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Crop Updates 2005 Oilseeds

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OILSEED UPDATES, 2005

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Thank you to the Crop Updates 2005 team for their patience and understanding with me in my debut role as the oilseeds convenor. Special thanks to the help and mentoring from Vicki McAllister and also Nadine Eva, both of whom always made time to give me assistance when I needed it or to allay any unfounded fears that I had from time to time.

The last thanks I have goes out to all the farmers and associated agri-business who attend and contribute to these days, thereby helping agriculture in WA retain its reputation for innovation and quality.

Douglas Hamilton
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CANOLA WORKSHOP AT CROP UPDATES 2005

The Canola Workshop at the Crop Updates 2005 will present information on a range of agronomic issues in canola from the 2004 season. The workshop will discuss variety trials results and variety recommendations for the coming 2005 season.

Printed update information

Oilseeds WA will provide agronomic updates for the high, medium and low rainfall zones along with copies of recently released guides to canola growing for use by agronomists and growers.

Blackleg breaks down sylvestris resistance

In 2004 concern over a significantly lowered blackleg resistance by varieties with single dominant gene-based resistance derived from *Brassica rapa* ssp. *Sylvestris* was widespread. Because of the concern many growers swapped varieties for sowing in 2004.

During the 2004 growing season an increased, although by no means dramatic, rise in Blackleg canker in varieties with *sylvestris*-derived resistance in the medium to high rainfall districts this year, was reported. Oilseeds WA recommendation for 2005 is to sow varieties with strong polygenic resistance in medium to high Blackleg risk situations. David Sermon (ConsultAg) and Graham Walton (DAWA) will present information on newer varieties and Graham will discuss trials comparing IT and TT varieties.

Slugs, fungus and bugs

Neil Harris (Dovuro) will discuss the occurrence and impact of Sclerotinia, Slugs and other challenges in 2004. Lisa Blacklow (Bayer Crop Science) will present a report on the use of Jockey® & Gaucho® seed treatments for management of blackleg disease and insect pests in canola. This report was not available at the time of printing. .

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Comparison of IT and TT canola varieties in geographic zones of WA, 2003-04

Graham Walton and Hasan Zaheer, Department of Agriculture, Western Australia

KEY MESSAGES

- The top-ranked varieties comprise both Clearfield and triazine tolerant varieties in all zones.
- In the Southern region, Clearfield varieties yielded well, showing a good control of grass weeds that have been a threat to Clearfield canola production in this region during previous years.
- The Crop Update Paper 2003, showed that Clearfield and triazine tolerant varieties had similar gross margins, if they yield equally, the return from higher oil in the IT varieties countered the additional cost of its production.
- Consideration of the blackleg resistance ratings is important when choosing varieties.

AIMS

To assist WA canola growers in selecting the most appropriate variety for their situation, by providing comparisons of variety performance over a number of seasons and in a range of geographic locations.

METHOD

Triazine tolerant varieties and imidazolinone tolerant (IT) varieties were compared in the same trial using a split-block design, with the herbicide system as Main Block and the varieties as Sub-Blocks. The herbicide blocks had the same agronomic management, except for the application of either Atrazine (early post-seeding) or On-Duty® (post-seeding). The plots were 6, 7 or 8 rows and 17 or 18 m in length. The canola varieties were sown at 6 kg/ha. The results summarise 12 trials in 2003 and 9 trials in 2004.

The statistical comparison of the relative yield (as a percentage of Surpass 501TT yield - the dominant variety in WA) results provide a Least Significant Difference (LSD) required between yield of Surpass 501TT and individual varieties to have 95% confidence that the difference in relative yields is true and acceptable.

RESULTS

Northern zone

(Mingenew, Badgingarra, Eradu and Wongan Hills sites)

The varieties 44C73, 46C76, ATR-Stubby and Tribune were all more than 10% higher yielding than Surpass 501TT.

The varieties ATR-Stubby and Tornado TT are alternatives to Surpass 603CL and Surpass 501TT.

Eastern low rainfall zone

(Yuna, Cadoux, Merredin, Doodlakine, Lake O'Connor and Ravensthorpe sites)

The early maturing varieties (refer to Table 2) 44C73, ATR-Stubby and Tranby were more than 25% higher yielding than Surpass 501TT. In one trial Tribune and in three trials Trilogy and Trigold gave significantly higher yields than Surpass 501TT.

The varieties Trilogy, Trigold, Tranby and ATR-Stubby are suitable varieties for these regions.

Table 1. Comparison of average seed yield of IT and TT canola varieties expressed as a percentage of seed yield of Surpass 501TT in four zones of WA in 2003-04

Variety	North	East (Low RF)	South	South coast
44C73	118*	140*	97	114
45C75	101	90	92	114
46C76	111	107	106	125*
Surps603CL	104	112	112*	135*
ATR-Beacon	102	89	93	100
ATR-Eyre	98	113	83*	90
ATR-Hyden	105	105	96	99
Pinnacle	85	83	81*	98
Surps501TT	100	100	100	100
ATR-Stubby	114	126*	102	121*
TornadoTT	107	110	106	111
Tranby	94	131*	91	108
Tribune	116	119	112*	143*
Trigold	78*	146*	104	132*
Trilogy	78*	137*	69*	138*
AGT346	81*	144*	95	138*
No. trials	5	7	6	2
Date sown (range)	9-20 May	9-26 May	19-31 May	13-20 May
Surpass 501TT mean yield, kg/ha	1688	989	1645	1912

Values with an asterisk (*) indicate the varieties with relative mean yield values significantly (LSD 5%) above or below the Surpass 501TT yield.

Values in bold *italics*, indicate results from one trial only.

Values in bold only, indicate results from two trials only.

Values in *italics only*, indicate results from three trials only.

Shaded value indicates results from four trials only.

Southern zone

(Williams, Katanning and Mount Barker sites)

The varieties Tribune, 44C73, 45C75, 46C76 and Surpass 603CL gave yields higher than Surpass 501TT. In one or two trials ATR-Stubby, TornadoTT and Tranby significantly outyielded Surpass 501TT.

The varieties ATR-Hyden and TornadoTT are alternatives to Surpass 501TT. The varieties 45C75 and 46C76 are alternatives to Surpass 603CL. It is important for blackleg ratings for varieties to be considered as the risk of blackleg disease can be high in the great Southern region.

South coastal region

(Esperance Downs Research Station)

The varieties ATR-Beacon, ATR-Hyden and Pinnacle yielded equal to Surpass 501TT while all other IT and TT varieties significantly outyielded Surpass 501TT, gave yields at least 8% higher than that Surpass 501TT yield.

The varieties 46C76, ATR-Stubby, Trilogy, ATR-Hyden and TI1-Pinnacle are alternatives to Surpass 603CL and Surpass 501TT. It is important for blackleg ratings for varieties to be considered as the risk of blackleg disease can be high on the sandplain soils of Esperance.

Table 2. Approximate characteristics of the canola varieties in WA

Variety	Flowering Nth, Sth d.a.s.	Rel. develop- ment score	Height cm	WA Blackleg resistance rating	National Blackleg survival rating	Oil content ¹	Protein content ²	1000 seed wt g
44C73	86, 104	6.8	110	4	5	7	2	3.61
45C75	85, 100	6.4	115	5	6	6	5	3.40
46C76	87, 106	6.3	110	4P*	7	5	3	
Surpass404CL	77, 100	7.1	105	7	8.5	8	6	3.50
Surpass603CL	86, 105	6.7	125	8+	9	8	5	3.85
ATR-Beacon	85, 100	6.5	105	6	6	5	7	3.24
ATR-Eyre	80, 98	6.8	110	3	4.5	7	5	3.14
ATR-Grace	90, 108	5.8	114	6	6.5	6	5	3.26
ATR-Hyden	85, 106	6.2	110	6	6.5	5	7	3.57
ATR-Stubby	76, 100	7.0	100	4P*	6.5	5	7	3.74
Pinnacle	90, 108	5.8	105	5	5	5	7	3.24
Surpass501TT	84, 100	6.5	120	8+	8.5	8	6	3.70
TornadoTT	82, 102	6.8	105	7P*	7.5	6	6	
Tranby	78, 100	7.3	85	3	4.5	7	7	3.80
Karoo	73, 90	7.0	114	3	3.5	4	5	
Trigold	77, 95	7.4	100	3P*	4P*			
Trilogy	76, 82	7.5	85	5P*	7P*			
Tribune	78, 96	7.3	100	8+P*	8+P*			

d.a.s.: Days after seeding.

Development Score observed in October: 1 (germination) - 9 (mature).

Blackleg Resistance rating: 0-2 (highly susceptible – 8* (highly resistant); * varieties with less than 2 years or 4 sites data have a provisional (P) rating.

¹ Oil content on a 1 (low) – 9 (high) scale, for 2002 and 2003 trials.

² Protein content of seed on a 1 (low) – 9 (high) scale, for 2002 and 2003 trials.

CONCLUSIONS

Highest yielding varieties in all zones come from both IT and TT systems. New varieties have performed well over the last two years.

The choice of variety for high oil, yield and blackleg resistance is crucial. Especially with the concern about the ability of varieties which have the single dominant gene for resistance, e.g. Surpass 501TT and Surpass 603CL, etc. (refer to Farmnote No. 12/2004, 'WA blackleg resistance ratings on canola varieties for 2004', R. Khangura, G. Walton and M. Barbetti.), to maintain resistance to blackleg.

ACKNOWLEDGEMENTS

Rod Hunter, for the crop variety testing results and the Department of Agriculture Research Units for conducting the trials.

GRDC Project No.: CVT and DAW 714

Paper reviewed by: J. Garlinge

Farmer scale canola variety trials in WA, 2004

Graham Walton, John Duff, Neil Harris and Heather Cosgriff, Oilseeds WA

KEY MESSAGES

- Canola yields were above the State average in the five trials in 2004, however, there was no substantial yield difference among the varieties tested in this limited data set.
- Over three years of testing, average yield of all varieties, except Tribune, showed similar yield responses to increasing mean site yields (environment).
- Tribune was the only variety to vary its yield response to different environments (high yield in low-yielding sites and low yield in the high-yielding site).

AIMS

To evaluate yield performance of commercial varieties of canola, by conducting farm-scale trials (using 90–200 m x 10–15 m plots) in the agricultural areas of WA.

METHOD

In 2004, Oilseeds WA conducted eight canola variety trials in the WA wheatbelt with and without fungicide (Jockey) treatment. Each variety was replicated in two plots in 5 trials, but was un-replicated in three trials. At all sites crops were managed following district agronomic practices for TT/IT/conventional canola production. Using conventional farm machinery, five successful trials were harvested by farmers and seed yield was determined using a weigh trailer. Seed samples were analysed by 'Infratech' for percent oil and protein content and moisture.

In order to provide a valid (statistical) comparison of variety performance at different locations, yield of each variety was regressed against mean yield of each site (average yield of all varieties) in trials conducted during 2002, 2003 and 2004. This comparison shows yield response trend of each variety to changing environments (Finlay and Wilkinson, *AJAR*, **14**: 1963).

RESULTS

2004 trials

There were only small differences between seed yields of canola varieties in the five trials harvested (Table 1). In this low rainfall season, the early maturing varieties ATR-Stubby and Trigold yielded well and Tribune at the Tunney site. Surpass 501TT consistently had high oil per cent at all sites, with Tribune, Trigold, ATR-Stubby, AV-Sapphire and AV-Spectrum at individual sites. The application of fungicide seed dressing (Jockey) gave a 12% increase in ATR-Stubby yield at Mingenew site and a 24% yield increase in Surpass 501TT at Wittenoom Hills. At other sites fungicide seed dressing had no effect on, or depressed, yield.

2002-2004 trials

The Figure 1 shows that yields of canola varieties are similar to the site yield. For a site yield of 1 t/ha, eight varieties yielded between 0.6 and 1.4 t/ha, while at a site yielding 2 t/ha, the yield of varieties ranged between 1.9 and 2.2 t/ha.

