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Effect of Field Crops on Density of *Pratylenchus* in SouthEastern Australia; Part 2: *P. thornei*[1]

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Abstract: The effect of 93 field crop and pasture cultivars on the end-of-season population densities of *Pratylenchus thornei* in soil was determined in the field in southeastern Australia. Wheat and barley cultivars had different effects on the population densities of *P. thornei*. Most commercial wheat cultivars that are grown in southeastern Australia were susceptible, while the barley cultivars were resistant or moderately resistant. Lentil, field pea, fenugreek, linseed, and medic were found to be resistant to *P. thornei,* while faba bean and canola were moderately resistant and narbon bean, subterranean clover, and vetch were susceptible. This study will enable growers to select rotational crops to reduce the population densities of these nematodes and therefore minimize the yield loss they cause.
Key words: barley, canola, crop rotation, faba bean, fallow, field crop, field pea, lentil, management, *Pratylenchus thornei,* resistance, root lesion nematode, vetch, wheat.

Root-lesion nematodes, *Pratylenchus thornei* (Sher and Allen) and *P. neglectus* (Rensch) Filipjev Schuurmans Stekhoven, are migratory endoparasites that are common in the dryland field cropping soils of southern and eastern Australia (Eastwood, 1993; Nicol, 1996; Taylor and Evans, 1998). These nematodes have been shown to reduce the yield of cereal (Taylor et al., 1999; Thompson et al., 1995; Vanstone et al., 1998) and pulse crops (DiVito et al., 1992; R. Eastwood, unpub. data). Since the extent of yield loss in intolerant field crops is related to the population density of these nematodes in the soil, yield loss can be minimized by reducing the nematode density in the soil (Taylor et al., 1999; Vanstone et al., 1998). The most economical and environmentally appropriate way of reducing the population density of plant-pathogenic nematodes in low-value crops is to expand the interval between susceptible crops or to grow resistant crops (Brown, 1987).

If farmers in southeastern Australia are to minimize root lesion nematode population densities, they require information on the effect of the main crop species and cultivars that are grown in the region on nematode densities. The most important annual field crop species in southeastern Australia include wheat (*Triticum aestivum* L.), barley (*Hordeum vulgare* L.), durum wheat [*T. turgidum* L. subsp. *durum* (Desf.) Husn], canola (*Brassica napus* L.), field pea (*Pisum sativum* L.), chickpea (*Cicer arietinum* L.), lentil (*Lens culinaris* L.), faba bean (*Vicia faba* L.), vetch (*Vicia sativa* L.), and oat (*Avena sativa* L.). The relative importance of each of these species in the rotation varies with soil type and rainfall, with wheat being the dominant crop in all areas.

Taylor et al. (2000) provided information from the field on the effect of 81 crop and pasture cultivars commonly grown in southeastern Australia on the final population density of *P. neglectus*. However, there is limited information on the effect of these field crops and pastures on the population density of the closely related species *P. thornei* at the end of the growing season. Although *P. neglectus* and *P. thornei* are widely distributed and have a similar crop host range, host resistance to one species does not necessarily imply resistance to the other.

This study reports results of field studies

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undertaken to evaluate rotational crop and pasture cultivars for relative effects on population densities of *P. thornei* in the soil after harvest. The management implications of these results for the control of root-lesion nematodes in field cropping areas in southeastern Australia are discussed.

Materials and Methods

Field trials: Field trials were conducted in 1996, 1997, and 1998 at sites naturally infested with *P. thornei* to determine the effect of a range of crop and pasture cultivars on the end-of-season population density of *P. thornei* in the soil. End-of-season soil densities of *P. thornei* were measured, as these have been shown to relate directly to the pre-sowing levels the following season (unpubl. data), which is indicative of the potential yield loss that can be caused by these nematodes. All the trials were located in the Wimmera region of Victoria, either at Swanwater (36°29′E, 143°07′S), Gooroc (36°29′E, 143°,11′W), or Vectis (36°44′E,142°04′W) in Wimmera grey cracking clay soils.

To enable effective weed management with herbicides, the crop types were grouped each year into separate trials containing cereals, pulses, oilseeds, or pasture legumes. In 1998, the susceptible wheat cv. Meering and the resistant barley cv. Arapiles, identified from trial results in 1996 and 1997, were included in each trial to enable more effective comparison of nematode host status among crop types.

