Comparison of historical canola varieties in Australia

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ABSTRACT

Many canola varieties have been developed in Australia over the past 30 years but most have been bred on a narrow germplasm base. Thirty varieties, released between 1978 and 2007 were tested at three sites in 2008, as well as in two blackleg nurseries. Varieties released before 2002 all had poor blackleg resistance but recent releases had improved survival under heavy blackleg pressure. Grain yield has improved by an average of 24 kg/ha/year over three trials but this ranged from 10-44 kg/ha/year at individual sites. Oil content and protein content have both increased by about 2% each over 30 years while glucosinolate content has decreased from over 50 to 7-16 μmoles per gram of seed since 1990s. In addition there was a trend for slightly earlier flowering in the more recent releases.

Key words: Canola - historical varieties – blackleg - grain yield - grain quality

INTRODUCTION

The first canola variety bred in Australia was released in 1978. Many varieties were developed and marketed over the next 30 years. Initially all had conventional herbicide tolerance but triazine tolerant varieties were first released in 1993 and Clearfield types were first released in 2000. The breeding of canola varieties began from a narrow base, for example, in the breeding of the early varieties in Australia, only 18 parents were used (Cowling, 2007), while of the varieties released between 1995 and 2002, 11 ancestral varieties contributed 98.7% of the pedigree composition.

Trials were conducted in 2008 to investigate the phenological development, yield and quality of 30 canola varieties released between 1978 and 2007. Blackleg nurseries were conducted in SA and Victoria to measure the survival rate of these varieties under heavy blackleg pressure.

MATERIALS AND METHODS

In 2008, four trials were established at Bool Lagoon (SA), Cowra (NSW), Horsham (Vic, not harvested and results not presented due to drought) and Wagga Wagga (NSW) to investigate the grain yield and grain quality of 30 historical canola varieties released between 1978 and 2007. Varieties chosen had conventional herbicide tolerance and, except for the most recently released varieties, all sowing seed was produced from bagged plants in a glasshouse over summer 2007/08. Conventional varieties were chosen instead of triazine tolerant or Clearfield varieties to test older varieties, to avoid issues with using different herbicides and to avoid the yield penalty of the triazine tolerance system.

Trials were sown on 26 May, 30 May and 27 June at Bool Lagoon, Cowra and Wagga Wagga respectively. Three replicates were used and plot length ranged from 5.5 m at Wagga Wagga to 10 m at Cowra. In addition, two blackleg nurseries were sown at Bordertown (SA) and Wonwondah (Vic), with rows sown onto canola stubble from 2007. All usual agronomic treatments for good canola production were used.

The data were analysed using the ASREML package in the R statistical environment. For each trait, sites were analysed together using a mixed model with genotype as a random effect, allowing for correlations between sites. From this model, predicted values for each genotype for each site for each trait were calculated.

RESULTS AND DISCUSSION

Results from both blackleg nurseries were very highly correlated so mean survival data are shown in Figure 1. All canola varieties released prior to 2002 had survival less than 30%, while the most recently released varieties had survival up to 60% (Hyola 50 produced over 80% survivors).