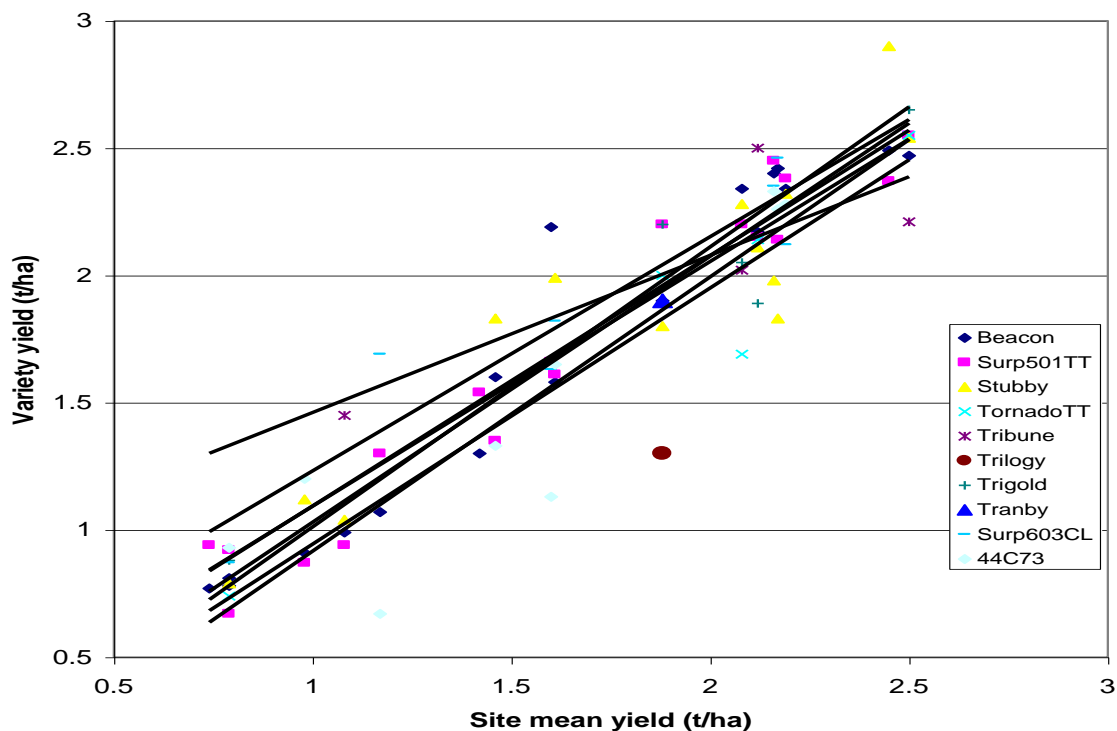


Figure 1. Regression of average yield of variety against average yield at each site.

CONCLUSION

Favourable climatic and edaphic conditions which promoted above average yield production in these trials and some expected spatial variations within farm-scale plots seems to be the factors which masked yield differences in a range of canola varieties tested in this study. Yield responses of the new canola variety Tribune to low and high yielding environments indicate that this variety is produced to cope with conditions in lower rainfall, lower yielding environments. In areas where it is likely that the conditions will favour blackleg disease infection, application of a fungicide is useful to assure a reasonable crop production.

KEY WORDS

canola, farm-scale, fungicide, variety, yield

ACKNOWLEDGEMENTS

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In addition, Grain Pool WA, Dovuro, Pacific Seeds, Canola Breeders WA, Pioneer Seeds and Plant Tech made significant inputs to the program.

Project No.: Grains Research and Development Corporation, CAA 00003

Paper reviewed by: Hasan Zaheer

Table 1. Average yield (t/ha) and oil% for farmer cooperative canola variety trials in 2004

Variety	Mingenew	Williams	Oil%	Boyup Brook	Oil%	Tunney	Oil%	Wittenoom Hills	Oil%
ATR-Beacon	1.9	2.5	45.1	2.3	43.3	2.2	41.2	0.8	39.0
Surpass 501TT	2.2	2.5	45.7	2.2	43.8	2.1	46.1	0.7	43.7
Surpass 501TT+ Jockey	1.9							0.8	44.1
ATR-Stubby	1.8	2.5	43.1	2.3	41.6	2.0	42.7	0.8	41.2
ATR-Stubby+ Jockey	1.9	2.5	46.6	1.9	42.6			0.8	40.6
ATR-Stubby+ Jockey + Gaucho	2.3		44.2	1.9	43.0			0.8	38.4
ATR-Stubby+ Jockey + Cosmos	2.7		43.9	2.1	42.9			0.8	38.4
ATR-Stubby + KSX 18,25	1.8								
Tornado TT	2.0	2.5	44.7	1.7	41.5	2.1	43.7	0.7	40.0
Tornado TT + Jockey	2.0								
Tribune		2.2	45.7	2.0	45.0	2.5	42.4		
Trilogy	1.3								
Trigold	2.2	2.6	44.4	2.0	44.0	1.9	42.8	0.9	39.8
Tranby	1.9					2.3			
Surpass 603CL								0.9	43.8
44C73								0.9	40.9
Rainbow						2.0	42.8		
AV-Sapphire						2.1	45.5		
AV-Spectrum						2.4	44.6		
Hyola 61						1.9	43.5		
Hyola 43						2.1	47.2		
Site mean	1.9	2.5		2.1		2.1		0.8	

Oil% calculated at 6.0% seed moisture.

Oilseed crops for industrial uses

Margaret C. Campbell, Centre for Legumes in Mediterranean Agriculture (CLIMA)
Graham Walton, Department of Agriculture, Western Australia (DAWA)

KEY MESSAGE

Oilseeds have the potential to be renewable, sustainable sources of oil for fuel, heat or energy and for industrial uses such as for lubricants, to produce erucamides (often used as a slip agent in plastics), in the manufacture of nylons and polymers, in printing inks and for many other uses. Oilseed crops are also a source of high protein meal that could be used as livestock feed, in biodegradable bioplastics, adhesives, cosmetics, lawn care and fertiliser products. The agronomic performance of a number of different oilseed species to WA growing conditions has and is being measured. These species include *Brassica juncea* (Indian and Oriental Mustards), *Brassica carinata* (Ethiopian mustard), *Brassica rapa ssp campestris* (Turnip Rape), *Crambe abyssinica* (Crambe or Abyssinian mustard), *Camelina sativa* (false flax, Gold of Pleasure) and *Linum usitatissimum* (Linseed).

BACKGROUND

Australia is seriously dependent on fossil fuels. Mineral oil, mostly in the form of petroleum, diesel, pesticides and fertilisers, is currently essential for agriculture and in those and other forms, e.g. synthetics and plastics, for most aspects of community life and economic systems. Australia is dependent on a resource that is non renewable and depleting. Potentially, there are various sources of energy available, some renewable some not, e.g. wind, solar, nuclear, coal, gas and plants. It is doubtful if there is one single renewable source that can replace all that is derived from mineral oils. It will need to be a combination of alternative resources that could impact significantly on fossil fuels. Oilseed crops, both annual and perennial, could provide alternative resources that would help reduce the Australian dependence on mineral oil.

Over the past few years, in projects funded by RIRDC and GRDC, conducted by CLIMA and DAWA and with the support of Elders and the Grain Pool, a number of alternative annual oilseeds have been evaluated for their suitability to Western Australian growing conditions. Those species particularly suited for specialised industrial applications include those with oils that have a high content of erucic acid such as crambe, and those with fast drying characteristics such as linseed oil. Increasing the diversity of crops that may be profitably grown in WA could also have additional benefits in rotations, as disease breaks and in the reduced use of chemicals.

METHODS

During May 2004 several trial sites were established, some in farmers paddocks, others on research stations and one on the WANTFA demonstration site at Meckering. Trial plots on the research stations and the WANTFA site were seeded using a cone seeder at varying seed rates depending on the species. Various lines of canola (*Brassica napus*) were used as controls in the trials. Plots were harvested as soon after maturity as was possible using a conventional plot harvester. Seed for each species was collected, cleaned by sieving, weighed to determine yield and then analysed using NMR and gas chromatography for oil content and quality. The seed yields are given, plus the oil content and quality. The mean yields of the various species calculated from 11 trials grown over the past 5 years are given as a comparison. Additionally, some larger areas of mustard (*Brassica juncea*) were put in by DAWA for a biodiesel demonstration trial. These included 40 hectares at Wongan Hills and 30 hectares at Newdegate,

Seed of various alternative oilseeds lines from 2003 trials was analysed for oil, glucosinolates and protein contents. The erucic acid contents were determined using gas chromatography.

RESULTS AND DISCUSSION

The average harvest yields for the species grown during 2004 in most of the locations are shown in Table 1. The sowing rates are quoted in kg/ha and the cleaned seed yields are in tonnes/ha. The seed yield of the 2 bulk areas were 50 tonnes for Wongan Hills (1.25 tonnes/ha) and 15 tonnes at Newdegate (0.5 tonnes/ha). However, canola grown at Newdegate yielded only 0.2 tonnes/ha.

Table 1. Comparison of seed yield for a range of oilseed species

Species	Sowing rate	Meckering	Avondale	Merredin	Mullewa	Albany	Mean*
<i>Brassica napus</i>	5	1.04		0.56	0.14	1.8	1.33
<i>Brassica rapa</i>	5	0.71					0.77
<i>Brassica carinata</i>	5	1.22	0.73	0.16	0.16	1.15	1.52
<i>Brassica juncea</i>	5	1.23	0.74	0.39	0.25	1.58	1.8
<i>Camelina sativa</i>	4	0.2					0.95
<i>Crambe abyssinica</i> **	15	0.98	0.96	0.27	0.08	1.7	1.49
<i>Linum usitatissimum</i>	40	0.61					1.05

* The average yields of the different species grown in trials between 1999 and 2003.

** The seed of *Crambe abyssinica* retains its fruit coat intact during and after harvesting, i.e. seed is unhulled.

In many cases, the mustards have yielded more than canola. However, lack of options for weed control has contributed to the reduced yields for the alternative oilseeds in some trials. The species generally would have a place in the rotations with canola due to better resistance to root diseases. They also provide the opportunity for oilseed production in environments in which Canola often performs poorly, e.g. *Linum usitatissimum* is adapted to wet soils, *Camelina sativa* to sandy soils and *Brassica juncea* for more marginal areas, which could significantly out yield canola in such situations.

Table 2. Comparison of the glucosinolate, oil, erucic acid and protein contents of some of the alternative oilseeds

Species	Line	Site	Oil %	% Protein	Glucosin (umol/g)	%Erucic acid
<i>Brassica napus</i>	Beacon	New Norcia	47.1	21.2	46	0.4
<i>Brassica juncea</i>	Original	New Norcia	48.0	22.2	106	11.7
<i>Brassica juncea</i>	Sel 21	Medina	42.9	25.9	152	16.4
<i>Brassica juncea</i>	Sel 8	Field Station	46.8	20.9	96	0.9
<i>Brassica juncea</i>	4355	Field Station	44.0	23.1	104	47.1
<i>Brassica carinata</i>	94024.2	New Norcia	43.8	21.9	84	44.5
<i>Brassica carinata</i>	195923 5 2	New Norcia	44.0	22.4	98	49.6
<i>Brassica carinata</i>	193467 7.1	New Norcia	44.4	21.5	97	42.4
<i>Camelina sativa</i>	4164	Jennapulin	41.9	28.3	104	3.7
<i>Camelina sativa</i>	4183	Popany/ing	42.8	26.9	106	3.2
<i>Crambe abyssinica</i>	94053	New Norcia	53.6	8.6	166	60.0
<i>Crambe abyssinica</i>	32855	New Norcia	52.6	9.0	131	58.7
<i>Sinapis alba</i>	94488	New Norcia	39.0	25.7	124	54.3
<i>Sinapis alba</i>	92880	New Norcia	41.6	24.6	113	37.6
<i>Brassica rapa</i>	91182	Field Station	45.3	23.0	102	44.2
<i>Brassica rapa</i>	Pusa Kalyana	New Norcia	45.0	21.9	108	39.3

Crambe seed was shown to have the highest oil content of all the species but is only about 30% if the harvested unit, the fruit is analysed. Crambe oil had the highest content of erucic acid, making it very valuable as an industrial oil. The mustards generally, had high oil content and as they can often yield better than canola, it gives them economic potential as a feedstock for biodiesel. However, the higher content of glucosinolates found in the mustard seed would currently reduce the use and therefore the value of the meal despite the reasonable protein content.

CONCLUSIONS

The oilseeds that would be grown for energy must consistently produce a nett profit of energy. Crops that are high yielding, have seed with high oil content but have reduced inputs are needed. Amongst the alternative oilseeds there are species with the potential to be grown for fuel. Other species have greater value in specialised industrial applications.

KEY WORDS

oilseeds, energy, industrial uses, erucamides, biodiesel

RIRDC Project No.: UWA 47a

Paper reviewed by: Prof. Clive Francis

Weed control opportunities with GM canola

Bill Crabtree, Independent Consultant, Northam; bill.crabtree@wn.com.au

KEY MESSAGES

Australia's agricultural profitability and sustainability is being threatened by weeds proliferating and becoming resistant to many different herbicide groups. Annual ryegrass (*Lolium rigidum*) is a particularly severe problem in Western Australia. Farmers are increasingly growing wheat on wheat as part of their rotation and are consequently increasing the amount of stubble burning for slight improvements in trifluralin efficacy on ryegrass. GM canola would greatly improve our ability to control weeds, maintain stubble as a carbon sink and protect our soil from wind and water erosion.

With less pastures in their rotations, inconsistent returns from pulse crops, high levels of resistance to grass selective herbicides, and with canola being a risky and expensive crop to grow, farmers are increasingly vulnerable to weeds. This puts our farmers in a similar position to Canadian farmers 10 years ago with wild oat, kochia and green foxtail resistance, before the advent of GM technology.

GM canola has largely been responsible for sustained clean crop rotations in Canada. Canada now boasts 77% of their canola crop being GM. This does not include another 18% of IMI canola which is produced by mutagenesis (arguably GM) and they have no TT canola. This leaves only about 5% of their canola being not herbicide tolerant. Western Australian farmers have to mostly (90%) rely on the ground water-polluting herbicide Atrazine which is somehow supposed to maintain our 'clean and green' image. Anti-GM activists have the ear of politicians with shallow logic and this is hurting us.

