Measuring the impact of bacterial blight (*Pseudomonas syringae* pv. *syringae*) on production of Australian field pea varieties.

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Abstract

A series of field experiments were conducted from 2006 to 2009 at Wagga Wagga in southern NSW to measure production losses in field pea resulting from artificially created epidemics of bacterial blight (caused by *Pseudomonas syringae* pv. *syringae*). Yield losses varied widely from 0 to 100% across the range of experiments and depended largely on the season and the variety or breeding line. Planting material was sourced from current commercial field pea varieties and advanced breeding lines from the National Field Pea Breeding Program of Pulse Breeding Australia. Infected and infection-free areas were successfully established within the confines of the trial design. Significant differential responses across the range of commercial and breeding lines developed. These results not only provide a measure of production losses from the disease, but also provide excellent prospects for the future development of resistant field pea varieties in Australia. Bacterial blight appears sporadically in field pea in this environment but can have devastating impacts on both production and grower confidence.

Key Words

Bacterial blight, disease, resistance, varieties, production losses, field pea

Introduction

Bacterial blight occurs sporadically in field pea crops across southern Australia (Hollaway et al. 2007). Its' highly unpredictable occurrence combined with an unpredictable affect on yield makes it a difficult disease to manage, particularly as control options are limited, expensive and often cosmetic. Variety resistance offers a good alternative for its management under these circumstances. Currently there is little or no information on susceptibility of Australian field pea varieties or breeding lines to bacterial blight and the associated yield penalties due to bacterial blight infection.

There are two major pathovars of bacterial blight in Australia - *Pseudomonas syringae* pv*. pisi* and *Pseudomonas syringae* pv*. syringae* (Kraft and Pfleger 2001). While *P. syringae* pv*. pisi* is considered the more important and economically damaging of the two on a global scale, over recent times *P. syringae* pv. *syringae* appears to be more damaging under southern Australian conditions (Richardson *pers com*).

This paper describes a series of field experiments designed to measure the biological impact of bacterial blight (*Pseudomonas syringae pv. syringae*) on production and yield of field pea germplasm.

Methods

Randomised blocks of infected and disease-free areas of bacterial blight where established over 4 seasons (2006-09) in a border-check irrigation system at Wagga Wagga Agricultural Institute, Wagga Wagga NSW. Varieties and advanced breeding lines were contained within these blocks to eliminate or minimise spread from infected to disease-free areas.

The site was pre-irrigated each year to enable early sowing (15-30 May) and specifically selected for flat topography and low altitude relative to the surrounding to encourage frost damage which pre-disposes the plants to infection by the bacteria. The organism had been previously collected from locally infected crops and stored under laboratory conditions. Samples were subsequently cultured and multiplied then sprayed onto coarsely chopped pea straw as a liquid broth. This was spread by hand across the plots when plants were at the 2-4 node stage (2-3 weeks after emergence). After spreading, plots were mechanically damaged to further assist entry and infection by the bacteria. In all years, severe epidemics developed from mid August onwards. Subsequent growth and development of the plots was observed and yield taken at maturity using a small plot harvester.

Results

All varieties developed scattered bacterial blight symptoms during early growth (4-8 nodes, around July) but came under heavy disease pressure from around mid August onwards when the disease developed into epidemic proportions across the infected blocks. However, each year the disease haltered from around mid September onwards, and at that time, differential responses between varieties were clearly apparent. From this point onwards, the more resistant varieties tended to grow away from the disease to become almost symptom-free, while the most susceptible were slow to recover, if at all.

Bacterial blight reduced yields on average by around 25%, however there were large differential responses between varieties (Table 1). Line OZP0901 stood out, being one of the highest yielding varieties and the least affected by bacterial blight, and on this basis was classified as resistant (R). Line OZP0703 and Parafield fell into the next category of moderately resistant (MR) while Yarrum and Morgan moderately resistant/ moderately susceptible (MR/MS). The rest of the varieties were considered to have no useful field resistance to bacterial blight and classified as either moderately susceptible (MS) or susceptible (S). Both OZP0703 and Yarrum had both high yield potential and useful resistance. The data clearly shows Kaspa to be one of the most susceptible varieties evaluated.

Table 1. Comparisons of grain yield (t/ha) from disease-free and bacterial blight (BB) infected treatments of Australian field pea varieties and advanced breeding lines. Data are means over four seasons (2006-09). The percentage yield loss is calculated from the differences, and a disease resistance rating proposed.