Field trials were sown in May or June and harvested at maturity in December of each year. Crop and cultivars in each trial are shown in Tables 1–4. Experimental design was a randomized complete block with either four or five replications. Each plot consisted of six drill rows, 6.6 m long with 15-cm row spacings. Fertilizer (N:P:K:S 0:9:0:10, Zn 1.0% at 90 kg/ha) was applied to all plots at sowing. Weeds were effectively controlled using pre- and post-emergent herbicides following current district practice (Code, 1998).

Seed was sown at the following rates: cereals 70 kg/ha (barley 175 seeds/m, wheat 185 seeds/m^2), field pea 100 kg/ha (42 seeds/m^2), lentil 80 kg/ha (180 seeds/m^2), vetch 45 kg/ha (65 seeds/m^2), narbon bean (*Vicia narbonensis*) 100 kg/ha (55 seeds/m^2), faba bean 170 kg/ha (38 seeds/m^2) [except cv. Aquadulce at 245 kg/ha (16 seeds/m^2)], fenugreek (*Trigonella foenum-graecum* L.) 18 kg/ha (120 seeds/m^2), canola 5 kg/ha (170 seeds/m^2), linseed (*Linum usitatissimum* L.) 50 kg/ha (700 seeds/m^2), and legume pastures 20 kg/ha. All trials (except Gooroc 1998) included an unsown non-cultivated fallow (maintained weed-free with herbicides) assumed to be equivalent to a fully resistant crop (a resistant control). In 1998, to measure the effects of green manuring of a vetch crop on the relative final population density of *P. thornei,* an additional vetch treatment (cv. Blanchfleur) was added to the pulse trial and chemically fallowed with an herbicide at flowering.

Nematode sampling: Nematode densities at the end of the season were assessed from moist soil (including roots) taken from each field plot. Individual trials were sampled on a single day during an interval 2 weeks prior to 6 weeks after harvest. Four soil samples were taken at random from each plot using a 75-mm-diam. Jarrett Earth Auger (Clutterham, Adelaide, South Australia) to a depth of 300 mm. Samples from each plot were mixed and a 1-kg subsample sealed in a plastic bag. The samples were stored in the dark at 5°C until nematodes were extracted.

Nematode extraction and quantification: Nematodes were extracted from two 200-g subsamples of soil and roots from each plot at 22°C for 72 hours using modified Whitehead trays (Whitehead and Hemming, 1965). Soil dry weight was determined by oven-drying a minimum of five 200-g soil subsamples from each trial at 60°C for 3 days. Nematode suspensions were assessed by counting two sub-samples from each extraction (one sub-sample from each extraction in 1998), and the mean of the samples was expressed as number of *P. thornei*/g dry soil. *Pratylenchus* spp. were identified on the basis of vulval position in adults (*P. neglectus*

TABLE 1. Effect of cereal (wheat, durum wheat, and barley) cultivars and breeder's lines on the final soil population density of *Pratylenchus thornei* in five field trials conducted in the Wimmera region of Victoria in 1996–1998.

