The effect of seed generation on yield and quality of canola

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ABSTRACT

The effect of farmers retaining canola seed over successive generations on yield and quality has long been a concern amongst canola breeders, agronomist and growers. In Western Australia where production costs are low and crop profit margins tight, over 50 percent of growers retain canola seed. In theory a decline in quality and yield would be expected due to contamination, cross pollination and increased variability in maturity with successive generations of retained canola seed. This paper illustrates from trial data in 1995, and again in 2001, that growers don't necessarily suffer from a significant yield decline by retaining their own seed for up to three years. The trials compared grower retained seed of different generations with 'new' or quality assured seed sown in the same environment to determine the effect on yield and oil quality. These results will be of interest to many seed producers.

INTRODUCTION

The effect of retaining successive generations of canola seed on yield and quality of canola has long been a concern amongst canola breeders, agronomist and growers. In theory a decline in quality and yield would be expected due to contamination, cross pollination and increased variability in maturity with successive generations of retained canola seed. Commercial production of canola in Australia is predominantly based on open-pollinated varieties which are more heterogeneous than commercial seed in Europe. This is because, after the initial selection by breeders, canola varieties undergo 5 to 6 generations of seed increase before release. The use of double haploid is not widely used to provide homogenous lines.

Australian canola varieties are not genetically homogenous and continue to segregate for plant characters with each successive generation. With canola being approximately 30% outcrossing this also contributes to genetic impurity with each generation. Previous seed source research on lupins showed variations in seed phosphorus status carried over in subsequent generation to express lower yields on low P soils (Tapscott & Cowling 1995). Contrary to this others have shown lupin crop grown with different Maganese level had no effect on the performance of the subsequent crop (Moreschi, 1999). As it is a small seed there has been limited work on canola and the impact of seed source on subsequent yield. Australian trials which examined the effect of seed source found little differences in seedling vigour (Salisbury et al 1995).

The concern of retained seed was raised by the industry after it estimated that over 50% of canola seed in Western Australia was being retained. This paper summarizes the result of trials conducted to quantify the effect that retained seed has on yield (performance) and oil quality of different generations of canola seed compared to 'new' or quality assured seed.

MATERIALS AND METHOD

Seed is first released by seed companies as 'Certified Seed'. Before this release the seed companies obtain Pre-basic seed from the breeder or licencee of the variety and bulk this up to Basic seed in the first year before commercial release as Certified Seed. When growers sow Certified seed and retain it for planting the following year, it is referred to as 'first generation retained seed'. If they repeat this and sow it the following year it is called the

'second generation' and so on. In 1994, retained seed of different generations of the most popular varieties Narendra, Rainbow and Oscar, were collected from canola growers throughout the state. In addition, quality assured (QA) seed of different generations (Pre-basic, Basic and Certified seed) supplied by seed companies were included. All treatments were sown in a randomised block design at 5kg/ha at the Great Southern Research Agricultural Research Institute (GSARI), located at Katanning in 1995, with standard fertiliser practices. Yields were obtained in 1995 and oil concentration analysed on the 1994 seed sown and 1995 harvested seed.

For the second trial, seed was collected from a number of canola growers across the State In 1999 who retained seed for sowing in 2000 (Treatments 2, 4, 6 and 9). A commercial seed company supplied quality assured Certified seed of Karoo and Pinnacle varieties in 1999 (Treatments 1 and 8), and 2000 (Treatments 5 and 7). This seed was then grown out in 2000, on high (120 kg/ha Agras plus 100 kg/haUrea topdressed) and low (60 kg/ha Agras plus 70 kg/ha Urea topdressed) fertiliser inputs. The harvested seed was retained for re-planting in 2001, at Beverley on 30 May, along with some original 2000 seed and fresh 2001 Certified seed of Pinnacle and Karoo (Treatments 10 and 11). To remove seed size effects only seed greater than 1.7mm was sown. The trial was harvested and the yield statistically analysed. Oil quality, including erucic acid contents were measured using NIR and gas chromatography techniques respectively.

RESULTS

The 1995 trial at GSARI experienced delayed germination due to a dry start but establishment in plots evened up as the season progressed and the harvested seed results are listed in table 1. The yield of consecutive generations of each variety were compared over as was quality in terms of oil and glucosinolate concentrations. Applying Duncan's Multiple Range testshowedno significant difference in yield between successive generations.

Table 1. Summary of mean seed yields, seed generation, oil concentration and glucosinolates of grower retained seed and quality assured seed collected in 1994 and grown at GSARI in 1995.