AIMS

To discuss how Canadian farmers have successfully embraced GM canola with profound weed control benefits and to show how Western Australian farmers are being denied this powerful new tool to fight herbicide resistant weeds which is affecting our agricultural competitive ability.

METHOD

To share some experiences of weed control in Canada with GM canola, discuss some principles of herbicide resistance that are relevant to our Western Australian experience and discuss the political impasse we currently have with GM canola in Western Australia.

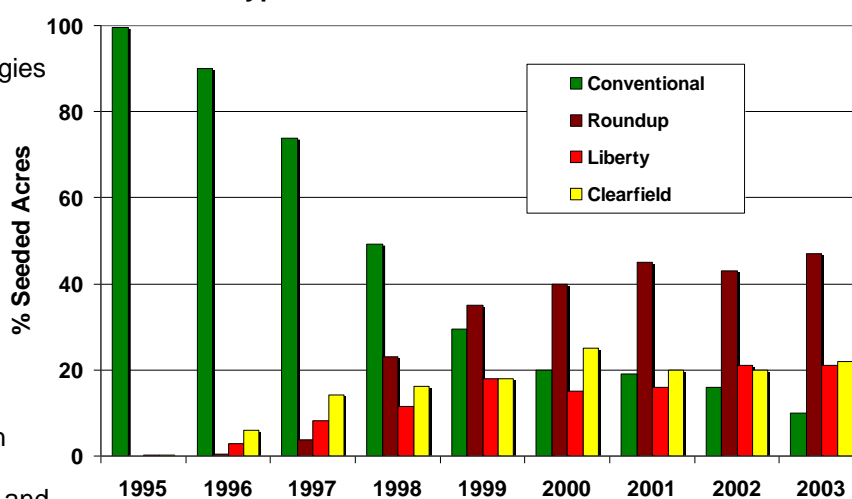
RESULTS

The Canadian weed experience with GM canola

Canadian farmers have almost universally embraced GM canola. It has been one of the most rapidly adopted technologies ever by farmers. This is confirmed to me by my almost weekly e-mails with Canadian scientists or farmers and from my visit to Canada in August 2004 with 44 Australian farmers and scientists.

Canadians are enjoying good weed control, good herbicide resistance management, much less herbicide use, less costs, better crop yields, more return and more profit from the adoption of GM canola. This is shown in a report to the Canadian Canola Council in 2000, and is found on GRDC's website (www.grdc.com.au/growers/gc/gc41/canada.htm).

Canola Types as % of Sown Canola Acres in Canada



Australian weed issues and GM canola

Some people believe that if we introduce RR canola then this will bring on glyphosate resistance more rapidly. While this is a valid argument, other truths also exist with this issue and they need to be discussed in full when considering GM canola and weed management. These issues include:

- Liberty (glufosinate ammonia) is effectively a new knockdown herbicide and mode of action.
- SpraySeed before sowing GM canola, when possible, would become a compelling argument.
- Applying glyphosate in-crop is a useful resistance diversity tool, as Canadians have observed.
- The option exists to use SpraySeed between wide rows and Roundup or Liberty for furrow weeds.
- Resistance is a numbers game and we need to use all knockdown herbicides and rotate them.
- Good weed control is more likely with knockdowns in drought years – less reliant on soil moisture.
- More weed competitive crops, earlier time of sowing and having hybrids with higher yields.
- The option to rest 'fop' and 'dim' herbicides would be an option, yet they still could be used.
- The ability to sow on the first rain and not have to wait for a weed germination is advantageous.
- More flexibility with dry starts to the season – farmers would not be committed to a triazine crop.
- Resistance to triazines is likely – being used in canola, lupins, beans, barley and Eagle Rock wheat.
- The resistance load that trifluralin is carrying for ryegrass control is huge and not sustainable.
- Good grass weed control requires at least two broadleaf crops to be grown in succession.
- The ability to grow two consecutive broadleaf crops – currently triazine restrictions limit this.

These issues with GM canola and higher yields would make growing canola in dry regions, or in drought years, a sensible risk for farmers to take. Independent WA canola trial data, as reported in the 2004 Crop Updates, show a 15-20% yield increase for GM canola. GM canola would enable farmers to make more profit and better managing herbicide resistant ryegrass with a new knockdown.

Monsanto currently plans to use an 'end point royalty' scheme to re-coup their investment and plan not to collect fees if the crop fails. Note also that the ACCC does not allow Monsanto to link Roundup sales to their Roundup Ready (RR) crop (nor in Canada). By rejecting GM canola in 2004 it is estimated that WA lost \$170 million, www.no-till.com.au/publications/pressrelease.html.

The problem is political

There appears to be no desire for politicians, senior public servants and agro-politicians to honestly talk of the real benefits and small risks of the GM canola technology. These people have been hiding behind the fears of activists who say that markets are rejecting GM canola – this is not true! Data from ABARE show that Australian non-GM canola receives the same price as Canadian GM canola.

It is clear that canola profitability in Australia is lagging behind our, only serious, canola export competitor (Canada) both in terms of production and efficiency. The State governments are listening to and effectively perpetuating erroneous market comments. This is perplexing given the profoundly rapid adoption of Canadian GM canola and the ease with which they market their canola into mostly the same markets as us. Politicians need to support their farmers in their pursuit of sustainability.

CONCLUSIONS

There is a \$170 million opportunity for WA farmers to embrace GM canola as a profound weed management and profit making tool. There needs to be a general farmer uprising of discontent to change the political will and resist the fear campaign waged by the anti-GM activists.

KEY WORDS

GM crops, canola, weed control, grain yields, politics

ACKNOWLEDGMENTS

Scott Day (Manitoba, Canada) for his generous knowledge sharing of canola production in Canada, Dr Neil Harker (Alberta, Canada) for supplying data, to the many other Canadians who have shared freely their GM experiences. To the growing number of Australians who have been to Canada and have shared candidly what they have seen, in the face of anti-GM activists.

Project No.: WAN3

Paper reviewed by: Todd Andrews, NSW DPI, former Weeds Specialist, Manitoba Agric., Canada

Soil and tissue tests for the sulfur requirements of canola

R.F. Brennan and M.D.A. Bolland, Department of Agriculture; Albany and Bunbury

KEY MESSAGES

The critical KCI-40 soil test S value (mg/kg) was 6.3 for the top 10 cm, decreased to 5.0 for the 10-20 cm soil depth, and was 6.9 for the 20-30 cm zone. For the top 10 cm of soil, no increases in canola grain yields to applied S were obtained for values > 7 mg S/kg soil even if soil test S below 10 cm was < 7 mg/kg. At about 90 DAS shoot yield responses to applied S occurred in about 70% of the harvests when soil test S was < 7 mg/kg in the top 10 cm of soil regardless of the soil test values below 10 cm. By contrast, when roots accessed adequate S deeper in soil, grain yield responses to applied S only occurred for about 30% of harvests and only when soil test S was < 7 mg/kg to 30 cm depth. The standard soil test procedure (top 10 cm soil) therefore mostly overestimated the likelihood of S deficiency in soil for canola grain production.

Critical diagnostic S values for dried shoots at about 90 DAS was 3.8 g/kg. Tissue test values for dried shoots at 90 DAS poorly predicted S deficiency for grain production (prognostic test) because in most cases the roots of S deficient plants at 90 DAS subsequently accessed adequate S deeper in soil for grain production.

Applications of fertiliser S mostly had no effect on concentrations of oil in canola grain.

AIMS

Fertiliser S is often applied to canola crops showing S deficiency symptoms. A soil and tissue test study was undertaken to determine critical soil and tissue test values to indicate when S deficiency for canola grain production is likely.

METHODS

The 57 sites chosen for the experiments had a wide range in soil S status in the top 30 cm of soil. Narenda was the main cultivar sown up to 1995. Thereafter TT canola cultivars, Karoo in 1996-1997, Pinnacle in 1998-2001 and Surpass 501 in 2001-2003, were used. In all experiments 4-5 kg/ha of seed of each cultivar was sown about 2 cm deep.

The KCI-40 soil test procedure was used and grouped into classes. These were: (i) High S (arbitrary chosen as high = 10 mg S/kg) and S values increasing down to 30 cm; (ii) Low S (low < 10 mg S/kg) and S values uniform down to 30 cm; (iii) Low S (low < 10 mg S/kg) and S values increasing down to 30 cm; (iv) Low S (low < 10 mg S/kg) and S values decreasing down to 30 cm; and (v) Low S (low < 10 mg S/kg) and grain yield from sites < 1000 kg/ha.

Yields are expressed relative to the maximum yield responses of canola to applications of fertiliser S.

RESULTS AND DISCUSSION

Relating grain yield response to soil test S values

When the relative grain yields were related to soil test S values, about 22% of the variation was accounted for in the top 10 cm, compared with 32% for the 10-20 cm soil profile and 52% for the 20-30 cm soil profile (Figure 1).

Concentrations of S in dried shoot

Applications of S increased concentrations of S in canola dried shoots. The critical S (10% relative yield response) was about 3.8 g S/kg for shoots collected at 90 DAS (Figure 2). At maturity there were far fewer plant yield responses to applied S than at 90 DAS, suggesting that yield responses to applied S decreased as roots grow deeper and accessed adequate S in the subsoil for grain production.

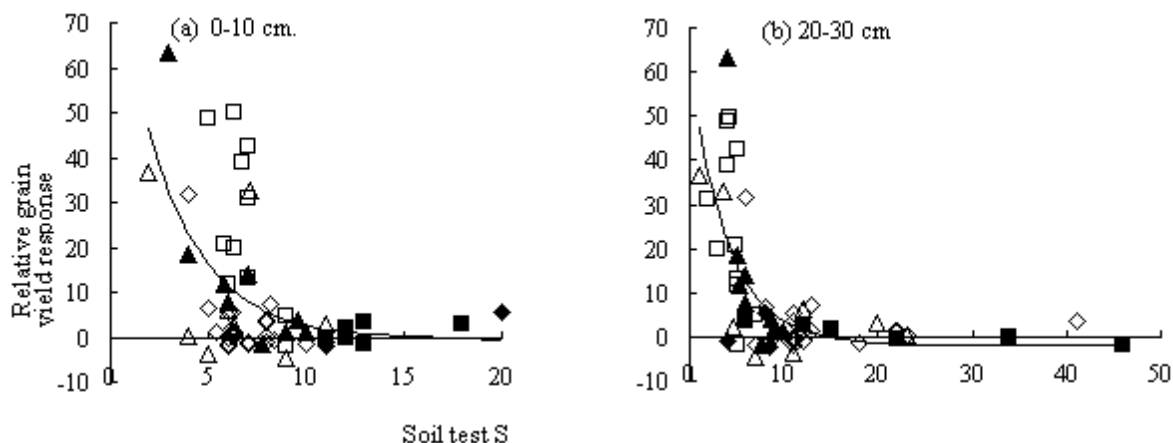


Figure 1. Relationship between relative grain yield response of canola, (a) KCI-40 soil test S in the top 10 cm of soil for all 57 experiments, and (b) KCI-40 soil test S in the 20-30 cm of soil depth for all 57 experiments. Symbols for soil classes; (♦) high and decreasing, (■) high and increasing, (▲) low and uniform, (◇) low and increasing, (□) low and decreasing, and (Δ) low with poor grain yields.

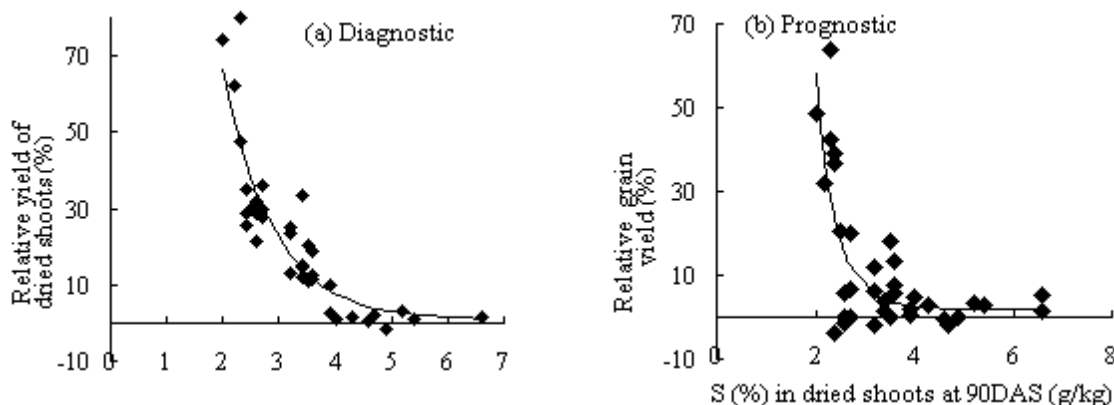


Figure 2. Relationship for 36 experiments between S concentration in dried canola shoots at 90 DAS and (a) relative DM yield response of dried shoots at 90 DAS (diagnostic tissue test) and (b) relative grain yield response (prognostic tissue test). Fitted Mitscherlich equations were for (a) $y = -0.61 + 622.6 \exp(-1.13x)$, $R^2 = 0.77$; and (b) $y = 1.97 + 6721.8 \exp(-2.39x)$, $R^2 = 0.58$.

