Pratylenchus teres- WA's home grown Root Lesion Nematode (RLN) and its unique impacts on broadacre crops

Sarah Collins, Sean Kelly, Helen Hunter, Bill MacLeod, Lucy Debrincat, Jodie Teasdale, Caroline Versteeg and Xiao Zhang, *Department of Agriculture and Food, Western Australia; South Perth*

KEY MESSAGES

- *P. teres* is unique to WA, has a wide host range and is capable of causing significant yield damage.
- Crop rotation and resistant cultivar selection are the keys to management of Root Lesion Nematode (RLN). Growers need to know which species of RLN are present as cultivars resistant to one nematode species may be susceptible to another, so suitable rotations will vary.
- Ongoing DAFWA research is developing rotational recommendations through the characterization of wheat cultivar resistance & tolerance levels.
- Become familiar with root and crop symptoms associated with nematode damage.
- Make use of available testing services to determine nematode species and levels, but be aware that PreDicta-B™ cannot currently detect *P. teres* present in WA crops.
- AGWEST Plant Laboratories can conduct in-season nematode diagnosis.
- Consider the influence of soil nematode levels not only on the current, but also on subsequent, crops in the rotation.

AIMS

Root Lesion Nematodes (RLN, *Pratylenchus* spp.) are microscopic migratory endoparasites. This means that RLN enter roots, feed on cell contents then either remain to continue feeding within the same root or exit and move to nearby root systems. This process damages the root system making water and nutrient uptake less efficient, therefore plants are less able to tolerate other stresses. Currently, RLN damage is estimated to cause crop losses in the order of $190 million p.a. in Southern and Western Australia (Vanstone *et al*. 2008, *Australasian Plant Pathology* 37, 220-234). These huge losses are put into perspective when the magnitude of the area affected by RLN in WA alone is considered. It is estimated that one or more species of RLN occur in at least 60% of WA cropping paddocks - that is over at least 5.3M ha of the WA cropping zone. Surveys also found that RLN is at yield limiting levels in at least 40% of paddocks. Several types of RLN are responsible and paddocks usually have 1 or more species: *P. neglectus* is the most frequent RLN identified in WA, occurring in at least 40% of paddocks; *P. thornei* occurs rarely (around 8% of paddocks); *P. teres* is found in around 15% of cropping paddocks in WA. Cereal yield losses due to RLN are in the order of 10-30%, but can be higher (25-75%) for individual crops, particularly where *P. teres* occurs.

P. teres is unique to WA, can reach high populations and cause more significant and widespread damage within a crop than *P. neglectus*. Information is required to enable growers to manage *P. teres* within their cropping rotations through the use of species which are poor- or non-hosts, or resistant wheat and barley cultivars to limit the multiplication of this pest in the soil. Although *P. teres* is less frequent, crops resistant to *P. neglectus* can be highly susceptible to this species, requiring a different suite of rotational crops and cultivars for effective management. It is therefore imperative that in field diagnoses, the species of RLN is correctly identified to enable growers to deploy appropriate crop cultivars and species to minimise current and future losses.

Since nematodes cannot be controlled currently in broadacre Australian agriculture by chemical means, genetic solutions must be deployed to facilitate their effective management in dryland cropping systems. This involves not only the development and use of cereals with resistance and/or tolerance, but also the appropriate use of non-cereal crops in rotational sequences to maintain low nematode populations. By screening and field testing the resistance and tolerance of wheat and barley cultivars, relevant information can be supplied to allow growers to incorporate cultivars into rotations that limit the populations of and damage caused by nematodes.

METHOD

Field assessments

Resistance trials conducted in 2009 Katanning assessed a wide range of crops to *P. teres* – 22 wheat, 21 barley and 12 canola cultivars. Resistance refers to the effect of the plant on the nematode so resistant plants inhibit nematode reproduction, resulting in declining nematode numbers. To determine resistance nematode numbers were compared at planting and anthesis and the level of multiplication of the nematodes over the growing season provided an estimate of the relative susceptibility or resistance of the cultivars assessed (multiplication >1 indicates a susceptible cultivar). These assessments provided valuable information for development of current field and glasshouse trials.

Current trials are conducted over 2 years. In the first year, *P. teres* resistant and susceptible crops are bulk sown to manipulate nematode levels to produce 'high' and 'low' populations at which to compare yields of 24-26 wheat cultivars in the following year. In this way, relative cultivar tolerances are determined based on the yield differences that occur between the 'high' and 'low' nematode populations. Tolerance is a measure of the effect of the nematode on plant growth so the larger the yield difference, the more intolerant the cultivar. For tolerant cultivars, there will be little difference in yield between the 'high' and 'low' nematode populations. Resistance information was also collected for each variety.

Glasshouse trials

Crop cultivar resistance data are required to recommend management and rotations. Glasshouse trials allow assessment of multiple cultivars in highly replicated trials. Wheat, barley, canola, pea & lupin cultivar testing was conducted. Due to inherent variability in nematode experimentation trials will be repeated up to 5 times to validate.

RESULTS AND DISCUSSION

Susceptibility to *P. teres* varies between cultivars and crops. For example, at the Katanning field trial nematodes multiplied between 3 and 16, 3.5-14, 3-11 times for wheat, barley and canola cultivars respectively. In Toodyay 2012 and in glasshouse trials, although average multiplication was lower, ranging from 1-4.5 times, also indicate cultivar susceptibility ranges from VS to MR-MS (Table 1 and 2). Data collected from field and glasshouse trials between 2009 and 2012 are being used to build reliable information for *P.teres*.

