Shatter-resistant canola germplasm from interspecific hybridization – a progress report

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ABSTRACT

Pod shattering is a significant production problem as it is reported to result in yield losses of up to 25% in commercial cultivars of *Brassica napus*. As windrowing is not always cost-effective and is not completely effective in preventing yield losses, breeding canola to identify germplasm with superior shatter resistance is important. This study aimed to assess germplasm derived from interspecific crosses using pod rupture energy (RE) as a measure of shatter resistance. A set of sixty two lines derived either from *B. napus x B. rapa var. yellow sarson*, *B. juncea x B. napus* or *Raphanobrassica x B. napus* were evaluated. Results indicated good variation for shatter resistance in material derived from *B. napus* x *B. rapa* crosses, representing a three-fold increase in RE in comparison with check varieties. These lines possessed *B. napus*-like appearance and were stable for shatter resistance in limited progeny testing. Further work is in progress to fully characterise this material which could be a useful source for shatter resistance in *B. napus*.

Key words: shatter resistance – pendulum test – interspecific hybridisation.

INTRODUCTION

Dehiscence of pod at or after maturity is commonly known as pod shatter. It is a natural process by which many plant species disperse their seed in order to survive and spread in the wild. Shatter resistance is usually an early consequence of domestication but *B. napus* has a relatively short history of cultivation. Whilst there is no active dehiscence mechanism in *B. napus* a separation layer in the pod suture facilitates shattering (Kadkol *et al.* 1986). Yield losses are typically quoted around 10%, with losses up to 25% not uncommon (Price *et al*. 1996). Seed loss of as much as 50% (1.6 t ha^{-1}) of yield has been reported under adverse climatic conditions and delayed harvesting (MacLeod 1981; Child & Evans 1989). Kadkol (1985) reported limited variation for resistance to pod shattering in *Brassica napus* but observed very high levels of shatter resistance in *B. rapa* vars *Brown Sarson* and *Yellow Sarson* lines. The shatter-resistant *B. rapa* were crossed with *B. napus* lines to transfer shatter resistance to *B. napus*. This material was continued to BC_1F_7 by Ag-Seed Research/Nuseed P/L.

The present study was conducted to screen a number of lines from the above crosses together with other material of interspecific origin using a pendulum method (Liu *et al*. 1994) with a view to identify shatter-resistant material which can be potentially deployed in the Australian breeding programs.

MATERIALS AND METHODS

A set of sixty two interspecific lines was assembled containing material from *B. napus X B. rapa var. yellow sarson* (Kadkol 1984, source: Nuseed), *B. juncea* X *B. napus* (Dr. Janet Wroth, source: UWA) and *B. napus* X *Raphanobrassica* (Dr. Abha Agnihotri, source: TERI, India) crosses respectively. Eight plants per accession were grown outdoors under normal daylength, in pots containing pasteurised potting mix. The outdoor conditions allowed normal pod set and growth. Plants were allowed to grow to maturity and pods from each plant were collected from the main stem when ripe.

Five pods from each plant were tested to determine pod rupture energy (RE) using a pendulum method (Liu *et al*. 1994; Kadkol 2009). Data from the tests was analysed using GenStat ver. 11.1. to determine significance of differences in RE between the experimental lines using one way analysis of variance.

RESULTS AND DISCUSSION

The experimental lines differed significantly in rupture energy. Several lines possessed mean RE levels in excess of 8 mJ and this is beyond the range of variation for RE in *B. napus* indicating some success in recovering high RE expression in the advanced generations (Table 1, Fig 1). We tested eight individual plants in most lines and this provided a limited plant-progeny test for preliminary assessment of the material (GK lines were single plant selections). Most lines showed considerable variation for RE between plants indicating genetic segregation (Table 1). This could be due to chromosomal imbalances in the material although a portion of the segregation could be due to heterozygosity arising from lack of pollination control in previous generations.