Effect of S on oil concentration

The application of S fertiliser increased the per cent oil in two experiments. Otherwise, S had no significant effect on per cent oil.

GENERAL DISCUSSION

The soil test calibration relating grain yield response to soil test S values still had substantial variability. Each data point in Figure 1a is for that site in that year, so was unique in terms of soil type and properties, climate, environment, canola growth rates, and management of the experiment. Each of these many factors, or various combinations and interactions of the factors, may have influenced the calibration relating canola yield response and soil test S values for the various sites.

KEYWORDS

critical S, Soil test S, per cent oil.

ACKNOWLEDGMENTS

Technical Staff (R. Lunt, F. O'Donnell and T. Hilder) and Research Station staff.

Project funded by: GRDC (DAW0075)

Tests to predict the potassium requirements of canola

R.F. Brennan and M.D.A. Bolland, Department of Agriculture; Albany and Bunbury

KEY MESSAGES

Significant increases in yields of dried shoots and grain to fertiliser K were obtained in 25% of the experiments. When percentage of the maximum (relative) grain yield responses were related to Colwell soil test K for the top 10 cm of soil about 50% of the variation was accounted for. At 75% of sites no increases in grain yields to applied K were obtained for Colwell K > 44 mg K/kg soil in the top 10 cm regardless of the soil test values below 10 cm. There was a grain yield increase to applied K at 9 sites when Colwell K was < 44 mg/kg to 30 cm. However, at 6 sites there was no grain yield response to applied K even though soil test K was < 44 mg/kg in the top 10 cm of soil because soil test K was > 44 mg/kg below 10 cm suggesting K was accessed by plant roots from the subsoil for shoot and grain production. The concentration of K in dried shoots that was related to 10% grain yield response (critical prognostic K value) was about 45 g K/kg at 7 weeks after seeding (WAS), 38 g K/kg at 10 WAS, 27 g K/kg at 13 WAS, and 20 g K/kg at 18 WAS. Application of fertiliser K had no effect on either per cent oil or K concentrations in grain.

INTRODUCTION

Most soils in WA originally had adequate K for crop production. However, due to removal of K in hay and grain, many sandy soils are now K deficient for grain production of cereals. The K requirement of canola is unknown. This study determined critical soil and tissue test values for K for canola grain production.

METHOD

The 57 sites chosen for the field experiments were selected to include a wide range in soil K status in the top 30 cm of soil. Yields are expressed relative to the maximum yield obtained from application of K fertiliser.

RESULTS AND DISCUSSION

Relating grain yield response to soil test K values

When relative grain responses of canola were related to Colwell soil test K values measured in the top 10 cm of soil, about 50 per cent of the variation was accounted for (Figure 1). A similar variation was accounted for in the 20-30 cm profile depths.

Concentrations of K in dried shoots

Diagnostic and prognostic K levels decreased as the growing season progressed. Consequently, the concentration of K that was related to 10% of the relative yield response (critical prognostic K) was 44 g K/kg for shoots at 7WAS, 38 g K/kg for samples collected at 10WAS, and 27 g K/kg for samples collected 12WAS (Figure 2).

Effect of K on oil concentration in canola grain

Oil concentrations were measured in 46 of the 57 experiments. Applications of K had no significant effect ($P < 0.005$) on the per cent oil in grain, except 2 sites. At 1 site K increased the per cent oil by about 3.3%. At the other site K decreased the per cent oil by about 2.3%.

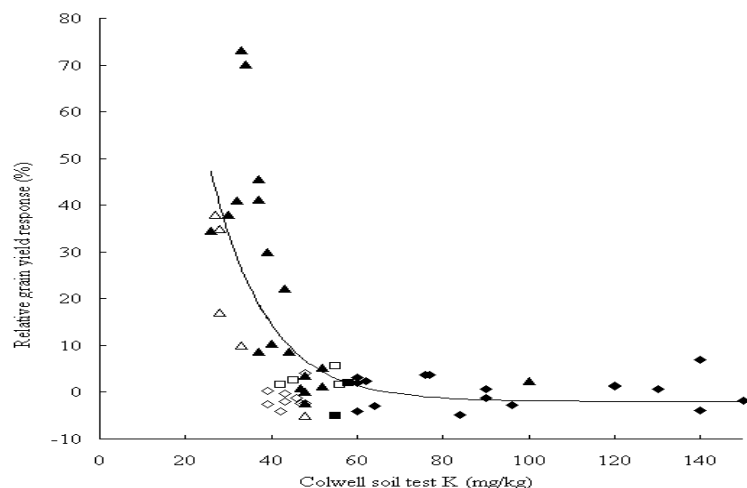


Figure 1. Relationship between relative canola grain yield and Colwell soil test K values for top 10 cm of soil. Data are for all 57 experiments. Fitted relationship for $y = -2.0 + 381.1\exp(-0.08x)$, $R^2 = 0.50$. Symbols for soil classes; (◆) high and decreasing, (■) high and increasing, (▲) low and uniform, (◇) low and increasing, (□) low and decreasing, and (△) low with poor grain yields.

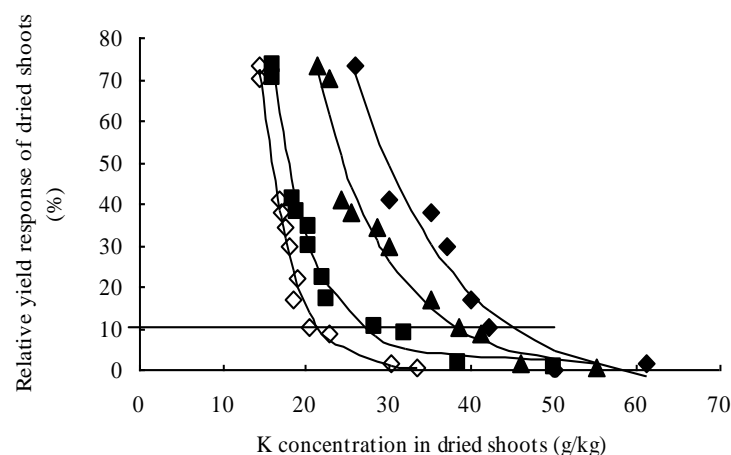


Figure 2. Relationship for 36 experiments between K concentrations in dried canola shoots at 7WAS, 10WAS and 13WAS and relative grain yield response (prognostic tissue test). Symbols (◆) 7WAS, (▲) 10WAS and (■) 10WAS and grain (◇) 13WAS. Fitted Mitscherlich equations were for (7WAS, ◆) $y = -5.0 + 676.5\exp(-0.08x)$, $R^2 = 0.95$; (10WAS, ▲) $y = 0.36 + 904.6\exp(-0.11x)$, $R^2 = 0.96$; and (13WAS, ■) $y = 2.73 + 1856.9\exp(-0.21x)$, $R^2 = 0.99$.

KEYWORDS

critical S, Soil test S, per cent oil

ACKNOWLEDGMENTS

Technical Staff (R. Lunt, F. O'Donnell, and T. Hilder) and Research Station staff.

GRDC funded (DAW 0075)

Paper reviewed by: Graham Walton

Genotypic variation in potassium efficiency of canola

P.M. Damon and Z. Rengel, Faculty of Natural and Agricultural Sciences, UWA, Crawley WA

KEY MESSAGES

There are significant differences among canola varieties in their ability to take up and utilise K during early shoot growth. Varieties efficient and inefficient for the uptake and utilisation of soil K have been identified. This knowledge will assist further research into how soil K can be managed in WA cropping systems.

AIMS

Canola is a high input crop and an aggressive acquirer of soil nutrients. Better understanding of the differences in K requirements between canola varieties is important for improved production in WA. Potassium efficiency is a measure of the ability of plants to produce optimal yield in soils with sub optimal K availability. This study was aimed at identifying canola genotypes differing in K efficiency to improve our knowledge on management of soil K in WA cropping systems.

METHOD

Twelve varieties of canola (*Brassica napus*) were selected based on the results of a screening experiment in 2003. Six varieties identified as potentially efficient and six identified as potentially inefficient were selected for more detailed assessment of efficiency. Plants were assessed for shoot dry weight and K content during vegetative growth and for shoot dry weight and grain yield at maturity.

Vegetative

Plants were grown in a K deficient (20 mg extractable K/kg soil) sandy soil in pots (5 kg soil/pot) in an evaporatively cooled glasshouse in Perth WA during April to May 2004. The treatments were: (i) no K applied; and (ii) K applied as muriate of potash (KCl) at 87 mg K/kg soil.

Six weeks after sowing three plants per pot were harvested by removing whole shoots at the cotyledons. The remaining three plants per pot were harvested at 8 weeks after sowing. Shoots were analysed for dry weight and K concentration. Results from individual harvests were inconsistent due to variation in plant growth within pots. Results from both harvests were therefore assessed together, with harvest date as a treatment factor.

Mature

Six canola varieties were grown to maturity in the same soil type as above (5 kg soil/pot) in the same glasshouse during July to November 2004. The treatments were: (i) K applied at 20 mg K/kg soil; and (ii) K applied at 185 mg K/kg soil as muriate of potash (KCl). Whole shoots were harvested at maturity and grain collected.

RESULTS

Vegetative

There was significant variation among canola varieties in their response to K amendment in terms of shoot weight ($p = 0.018$) and shoot K concentration ($p = 0.018$). Efficiency ratio for shoot dry weight was significantly different among varieties ($p = 0.004$), ranging from 0.317 to 0.613. There was a significant negative correlation between K concentration and total K content in shoots ($r = -0.72$). Plants that grew better at suboptimal K had a lower K concentration in shoots and took up more K into shoots.

K-efficient and K-inefficient varieties were identified as those with a mean efficiency ratio greater than one standard deviation from the median efficiency ratio. Genkai and IB1368 were inefficient and BLN313 and Wesbarker efficient for shoot weight. BLN 301 had very good growth at both adequate and suboptimal K.

There was significant differences between genotypes at low K in shoot weight ($p = 0.001$) and shoot K concentration ($p = 0.001$). There was no significant difference in total shoot K content.

Mature

Differences between varieties in response to K application were significant for grain weight ($p = 0.021$) and for harvest index (= grain weight/total shoot weight) ($p = 0.018$). There was no significant difference between varieties for efficiency ratio. However, efficiency ratio for total shoot weight at maturity was highly correlated with efficiency ratio for shoot weight from the vegetative harvests ($r = 0.80$).

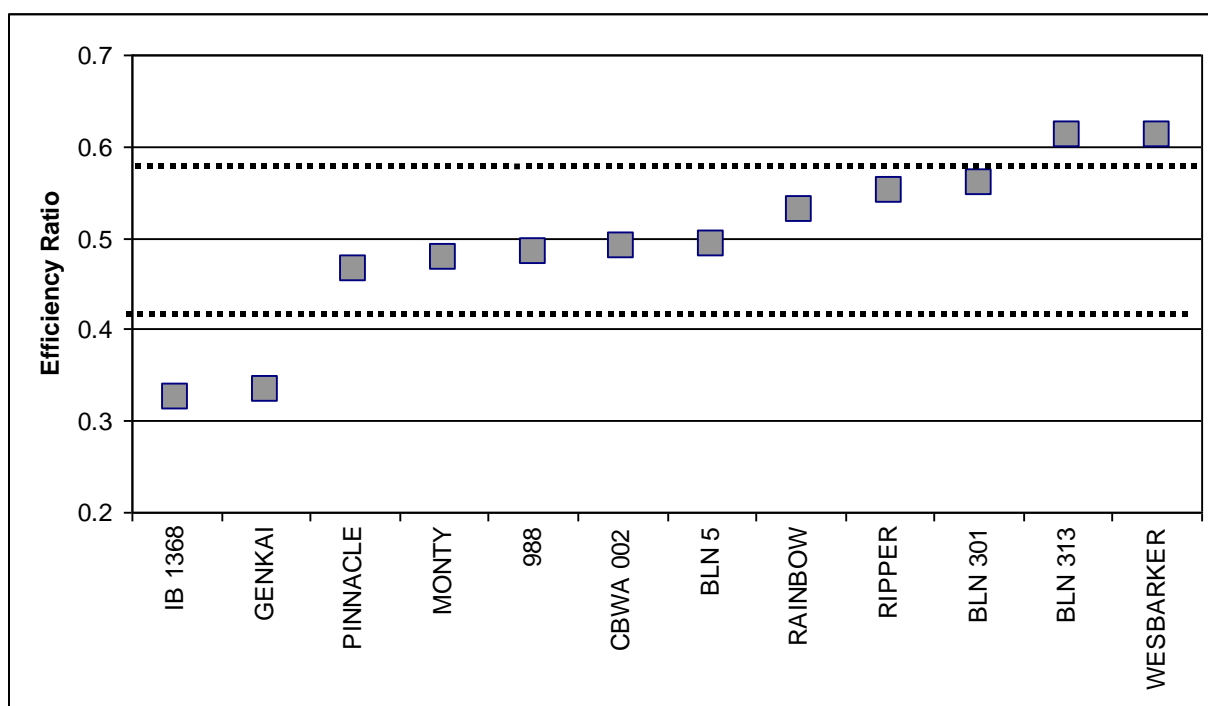


Figure 1. Mean efficiency ratios for canola varieties with nil or 87 mg K/kg soil added. The interval limited by dotted lines was constructed by adding and subtracting one standard deviation from the median value. Efficiency ratio is grain yield at nil K/grain yield at 87 mg K/kg soil.

