Department of Primary Industries
Department of Regional NSW

NSW research results

RESEARCH & DEVELOPMENT – INDEPENDENT RESEARCH FOR INDUSTRY

The following paper is from an edition of the Northern or Southern New South Wales research results book.

Published annually since 2012, these books contain a collection of papers that provide an insight into selected research and development activities undertaken by NSW DPI in northern and southern NSW.

Not all papers will be accessible to readers with limited vision.
For help, please contact: Carey Martin at carey.martin@dpi.nsw.gov.au

Published by NSW Department of Primary Industries,
a part of the Department of Regional New South Wales.

Phytophthora root rot–reduced yield losses in crosses with wild *Cicer* relatives – Warwick 2018

Sean Bithell[1], Kristy Hobson[1], Willy Martin[2], Merrill Ryan[2], Steve Harden[1], and Kevin Moore[1]

[1] NSW DPI, Tamworth

[2] Queesland Department of Agriculture and Fisheries, Warwick QLD

Key findings

- Crosses between chickpea and wild *Cicer* species, such as the breeding lines CICA1328, CICA1718 and CICA1812, offer improved levels of resistance to phytophthora root rot (PRR).
- Avoid paddocks prone to waterlogging, with poorly drained areas, or a history of lucerne, medics or chickpea PRR.
- Use the most PRR-resistant varieties (rated MR) where there is a disease risk.
- A higher number of chickpea varieties now have improved resistance to PRR, but substantial yield losses (40–68%) can still occur, even in a relatively dry season, if one soil saturation rainfall event occurs.

Introduction

Phytophthora medicaginis, which causes PRR in chickpea, is endemic and widespread in southern Queensland and northern NSW. The pathogen carries over from season to season on infected chickpea volunteers, lucerne, native medics and as resistant structures (oospores) in the soil. Although registered for use on chickpeas, metalaxyl seed treatment is expensive, does not provide season-long protection and is not recommended as a general management tool for PRR. There are no in-crop control measures for PRR – reducing losses from the disease are based on avoiding risky paddocks and choosing the right chickpea variety.

This annually-occurring experiment aims to compare the yields of established chickpea varieties and advanced (CICA) breeding lines for differences in yield losses due to PRR disease. This information will be used to produce PRR yield loss information for advanced breeding lines (if they are released as varieties) and provide information on the current PRR resistance in established chickpea varieties.

Site details

Location	Warwick QLD – Hermitage Research Facility
Trial design	Trials consist of two treatments being: 1. Plus PRR – seed treated with thiram + thiabendazole only, plots inoculated at planting with a mixture of oospores from 10 *P. medicaginis* isolates and receive no metalaxyl soil drenches. 2. Minus PRR – seed treated with thiram + thiabendazole + metalaxyl and plots received regular soil drenches with metalaxyl. (Note: metalaxyl is not currently registered as a soil drench in chickpea). This metalaxyl treatment prevents infection by the PRR pathogen. The difference in yield between the metalaxyl-treated plots and untreated plots is used to calculate the PRR-caused yield loss.

Rainfall and irrigation	Fifty millimetres of irrigation was applied before sowing in 2018. There was below average rainfall in July, August and September (total 15 mm). However, 22 mm of dripper-tape-applied irrigation in late September and frequent October rainfall (128 mm) favoured PRR development later in the season.
Sowing date	16 July 2018
Fertiliser	25 kg/ha Granulock Z (nitrogen:phosphorus:sulfur:zinc; 11:21.8:4:1) placed in-furrow with seed.
Sowing rate and established plant population	Target 35 plants/m^2. Once emergence is complete, seedlings are hand thinned to provide common plant density across varieties and breeding lines. In 2018, plants were thinned to 28 plants/m^2.
Weed management	Post plant pre-emergent herbicide: 500 g/ha Simazine 900 (900 g/kg simazine) plus 1043 g/ha Terbyne® (750 g/kg terbuthylazine) plus 50 g/ha Balance® 750 WG (750 g/kg isoxaflutole) applied on 20 July.
Insect management	Targeting *Helicoverpa* spp: 70 g/ha Dupont™ Altacor® (350 g/kg chlorantraniliprole) applied on 23 October and 9 November.
Disease management	Targeting ascochyta blight: 1 kg/ha Mancozeb 750 SC (750 g/L mancozeb) applied on 23 August and 26 September; and 500 ml/ha Howzat (500 g/L carbendazim) applied on 24 October and 9 November.
Harvest date	4 December 2018.

