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MODIFICATION OF BRASSICA SEED OIL FATTY COMPOSITION UTILIZING INTERSPECIFIC CROSSING

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ABSTRACT

A cross was made between zero erucic *Brassica carinata* and low linolenic *Brassica napus*. The F_1 plant was backcrossed to both the *B. carinata* parent and the *B. napus* parent to develop either low linolenic *B. carinata* or high linoleic *B. napus* (similar to standard sunflower type oil). Selection for low linolenic *B. carinata* and high linoleic *B. napus* has been carried out utilizing half-seed analysis for several generations. The success of this approach is discussed.

INTRODUCTION

Zero erucic lines of *B. carinata* have recently been developed (Alsono et al. 1991, Fernandez-Escobar et al. 1988, Getinet et al. 1994). However these lines have significantly higher levels of linoleic acid and linolenic acid than canola cultivars and even higher than zero erucic *B. juncea* (Getinet et al. 1994). The total of these two fatty acid is greater than 60%. Because of the increased instability of oil that is associated with high levels of linolenic acid (Eskin et al. 1989, Przybylski et al. 1993) the oil of these lines is therefore still not highly desirable. In an attempt to reduce the polyunsatuated level of these lines an interspecific cross was made with a zero erucic, low linolenic, low glucosinolate line of *B. napus* obtained from R. Scarth of the University of Manitoba. The very high levels of polyunsaturated fatty acids in these lines create the possibility that if synthesis of linolenic acid could be prevented using the gene from the low linolenic *B. napus* a standard sunflower-like canola oil could be developed. Therefore the F_1 of the interspecific cross was backcrossed to both the zero erucic *B. carinata* parent and the low linolenic *B. napus* parent in an attempt to make either low linolenic *B. carinata* or high linoleic, low linolenic *B. napus*. Selection of fatty acid phenoltypes succeeding generations of this material utilizated half- seed analysis. This paper discusses the progress made so far with this cross in both species.

EXPERIMENTAL

Materials and Methods

The fatty acid composition of whole seeds and half seeds was determined by the method of Thies (1971), except that gas chromatography of the methyl esters was performed with a Supelcowax 10 (0.5 μm by 0.32 mm by 15 m) fused silica capillary column at 210 ° using hydrogen as the carrier gas. The transesterification reagent was 0.8% sodium metal in methanol.

25 plants of the zero erucic, lines of *B.carinata* (C90-0010, C90-0012) were crossed with the low linolenic *B. napus* selection (C92-0027). The F_1 interspecific seed was backcrossed to both the *B. carinata* parents and the *B. napus* parent. The BC_1F_1 seed of the *B. carinata* backcross was planted and selfed. Then 63 of BC_1F_2 seeds were half seed analysed for fatty acid composition. 1 half seed was selected on the basis of low linolenic acid content. This half seed was planted and selfed. Six seeds of this plant were half seed analysed and an additional 4 seeds planted without half seeding. 143 seeds of the BC_1F_4 generation were half seed analyzed of which 4 were continued onto generation BC_1F_5. Again 60 half seeds were analyzed of which 13 were kept. At BC_1F_6 generation 123 half seeds were analysed and two were kept because of they high in oleic acid and low in both linoleic acid and linolenic acid. An additional 3 were kept because of their high linoleic/low linolenic acid profile. Table 1 summarizes the fatty composition data for the parents used in the cross and their progeny.