CONCLUSION

Canola varieties differ in their capacity to take up and utilise soil K when availability is suboptimal during vegetative growth. Further research will attempt to identify the mechanisms of these differences and whether they may relate to more efficient production systems. This knowledge will contribute to the decision support systems for optimising K fertilisation in WA farming systems.

KEY WORDS

canola, potassium

ACKNOWLEDGMENTS

Funding for this research is provided by Grains Research and Development Corporation through the Sustainable Farming Systems Program.

Project No.: UWA00031

Paper reviewed by: Zed Rengel

Atrazine contamination of groundwater in the agricultural region of Western Australia

Russell Speed¹, Neil Rothnie², John Simons¹, Ted Spadek² and John Moore¹;

¹Department of Agriculture, ²Chemistry Centre (WA)

KEY MESSAGES

Atrazine has been detected in shallow groundwater (< 5 m depth) beneath the area of application for at least two years after it has been applied. The levels of atrazine detected are below the Australian Drinking Water Guidelines (2004) health action values and therefore do not pose a significant health threat.

AIMS

A project to investigate the hydrogeological transport of atrazine at a site in Chapman Valley and on Esperance Downs Research Station began in 2002. It is a collaborative project between the Department of Agriculture and Chemistry Centre (WA) with support from Grains Research and Development Corporation (GRDC) and Syngenta.

It was anticipated that atrazine would be detected migrating down the soil profile and in the groundwater. However, it was equally anticipated that the rate of lateral groundwater movement would be so slow that it would take in the order of years to decades for contaminated groundwater to discharge into the Chapman River (Chapman Valley) or Dalyup River (Esperance Downs Research Station). These timeframes are likely to be beyond the decay life of atrazine and its metabolites. Therefore, if used according to label and guidelines, atrazine should not pose significant threat.

The project aims to investigate the rate and extent of hydrological transport of applied atrazine through the soil profile to groundwater as a function of soil type, soil chemistry, timing and rate of application. It also aims to quantify hydrogeological transport of atrazine off-site to determine best environmental and agricultural management practices, particularly for protecting water bodies and water resources.

METHOD

Three parallel blocks (2002, 2003 and 2004), each consisting of a line of nine 20 m by 20 m plots individually surrounded by a 10 m buffer, were treated and sown to canola in separate years. The blocks are orientated along the groundwater flow direction and there is a 20 m gap between the blocks. Three treatments replicated three times were applied to a different block of plots in each of the three years (2002–2004).

The three treatments were:

1. Simazine (2 L/ha) and atrazine (2 L/ha) applied before sowing.
2. Metalochlor (1 L/ha) applied before sowing followed by atrazine (2 L/ha) applied post emergence.
3. Atrazine (2 L/ha) applied before sowing followed by atrazine (2 L/ha) applied post emergence.

Monitoring bores are located in the centre of each plot and at 2 m and 5 m spacing hydraulically down gradient from the edge of each plot in the buffers.

Soil and groundwater samples were collected in the plots and buffers prior to treatment and then after treatments were applied, groundwater was sampled regularly with frequency determined by seasonal conditions and herbicide detection. Samples were analysed using Liquid Chromatography – Mass Spectrometry (LC – MS).

RESULTS

None of the 2002 application of herbicides (or metabolites) was detected in groundwater at either site in 2002. In 2003 trace amounts of atrazine or its metabolites were detected in groundwater beneath the plots treated in 2002 and 2003 at the Esperance Downs Research Station site where no atrazine had been applied for at least 10 years prior to the experiment. To date, atrazine or its metabolites have not been detected outside of the plots at the Esperance Downs Research Station site.

At the Chapman Valley site, atrazine or its metabolites have been detected in groundwater beneath plots and in the buffers where no atrazine was applied during this experiment. Figure 1 depicts the typical response of groundwater levels to seasonal conditions during the experiment and total atrazine (atrazine plus metabolites) concentrations in groundwater from one centre bore and the two buffer bores hydraulically down-gradient, for one of the treated plots at the Chapman Valley site. The concentrations associated with a rainfall event in May 2003 were detected before atrazine was applied on that plot.

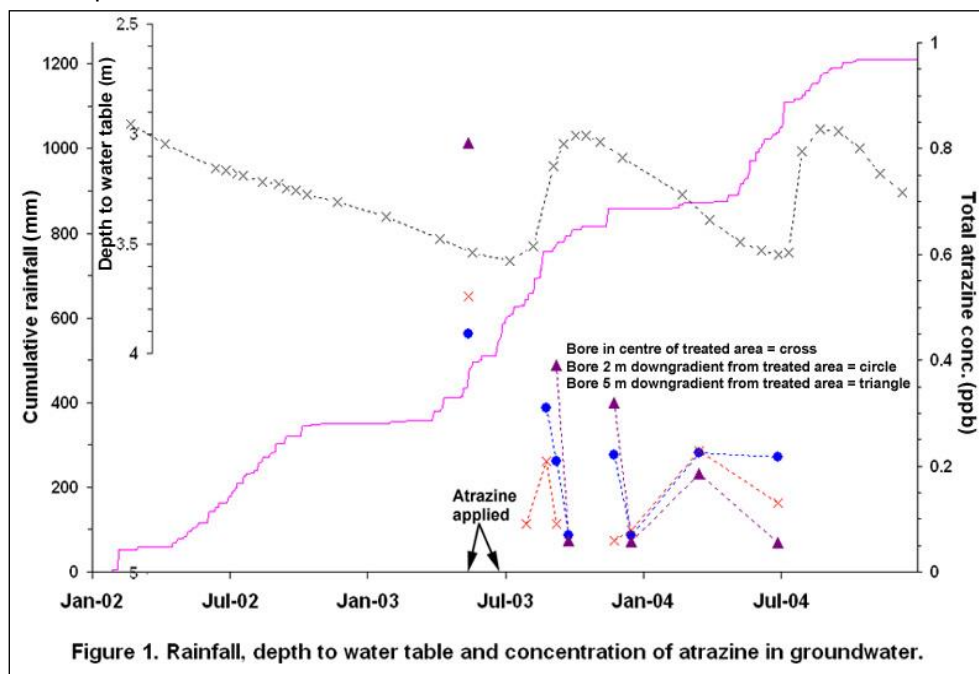


Figure 1. Rainfall, depth to water table and concentration of atrazine in groundwater.

To date the highest concentration of total atrazine detected in groundwater is two parts per billion in one bore on one date at the Esperance Downs Research Station site. However, when detected in the groundwater samples, total atrazine concentration is typically less than one part per billion at both the sites.

CONCLUSIONS

Detection of atrazine or its metabolites in groundwater is linked to episodes of recharge. There was no recharge at either site during 2002 and hence no migration of atrazine to groundwater was detected. Recharge that occurred during 2003 transported atrazine or its metabolites to groundwater beneath plots that were treated in either 2002 or 2003 at both sites. Current data analysis shows that recharge that occurred in 2004 also transported atrazine or its metabolites to groundwater beneath the plots treated in 2002 at the Chapman Valley site. It is also clear that some of the atrazine or its metabolites detected in 2003 is residual from 2001 when the entire paddock in which the Chapman Valley site is located was sown to canola.

The National Health and Medical Research Council does not consider atrazine in drinking water a health concern unless the concentration exceeds the Australian Drinking Water Guidelines (2004) health action value of 40 parts per billion. This is twenty times the maximum concentration of total atrazine detected in one bore on one date at the Esperance Downs Research Station site.

Some atrazine appears to remain in the soil profile for a number of years; however, the lateral movement of atrazine or its metabolites in groundwater is yet to be unambiguously demonstrated.

KEY WORDS

atrazine, groundwater, Chapman Valley, Esperance

ACKNOWLEDGEMENTS

Barry Stokes, David Nicholson, Esperance and Geraldton Research Support Units

Project No.: 02GE24

Paper reviewed by: Andrea Hills and Angela Alderman

Controlling aphids and *Beet western yellows virus* in canola using imidacloprid seed dressing

Brenda Coutts and Roger Jones; Department of Agriculture, Western Australia

KEY MESSAGES

- Dressing seed of canola cv. Grace with imidacloprid at 240 or 525 gai/100 kg controlled green peach aphids (GPA) for up to 3.5 months, but suppression of early *Beet western yellows virus* (BWYV) spread was poor due to high levels of introduced virus inoculum.
- The overall combined yield reduction caused by early BWYV spread and direct GPA feeding damage together was 33%. Later infection with BWYV still reduced yield by 22%. The seed dressing used alone increased seed yield by 19-21%.

BACKGROUND

Imidacloprid is a multipurpose insecticide belonging to the neonicotinoid group. It kills GPA, the principal vector of BWYV. It is available as a seed dressing (Gaucho®) or a foliar spray (Confidor®). Gaucho® is already registered for control of red-legged earth mite and blue oat mite in canola. In the grainbelt, aphids spread BWYV to canola crops from infected weeds, especially wild radish. In surveys in 1998 and 1999, BWYV was found in 59% and 66% of canola crops sampled respectively. In two field experiments in 2001, infection with BWYV that started early and reached 98% and 93% of plants decreased seed yield of canola by 37% and 46% respectively. In field experiments in 2002, Gaucho® seed dressing used alone at 525 gai/100 kg increased seed yield of canola cv. Pinnacle by up to 88%.

METHODS

In the 2004 growing season at the Department of Agriculture's Badgingarra Research Station, a field experiment with BWYV and canola cv. Grace was done to provide further information on the effectiveness of imidacloprid seed dressing (Gaucho®) against BWYV and GPA. Small numbers of 'infector' canola plants were introduced into these experimental plots; these 'infector' plants were BWYV-infected and infested with GPA. Two rates of imidacloprid seed dressing (Gaucho® 600FS 525 gai/100 kg and 420 gai/100 kg of seed) and one of imidacloprid foliar spray (Confidor® 35 gai/ha) applied at 3 and 7 weeks post emergence were used. Aphid counts and plant sampling to determine BWYV incidence in each plot was done fortnightly.

RESULTS

GPA numbers were effectively suppressed by the seed dressing for 111 days after sowing (DAS), with no difference between the 2 application rates (Figure 1). GPA numbers increased more rapidly on BWYV-infected than healthy plants. BWYV caused symptoms of chlorosis on the lowermost leaves, with plants being less vigorous than healthy plants. In plots with 'infector' plants, BWYV spread quickly in the first 57 DAS, with no difference in virus incidence between plots with seed dressing, foliar treatment or no insecticide application. From 72 until 111 DAS, BWYV spread slowed by 20% in imidacloprid treated plots compared with spread in untreated plots. However, during this time there was no difference in virus incidence due to the different rates of seed dressing or the foliar application. In control plots without insecticide but with 'infector' plants, BWYV infection reached 90% by 111 (DAS). The overall combined seed yield loss caused by BWYV infection and direct feeding damage from GPA was 33% (Figure 2). Seed dressing used alone increased seed yield by 19-21%. Late BWYV spread in plots without infector plants or insecticide still decreased yield by 22%.

CONCLUSIONS

This research shows that the commercial recommended rate of Gaucho® seed dressing (240 gai/100 kg seed) can control GPA and increase yield significantly. However, early BWYV spread was not controlled presumably because the initial inoculum level introduced was too high so the yield increase would have been greater if this initial inoculum had been less. Use of the imidacloprid seed dressing is appealing as it has the potential to provide effective multipurpose control not only of

aphids, including GPA, but also of other early insect and mite pests of canola. Other interesting outcomes of the work were the demonstration that later infection with BWYV still reduces yield substantially, and that GPA multiplies faster on BWYV-infected plants than healthy ones.

KEY WORDS

canola, seed dressing, virus, disease

ACKNOWLEDGEMENTS

We thank Rohan Prince and Badgingarra RSU staff for technical support.

