

CONFECTIONERY SUNFLOWER HYBRID BREEDING IN VNIIMK (RUSSIA)

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ABSTRACT

Experiments were conducted at the Central Station (Krasnodar) of All-Russia Research Institute of Oil Crops (VNIIMK). Released, prospective and experimental sunflower hybrids and inbred lines of VNIIMK breeding were used as a material. Randomized block design was used to test the obtained hybrids. Plant density was 50 000 plants per ha. Plots were 25.2 m² in size and had four rows; two central rows were harvested to evaluate seed yield, oil and husk content, 1000-seed weight. Field resistance to all pathogens was registered under the natural conditions. The aim of our breeding efforts was to develop sunflower hybrids suitable for double-using – as a confectionery and oil-type hybrid. No such commercial hybrids were available at this time in Russia. Such hybrids should perform high seed yield, rather high oil content and high 1000-seeds weight. Results show that the best hybrid (VK-905 A × VK-944) have significantly higher seed yield in comparison with the check. Seed yield level was rather high in the trial. Check OP variety Oreshek gave 3.23 t/ha. Oil content in the absolutely dry seeds was 454 g/kg for the check variety, and varied from 431 to 480 g/kg in the seeds of studied hybrid combinations. As a result tested hybrids could be used in two different ways (for oil production and for confectionery use) along with released confectionery OP varieties (Oreshek, SPK and Lakomka). Significantly less oil content is typical for the confectionery sunflower produced outside the Russia. To evaluate general combining ability (GCA) of our new confectionery lines we crossed two CMS-lines with four restorer lines. As a conclusion line with the best GCA value for the seed yield was VK-944 (0.40) and VK-905 A was the best line among the testers. Combination of two the most important traits (seed yield and seed size) allowed us to define the most prominent hybrids and lines. It was proved that to develop sunflower hybrids suitable for double-using – as a confectionery and oil-type hybrid – is quite possible. Such hybrids should perform high seed yield, rather high oil content and high 1000-seeds weight. Three-year trial allows us to define the most prominent hybrid combination (VK-905 A × VK-944).

Key words: Hybrid – sunflower – confectionery – broomrape resistance

INTRODUCTION

Sustainable market demand for confectionery sunflower seeds made VNIIMK initiate a special breeding program with the aim to develop modern confectionery open-pollinated varieties. Dr. S. Borodin with his colleagues released three OP varieties – SPK, Lakomka and Oreshek (Gontcharov and Beresneva, 2009). Their seeds are close to the oil-type one by structure but larger in size and 1000-seed weight, has bigger husk content and less oil content (450-490 g/kg). Husk is black or black with grey stripes in color. This type of seeds has special Russian name “mezheumok” and means intermediate. People in Russia and Ukraine prefer such types of sunflower seeds for the direct consumption. The seeds also could be easily dehulled by the machinery for confectionery use. Now these four OP varieties covered more than 700 thousands hectares in Russia. Commercial success of confectionery OP varieties encouraged us to start confectionery hybrid breeding program also. This program started in 1999. Russian market demands for sunflower with 1000-seed weight 80 g or more, oil content on the level 450-490 g/kg and seeds should be easily dehulled.

As a new initial breeding material we used non-oil samples of sunflower from Iran and Syria, Russian modern confectionery OP varieties and high-oil inbred lines of our breeding with relatively big seed size.

As a result of crossing this material and self-pollination we developed a number of inbred lines for confectionery hybrid breeding. Lines were crossed with CMS-lines to test their ability to restore pollen fertility. So we found some restorer lines and some maintainer lines. Several of such lines were converted to CMS-lines by back-crossing.

The aim of our breeding efforts was to develop sunflower hybrids suitable for double-using – as a confectionery and oil-type hybrid. Such hybrids should perform high seed yield, rather high oil content and high 1000-seeds weight.

MATERIALS AND METHODS

Experiments were conducted at the Central Station (Krasnodar) of All-Russia Research Institute of Oil Crops (VNIIMK). Krasnodar region is situated in the Southern part of Russia near the Black Sea. Climatic conditions are very favorable here for sunflower production. Sunflower usually covers about 0.5 million ha in this region.

Released, prospective and experimental sunflower hybrids of VNIIMK breeding were used as a material. To produce confectionery hybrids we used two CMS-lines of our own breeding (VK-905 A and VK-934 A). Restorer lines were developed from crosses of our elite lines with dolichocarpous sunflower. The most interesting sample was bought in the local Iranian market. It was very specific dolichocarpous sunflower *Helianthus annuus* var. *armeniacus* Wenzl. & Anaschz (Anaschenko, 1971). This botanical variety of cultivated sunflower considered to be the most genetically distant from usually used sunflower cultivars. Main traits for individual selection were early flowering time (Iranian sample was very late in our conditions), short stem (initial material population was very tall – up to 3 m and more), bigger seed and kernel size, resistance to diseases.