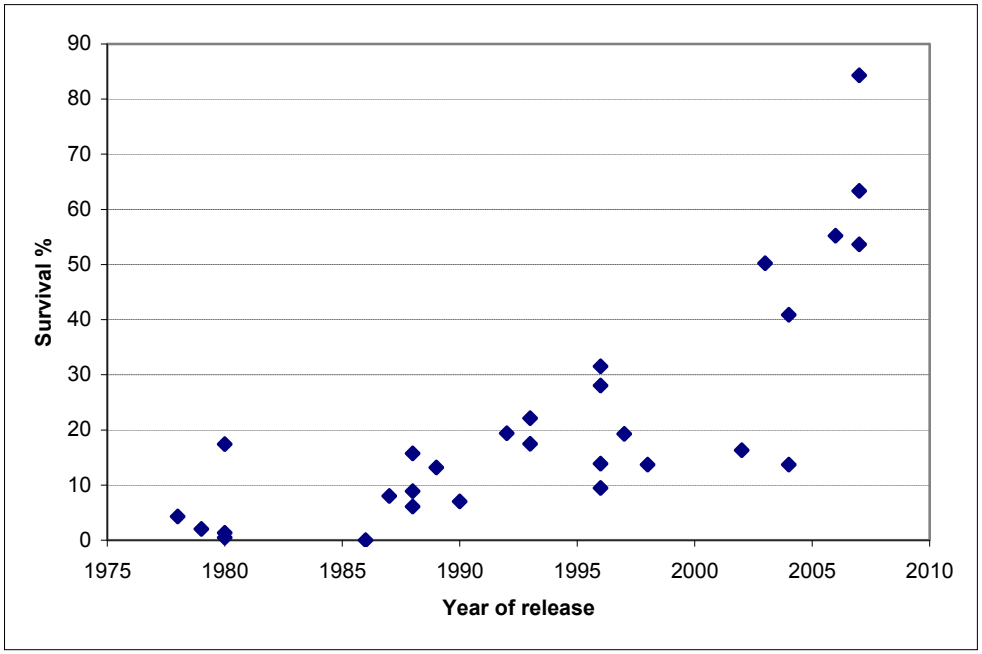

Fig. 1. Survival of canola varieties in blackleg nurseries at Bordertown and Wonwondah in 2008

The number of days from sowing to flowering decreased as sowing was delayed and also as trials were sown further north. The difference from earliest to latest flowering varieties ranged from 16 days at Bool Lagoon, 12 days at Cowra to 7 days at Wagga Wagga (Table 1). The latest flowering varieties at Bool Lagoon and Cowra were Wesreo, Wesway and Wesbell, all derived from the winter varieties Major and Ramses and the spring variety Oro. Dry matter accumulated between sowing and flowering at Bool Lagoon ranged from 5.4 t/ha up to 6.5 t/ha (Table 1). The early mid varieties AV-Garnet and Hyola 50 produced high amounts of dry matter compared to other recently released varieties. Similar amounts of dry matter were also accumulated by several of the oldest varieties but this may in part be because they took longer to reach flowering.

Mean grain yield ranged from 0.36 t/ha at Wagga Wagga up to 2.8 t/ha at Cowra (Table 2). Particularly at the higher yielding sites there was a significant increase in grain yield for the more recently released varieties. The average grain yield of the 4 varieties released after 2005 was compared to that of 5 varieties released between 1978 and 1980. At the highest yielding site (Cowra) yield increased by about 44 kg/ha/year down to 9.6 kg/ha/year at the lowest yielding site (Wagga Wagga). On average, grain yield increased by 24 kg/ha/year over the three sites.

Table 1. Days to flowering of canola varieties grown at Bool Lagoon, Cowra and Wagga Wagga in 2008 and dry matter at flowering (kg/ha) at Bool Lagoon

Year of release	Variety	Days sowing-flowering			Dry matter at flowering (kg/ha)
		Bool Lagoon	Cowra	Wagga Wagga	Bool Lagoon
1978	Wesreo	121	112	92	6286
1979	Wesway	122	112	90	6312
1980	Marnoo	116	109	89	5704
1980	Wesbell	121	112	92	6307
1980	Wesroona	117	108	90	6182
1986	Tatyoon	114	107	85	5622
1987	Wesbarker	117	107	89	5885
1988	Maluka	113	105	86	5815
1988	Nindoo	116	107	90	6123
1988	Shiralee	112	107	87	5621
1989	Eureka	115	108	88	5838
1990	Barossa	114	108	89	5064
1990	Yickadee	114	106	89	5398
1992	Oscar	115	108	90	5901
1993	Dunkeld	114	108	90	5313
1993	Rainbow	114	108	89	5618
1996	Grouse	115	108	90	5643
1996	Monty	107	102	85	5661
1996	Range	117	107	90	5035
1996	Scoop	110	104	89	5225
1997	Charlton	115	108	91	5964
1998	Mystic	109	103	84	6002
2002	Rivette	108	104	87	5370
2003	46C04	111	107	88	5419
2004	Ag-Spectrum	111	106	87	5505
2004	Skipton	115	107	89	5777
2006	AV-Opal	107	104	84	5636
2007	AV-Garnet	111	105	85	6161
2007	Hyola50	114	107	86	6513
2007	Tarcoola	105	100	85	5830

Table 2. Grain yield (kg/ha) of canola varieties grown at Bool Lagoon, Cowra and Wagga Wagga in 2008