Paper reviewed by: Geoff Thomas

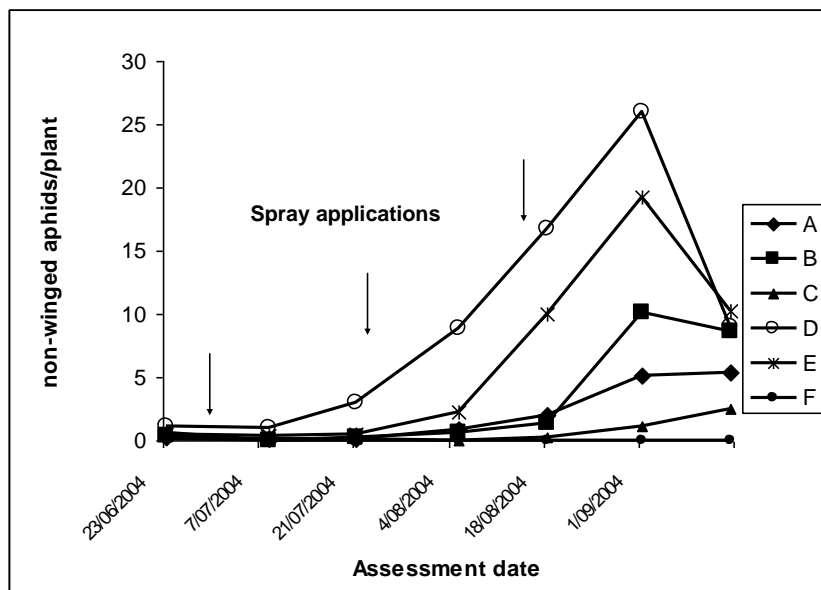


Figure 1. Effect of insecticide treatments on numbers of non-winged green peach aphid.

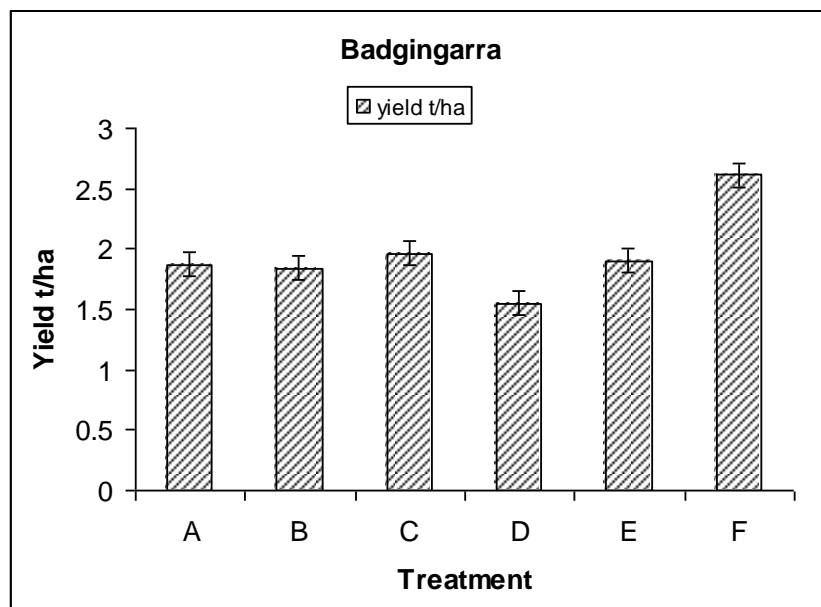


Figure 2. Effect of insecticide treatments and the virus control achieved on yield of canola.

A = Gaucho® 525 gai/100 kg seed + infector plants; B = Gaucho® 240 gai/100 kg seed + infector plants; C = Confidor® spray 35 gai/ha at 3 and 7 weeks + infector plants; D = no insecticide + infector plants; E = no insecticide - infector plants; F = Gaucho® 525 gai/100 kg seed + Fastac® spray 25 gai/ha with Confidor® spray 35 gai/ha at 3, 7, 11 and 15 weeks - infector plants. Bar = LSD.

Managing sclerotinia in canola

Neil Harris, Dovuro Seeds Western Australia

INTRODUCTION

Sclerotinia stem rot (*Sclerotinia sclerotiorum*) is a fungal disease with the potential to damage canola severely. The high rainfall Northern wheat belt of WA has experienced some devastating damage from the disease in the last couple of seasons. The disease has occurred intermittently throughout the high rainfall and irrigated parts of WA for a number of years. Sclerotinia can be managed with a basic understanding of the disease and its life cycle.

SYMPTOMS

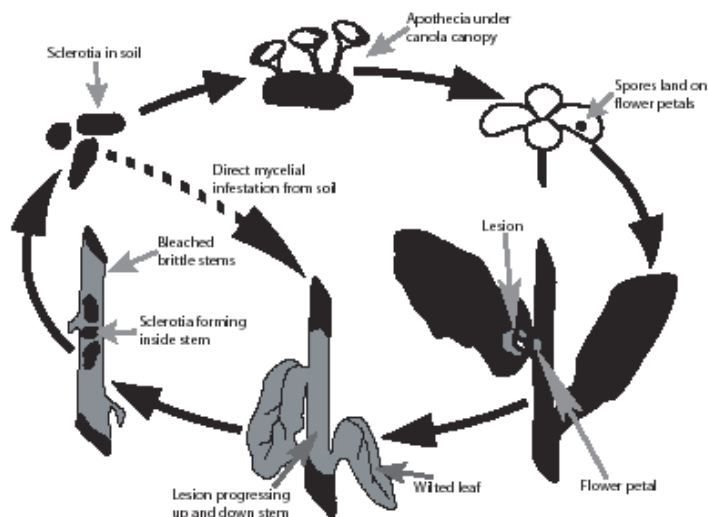
Initially the disease appears as light brown discoloured patch either on the stem leaves or pods. The lesions then expand into a greyish white colour. This is followed by the development of the hard black fruiting bodies called 'sclerotes'. In wet humid conditions a white fungal infection may be observed on the outside of the plant, sclerotes may also develop externally in some such cases.

In a maturing canola crop sclerotinia is easily detected as plants in the crop appear bleached and die prematurely. Infected plants produce fewer pods with small shrivelled grains. In severe cases the crop may lodge with substantial yield losses. When an infected stem is split the hard black fruiting bodies can usually be found inside. The sclerotia may be small and round like canola seed or it may be cylindrical and a centimetre or more in length resembling rat faeces.

LIFE CYCLE

The resting fruiting bodies or sclerotia may remain dormant and viable in a paddock for a number of years. Moisture and soil temperature in the spring will encourage sclerotia near the surface to germinate and grow into small mushrooms (apothecia). These mushrooms then release spores into wind which are blown onto the host plant. The spores land on the flowering petals of the canola plant, the petals then die at the end of flowering fall off and lodge in the canopy of the crop. The petal is then used as a nutrition source for the spores to germinate and develop into a fungal mycelium which eventually penetrate the plant.

The disease cycle



BASAL INFECTIONS OF SCLEROTINIA

While Sclerotinia is also capable of infecting plants directly from the soil, this type of infection rarely occurs in canola. Basal infection in canola can be caused by two different Sclerotinia species:

S. sclerotiorum and *S. minor*. The main difference between the two types is the size of the sclerotia. *S. sclerotiorum* has larger sclerotia that resemble rat faeces, while *S. minor* has much smaller sclerotia that resemble shrunken canola seeds that usually clump together. Basal infections of Sclerotinia can be seen in a canola paddock before flowering starts.

MANAGEMENT OF THE DISEASE

Currently there is no resistance in Australian varieties. Canola researchers in Canada are attempting to use a Chinese variety with Sclerotinia resistance in their breeding program.

Plant breeders have also experimented with developing canola plants with fewer and smaller petals, these varieties are called 'Apetalous'. To date these varieties have shown little advantage in reducing the level of infection.

Rotation will reduce the risk of infection. Leaving canola out of the rotation for a number of years and any other susceptible crops such as clover, field peas, faba beans, lucerne, and lupins is preferable. The control of volunteer plants such as capeweed, wild turnip, wild radish and wild mustard in cereals and pastures also helps.

Stubble fires in infected canola stubble do not burn evenly or give consistently high enough temperatures to kill all the sclerotia. This also applies to other susceptible break crops.

Burial of sclerotia by deep ploughing to 8 cm below ground level can be an effective method of reducing sclerotia. However live sclerotia may be ploughed up the following year. This method would not be popular where No-Till has been promoted to prevent soil erosion and to protect soil structure.

Avoid sowing canola next to a paddock that was heavily infected with Sclerotinia the previous year.

Fungicide application may be another consideration in controlling Sclerotinia. Currently Rovral Liquid Fungicide is the only registered chemical in Australia for controlling Sclerotinia. Other fungicides are currently being considered for registration. The current recommendation is to apply the fungicide at between 20% and 50% flowering. Applying a fungicide will need careful consideration due to the price of both the chemical and canola if an economical return is to be made.

Returns from the use of Rovral fungicide for Sclerotinia control. Net returns from Sclerotinia control with Rovral are based on a 2 t/ha potential yield and chemical and application costs of \$79/ha.

% yield loss	yield loss (t/ha)	On Farm Price Canola (\$/tonne)					
	at 2 t/ha potential	\$350/t	\$360/t	\$370/t	\$380/t	\$390/t	\$400/t
5	0.1	-\$44	-\$43	-\$42	-\$41	-\$40	-\$39
10	0.2	-\$9	-\$7	-\$5	-\$3	-\$1	\$1
15	0.3	\$26	\$29	\$32	\$35	\$38	\$41
20	0.4	\$61	\$65	\$69	\$73	\$77	\$81
25	0.5	\$96	\$101	\$106	\$111	\$116	\$121
30	0.6	\$131	\$137	\$143	\$149	\$155	\$161

A petal test is offered to growers and agronomist through NSW Agriculture's Plant Health Diagnostic Service. This helps to determine the level of petal infection, enabling the grower to assess the disease risk before applying a fungicide.

CONCLUSION

Sclerotinia stem rot can be a serious disease of canola. Whilst only occurring intermittently the disease can be controlled with good management practices. This also reduces the risk to other susceptible crops in the rotation.

Several different Sclerotinia forecasting tools are currently used overseas to predict the risk of infection in canola. These systems rely on weather data, crop history and spore presence. They have shown not to be adaptable to Australian conditions so far. Further development and research is therefore needed to bridge this adaptation.

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Paper reviewed by: Associate Professor Martin Barbetti

Slugs, the trail of destruction in canola

Neil Harris, Dovuro Seeds Western Australia

INTRODUCTION

In 2004 slug damage to canola increased greatly in the higher rainfall regions of WA. The increase is mainly attributed to changes in agronomic practices such as No-Till, lower seed application rates, warm wet conditions following seeding, incorporation of previous crop residue into the soil and the use of cover crops. In addition lower glucosinolate varieties of canola have increased in popularity. These varieties are more palatable to slugs. The increase in slug damage to canola is mirrored in reported increased usage of molluscicides in canola.

SLUG MANAGEMENT PRACTICES

Slugs become active following the break of the season. Slugs surviving from the previous season do most damage, and eat two or three times their body weight daily. Slug activity is increased in No-Till paddocks where stubble residues create a micro-climate conducive to the slug life cycle. Paddocks after pasture in a high rainfall zone are also prone to greater slug damage.

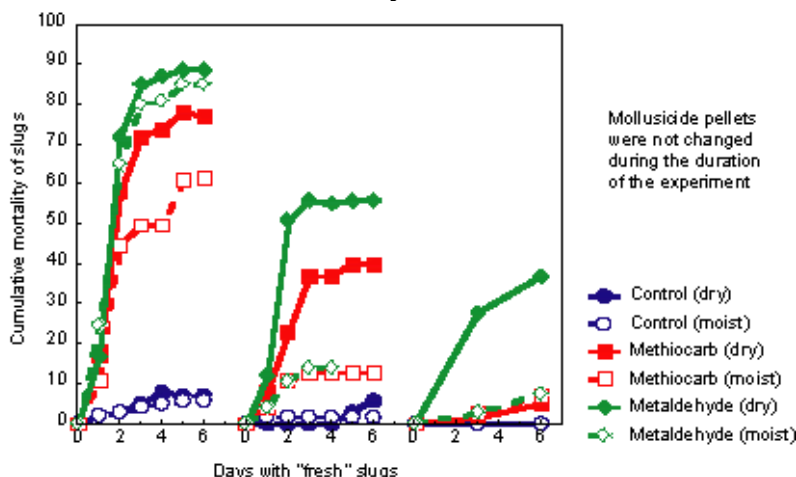
Monitoring is highly recommended. Paddocks with potential slug problems can be identified before seeding by creating humid sheltered hiding places for slugs. A pit four inches in diameter and six inches deep covered with a board coated with aluminium foil on one side will provide a cool refuge from the sun. In dry conditions the pit needs to be kept moist. As a rule of thumb, you can expect problems in the paddock if you find one to five slugs per trap. Since slugs are nocturnal sampling should be done in the evening or when the weather is cloudy. Metaldehyde bait may also be needed in the trap to attract slugs.

Control options are limited to baits and cultural practices. If a number of factors are present which favour slug development, then a combination of cultural practices and baits may be needed.

In recent research the introduction of metaldehyde (Slug Out) bait has shown improved control. Metaldehyde can attract slugs from up to one meter away. Its primary mode of action is dehydration. If conditions remain extremely wet, slugs can sometimes absorb enough moisture to compensate for water loss through mucus production and will recover from the effects of metaldehyde. If enough metaldehyde is consumed by the slug it will not recover. Research has also shown that metaldehyde also causes slight paralysis of the slugs jaw so ingestion of enough metaldehyde bait to kill the slug may not be possible.

Therefore in certain scenarios a combination of methiocarb and metaldehyde may be needed. Iron phosphate is another bait product available to growers although research has shown inconsistency in its performance. Spreading Mesurol granules (containing methiocarb) in the front lines of the enlarging circles in order to stop any damage occurring can also be tried. Granules work best on a smooth flat surface with low stubble residue.

