The relationship between blackleg resistance and grain yield in Australia

T D Potter[1], J R Kay[1], I R Ludwig[1],
[1]SARDI, PO Box 618, Naracoorte, South Australia, 5271, Australia

potter.trent@saugov.sa.gov.au

ABSTRACT

In Australia, increased canola production has increased the inoculum loads of blackleg. Under these conditions, further clarification of the minimum threshold of resistance required to minimise yield loss under heavy blackleg infection is needed. The yield losses caused by blackleg were quantified using +/- fungicide for a series of lines with differing levels of blackleg resistance. In addition, the relationship between resistance rating and yield was evaluated in canola field trials.

Under heavy natural blackleg infection in 2000 many canola cultivars showed significant infection and yield loss due to blackleg. There was a good relationship between blackleg survival rating and grain yield. In fungicide trials conducted in 2000 and 2001, canola cultivars with blackleg survival ratings ranging from 2 to 9 were grown under heavy blackleg infection both with flutriafol amended fertiliser and also untreated. Grain yield and oil content were determined and response was related to blackleg survival rating. Cultivars with low levels of blackleg resistance showed up to a 50% yield increase when fungicide was used. Cultivars with resistance ratings of 7.5 and above showed no response to fungicide. Under severe blackleg pressure, it is recommended that farmers grow cultivars that have blackleg survival ratings of 7 and above to reduce the affect of blackleg on grain yield and oil content.

Key words: canola – blackleg – survival – yield – fungicide

INTRODUCTION

In Australia, breeding for blackleg resistance is a major focus of all breeding programs. Resistance of lines is rated on a 1-9 scale; a rating of 9 is allocated to the most resistant cultivar, with resistance of other cultivars scaled relative to this. Blackleg survival ratings (BSR) are derived from nurseries grown on stubble from a previous canola crop. Cultivars and lines are sown in rows with plant numbers being counted at emergence and at maturity to determine survival percentage. The blackleg inoculum load has increased significantly in recent years due to the major increase in area sown (Colton and Potter, 1999). Under these conditions, further clarification of the minimum threshold of resistance required to minimise yield loss under heavy blackleg infection is needed. The yield losses caused by blackleg were quantified using +/- fungicide for a series of lines with differing levels of blackleg resistance. In addition, the relationship between resistance rating and yield was evaluated in canola field trials.

MATERIALS AND METHODS

The relationship between blackleg resistance and yield was determined from two cultivar evaluation experiments undertaken at Riverton and Bordertown in 2000. At both sites, canola was sown at 5 kg/ha in three replicates. Plot size was 10 m by 8 rows at 18 cm row spacing at Riverton and 8 m by 8 rows at 15 cm row spacing at Bordertown. Plots were managed with appropriate agronomic inputs and were swathed prior to harvest. Grain yield was determined by mechanical harvest.

In 2000 and 2001, fungicide trials were established at Kybybolite and were sown into canola stubble from the previous year. Plot size and management was as above at Bordertown and four replicates were sown in a split plot design with cultivars as main plots and fungicide as sub plots. A range of canola cultivars that varied for BSR was used (Tables 1 and 2). The fungicide flutriafol was mixed with fertiliser and sown with the seed at 400 g a.i./ha. Plots that were untreated with fungicide only received the fertiliser. Grain yield was measured as above and oil content was determined by NIR.

RESULTS AND DISCUSSION

The sites at Riverton and Bordertown were both in the medium to high rainfall zone of South Australia. In 2000, Riverton and Bordertown received 392 and 310 mm rainfall between April and October respectively. At Riverton there was little evidence of stem canker while at Bordertown severe infection occurred with many plants of less resistant cultivars being cankered. Grain yield as a percentage of the highest yielding cultivar (percent maximum yield) at each site was plotted against BSR (Figure 1). Regression lines were % yield = 6.65 BSR+ 38.92, r^2 = 0.45 at Riverton and % yield = 13.19 BSR – 23.03, r^2 = 0.47at Bordertown. A good relationship between BSR and grain yield under severe blackleg pressure has been shown. All cultivars with BSR of less than 7.5 produced lower relative yields at Bordertown than at Riverton.