Randomized block design was used to test the obtained hybrids. Plant density was 50 000 plants per ha. Plots were 25.2 m² in size and had four rows; two central rows were harvested to evaluate seed yield, oil and husk content, 1000-seed weight. Field resistance to all pathogens was registered under the natural conditions. Shneider and Miller's method (1981) was used for phenological observations. Oil content was evaluated by NMR-analyzer.

RESULTS AND DISCUSSION

New breeding program with the aim to develop sunflower hybrids suitable for double-using – as a confectionery and oil-type hybrid – started at VNIIMK in 1999. As a first result the most prominent hybrid combination Katyusha (VK-905 A × VK-944) was put in the State trial (table 1).

Oil content in the absolutely dry seeds was 454 g/kg for the check variety, and 477 g/kg in the seeds of studied hybrid combination. As a result seeds could be used in two different ways (for oil production and for confectionery use) along with released confectionery OP varieties (Oreshok, SPK and Lakomka). Significantly less oil content is typical for the confectionery sunflower produced outside the Russia. But such material had no commercial success here.

1000-seeds weight of all tested hybrid combinations was higher 80 g, thought superiority of check variety was obvious. Comparison of 1000-seeds weight of all tested combinations showed big variation for this trait. 1000-seed weight varied from 79.1 g (VD-354 × K-3) to 109.9 g (VK-905 × K-3).

To evaluate general combining ability (GCA) of our new confectionery lines we crossed two CMS-lines (VD-354 A and VK-905 A) with four restorer lines (K-1, K-3, K-4 and K-5). CMS-lines were used as testers. Obtained hybrids were tested for the seed yield. Analysis of results allowed us to calculate GCA values (Table 2).

Table 1. Trial results of new confectionery sunflower hybrid Katyusha (Krasnodar, 2009-2011)

Hybrid variety	or OP	Seed yield		Oil content, %	Oil yield		1000-seed weight, g
		t/ha	± to check		t/ha	± to check	
Oreshkek (check)		2.29	-	45.4	0.94	-	117.2
Katyusha		2.66	+0.37	47.7	1.14	+0.20	106.8

After three years of State trial this hybrid was released.

Table 2. General combining ability evaluation of confectionery sunflower lines for seed yield (Gontcharov and Beresneva, 2011)

Line	Type	GCA value
K-1	Paternal (pollinator) line	-0.35
K-3	Paternal (pollinator) line	0.13
K-4 (VK-944)	Paternal (pollinator) line	0.40
K-5	Paternal (pollinator) line	-0.18
VK-905 A	Mother line (tester)	0.17
VD-354 A	Mother line (tester)	-0.17

As a conclusion line with the best GCA value for the seed yield was K-4 (0.40), average value was demonstrated by K-3 line (0.13). Other two lines showed poor results. VK-905 A was the best line among the testers. Next breeding effort allowed us to develop new CMS-line 934 A (confectionery type) and to identify restorer line VK-930 (oil-type) with high combining ability. New hybrids were tested in 2015 (Table 3).

Table 3. Trial results of new confectionery sunflower hybrids (Krasnodar, 2015)

Hybrid or OP variety	Seed yield		Oil content, %	Oil yield		1000-seed weight, g
	t/ha	± to check		t/ha	± to check	
Oreshkek (check)	3.49	-	44.5	1.40	-	104.1
VK-934 A×VK-930	4.12	+0.63	45.6	1.69	+0.29	85.2
VK-934 A×VK-944	3.92	+0.43	39.4	1.39	-0.01	106.6
VK-905 A×VK-930	3.61	+0.12	47.2	1.53	+0.13	75.6
LSD ₀₅	0.26					

It was proved that to develop sunflower hybrids suitable for double-using – as a confectionery and oil-type hybrid – is quite possible. Such hybrids should perform high seed yield, rather high oil content and high 1000-seeds weight. The most prominent hybrid combinations (VK-934 A×VK-930, VK-934 A×VK-944 and VK-905 A×VK-930) are recommended for the future trials. Their parental forms (CMS-lines VK-905 A and VK-934 A and restorer lines VK-944 and VK-930) will be used for the future breeding work.

LITERATURE

- Anaschenko, A.V. 1971. The dolichocarpous sunflower in the Transcaucasia. Bulletin of Applied Botany, Genetics and Plant Breeding. 45 (2): 51-60. (in Russian with English ABSTRACT).
- Gontcharov, S.V. and N.D. Beresneva. 2011. Confectionery hybrid sunflower breeding in Russia. Journal of Agric. Sci. and Technology B 1: 919-924.
- Shneider, A.A. and J.F. Miller. 1981. Description of sunflower growth stages. Crop Science 20: 901-903.