The effectiveness of metaldehyde and methiocarb are shown in the figure below.



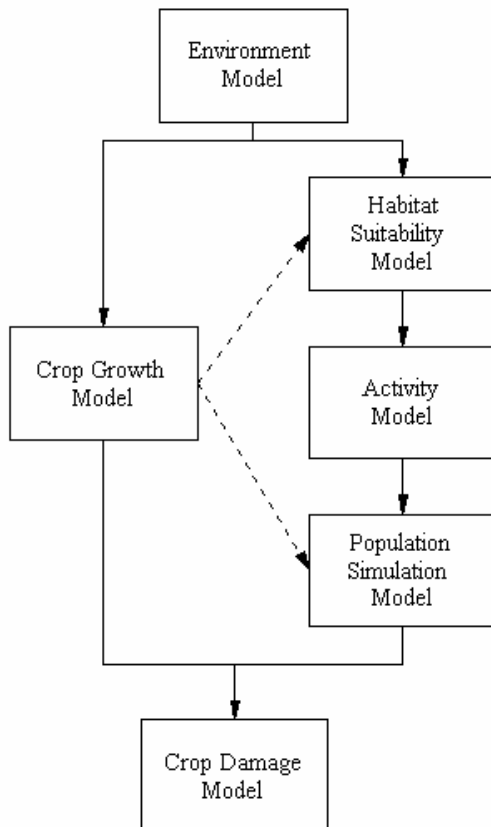
Source: Rothamstead Research Institute.

THE FUTURE OF SLUG CONTROL

Investigation into seed coatings with metaldehyde and methiocarb is under evaluation by the Home Grown Cereals Authority in the UK. The efficacy of both products in laboratory experiments has shown good results so far. Field trials still need to be evaluated before any conclusion can be made on seed treatment with both products.

Computer modelling may also help in the future enabling prediction in both weather and likely crop damage from slugs (see table below).

Overall structure of model



Source: Newcastle University.

CONCLUSION

Growers and Agronomists need to be aware of potential slug problems in canola given changing cropping practices that increase stubble retention and where lower glucosinolate varieties of canola are to be grown.

Slug potential can be assessed using slug traps. If slugs are expected to be a problem then a combination of baits and cultural practices is recommended.

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Department of Agriculture, Centre for Cropping Systems Northam
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Newcastle University, UK

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Blackleg risk assessment and strategies for risk management in canola during 2005 and beyond

Moin Salam, Ravjit Khangura and Art Diggle, Department of Agriculture, Western Australia

KEY MESSAGES

- Many canola growers are expected to look for canola varieties with polygenic resistance to blackleg during 2005 due to the breaking down of the monogenic or sylvestris resistance in popular varieties. Consequently, blackleg and its management has become an important issue for canola in the coming seasons.
- We have defined the risk of blackleg occurrence based on the last 35 years of historical weather in 14 locations in the Western Australian cropping regions. The risk of blackleg is both location and season specific, and the time of sowing can greatly modify this risk in a location.
- The effectiveness of fungicides largely depends on the crop at risk in addition to the level of varietal resistance. Using fungicides opportunistically in years of high risk could be a way of gaining better economic benefit from fungicide use.
- Observing crop separation distances from stubble, paddock use planning within a property and neighbouring properties, could play a significant role of blackleg management in a region.

AIMS

Following reports of the breaking down of resistance of canola varieties with the sylvestris blackleg resistance gene (such as Surpass 510TT), it is expected that many growers will revert to varieties with polygenic resistances (like ATR-Beacon). Therefore blackleg and its management has become an important issue for canola.

The overall aim of the paper is to suggest how blackleg may be managed successfully and economically during 2005 and beyond. The specific aims are to: (i) review the status of resistance breakdown in varieties with the sylvestris gene throughout the State; (ii) assess the risk from the disease in major canola growing regions; (iii) analyse the economics of fungicide use; (iv) to show the gradient of disease development from last year's paddock and hence impact of paddock separation distance on disease management; and (v) to view the impact of crop arrangement on regional spread of the disease.

METHOD

The overwhelming source of blackleg inoculum is infected canola stubble from previous years' cropping. In autumn and winter, depending on the rainfall and temperature to which the stubble is exposed, the pseudothecia (fruiting bodies) mature and release ascospores when triggered by rainfall events. As most of the canola cultivars, irrespective of the level of their adult plant resistance, are susceptible to infection by the fungus at the seedling stage (may be termed as 'seedling susceptibility window') and consequent canker formation, therefore the timing of ascospore release in relation to the onset of adult plant resistance provides information on the risk of blackleg. The 'Blackleg Sporacle' model (Salam *et al.* 2003) can now estimate the start and peak of ascospore release and the number of blackleg spores that will fall on a canola crop taking into account sowing time, regional location and weather conditions before and during the growing season.

The 'Blackleg Sporacle' model was run using weather data for 35 years to predict the onset of pseudothecia maturity for 14 locations – Badgingarra, Carnamah, Esperance, Hyden, Katanning, Kellerberrin, Merredin, Mingenew, Mt Barker, Mullewa, Newdegate, Northampton, Williams and Wongan Hills. The risk of the disease was calculated as nil (spores were not released during the 'seedling susceptibility window'), medium risk (spores were released during last 7 days of the 'seedling susceptibility window') and high risk (spores were released on more than 7 days during the 'seedling susceptibility window'). The 'seedling susceptibility window' was calculated for each location as the time required for 6th leaf to appear as determined from the temperature to which the crop was exposed.

The spread of the available spores from an infected stubble source during a given time was calculated using a spread function determined by wind speed and direction (Salam *et al.* 2001). The spread model was run using the weather for Scaddan 1999 as hourly rather than daily summary data is required. The gradient of disease development was validated against the findings of Wherrett *et al.* (2004).

The gross margin for different regions was calculated based on the potential yield and the total variable cost of canola production for various regions as mentioned in the 'Gross Margins Guide 2003'. For this analysis, we assumed \$22/ha as the cost of fungicide (Impact-in-furrow®) and its application and \$320/t as the farmgate canola price. Furthermore, we considered three likely disease pressure scenarios based on concentration of spores spread from an infected stubble source, as mentioned above (see white-bordered paddock in Figure 2). We used the same estimated maximum potential yield loss (under different disease pressures for canola varieties with different blackleg canker ratings) as mentioned in the 'Managing Blackleg 2003' bulletin.

RESULTS

Blackleg strains capable of attacking the sylvestris resistant varieties of canola are present in Western Australia but as yet have not caused the devastation seen in South Australia (Marcroft *et al.* 2005). A survey conducted during 2004 indicates that such varieties had a similar level of disease severity as for the polygenic resistant varieties in four locations (Badgingarra, Esperance, Katanning and Mt Barker) out of nine surveyed areas. It may be mentioned that generally 2004 was a very low disease severity year. Previous surveys showed that the strains able to attack sylvestris resistant varieties were mostly concentrated in the south-western part of the cropping regions of WA.

There is a wide variability on the onset of blackleg ascospore release across the cropping regions of Western Australia. The predictions showed spore release started as early as mid-March in Mt Barker and as late as early-August in Badgingarra and Carnamah. The median (of 35 years) time of maturity for all 14 locations fell in the range between late April for Mt Barker and early July for Mingenew and Carnamah. At any one location the maturity varies considerably between years as dictated by the weather conditions before and during the growing season. Therefore the risk of blackleg appears to be both location and season specific. In addition, time of sowing at a location determines the risk seen by a crop. For example, in the Great Southern region (Katanning), a crop sown in early-May is exposed to 'high risk' in 5 of every 10 years; this risk may increase to 9 of every 10 years if sowing is delayed to mid-May (Figure 1). In contrast, early-May sowing in the North Coast (Northampton) poses no risk and a mid-May sowing could be exposed to a 'high risk' just 1 in 10 years. In general, risk increases as sowing are delayed.

The spread model re-emphasises that the recommended separation distance (500 m from the previous season's crop debris) is important in profitable canola production (Figure 2). It further shows a paddock may have different spore concentration gradient depending on its location to the previous season's canola paddock. The model predicts (not shown here) that arrangement of crops (aggregated paddocks vs. dispersed paddocks) and consideration of neighbours' crop planning could play a significant role, on the management of blackleg disease in canola.

The protection provided by fungicide (i.e. Impact-in-furrow®) during the 'seedling susceptibility window' was taken as that given by 'Managing Blackleg 2003', for the purposes of these calculations. Additionally, the disease pressure based on likely spore concentration a paddock may experience due to its position from previous season's canola crop (Figure 2), level of varietal resistance and time of sowing were considered. Three possible scenarios of fungicide use were taken into account: (i) no use of fungicide; (ii) fungicide used every year (during the last 35 years); and (iii) fungicide used only during high risk years. Tables 1 and 2 show that there is a strong interaction between time of sowing, disease pressure in a section of a paddock and location to determine which of these scenarios would provide the best economic return. For example, at Katanning (Great Southern Region), using a variety rated 4 sown mid-April, better economic return may not be expected using fungicide every year compared to using no fungicide, regardless of the disease situation, whereas better returns would be expected from using fungicide every year if sown early-May where disease is expected to be moderate or high. On the other hand, in the North Coastal Region, fungicide use is unlikely to yield better economic return under low disease situation even at later sowings, and up to mid-May sowing under medium or high disease situation. The results of this study show that opportunistic fungicide use (using fungicide during the high risk years only) gives better economic benefit.

CONCLUSION

Blackleg could be managed in the traditional polygenic resistance varieties of canola if all possible options are employed.

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Paper reviewed by: Graham Walton, Bill MacLeod, Rob Loughman and Geoff Thomas

Table 1. An example of gross margins for the Great Southern Region with canola varieties having WA blackleg resistance rating 4, calculated for three situations (based on likely spores concentration as shown in white-bordered paddock in Figure 2), three options for frequency of fungicide use and four times of sowing

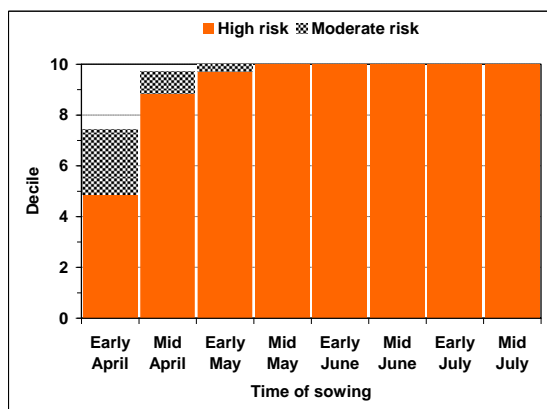
Fungicide use status in a section of the paddock (marked white in Figure 2)	Time of sowing			
	Mid April	Early May	Mid May	Early June
Light grey area (low disease pressure)				
No fungicide	111	91	70	60
Using fungicide every year	92	82	72	68
Using fungicide in high risk years	112	95	77	69
Dark grey area (moderate disease pressure)				
No fungicide	104	58	8	-15
Using fungicide every year	88	66	42	31
Using fungicide in high risk years	109	79	46	31
Black area (high disease pressure)				
No fungicide	95	9	-84	-126
Using fungicide every year	82	36	-14	-37
Using fungicide in high risk years	103	49	-9	-36

Table 2. (As for table 2) An example of gross margins for the North Coastal Region with canola varieties having WA blackleg resistance rating 4 calculated for three situations (based on likely spores concentration as shown in white-bordered paddock in Figure 2), three options for frequency of fungicide use and four times of sowing

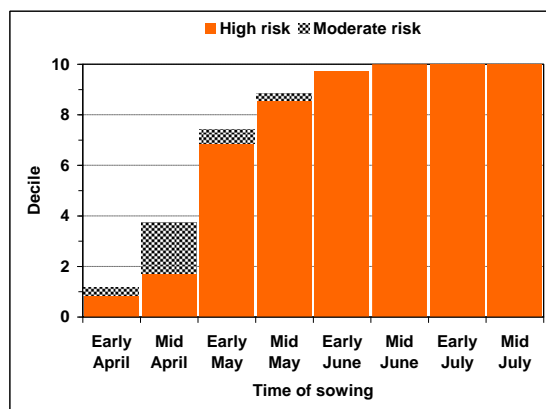
Fungicide use status in a section of the paddock (marked white in Figure 2)	Time of sowing			
	Mid April*	Early May*	Mid May*	Early June
Light grey area (low disease pressure)				
No fungicide	91	91	91	70
Using fungicide every year	69	69	69	59
Using fungicide in high risk years	91	91	91	72
Dark grey area (moderate disease pressure)				
No fungicide	91	91	91	42
Using fungicide every year	69	69	69	45
Using fungicide in high risk years	91	91	91	58
Black area (high disease pressure)				
No fungicide	91	91	91	-1
Using fungicide every year	69	69	69	20
Using fungicide in high risk years	91	91	91	33

* There were no high risk years at that site at those sowing times.