Treatments

Varieties (10)	CICA1328, CICA1521, CICA1718, CICA1811, CICA1812, Kyabra$^{\Phi}$, PBA Drummond$^{\Phi}$, PBA HatTrick$^{\Phi}$, PBA Seamer$^{\Phi}$, Yorker$^{\Phi}$.

Results

Grain yield

The level of PRR disease that developed in 2018 was lower than that in 2017, reducing the extent of the yield loss. In 2017, losses ranged from 29% for CICA1328 to 95% for PBA Boundary$^{\Phi}$ (rated S). However, in 2018, CICA1328 had no significant yield loss from PRR, while the most susceptible entry, PBA Drummond$^{\Phi}$ (S), lost 68% (Table 1).

The lower yield losses in the 2018 experiment reflect low early season levels of PRR resulting from below average rainfall in July, August and September. However, 22 mm of irrigation applied in late September and frequent October rainfall (128 mm) favoured PRR development later in the season, caused moderate yield losses in the more susceptible entries.

In the presence of PRR, the high yields of the advanced breeding lines (crosses between a chickpea (*Cicer arietinum*) line and a wild *Cicer* species) was a highlight of this experiment. Three lines in particular, CICA1328, CICA1718 and CICA1812, produced over 2 t/ha in the plus-PRR treatment and correspondingly had the lowest yield losses. These three lines yielded significantly higher than all other entries, which lacked non-wild *Cicer* genetics, with the exception of PBA HatTrick$^{\Phi}$ and Yorker$^{\Phi}$ (Table 1). The breeding lines CICA1718 and CICA1812 are being multiplied as possible new variety releases.

Table 1 Yield of chickpea varieties and breeding lines plus or minus PRR.
l.s.d. ($P = 0.047$) yield = 0.77 t/ha

Variety/line	Yield (t/ha)		PRR yield loss (%)
	Minus PRR	Plus PRR	
CICA1328A	2.40	2.58	–7.2 (ns)
CICA1521A	1.94	1.19	38.7 (ns)
CICA1718A	2.51	2.02	19.6 (ns)
CICA1811A	2.54	1.43	44.0
CICA1812A	2.84	2.08	26.7 (ns)
Kyabra	2.22	1.17	47.4
PBA Drummond	2.49	0.79	68.1
PBA HatTrick	2.28	1.36	40.5
PBA Seamer	2.81	1.08	61.5
Yorker	2.84	1.70	40.1

A these lines are crosses between chickpea (*C. arietinum*) and a wild *Cicer* species

Hundred seed weights of samples showed that all breeding lines and varieties produced good seed size in 2018 despite PRR infection (Table 2). In addition, two entries that had lower than average seasonal yields (CICA1521 and Kyabra[A]) also had significantly larger seed when PRR was present. This larger seed reflects reduced seed number per plant, plant recovery from PRR during dry spells and lower plant density (due to PRR losses) that provided greater soil moisture during pod fill.

Table 2 Hundred seed weights (HSD, g) of chickpea varieties and breeding lines plus or minus PRR.
l.s.d. ($P = 0.030$) HSD = 1.525 g

Variety/line	Minus PRR (g)	Plus PRR (g)
CICA1328A	22.82	21.50
CICA1521A	22.22	23.79
CICA1718A	21.51	22.81
CICA1811A	24.64	23.54
CICA1812A	25.99	26.57
Kyabra	25.50	27.51
PBA Drummond	24.17	23.46
PBA HatTrick	23.36	23.57
PBA Seamer	22.85	24.09
Yorker	21.96	22.87

A These lines are crosses between chickpea (*C. arietinum*) and a wild *Cicer* species

Conclusions

This experiment showed that a number of advanced breeding lines (CICA1328, CICA1718 and CICA1812), which are crosses between a chickpea (*Cicer arietinum*) line and a wild *Cicer* species can have high yields when PRR is present. This was the highlight in the 2018 experiment with these lines also producing good sized seed. These varieties that can produce high yields under PRR disease pressure indicates that the chickpea breeding program is successfully producing material with improved PRR resistance.

The experiment also demonstrated that substantial yield losses from PRR can occur in both S (47–68%) and MR (40–61%) resistance-rated varieties. This finding reinforces the need to minimise the risk of PRR disease losses in chickpea crops by choosing low risk sites (no history of PRR, good drainage, and free of medic weeds).

Acknowledgements

This experiment was part of the project 'Improving management of phytophthora root rot of chickpea', the subproject BLG205 in DAN00213, which is funded through the Grains Research and Development Corporation (GRDC) and NSW DPI's Grains Agronomy and Pathology Partnership (GAPP).

Contact

Sean Bithell
Tamworth Agricultural Institute, Tamworth
sean.bithell@dpi.nsw.gov.au
02 6763 1117