Tr. No	*Treatment*	*Yield tonne/ ha*	*Gen*	*Duncan multiple range test for yield*	*Oil % 1994*	*Oil % 1995*	*Gluc/ mmol/g 1994*	*Gluc/ mmol/g 1995*
1	Nar Pre-basic (QA)	2.04	1	abc	40.2	41.9	15.17	10.34
2	Nar Basic (QA)	1.84	2	bc	39.8	41.5	16.99	8.40
3	Nar Certified (QA)	1.99	3	abc	39.0	42.4	14.67	9.20
4	Nar 1st Gen retained(Central)	1.72	4	c	41.8	41.0	18.31	10.55
5	Nar 1st Gen retained (Sth)	1.75	4	bc	37.8	42.2	11.01	10.34
6	Nar 1st Gen retained (Nth)	1.63	4	abc	41.4	42.8	13.80	9.04
7	Nar 2nd Gen retained (Sth)	1.77	5	abc	37.3	42.4	15.06	9.98
8	Nar 2nd Gen retained (Nth)	1.82	5	abc	42.0	42.1	20.60	9.51
9	Oscar Basic (QA)	1.78	2	abc	37.8	41.4	30.37	10.12
10	Oscar Certified (QA)	2.05	3	bc	38.5	42.7	27.77	11.63
11	Oscar 1st Gen retained (Sth)	2.00	4	abc	44.3	42.0	9.01	11.03
12	Oscar 1st Gen retained (E.S.)	1.68	4	abc	41.7	41.4	11.03	12.46
13	Oscar 2nd Gen retained (Sth)	1.82	5	bc	44.2	42.0	9.32	10.37
14	Oscar 2nd Gen retained (E.S[#].)	2.04	5	abc	40.6	41.8	15.12	10.54
15	Rainbow Pre-basic (QA)	2.08	1	abc	*	42.2	*	8.57
16	Rainbow Basic (QA)	2.59	2	a	42.7	41.4	10.92	10.71
17	Rainbow Certified (QA)	2.19	3	abc	43.0	41.4	10.92	11.78
18	Rainbow 1st Gen retained (Sth)	1.99	4	ab	41.3	43.0	23.97	10.97

[#]E.S.; seed obtained from eastern states of Australia

No significant difference in yield was found between varieties, between seed generations, or between geographic sources of seed. A non-significant trend towards decreasing yields for each consecutive generation was seen in the variety Narendra only (figure 1). The oil, and

glucosinolate concentration varied between the geographic sources of seed (1994), however differences disappeared after the treatments were grown in the same location. Table 1 shows the variation in seed quality obtained from different sources within Australia.

The trial at Beverley in 2001 was designed to remove site effects by growing all the seed at the one site in 2000, then comparing the effect of seed generation on yield in 2001.

No difference in yield was found between seed sourced from the high and low P,N+S fertiliser levels, indicating that level of soil fertility had no effect on retained seed. Karoo yielded significantly better than Pinnacle for Certified seed obtained in 1999 and 2000, but not 2001. There was no significant yield difference in retaining seed for three generations compared to using new certified seed, (table 2).

Table 2. Summary of mean seed yields (tonnes/ha) from different sources/generations sown at Beverley in 2001

Treatment	Seed source	Generation[2]	Variety	Hi fert. (2000)	Lo fert. (2000)	Average	N°.plots [3]
8	Certified 1999	5	Pinnacle	1456	1196	1326	6
7	Certified 2000	4	Pinnacle	1267	1393	1330	6
11	Certified 2001	3	Pinnacle	-	-	1296	3
1	Certified 1999	3	Karoo	1526	1478	1502	6
5	Certified 2000	4	Karoo	1381	1522	1452	6
10	Certified 2001	3	Karoo[1]	-	-	1300	3
4	Grower retained South	6	Karoo	1448	1474	1461	6
6	Grower retained Central	6	Karoo	1463	1426	1444	6
9	Grower retained East	6	Karoo	1393	1256	1324	6
2	Grower retained North	6	Karoo	1493	1445	1469	6
			Mean	1435	1404	1397	
	LSD 5% for comparing within treatment 10 and 11					162.1	3 vs 3
	LSD 5% for comparing treatment 10 and 11 with the rest					140.4	3 vs 6
	LSD 5% for comparing within treatment s 1 to 9					114.6	6 vs 6

[1] Two plots harvested only. [2]Where pre-basic is gen 1, basic gen 2, certified gen 3 etc.

[3] Number of plots used in the statistical analysis

For both trials, the quality data was assessed on composite samples of each replicate and no statistical analysis was possible. In the 1995 trial, there was a slight trend for the glucosinolates in Rainbow to increase over successive generations of canola, however, in the 2001 trial, no apparent trend of deterioration in seed quality was seen.. .

CONCLUSION

Seed obtained from growers in a number of geographic locations varied greatly in quality in both seasons it was collected (1994 & 1999) and highlights the important impact environment has on retained seed quality. Of interest was the discovery that seed of different quality collected from different sources in 1994, when grown out at the same location in 1995, subsequently had similar level of seed quality. This suggests that environment has an over-riding effect on the quality of retained seed. This is a factor to be considered when making recommendations to growers to replace seed frequently. The 2000–2001 trial shows that seed obtained from different nutritional backgrounds (Hi and Lo P,N+S Fertiliser) had no significant impact upon yield of retained seed in Western Australia. In this trial no significant difference of yield was found when comparing QA ('Certified') seed with seed retained by growers for 2 to 3 consecutive years, whether Karoo or Pinnacle. It is possible that some out-crossing occurred within the trial plots over the two years, 2000-2001, to even out the quality and yield of the different treatments. However, Salisbury(2002) concludes that the extent of this occurring between the field crops in Australia is minimal (below 0.2%). It is thought to be

unlikely that cross pollination had any significant effect in shifting the varieties closer to homogeneity. It is concluded that seed retained by growers for up to two years (4 generations from 1st release) will have no significant decline in yield or quality in the Australia environment.

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Figure 1 Correlation between seed yield and generation of retained seed for three canola varieties at GSARI, 1995