		Final population density (ln *P. thornei*/g soil + 1)						
		Field trial location and year						
Crop	Cultivar/ breeder's line	Swanwater 1996	Gooroc 1997	Vectis 1997	Swanwater 1998	Gooroc 1998	Ranking[b]	Resistance designation[c]
Wheat	Ouyen	2.1 (7.1)[a]	2.8 (15.0)	2.4 (9.7)	3.4 (28.2)	3.9 (48.2)	2.8	S
Wheat	Janz	1.9 (6.0)	3.0 (18.3)	1.9 (5.5)			2.7	S
Wheat	Batavia					4.1 (60.1)	2.7	S
Wheat	VK237				3.1 (21.9)		2.7	S
Wheat	Trident		2.7 (13.3)	2.3 (8.7)			2.6	S
Wheat	Meering	1.7 (4.4)	2.5 (11.2)	2.6 (11.8)	3.1 (22.2)	4.1 (61.2)	2.6	S
Wheat	Goroke	2.0 (6.3)	2.9 (17.9)	1.8 (5.0)		3.6 (35.7)	2.5	S
Wheat	Goldmark	1.7 (4.5)	2.8 (15.9)	2.1 (7.0)	2.9 (16.7)	4.0 (50.9)	2.5	S
Wheat	Beulah		2.7 (14.1)	2.3 (9.4)			2.5	S
Wheat	Kellalac	2.1 (7.4)				3.4 (28.5)	2.5	S
Wheat	Rosella	1.6 (3.9)	2.6 (12.6)	2.3 (9.2)			2.5	S
Wheat	Frame	1.9 (5.6)	2.4 (10.0)	2.3 (8.7)	2.8 (15.2)	3.9 (46.7)	2.5	S
Wheat	VK292				3.0 (19.5)		2.5	S
Wheat	Gatcher	1.8 (5.0)				3.9 (48.5)	2.4	S
Wheat	Silverstar	1.7 (4.7)	2.6 (12.7)	2.3 (8.8)	2.9 (16.3)	3.6 (34.4)	2.4	S
Wheat	Pelsart					3.7 (38.0)	2.4	S
Wheat	Spear			2.2 (8.3)			2.4	S
Wheat	Worrakatta		2.0 (6.1)		2.9 (16.7)	3.8 (34.5)	2.3	S
Wheat	Yanac	1.7 (4.6)	2.4 (10.3)	1.5 (3.7)			2.3	S
Wheat	Buckley		2.5 (10.6)	1.9 (5.8)			2.3	S
Wheat	Bowie		2.3 (9.2)	1.8 (4.9)			2.2	S
Wheat	Krichauff	1.4 (2.9)	2.1 (7.2)		2.7 (13.7)	3.4 (28.9)	2.2	S
Wheat	Excalibur	1.1 (2.0)		2.2 (8.3)			1.9	M
Wheat	Chara		2.6 (8.6)	1.5 (3.4)	2.5 (11.3)		1.9	M
Wheat	Baxter					2.7 (14.4)	1.8	M
Wheat	VI184		1.9 (5.8)	1.5 (3.3)	2.3 (9.0)	3.4 (27.9)	1.8	M
Wheat	QT6285					2.8 (14.9)	1.8	M
Wheat	Sunvale					2.7 (13.4)	1.7	M
Wheat	GS50a	1.0 (1.6)	1.8 (4.8)	0.9 (1.4)	1.7 (4.6)		1.1	R
Durum	Tamaroi	1.0 (1.8)	1.0 (1.8)	1.1 (1.9)			1.2	R
Durum	Yallaroi	1.0 (0.7)	1.0 (1.6)	0.9 (1.4)	1.9 (5.8)	1.9 (5.5)	1.0	R
Barley	VB9524		2.4 (9.6)	2.0 (6.7)	2.9 (17.2)		2.4	S
Barley	Franklin		2.4 (10.2)	1.7 (4.3)			2.1	M
Barley	Galleon				2.5 (11.7)		2.1	M
Barley	Gardiner				2.5 (11.4)		2.0	M
Barley	Barque		1.8 (5.3)	1.2 (2.3)	2.4 (10.2)		1.7	M
Barley	Sloop	1.0 (1.7)	1.8 (4.8)	1.4 (2.9)	2.3 (8.8)		1.5	M
Barley	VB9613				2.2 (8.1)		1.5	M
Barley	Picola	0.8 (1.2)	1.2 (2.2)	1.3 (2.6)			1.2	R
Barley	Schooner	0.6 (0.8)	1.6 (4.1)	1.3 (2.5)			1.1	R
Barley	Arapiles	0.6 (0.9)	1.5 (3.7)	1.0 (1.7)	2.2 (7.9)	1.6 (3.7)	1.1	R
Fallow		0.6 (0.8)	1.5 (3.4)	1.6 (3.8)	1.7 (4.5)		1.0	R
LSD (P = 0.05)		0.66	0.59	0.74	0.54	0.54		

[a] Retransformed mean (*P. thornei*/g soil).
[b] Combined data analysis to give a ranking based on adjusted nematode population density where the scale is ln (*P. thornei*/g).
[c] Resistance/susceptibility designation where S = susceptible, M = moderately resistant, and R = resistant.

V = 81 to 85%, *P. thornei* V = 73 to 80% (Loof, 1991).