There were a small number of lines that showed high pod strength and were relatively stable, (e.g. GK18. GK2, GK3 and GK19 in Table 1). These lines possessed *B. napus*--like appearance and near normal pod set. In the next phase of work it will be necessary to test these lines further for stability and fertility in more extensive progeny tests and also check chromosome numbers and Mendelian inheritance of high RE in these lines.

There are more *B. napus* X *B. rapa* lines to be tested and also there are high RE segregates identified from the above tests. These will also be investigated in the next phase of this research.

Table 1. Rupture energy data for selected experimental lines derived from interspecific hybridisation.

Line	Mean RE	± SE	Significance (0.05)	Segregation	
				High RE	Low RE
GK 3	13.06	0.39	h	7	1
GK 18	12.77	0.40	h	7	0
GK 2	11.23	0.40	g	6	1
GK 19	10.98	0.39	f	7	1
UWA 20	8.19	0.39	de	4	4
TERI-4	7.57	0.45	de	5	2
UWA 15	7.22	0.40	d	4	3
GK 6	7.16	0.38	d	5	3
UWA 26	7.01	0.40	d	4	3
UWA 27	6.95	0.40	cd	3	4
UWA 28	6.94	0.38	cd	4	4
UWA 13	6.83	0.54	cd	3	1
JC134	6.83	0.38	cd	5	3
UWA 16	6.76	0.38	cd	6	2
Surpass400 NCB4	5.65	0.52	bc	2	6
JC67	5.13	0.45	bc	3	4
Rivette NCB5	5.05	0.45	bc	2	3
TERI-3	4.55	0.48	b	2	3
ATR-Stubby	3.33	0.38	a	0	8

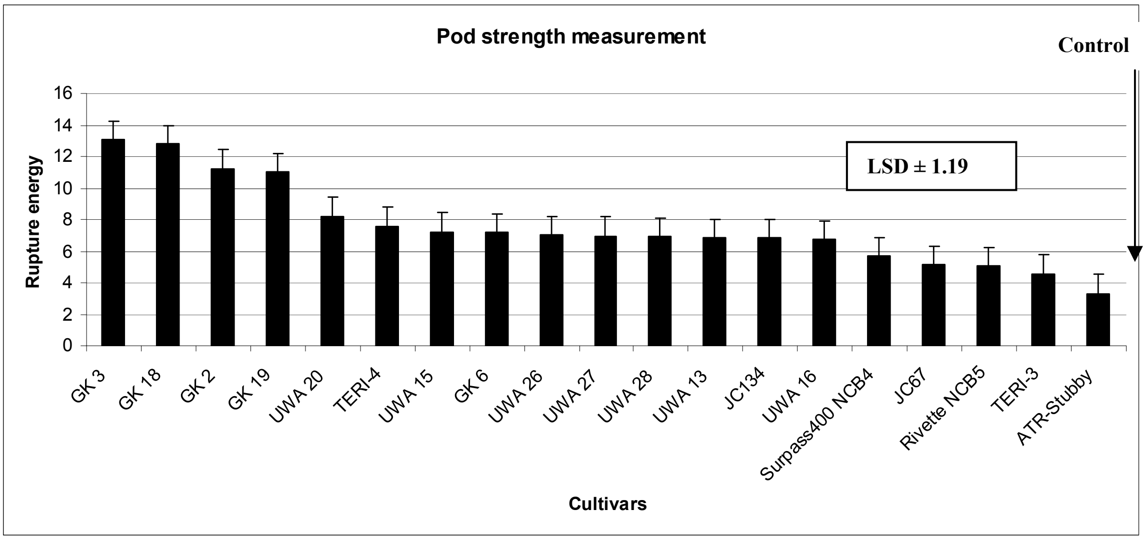

Fig 1. Graphical comparisons between accessions for pod rupture energy by pendulum machine.

CONCLUSION

This National Brassica Germplasm Improvement Program study has identified several interspecific lines derived from *B. napus* x *B. rapa* with high pod strength and good stability in inheritance. Further work is required to fully characterise this material which could be a useful source for shatter resistance in *B. napus*.

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