Table 1. Fatty acid composition (% of total ± SD) of parental lines and progeny

Generation (seed)	16:0	18:0	18:1	18:2	18:3	20:1	22:1
B. carinata parents	5.7±1.0	1.2±0.2	18.6±5.0	37.6±3.5	34.7±3.8	1.0±0.2	0.0±0.0
B. napus parent	3.7±0.4	2.0±0.6	65.6±3.6	23.2±3.6	2.2±0.3	1.4±0.1	0.2±0.4
BC_1F_2-car mean	5.5±1.7	1.2±0.4	26.6±7.0	42.6±5.6	21.6±4.1	1.3±0.3	0.1±0.2
BC_1F_2-car sel. half sd.	3.9	0.9	36.4	39.8	15.8	1.6	0.3
BC_1F_3-car mean	4.8±0.7	0.9±0.1	31.4±4.9	41.4±4.4	19.1±1.2	1.3±0.1	0.1±0.0
BC_1F_3-car sel. half sd.	4.5±0.4	0.9±0.1	33.3±5.0	40.2±5.2	18.8±0.2	1.3±0.1	0.1±0.0
BC_1F_4-car mean	4.3±0.9	0.9±0.2	31.2±3.2	42.2±3.9	17.7±2.6	1.5±0.2	0.7±0.6
BC_1F_4-car sel. half sd.	3.6±0.7	1.1±0.1	32.7±1.8	43.5±1.5	15.3±0.9	1.7±0.1	0.6±0.6
BC_1F_5-car mean	5.3±1.8	1.6±0.5	30.1±4.5	47.4±4.6	12.9±3.1	1.2±0.2	0.0±0.1
BC_1F_5-car sel. half sd.	4.6±1.0	1.7±0.5	29.4±5.8	51.0±4.8	10.7±3.0	1.1±0.1	0.0±0.0
BC_1F_6-car mean	5.0±1.8	1.7±0.7	33.2±7.4	44.8±6.2	12.9±3.5	1.2±0.3	0.0±0.0
BC_1F_5-car High 18:1.	4.5±2.6	3.4±0.1	60.2±8.1	24.1±5.0	4.4±0.1	1.7±0.4	0.0±0.0
BC_1F_5-car High 18:2	5.0±1.3	1.5±0.4	26.5±7.7	51.5±2.4	12.9±6.7	1.2±0.1	0.0±0.0
BC_1F_2-nap mean	4.7±1.2	1.2±0.5	41.0±8.3	40.7±7.9	9.0±3.0	1.4±0.4	0.1±0.4
BC_1F_2-nap sel. half sd	5.7	0.9	46.8	38.1	5.7	1.5	0.0
BC_1F_3-nap mean	6.8±0.3	0.7±0.1	33.6±3.8	49.7±2.6	6.7±1.2	1.0±0.1	0.1±0.1
BC_1F_3-nap sel. half sd	6.9±0.4	0.7±0.1	32.0±4.2	50.8±2.8	7.3±1.1	1.0±0.1	0.1±0.1
BC_1F_4-nap mean	5.7±0.6	0.8±0.1	41.4±4.7	42.3±3.8	6.2±1.1	1.3±0.2	0.7±0.7
BC_1F_4-nap sel. half sd	6.0±0.3	0.7±0.0	36.2±3.6	46.6±3.1	7.3±0.7	1.2±0.2	0.5±0.5
BC_1F_5-nap mean	7.1±1.3	1.3±0.5	43.8±8.1	38.6±6.1	6.8±2.1	1.0±0.3	0.1±0.1
BC_1F_5-nap sel. half sd	7.9±0.8	1.0±0.1	33.7±2.4	47.4±2.5	7.9±1.7	0.9±0.0	0.1±0.1
BC_2F_2-nap mean	4.7±0.9	1.1±0.2	53.1±6.4	34.5±5.5	4.1±1.1	1.4±0.2	0.0±0.1
BC_2F_2-nap sel. half sd	5.7±1.0	1.2±0.3	37.9±3.8	47.2±2.8	5.4±1.5	1.2±0.1	0.0±0.0

The BC_1F_1 seed of the *B. napus* backcross was also planted and selfed. Then 46 of BC_1F_2 seeds were half seed analysed for fatty acid composition. 1 half seed was selected on the basis of low linolenic acid content. This half seed was planted and selfed. Five seeds of this plant were half seed analysed, of which three were selected. 94 seeds of the

BC_1F_4 generation were half seed analysed of which 4 were continued onto generation BC_1F_5. Again 46 half seeds were analysed of which 4 were kept for another backcross to the *B. napus* parent. At BC_2F_2 generation 962 half seeds were analysed of which 32 were selected on the basis of an linoleic acid content of greater than 44 %. Table 1 summarizes the fatty composition data for the parents used in the cross and their progeny.

Discussion

Table 1 demonstrates a striking contrast between the low linolenic *B. napus* line and the low erucic *B. carinata* lines in the content of the polyunsaturated fatty acids, particularily in the content of linolenic acid. There was no significant difference between the two *B. carinata* parental lines. The table also shows that we were able to reduce significantly the linolenic acid content of in the interspecific cross backcrossed to *B. carinata* and that this decrease has been consistently demonstrated in succeeding generations. If the high oleic/low linoleic/low linolenic acid selections of BC_1F_6 prove to be stable, we may even be able to develop a *B. carinata* line with a canola quality type oil. In the backcross to B. napus we have been able to recover a significant increase in linoleic acid content (approaching 50%), while maintaining a low level of linolenic acid. These lines may lead to a new type of canola with a sunflower like oil.

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