Statistical analysis: Individual trials were first analyzed separately using ANOVA. The population density of *P. thornei* in the soil at the end of the season under each plot was individually log transformed [$\log_e$ (*P. thornei* /g soil + 1)] before analysis to normalize

TABLE 2. Effect of pulse (lentil, field pea, faba bean, vetch, and fenugreek) cultivars and breeding lines on the final soil population density of *Pratylenchus thornei* in three field trials conducted in the Wimmera region of Victoria in 1996–1998.

		Final population density (ln *P. thornei*/g soil + 1)				
		Field trial location and year				
Crop	Cultivar/ breeder's line	Swanwater 1996	Gooroc 1997	Swanwater 1998	Ranking[b]	Resistance designation[c]
Narbon beam	Tanami			4.7 (109.2)	4.6	VS
Narbon bean	ATC 60105			4.6 (97.6)	4.5	VS
Wheat	Meering			3.8 (42.8)	3.9	S
Vetch	Blanchefleur	2.9 (16.5)[a]	1.6 (4.0)	3.7 (40.9)	4.4	S
Vetch	Languedoc	2.2 (8.2)			4.0	S
Vetch	Morava		1.2 (2.3)	3.2 (24.3)	3.6	M-S
Vetch	Blanchefleur (Green manure)			3.3 (26.9)	3.5	M-S
Faba bean	Icarus	1.5 (3.5)	1.3 (2.5)		3.7	M-S
Faba bean	Aquadulce			3.2 (22.9)	3.5	M
Faba bean	Fiord	1.3 (2.5)	0.9 (1.6)	3.2 (23.7)	3.3	M
Faba bean	Ascot	1.2 (2.2)	0.9 (1.4)		3.1	M
Lentil	ILL61			2.3 (9.0)	2.8	R
Lentil	Cassab			2.3 (9.2)	2.8	R
Lentil	ILL7180		0.7 (1.1)	2.2 (8.3)	2.7	R
Lentil	Digger		0.6 (0.9)	1.8 (5.1)	2.5	R
Lentil	Laird	0.6 (0.8)			2.5	R
Lentil	Matilda	0.7 (1.0)	0.6 (0.9)		2.4	R
Lentil	Cobber	0.6 (0.8)	0.6 (0.8)		2.3	R
Lentil	Northfield	0.5 (0.7)	0.6 (0.8)		2.2	R
Lentil	Spinner	0.5 (0.6)			2.1	R
Field pea	Excell	1.1 (1.9)		2.6 (12.2)	3.0	R
Field pea	Mukta		0.8 (1.2)	2.0 (6.2)	2.8	R
Field pea	PSF10	0.8 (1.3)			2.7	R
Field pea	PSH10			2.2 (7.6)	2.7	R
Field pea	Parafield		0.7 (0.9)		2.6	R
Field pea	Paravic		0.6 (0.8)		2.6	R
Field pea	Bluey	0.4 (0.5)	0.8 (1.2)		2.4	R
Field pea	PSH4		0.6 (0.8)		2.4	R
Field pea	Dundale	0.8 (1.2)	0.7 (0.9)	1.6 (3.9)	2.4	R
Field pea	Bohatyr		0.6 (0.8)	1.6 (3.8)	2.2	R
Field pea	Alma		0.5 (0.6)		2.1	R
Field pea	Laura	0.4 (0.5)		1.7 (4.4)	2.1	R
Field pea	N20-5	0.4 (0.5)	0.4 (0.5)		1.7	R
Fenugreek	Fenugreek			2.2 (7.7)	2.7	R
Barley	Arapiles			1.7 (4.7)	2.3	R
Fallow		0.9 (1.4)	0.7 (1.0)	2.4 (5.3)	2.8	R
	LSD ($P = 0.05$)	0.70	0.30	0.66		

[a] Retransformed mean (*P. thornei*/g soil).
[b] Combined data analysis to give a ranking based on adjusted nematode population density where the scale is ln (*P. thornei*/g).
[c] Resistance/susceptibility designation where VS = very susceptible, S = susceptible, M = moderately resistant, and R = resistant.

variances and means compared by LSD ($P \leq 0.05$).

