultivars must be grown, apply other appropriate disease management strategies. The continuum of susceptibility to powdery scab in different cultivars and lines, from very resistant to very susceptible, indicates that resistance is of the ‘quantitative’ type and is probably based on the additive effects of several resistance genes. Selection for resistance to powdery scab is an important component of Plant & Food Research’s current potato breeding programme in New Zealand.

Mean powdery scab severity scores (9 = no tuber lesions; 0 = very heavily infected) for 133 potato cultivars and 18 germplasm lines (*) grown in disease assessment field trials from 1991/92 to 2010/11. Each line was tested over at least two growing seasons.

Very resistant		Moderately resistant		Moderately susceptible		Very susceptible	
Cultivar	Score	Cultivar	Score	Cultivar	Score	Cultivar	Score
Swift	9.0	Russet Burbank	7.9	2581.3*	6.9	Kennebec	5.9
Vtn62-33-3*	8.8	Highlander	7.9	Frisia	6.9	Concorde	5.9
Gladiator †	8.8	Ranger Russet	7.9	Bildtstar	6.9	Crebella	5.9
A84118-3*	8.8	Hermes	7.9	Courage	6.9	2885.1*	5.9
Donald	8.7	Nooksac	7.8	Tekau	6.9	Rosa	5.9
Winston	8.6	Umatilla Russet	7.8	810/7*	6.9	Golden Promise	5.8
Saxon	8.5	Innovator	7.7	White Delight	6.8	Annabelle	5.8
Red Rascal	8.4	Heather	7.7	Wha	6.8	Sinora	5.8
Norkotah	8.4	Fasan	7.7	Tiffany	6.8	Delikat	5.6
Van Gogh	8.3	Cliffs Kidney	7.7	Red Ruby	6.8	Ivory Crisp	5.5
Toru	8.3	Velox	7.6	Crop 9*	6.8	Whitu	5.5
Spey	8.3	Pacific	7.6	Jewel	6.7	89-33-1*	5.5
Moonlight	8.3	Valor	7.6	Rua	6.7	710/11*	5.5
Harmony	8.3	Fraser	7.6	Arran Banner	6.7	Crop 20 (1021/1)*	5.4
Foxton	8.2	Laura	7.5	Fronika	6.6	Agria	5.4
Snowden	8.2	Summit	7.5	Spunta	6.6	Allura	5.3
Ilam Hardy	8.2	Dawn	7.5	Hulda	6.6	Lone Ranger	5.3
Stroma	8.2	Rima	7.5	Obelix	6.6	Draga	5.3
Milva	8.2	Croft	7.5	Celine	6.5	Processor	5.3
Nadine	8.1	Purple Passion	7.5	Tahi	6.5	Coliban	5.3
Cantate	8.1	Jersey Benne	7.4	Matilda	6.5	Ukama	5.1
Fianna	8.1	Waru	7.4	Atlantic	6.5	Bondi	5.1
Driver	8.0	Tarago	7.4	759/3*	6.5	Bright	5.1
Lady Rosetta	8.0	Red King	7.4	Epicure	6.4	92-2-9*	5.1
Horizon	8.0	Desiree	7.4	Mondial	6.4	Riverina Russet	5.0
Granola	8.0	Pentland Dell	7.4	Symfonia	6.4	Iwa ‡	5.0
Record	8.0	Maris Anchor	7.3	Shepody	6.4	Cardinal	4.9
		Red Eye	7.3	Rocket	6.4	B5281-1*	4.8
† resistant standard		Majestic	7.3	Frontier Russet	6.3	Florissant	4.8
		Osprey	7.2	Victoria	6.3	Liseta	4.6
		Kaimai	7.2	672/6*	6.3	MacRusset	4.6
		Sebago	7.2	Fanfare	6.3	Marco Polo	4.6
		Kiwitea	7.2	Bolesta	6.2	Marlen	4.6
		Kolibri	7.1	Crop 22 (2886.3)*	6.2	Marabel	4.6
		Flame	7.1	Albatros	6.2	Angelina	4.5
		Delcora	7.1	Diamant	6.1	Shine	4.3
		Lutetia	7.1	Red Star	6.1	Markies	4.3
		Dakota Red	7.1	2000A*	6.1	676/2*	3.9
		718/6*	7.0	Morene	6.1	743/6*	3.5
		Karaka	7.0	Mona Lisa	6.0	Asterix	2.6
		Katahdin	7.0	Premiere	6.0		
				Summer Delight	6.0	‡ susceptible standard	
				Yvonne	6.0		