Significant yield impacts occurred for wheat varieties assessed in Toodyay 2012 when comparing yield to nematode numbers at anthesis (Table 2). Very high yield impacts were recorded for Carnamah and Emu rock (24%), Machete (16%), as well as Arrino and Westonia (12%). Significant yield loss was also evident when comparing yield and nematode multiplication for Brookton and EGA Eagle Rock (15%) and Ruby (7%). Coupled with resistance data, these results indicate Emu Rock may be only moderately susceptible but very intolerant to *P. teres* while the other varieties are intolerant but range in levels of susceptibility to the pest. Conversely, a yield impacts were negligible most of the other varieties tested. Of note, Yitpi and Yenda appeared to be tolerant of *P. teres* impacts.

Table 1: 'Most resistant' and 'most susceptible' cultivars tested crops are indicated

Crop	'Most resistant' cultivars tested	'Most susceptible' cultivars tested
Lupin	tanjil#	Coromup#
Field pea	Kaspa#	PBA Gunwah#
Barley	Yagan#, Wimmera#, Mundah■	Stirling■, Hamelin■, Vlamingh■, Bass#
Canola	Stubby#, Tanami■	Rottnest#, Thunder■
Wheat	MaceΔ, YitpiΔ, StilettoΔ	CalingiriΔ, CarnamahΔ, CatalinaΔ

Note: Provisional results based on: 1 trial = #, 2 trials = ■, 3 or more trials = Δ

Table 2: Yield impacts for field trial in Toodyay 2012. Provisional resistance ratings developed from results for *P. teres* glasshouse and field trials. Comparisons to *P. neglectus* resistance ratings

Cultivar	Percent yield loss (P-value >0.01)	Provisional resistance rating for *P. teres*	Resistance rating for *P. neglectus*
Arrino	12	S	S
Carnamah	24	VS	S
Emu Rock	24	MS-S	S
Mace	0	MS	MS
Magenta	0	MS	MS-S
Westonia	12	S	S
Wyalkatchem	0	MS-S	MR-MS
Yitpi	0	MS-S	MS-S

Data collected to date indicate that *P. teres* has a broad host range (Table 3). Wheat, canola, lupins, barley and field pea assessed between 2009 and 2012 all appear susceptible to this pest (Table 1 and 2). Importantly, levels of susceptibility varied for both host and cultivar. Therefore smaller increases in nematode numbers when growing a more resistant cultivar or crop may produce smaller impacts both current crop and for subsequent season could be mitigated by appropriate cultivar and crop selection.

Table 3: Reaction of major crop and pasture species to *Pratylenchus neglectus* and *Pratylenchus teres*

Hosting ability	*P. neglectus*	*P. teres**
Susceptible	wheat canola chickpea mustard	wheat canola barley oat
Moderate	barley durum wheat oat vetch	narrow-leafed lupin
Resistant	field pea narrow-leafed lupin faba bean triticale lentil serradella sulla	

*Information for *P. teres* is based on samples from *AGWEST Plant Laboratories* for diagnosis, combined with preliminary field and glasshouse trials.

Nematodes are characterised by patchy infestations and variable impacts on plants depending on environmental conditions. RLN lifecycle and impact in a crop is influenced by seasonal variations, soil type and management practices for any given year. For example, seasonal influence of rainfall may have effected multiplication of RLN in the field trials assessed in 2009 and 2012. In Katanning 2009, with rainfall of 356mm between May – Oct, *P. teres* multiplication ranged from 3 to 16 across the wheat barley and canola cultivars tested. In 2012 Toodyay experienced 260mm and *P. teres* multiplication of 1 to 4 was measured. Across trials, some cultivars have had inconsistent results to date that may be related to environmental influences. Endure for example; behaved as a highly susceptible crop in Katanning in 2009 with a multiplication of 16 but in subsequent glasshouse and 2012 the field trial has been much more moderately susceptible. Wyalkatchem and Arrino resistance has also ranged from susceptible to moderately resistant between trials. These inconsistencies highlight the importance of repeated trials in a range of circumstances.

CONCLUSIONS

The most commonly found RLN, *P. neglectus,* impacts broadacre cropping across Australia. The volume and reliability of information available for this pest reflects local and national research initiatives over more than 20 years. *P. teres* on the other hand is unique to WA and research into this nematode has been much more limited to date. Current DAFWA research initiatives will continue to develop tolerance and resistance information for rotation and suitable cultivar selection information. More data are required for this RLN species, but both glasshouse and field trial assessments to date indicated that crop reaction may vary compared to that for other *Pratylenchus* species. Therefore it is important to ascertain the type and species of nematode affecting crop to determine the appropriate course of action for management. This is particularly important where *P. teres* is concerned as it appears that crops may be more impacted by this species than the more common *P. neglectus.*

Research in WA focus' on management, principally through rotational recommendations for cereal cultivars and other host crops. Results for *P. teres* are still preliminary so while some provisional recommendations are appropriate at this time, development of rotational advice requires field and glasshouse assessment of the commercial cultivars grown within the farming system against this RLN species encountered in the WA broadacre growing areas. This information will be widely extended to growers and consultants to facilitate the management of RLN and minimise the losses incurred by grain growers.

KEY WORDS

Root Lesion Nematodes, RLN, *Pratylenchus Teres*, management options, crop rotation, resistance, tolerance

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