To enable cultivars of similar crop types to be ranked by their relative effects on final population densities of *P. thornei* in the soil, data from trials of similar crop type were also analyzed using the spatial techniques of Cullis and Gleeson (1991) and Gilmour et al. (1997). This method allowed for extraneous effects such as changes in soil fertility and seasonal variation, thus giving a better estimate of the effect of crop cultivars on the final population densities of *P. thornei*. All trials for each crop type were combined and modeled as a multi-environment trial (Smith et al., 1998), with all models fitted using the statistical package ASREML (Gilmour et al., 1996).

Because grain growers selecting cultivars for the management of root-lesion nema-

TABLE 3. Effect of oilseed (canola and linseed) cultivars on the final soil population density of *Pratylenchus thornei* in three field trials in the Wimmera region of Victoria in 1996, 1997, and 1998.

		Final population density (ln *P. thornei*/g soil + 1)				
		Field trial location and year				
Crop	Cultivar	Swanwater 1996	Gooroc 1997	Swanwater 1998	Ranking[b]	Resistance designation[c]
Wheat	Meering			3.1 (22.0)	1.2	S
Canola	Dunkeld	1.2 (2.4)[a]	1.0 (1.8)	1.7 (4.3)	0.9	M
Canola	Charlton			1.9 (5.8)	0.9	M
Canola	Monty	1.3 (2.8)	1.0 (1.6)	1.8 (5.1)	0.9	M
Canola	Oscar	1.2 (2.4)	1.2 (2.5)	1.8 (5.2)	0.9	M
Canola	Karoo		0.9 (1.6)	1.8 (5.0)	0.9	M
Canola	Pinacle		0.7 (0.9)	1.8 (4.8)	0.9	M
Canola	Mystic			1.6 (3.8)	0.8	M
Canola	Hyola 42			1.6 (3.7)	0.8	M
Canola	Rainbow	1.1 (1.9)	1.2 (2.2)		0.8	M
Canola	Grouse	0.9 (1.5)	1.0 (1.8)		0.7	M
Linseed	Areco			1.1 (2.0)	0.7	R
Barley	Arapiles			1.3 (2.5)	0.7	R
Fallow	Fallow	0.9 (1.4)	0.7 (1.0)	0.8 (1.3)	0.7	R
LSD ($P = 0.05$)		n.s.	n.s.	0.53		

[a] Retransformed mean (*P. thornei*/g soil).
[b] Combined data analysis to give a ranking based on adjusted nematode population density where the scale is ln (*P. thornei*/g).
[c] Resistance/susceptibility designation where S = susceptible, M = moderately resistant, and R = resistant.
n.s. = not sampled.

todes require a simple rating system, each field crop and pasture cultivar was designated as either susceptible (S), resistant (R), or (if intermediate to these categories) moderate (M) to *P. thornei* based on the relative final population density of the nematode. These designations were chosen because they are similar to the current system used and understood by growers in Australia for the control of cereal cyst nematode (*Heterodera avenae*). A cultivar was designated as resistant if the final population density did not differ (P = 0.05) from the density in the fallow or resistant barley (cv. Arapiles) treat-

TABLE 4. Effect of pasture (subterranean clover, medic, Balansa and Persian clovers) on the final soil population density of *Pratylenchus thornei* in two field trials in the Wimmera region of Victoria in 1996 and 1998.

		Final population density (ln *P. thornei*/g soil + 1)			
		Field trial location and year			
Crop/pasture	Cultivar	Swanwater 1996	Swanwater 1998	Ranking[b]	Resistance designation[c]
Wheat	Meering		4.1 (60.6)	3.0	S
Subterranean clover	Seaton Park	2.1 (7.5)[a]	4.3 (73.9)	3.0	S
Subterranean clover	Trikkala	2.1 (6.8)		2.9	S
Subterranean clover	York		3.7 (40.5)	2.7	S
Subterranean clover	Gosse	2.0 (6.5)	4.1 (61.5)	2.7	S
Balansa clover	Bolta		3.2 (24.1)	2.3	M
Medic	Parragio	0.8 (1.2)	2.5 (11.0)	1.4	R
Medic	Sava	0.7 (1.1)	2.7 (14.0)	1.3	R
Persian clover	Nitro		2.2 (8.0)	1.1	R
Medic	Mogul	0.5 (0.7)	1.9 (5.5)	0.9	R
Barley	Arapiles		2.0 (6.6)	0.3	R
Fallow		0.7 (1.0)	1.9 (5.7)	0.6	R
LSD ($P = 0.05$)		0.87	0.39		