Year of release	Variety	Grain Yields (t/ha)			
		Bool Lagoon	Cowra	Wagga Wagga	Average
1978	Wesreo	1723	2450	360	1511
1979	Wesway	1457	2073	241	1257
1980	Marnoo	1896	1614	197	1236
1980	Wesbell	2106	2408	269	1594
1980	Wesroona	1534	2144	219	1299
1986	Tatyoon	1705	2363	230	1433
1987	Wesbarker	1751	2660	289	1567
1988	Maluka	1908	2949	383	1747
1988	Nindoo	2073	2366	223	1554
1988	Shiralee	1869	2750	399	1673
1989	Eureka	2126	2905	394	1808
1990	Barossa	2234	2946	381	1854
1990	Yickadee	2017	2726	326	1690
1992	Oscar	2077	2979	339	1798
1993	Dunkeld	1952	2893	405	1750
1993	Rainbow	2214	3060	450	1908
1996	Grouse	1817	2861	361	1680
1996	Monty	1893	2835	345	1691
1996	Range	1883	2677	338	1633
1996	Scoop	1915	2554	279	1583
1997	Charlton	2175	2942	433	1850
1998	Mystic	2260	2891	352	1834
2002	Rivette	2085	2948	384	1806
2003	46C04	2028	3031	372	1810
2004	Ag-Spectrum	2162	3262	417	1947
2004	Skipton	1969	2887	413	1756
2006	AV-Opal	1982	3194	362	1846
2007	AV-Garnet	2808	3588	550	2315
2007	Hyola50	2384	3654	755	2264
2007	Tarcoola	1908	3212	479	1866
	Average	1997	2794	365	1719

Even though trials were conducted in 2008 only, the three sites covered the likely range of growing conditions and yield that could be expected in Australia (Table 2). Glucosinolate levels of varieties released before 1986 were higher than those acceptable for canola quality ie. More than 24 μmoles per gram of seed (Table 3). Varieties released after 1990 all had glucosinolate content of less than 20 μmoles per gram of seed.

In general, oil and protein content have increased over the past 30 years with oil increasing from about 37-38% up to 40% and protein increasing from about 44% up to 45-46%. Overall, oil plus protein has increased from about 81% up to about 86-87%. Breeders have concentrated on increasing oil content in Australian varieties as a bonus has been paid for higher oil content canola, particularly for the domestic crush. However, as much of the Australian crop is now sold overseas, the exporters now require higher protein content as well and these trials have shown that increases in oil and protein have been possible.

Table 3. Mean grain quality of canola varieties grown at Cowra, Wagga Wagga and Bool Lagoon, 2008

Year of release	Variety	Oil (at 6% moisture)	Protein (at 10% moisture in meal)	Oil + protein	Glucosinolates (at 6% moisture in seed)
1978	Wesreo	37.5	44.0	81.5	51.3
1979	Wesway	38.0	43.5	81.6	41.8
1980	Marnoo	38.5	44.4	82.9	40.5
1980	Wesbell	36.7	44.1	80.7	39.8
1980	Wesroona	36.7	45.7	82.4	32.9
1986	Tatyoon	37.2	44.3	81.5	32.9
1987	Wesbarker	38.3	44.6	82.9	20.3
1988	Maluka	37.8	45.6	83.4	11.4
1988	Nindoo	37.9	45.6	83.5	22.7
1988	Shiralee	37.9	44.1	81.9	20.5
1989	Eureka	37.7	45.8	83.4	12.0
1990	Barossa	37.2	44.8	81.9	21.3
1990	Yickadee	37.5	45.1	82.6	23.6
1992	Oscar	37.1	45.6	82.7	10.3
1993	Dunkeld	39.4	46.6	86.0	7.6
1993	Rainbow	36.6	44.7	81.3	17.0
1996	Grouse	38.2	45.7	83.9	10.4
1996	Monty	38.5	44.8	83.3	7.0
1996	Range	38.4	45.5	83.9	11.0
1996	Scoop	39.1	46.7	85.8	8.9
1997	Charlton	41.3	46.1	87.4	7.6
1998	Mystic	39.8	45.0	84.8	12.4
2002	Rivette	39.7	47.4	87.1	9.9
2003	46C04	37.6	44.3	81.8	12.0
2004	Ag-Spectrum	38.4	44.0	82.4	10.4
2004	Skipton	39.6	47.0	86.6	17.4
2006	AV-Opal	40.2	47.4	87.6	8.3
2007	AV-Garnet	39.5	43.7	83.2	16.2
2007	Hyola50	40.4	45.6	86.1	9.8
2007	Tarcoola	40.2	46.1	86.4	13.8
	Average	38.4	45.2	83.7	18.7

CONCLUSIONS

Varieties released before 2002 all had poor blackleg resistance but recent releases had improved survival under heavy blackleg pressure. Grain yield has improved by an average of 24 kg/ha/year over three trials but this ranged from 10-44 kg/ha/year at individual sites. Oil content and protein content have both increased by about 2% each over 30 years while glucosinolate content has decreased to 7-16 μmoles per gram of seed since 1990s. Whether the industry requires even lower glucosinolate content needs to be decided and this information needs to be relayed to breeding programs. In addition there was a trend for slightly earlier flowering in the more recent releases.

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