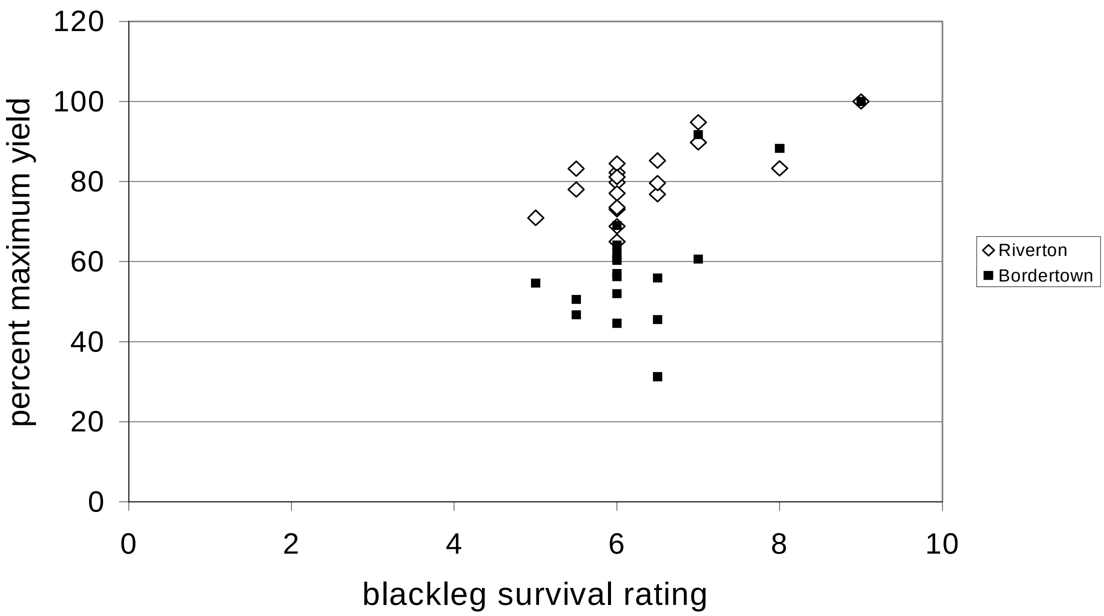

Fig.1. Blackleg survival rating and percent maximum yield for canola cultivars at Riverton and Bordertown in 2000

In fungicide trials conducted in 2000 and 2001, grain yield was affected by fungicide treatment with a significant interaction between cultivar and fungicide in both years. Cultivars with low BSR exhibited the greatest yield increase when fungicide was applied with no yield response for cultivars with blackleg ratings of 7.5 or higher (Tables 1 and 2).

Oil content was also affected by fungicide treatment, increasing from 39.6 to 40.2 in 2000 and from 41.3 to 41.7 in 2001 for the untreated and fungicide treatments respectively. While the interaction between fungicide and oil content was not significant it followed the same trend as fungicide and yield with cultivars with high BSR having little or no difference in oil content whether a fungicide was applied or not.

Table 1. Effect of flutriafol amended fertiliser on grain yield and oil content of canola cultivars with different blackleg survival ratings at Kybybolite, 2000.

Cultivar	BSR	Grain yield (kg/ha)		Oil content (%)	
		untreated	flutriafol	untreated	flutriafol
Q2	2.5	1197	1823*	39.94	40.85
Karoo	3.5	1192	1645*	36.37	37.00
Monty	4.5	1644	1715	39.32	39.65
Mystic	6.0	1709	2303*	40.17	41.91
Oscar	6.0	1909	2234	37.72	38.32
Dunkeld	6.0	1735	2311*	40.60	40.72
Grouse	6.5	1957	2314*	39.38	39.31
Surpass 400	9.0	2082	1978	43.43	43.44

* a significant increase in yield for the flutriafol treatment over the untreated for each cultivar (lsd=291)

Table 2. Effect of flutriafol amended fertiliser on grain yield and oil content of canola cultivars with different blackleg survival ratings at Kybybolite, 2001.

Cultivar	BSR	Grain yield (kg/ha)		Oil content (%)	
		untreated	flutriafol	untreated	flutriafol
Q2	2.5	1080	1661*	40.95	42.28
Karoo	3.5	1035	1418*	37.58	38.12
Monty	4.5	1653	2082*	39.78	41.35
Mystic	6.0	1815	2410*	41.05	42.62
Oscar	6.0	2615	2789	40.40	41.12
Dunkeld	6.0	2017	2785*	42.62	42.68
Rainbow	6.0	2232	2827*	41.40	43.35
Ripper	6.5	2362	2710*	43.35	43.08
Emblem	7.5	2744	2785	39.68	39.92
Surpass 603CL	8.5	2859	2739	42.55	42.55
Hyola 60	9.0	3043	2928	44.48	44.10

* a significant increase in yield for the flutriafol treatment over the untreated for each cultivar (lsd=363)

These responses to fungicide occurred under severe blackleg pressure as is found in a disease nursery but similar pressure also occurred in canola crops grown in wide rotations in 2000 in the South East of South Australia. Therefore, where high blackleg pressure is possible, it is recommended that farmers grow cultivars that have BSR of at least 7 to avoid significant yield and oil content loss due to blackleg. In the last two years seven new canola cultivars have been released that have a BSR of 7 or higher. However, cultivars also need to have a high genetic potential for yield as well as a high BSR.

REFERENCES

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