[a] Retransformed mean (*P. thornei*/g soil).
[b] Combined data analysis to give a ranking based on adjusted nematode population density where the scale is ln (*P. thornei*/g).
[c] Resistance/susceptibility designation where S = susceptible, M = moderately resistant, and R = resistant.

ments. Where the final population was not significantly different from the susceptible wheat (cv. Meering), the cultivars were assigned a susceptible rating. Cultivars intermediate between these two groups were designated moderate.

Results

The relative effect of each crop and pasture cultivar and advanced breeder's lines based on the final population density of *P. thornei* in the soil and their overall ranking are shown in Tables 1–4. The spatial analysis of the trials within each crop type showed good correlation between each trial, indicating that similar results were obtained from each site in each season (Table 5). An average correlation for each trial > 0.9 indicated that the environments were highly correlated and that the overall ranking can be used to describe the effect of each cultivar independent of site.

Cereals: The wheat cultivars differed in their relative effect on the final population density of *P. thornei* in the soil (Table 1). The resistant wheat, GS50a (Thompson and Haak, 1997), resulted in the lowest population density, which was not significantly different from the density following fallow. Most wheat cultivars tested were susceptible to *P. thornei.* Both durum wheat lines had densities at the end of the season that were similar to the densities after fallow or the resistant wheat line GS50a (Table 1).

In general, barley cultivars supported lower final populations of *P. thornei* than the majority of wheat cultivars tested, with final population densities that were not different from the fallow (Table 1). There were, however, differences in population density among the barley cultivars tested.

Pulses: End-of-season *P. thornei* densities under field pea and lentil cultivars and one fenugreek cultivar were not significantly higher than the fallow plots or resistant barley (Table 2). Nematode population densities were higher after the faba bean cultivars than following field pea or lentil, but lower than following vetch or susceptible wheat. Vetch supported a higher population of *P. thornei* than did lentil, field pea, or faba bean (Table 2). Populations of *P. thornei* did not differ where vetch was incorporated as a green manure than where the vetch cultivar Blanchefleur was harvested for grain. Both narbon bean accessions had *P. thornei* populations that were twice as high as in either vetch (cv. Blanchefleur) or susceptible wheat (cv. Meering).

Oilseeds: The final density of *P. thornei* under all canola cultivars was intermediate compared with the susceptible wheat cv. Meering and the fallow treatment (Table 3). The single linseed cultivar Areco had a final *P. thornei* population density similar to the densities found in the resistant barley and fallow plots.

Pastures: The subterranean clover (*Trifolium subterranean* L.) cultivars resulted in high final *P. thornei* population densities (Table 4). Balansa clover (*Trifolium michelianum* Sarvi) cv. Bolta was less susceptible than the susceptible wheat, but population densities were higher than in the fallow and the resistant barley treatments, suggesting that this cultivar is moderate in susceptibility to *P. thornei.* Medic (*Medicago truncatula* Gaertn cvs. [Parragio and Mogul] and *M. scutellata* L. Miller [cv Sava]) as well as the Persian clover (*Trifolium resupinatum* L.) cultivars were poor hosts for *P. thornei.*

Table 5. Average correlations of each trial conducted with the combined site mean.[a]

Trial	Average correlation			
	Cereals	Pulses	Oilseeds	Pastures
Goroc 1997	0.999	0.999	0.999	
Swanwater 1996	0.924	0.999	0.999	0.632
Swanwater 1998	0.921	0.999	0.999	0.999
Gooroc 1998	0.999			
Vectis 1997	0.859			

[a] Correlations > 0.9 signify that the individual trials are highly correlated with each other, indicating that the common effect may be used to describe the effect of each cultivar independent of site.

Discussion

These studies have identified many rotational crops that either suppress or maintain a low population of *P. thornei* and could be valuable in minimizing crop losses from these nematodes. The relative effects of the main crops grown in southeastern Australia on the population densities of *P. thornei* as determined in this study are summarized in Table 6.

