

Conventional breeding for high-oleic and low-linolenic Brassica napus oil profile

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Abstract

In generation F₂ developed as a result of crosses between winter OP rapeseed samples there were derived plants with oleic acid content in oil at level 68-70%, i.e. higher by 4-5% than the common fatty acid profile of rapeseed oil. Seeds of the derived plants were gathered together and sown in field isolated conditions without any limitation of intercrosses between plants of the population. Individual selection of plants was carried out in the beginning of flowering by using self-pollination. Traditional pedigree-breeding with analysis of oil fatty acid composition and selection of plants with maximum oleic acid content in oil was used.

In generation S₆ there were established variations of oleic and linolenic acids content in rapeseed lines 70.0-76.8% and 5.8-6.1% respectively and in separate seeds 70-80% and 2.9-7.2% respectively.

24 plants with oleic acid content in oil – 82.1-83.5%, linolenic acid – 3.1-4.0% and saturated fatty acids – 4.6-6.8% were derived in generation S₇ of line VN 40173 with oleic acid content 76.8% in 2010.

Key words: Brassica napus L., high-oleic and low-linolenic rapeseed

Introduction

High-oleic and low-linolenic rapeseed (*Brassica napus* L.) has been developed in world breeding institutions by using either conventional or transgenic breeding methods. The oil profile of this rapeseed consists of more than 75 % oleic acid, less than 3 % linolenic acid and less than 7 % of saturated fatty acids. Due to such fatty acid composition this rapeseed oil has an improved nutritional value.

Breeding for development of high-oleic and low-linolenic winter rapeseed was started in the All-Russia Research Institute of Oil Crops by V.S. Pustovoit (VNIIMK) in 2002.

Materials and Methods

Germplasm of VNIIMK was used for the creation of the parental material. Lines 40068, 39754 (female parents) with content of oleic acid in oil 69.6 % and 69.9 %; of linolenic – 5.4 % and 6.9 % respectively were used as parent forms. Variety Drakon and line 32577 with content of oleic acid 67.9 % and 65.8 %; of linolenic – 6.7 % and 7.4 % respectively were used as male parents.

In order to derive the parental material the individual selection of plants with the use of self-pollination and a traditional pedigree method together with analysis of fatty-acid content of oil and selection of plants with the maximal oleic acid content in oil were used.

The fatty acid profile was determined by a standard procedure using gas chromatography and capillary column Stabilwax-DA 50 m x 0.53 mm x 0.5 µm, which enables separation on the basis of unsaturation degree and chain length.

Results

Intraspecific hybrids derived from crossing the winter rapeseed line 40068 and variety Drakon and from crossing lines 39754 x 32777 were developed in 2001. In 2003 in generation F₂ developed as a result of crosses between winter OP rapeseed samples there were derived plants with oleic acid content in oil at level 68-70 %, i.e. higher by 4-5 % than the common fatty acid profile of rapeseed oil. Seeds of the derived plants were bulked and sown in field isolated conditions without any limitation of intercrosses between plants of the population. Individual selection of plants was carried out in the beginning of flowering by using self-pollination (S₁ - 2004). Then a traditional pedigree-breeding with analysis of oil fatty acid composition and selection of plants with maximum oleic acid content in oil was used.

In 2007 in generation S₄ there were developed seven lines of winter rapeseed in crossing combination «39754 x 32777» and five lines developed through crossing «40068 x Drakon» with oleic acid content in oil more than 70 %. The maximal content of oleic acid was 74.0 и 73.1 % respectively. In 2008 in generation S₅ there were derived 14 lines according to both crossing combinations, the maximal oleic acid content was 74,9 %.

In 2009 in generation S₆ there were developed variations of oleic and linolenic acids content in rapeseed lines 70.0-76.8 % and 5.8-6.1 % respectively and in separate seeds 70-80 % and 2.9-7.2 % respectively. Variation of content of oleic and linolenic fatty acids is presented in table 1.

Table 1 Variation of content of oleic and linolenic fatty acids in oil of winter rapeseed lines

Year	Fatty acid content in oil, %					
	Oleic			Linolenic		
	max	min	average	max	min	average
2007	74.0	70.8	72.1	6.3	5.3	5.6
2008	74.9	68.2	71.9	8.0	5.7	6.6
2009	76.8	70.0	73.6	6.1	5.8	5.9

The maximal oleic acid content in oil 76.8 % was shown in 2009 by the line 40173 developed through the crossing combination «40068 x Drakon». By the analysis of separate seeds of this line a variation of oleic acid from 70 to 80 %, linolenic – from 2.9 to 7.2 % was determined.

In 2009-2010 there was carried out an economic estimation of winter rapeseed lines which were the most promising according to the fatty-acid composition of oil (table 2).

Table 2 Characteristic of high-oleic lines of winter rapeseed

Line	Seed yield, t/ha	Oil content of seeds, %	Glucosinolate content, mcM/g	Fatty acid content, %		
				oleic	linoleic	linolenic
40173	4.8	45.9	16.9	79.0	8.3	5.5
40350	4.7	47.2	14.2	75.1	12.8	4.7
Standard	4.7	46.9	17.3	69.0	17.9	6.1
LSD 5%	0.6	0.5				

According to the set of economically valuable traits there were identified two lines 40173 by crossing combination «40068 x Drakon» and 40350 by crossing combination «39754 x 32577», equal to the standard according to yield, oil content, glucosinolate content in seeds. Line 40173 can be a promising one as a donor of high oleic acid content.

24 plants with oleic acid content in oil – 82.1-83.5 %, linolenic acid – 3.1-4.0 % and saturated fatty acids – 4.6-6.8 % were derived in generation S₇ of line VN 40173 with oleic acid content 76.8 % in 2010.

Conclusion

As result of the breeding work with the use of intraspecific hybridization and traditional pedigree-breeding there was derived a parental material of winter rapeseed with content of oleic acid – 82.1-83.5%, linolenic acid – 3.1-4.0% and saturated fatty acids – 4.6-6.8%.