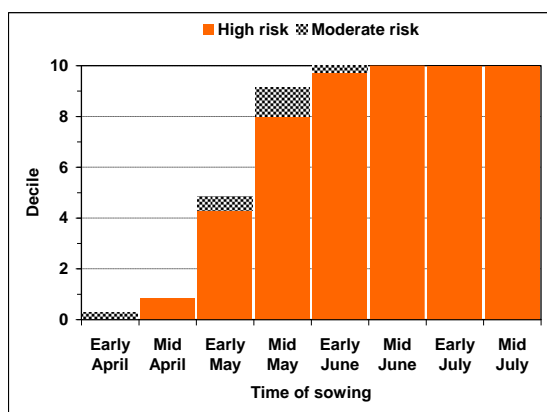
South west (Mt. Barker)



South east (Esperance)



Great southern (Katanning)



North coast (Northampton)

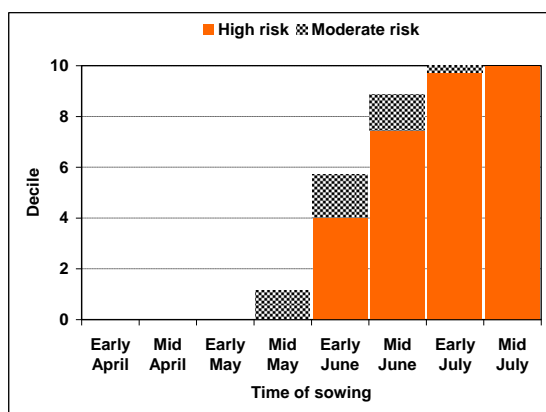
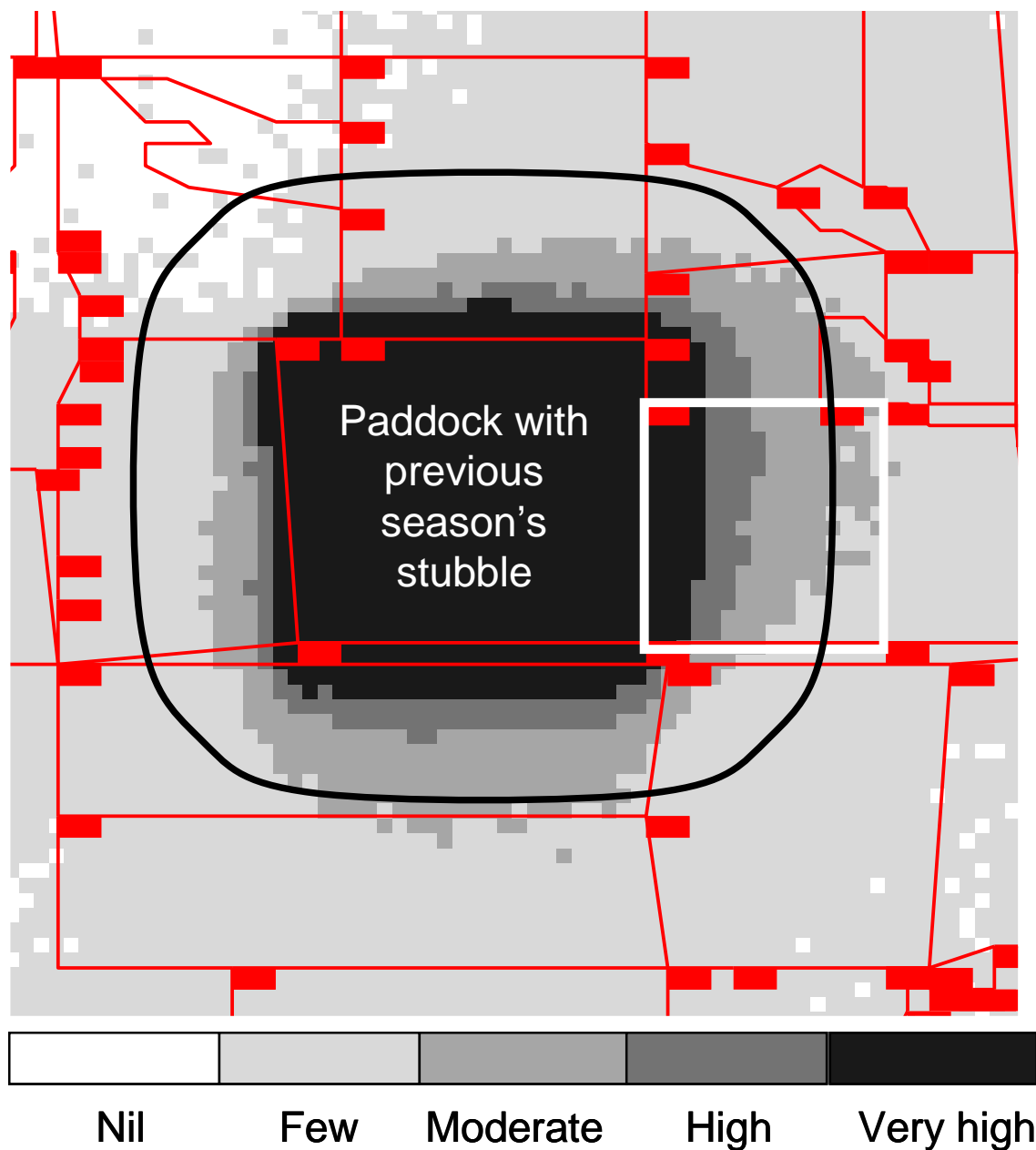


Figure 1. The risk of blackleg occurrence in canola in four crop growing regions of Western Australia.



Blackleg spore concentration gradient

Figure 2. The spread of blackleg spores, as predicted by the 'Blackleg Sporacle' model from a paddock with one year-old canola stubble and consequent cumulative spore concentration gradient in the adjacent paddocks. The model was run with Scaddan weather data for 1999. The black rounded rectangle marks the 500 m distance from the edges of the infected paddock. The economics of fungicide application was analysed for the situations as may be seen in the paddock with white border.

Modelling

BRAT - Blackleg Risk Appraisal Tool

Moin Salam and Ravjit Khangura, Department of Agriculture, Western Australia

KEY MESSAGES

BRAT is a tool for assessing the risk of infection of canola seedlings with blackleg. The risk assessment can be started as early as 1 April of the current season, thus helps in making decisions like sowing time and in-furrow fungicide application.

CONTEXT OF THE MODEL

Blackleg, caused by the fungus *Leptosphaeria maculans*, is the most serious disease of canola in Western Australia. Its epidemics are primarily initiated by airborne ascospores. The fungus survives as a saprophyte on infected stubble after the crop is harvested. Pseudothecia (the fruiting bodies which produce ascospores) of the fungus form readily on the woody remains of the infected plants. A combination of relatively low temperature and adequate moisture during summer and autumn progresses maturation of pseudothecia. Once pseudothecia are matured, rainfall or heavy dews and high humidity trigger ascospore release.

The early seedling infections are most critical as they lead to the development of stem cankers and yield loss. Canola seedlings of most of the varieties are susceptible to blackleg until they achieve a degree of adult plant resistance, usually at about the six-leaf stage.

BRAT uses local weather information and the planned sowing date to provide an assessment of the risk of blackleg infection in a canola crop. The risk assessment is based on the prediction from 'Blackleg Sporacle' model (Salam *et al.* 2003) of the maturity through time of the blackleg fruiting bodies on the previous season's infected canola stubble. The risk for a canola crop is the time of overlap between ascospore production from stubble and the susceptible seedling stage of the canola.

Applying the model: work examples

To run the tool for a specific location, one needs to use local weather (daily temperature and rainfall). BRAT uses year-to-date current weather and forward projects fruiting bodies maturity and risk based on historic data. Currently, the database (historical information) of BRAT consists of 14 locations - Badgingarra, Carnamah, Esperance, Hyden, Katanning, Kellerberrin, Merredin, Mingenew, Mt Barker, Mullewa, Newdegate, Northampton, Williams and Wongan Hills. With updated weather, a user can have an up-to-the-minute prediction for any of those locations. Figures 1 and 2 show two snap shots of BRAT.

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Salam, M.U., Khangura, R.K., Diggle, A.J. and Barbetti, M.J. (2003): Blackleg Sporacle: A Model for Predicting Onset of Pseudothecia Maturity and Seasonal Ascospore Showers in Relation to Blackleg of Canola. *Phytopathology* **93**: 1073–1081.

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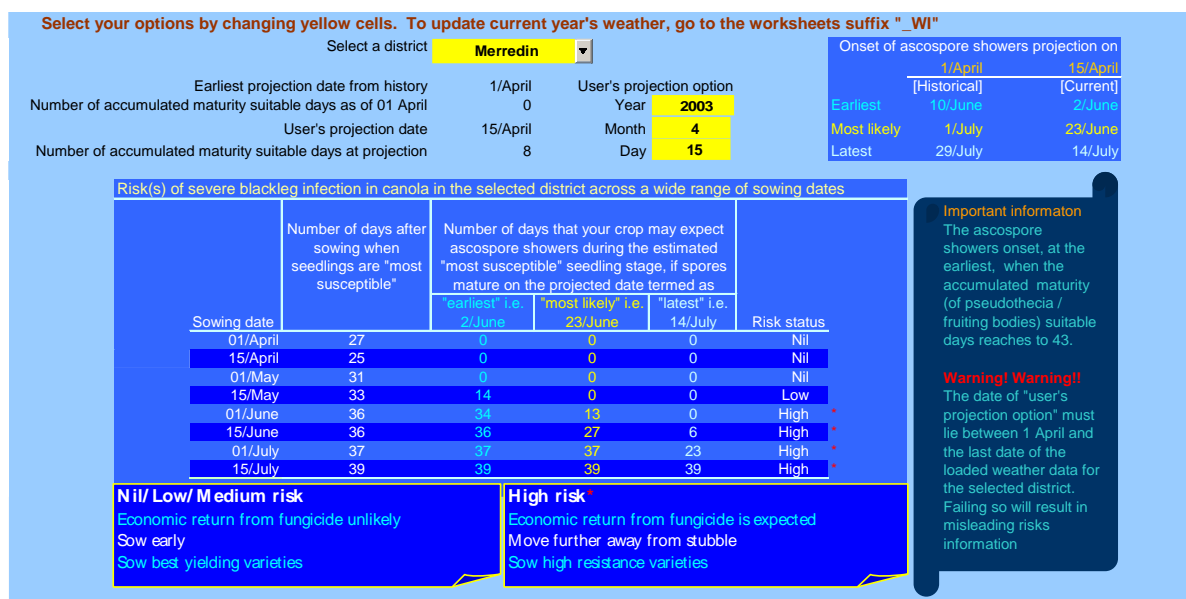


Figure 1. Output of BRAT showing the prediction of pseudothecia maturity and the risk blackleg during 2003 season at Merredin. This prediction was made on before the beginning of the cropping season (16 April).

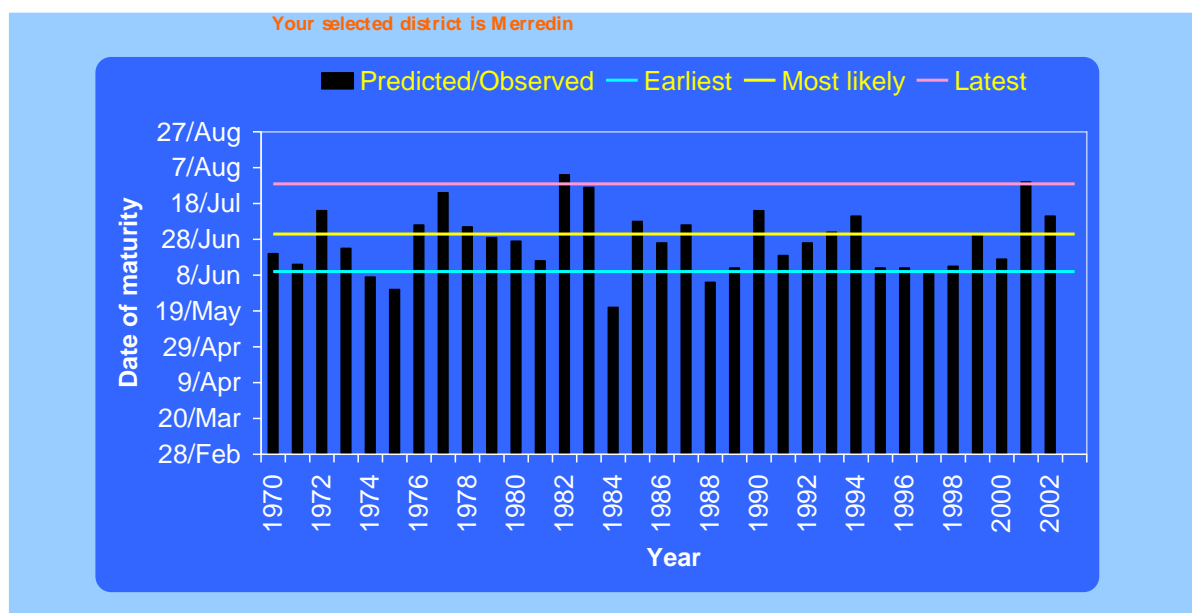


Figure 2. The historical onset of blackleg pseudothecia maturity in the Merredin district as stored in BRAT database.