The predominant wheat cultivars grown commercially in southeastern Australia (Meering, Frame, Ouyen) were all susceptible to *P. thornei*. The wheat line GS50a was resistant in this study. Although not agronomically suitable for release, GS50a is being used as a source of resistance to *P. thornei* in the Victorian and Queensland wheat improvement programs. Chara wheat and the advanced wheat line VI184 were designated moderately susceptible, resulting in a lower population density than the other commercial wheat cultivars evaluated. Although not as resistant as GS50a, these lines are an improvement over the cultivars currently grown in southeastern Australia, and the level of resistance present may be sufficient in a cropping system to prevent large increases in population densities of *P. thornei*. Differences in effects of wheat cultivars on final soil population densities of *P. thornei* seen in our studies concur with previous reports (O'Brien, 1983; Taylor et al., 1999; Tobar et al., 1995; Vanstone et al., 1998).

The barley cultivars all resulted in low *P. thornei* population densities and could be used to reduce the population density of *P. thornei* in a cropping sequence. Our results differ from studies in the northern hemisphere where Greco et al. (1988) found a single barley cultivar to be a ''moderate host'' of *P. thornei,* while Nombela et al. (1998) found barley to be a ''better host'' to *P. thornei* than wheat but a ''poorer host'' than vetch in the field.

The field pea, lentil, medic, fenugreek, linseed, and Persian clover cultivars tested had low *P. thornei* densities and could be useful in a crop rotation program to decrease population densities of *P. thornei.* However, as with barley, our results differ from those of Greco et al. (1988), where single cultivars of lentil and pea were found to be good hosts of *P. thornei.* These apparent contradictions could be due to differences in host cultivars studied, pathogenic variability in the nematode, or differences in the experimental methodology used.

The moderate population increases seen with faba bean, the canola cultivars, and the single cultivar of Balansa clover tested suggest that although these crops did not suppress the population of *P. thornei* to the same degree as barley or fallow, they will likely not result in large increases in populations of *P. thornei* if they are included in rotations. In

TABLE 6. Summary of reactions of field crops and pasture species to *Pratylenchus thornei* from the present study and to *Pratylenchus neglectus*.[a]

Crop/pasture	*Pratylenchus thornei*	*Pratylenchus neglectus*
Narbon bean[b]	Very susceptible	—[c]
Wheat	Resistant–susceptible	Resistant–susceptible
Vetch	Susceptible	Moderate–resistant
Chickpea	—	Susceptible
Subterranean clover	Susceptible	—
Faba bean	Moderate	Resistant
Canola	Moderate	Susceptible
Persian clover[b]	Moderate	—
Barley	Resistant–moderate	Susceptible–moderate
Durum wheat[b]	Resistant	Resistant
Field pea	Resistant	Resistant
Lentil	Resistant	—
Medic	Resistant	Moderate–resistant
Fenugreek[b]	Resistant	—
Linseed[a]	Resistant	—

[a] Data from Taylor et al. (2000).
[b] Based on less than three cultivars.
[c] Not tested.

this study, all canola cultivars had a similar effect on the *P. thornei* density in the soil at the end of the season, although Webb (1996) found that one of four oilseed lines suppressed *P. thornei* significantly more than the other cultivars tested. Consequently, it is important to continue to test new canola cultivars for their status as hosts for *P. thornei* before release, as there is the potential for differences to occur in new lines.

Narbon bean, a new minor crop in the lower rainfall Mallee region of Victoria, was highly susceptible to *P. thornei*. This crop has the potential to rapidly increase *P. thornei* populations, which may cause yield losses in subsequent intolerant crops. Where narbon bean is grown and *P. thornei* is present, care must be exercised in planning crop rotation sequences to minimize the potential for yield loss in subsequent intolerant crops due to high nematode population densities.

Pratylenchus thornei and *P. neglectus* often occur together in southeastern Australia. Growers planning to use crop rotation to control root-lesion nematodes in susceptible crops require information on resistance of field crops and cultivars to both species to enable effective management decisions. Information presented in this paper and in the preceding paper by Taylor et al. (2000) relative to the susceptibility of various field crops to both *P. thornei* and *P. neglectus* is summarized in Table 6. This information should enable growers to develop effective cropping strategies to minimize crop losses in fields infested with either or both nematode species.

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