Variety	Plant* Type	Seed Colour/ Shape	Yield T/Ha BB-Free	Yield Rank BB-Free	Yield T/Ha BB Infected	% Yield Loss	Proposed Resistance Rating
OZP0901	C-Tall	Dun-Dimpled	2.70	2	2.52	7	R
OZP0703	SL-SD	Dun-Dimpled	2.34	4	2.07	12	MR
PARAFIELD	C-Tall	Dun-Dimpled	2.01	9	1.70	15	MR
YARRUM	SL-SD	Dun-Dimpled	2.70	1	2.15	20	MR/MS
MORGAN	SL-Tall	Dun-Dimpled	2.36	3	1.86	21	MR/MS

STURT	C-Tall	White-Round	2.19	5	1.60	27	MS
BUNDI	SL-SD	White-Round	1.79	11	1.27	29	MS
OZP0602	SL-SD	Dun-Round	2.18	6	1.49	31	S
CELINE	SL-SD	White-Round	2.18	7	1.36	37	S
OZP0601	SL-SD	Dun-Round	2.13	8	1.33	38	S
EXCELL	SL-SD	Blue-Round	0.75	12	0.46	39	S
KASPA	SL-SD	Dun-Round	1.92	10	1.14	41	S
sed			0.349		0.347		

*Plant Type: C conventional; SL semileafless; SD semi-dwarf

When bacterial blight-free-yield is plotted against bacterial blight-affected-yield (Figure 1), the relative ranking of varieties becomes more apparent. The highest yielding and most resistant varieties are to be found above the regression line and to the upper right portion of the graph. Hence, OZP0901, OZP0703, Yarrum and Morgan stand out and group together as the best varieties, while Excell performed very poorly in these trials followed by Kaspa..

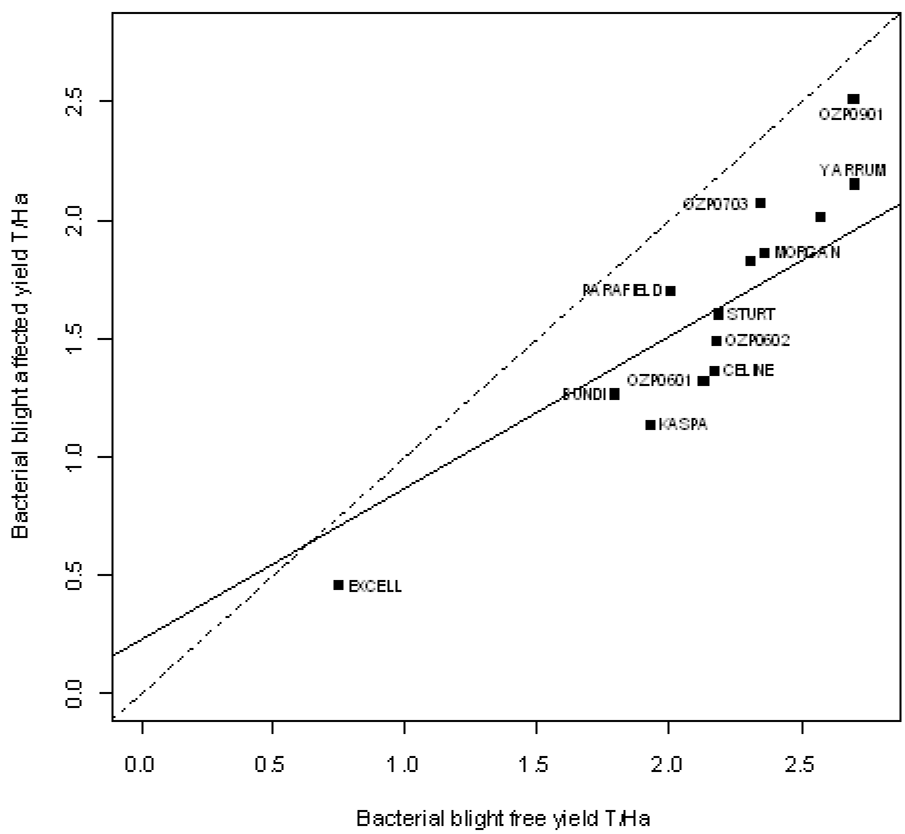

Figure 1. Bacterial blight-free yield plotted against bacterial blight-affected yield. The solid line regresses the linear relationship between these two yields. The dotted line represents a 1:1 relationship where disease would have no affect.

Conclusion

Production losses ranging from 7-41% from bacterial blight (*Pseudomonas syringae* pv. *syringae*) have been measured in field trials at Wagga Wagga Agricultural Institute, Wagga Wagga over the past four seasons (2006-09). This required establishing artificial epidemics of the disease and setting up diseased- and disease-free treatments.

Line OZP0901 was identified as being one of the highest yielding varieties and the least affected by bacterial blight, and on this basis was classified as resistant (R). The next group of varieties were either moderately resistant (MR) or moderately resistant/ moderately susceptible (MR/MS) and included OZP0703, Yarrum, Parafield and Morgan. Kaspa was one of the most susceptible varieties evaluated.

These findings have significant implications to future selection and development of field pea varieties in southern Australia, particularly in areas known to be affected by bacterial blight.

References

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