Breeding of winter rapeseed in the Central European Russia.

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Introduction. The main oil crop in Russia is a sunflower. Crop land expansion in the northern regions is unfeasible. The alternative to the sunflower is a rapeseed (*Brassica napus oleifera* Metzg.). Rapeseed is used in production of edible oil, high-energy fodder additives, as vegetation mass for fodder and sidereal purposes, biofuel and industrial oil production and as a raw material for many different industries. Winter rapeseed has an increasing importance in Central Russia, because its seed production is 1.5–2 times higher than of the summer one. The cultivation of a winter rapeseed allows cutting the costs and reducing the pesticide load in comparison with a summer rapeseed because winter rapeseed crops are not damaged by crucifer flea beetle and are only slightly damaged by blossom weevil. Sowing is made in August, while harvesting is typically carried out during the favorable weather conditions in July-August. The creation of ecologically adaptive high-yield winter-hardy double-low varieties is required for stable seed production and expansion of winter rapeseed crop lands. The assortment of winter rapeseed varieties on Russian market is rather wide, and the increasingly higher part of this market is taken up by the European varieties and hybrids, characterized by high raw fat content, low glucosinolate level and morphological uniformity. However, they all have a low winter-hardiness and thus are allowed to be used only in North Caucasus and Kaliningrad Oblast. In favorable years with mild winters they can yield about 4.2–4.5 tons per ha, which is at a level of a Russian varieties yield, but in harsh winters (1982-83, 1994-95, 2002-2003 years) all foreign varieties died out, while varieties bred in All-Russian Williams Fodder Research Institute (VIK) allowed getting a yield of approximately 1.4–2.1 tons per ha.

Object. The main directions of winter rapeseed breeding are the increase of seed yield, winter-hardiness, disease resistance, oil content, glucosinolate level decrease, improvement of fatty acid composition and protein quality.

Methods. Methods of hybridization, biotechnology, freezing in climatic chamber, inbreeding and directional selection of winter-hardy resistant genotypes are used in new winter rapeseed varieties breeding. Creation and evaluation of new initial material with resistance to root rot and to *Sclerotinia* disease is carried out by means of a lab express benzimidazole method with the use of spore suspension pathogen culture and by means of screening on natural and artificial infection backgrounds. In the current work greenhouse was widely used, which facilitates the production of hybrid and breeding material during the winter and thus shortens new variety breeding time by 3–5 years.

The measurement of erucic acid and glucosinolate levels is carried out during all stages of a breeding process. The screening of genotypes with low erucic acid content is executed by a gas-liquid chromatography method (Kharchenko L.N. et al. 1984). Glucosinolate level measurement is conducted by a “gluco-test” express method and by a more precise “palladium” method.

Results. In rapeseed breeding we use winter-hardy varieties as a female parent and the most qualitative and productive Russian and foreign varieties and breeding samples as a male parent.

Assessment and winter-hardiness screening are carried out by such characteristics as apex height, shape and development of rosette in autumn, dry matter-productivity of plants before the winter. The selection of plants which stop their autumn growth at early stages allows choosing the most winter-hardy genotypes.

In Moscow region the following varieties showed their high winter-hardiness: the Russian ones – Promin, Otradnensky; the Swedish ones – Status, Jupicu, № 843, № 942; the German ones – Liraston, Lirajet; the French ones – Tandem, Darmor. High seed yield was present in Tandem, Darmor, Liraston, Jupicu varieties.

The relative frost-hardiness measurement in various breeding samples was carried out in the greenhouse complex of VIK with the use of a KNT-16 climatic chamber. This measurement was used later in screening of the most frost-hardy genotypes (Volovik, 2002). The highest frost-hardiness was observed in hybrid combinations with Promin variety.

All this helps to organize efficient screening. Along with an intensive and accurate artificial selection it is necessary to create the conditions for the natural selection of winter-hardy varieties. For this hybrid populations are grown in the harsh winter conditions. These conditions are provided on snowless slopes or slopes with little snow, or on the specific provocative infection backgrounds.

The following procedures are used for providing conditions for selection: snow raking, the shortage of phosphorus fertilizer treatment, sowing on a plot with lowered microrelief, artificial formation of ice crust etc. Preferably, these conditions must facilitate the dying of 80-90% plants.

Phytosanitary monitoring of winter rapeseed crops carried out since 1995 shows that the main diseases in this culture in the Central Russia are *Typhula* disease, fusariosis, *Sclerotinia* disease, *Rhisoctonia* disease, bacterioses, *Phoma* rot, alternariose and powdery mildew. Fusariosis in winter rapeseed (pathogen – *Fusarium oxysporum* Schlecht.: Fr.) was first registered in Russia not long ago – in 1989 (Nikonorenkov et al., 1996)

The highest harmfulness of fusariosis in Moscow region is present in plants contaminated in early development stages, and the damage in these plants has form of a root rot which are caused by a complex of a genus *Fusarium* Lk. The most widespread species in this genus are *F. oxysporum*, *F. solani* (Mart.) App. et Wr., *F. avenaceum* (Fr.) Sacc., *F. culmorum* (W.G. Sm.) Sacc., *F. sambucinum* Fuck.

There is a dependence of *Fusarium* fungi on the age of winter rapeseed plants. *F. oxysporum* is the most widespread species in seedlings, while *F. sambucinum* and *F. solani* are the most widespread in plants observed in spring.

The research of plant death dynamics caused by fusariosis root rot was carried out with Otradnensky recognized variety. Plant loss in seedling stage was 15%, plant loss before winter – 10%, and during the winter and the spring the loss was 40% of the initial number of plants.

A benzimidazole method was used in the immunity lab of VIK for assessment of red clover resistance to fusariosis and *Sclerotinia* root rot (Razgulayeva et al., 2010). The modification of this method is used for express assessment of rapeseed resistance to fusariosis and *Sclerotinia* disease. Promising samples found during this assessment are currently included into the selection process.

Long-term average annual damage of plants caused by *Sclerotinia* disease in Moscow region is 12%. In years 2002, 2006, 2007 and 2009 the occurrence of Sclerotinia disease on winter rapeseed was rather low (1–4 %), while in year 2004 it reached the maximum (29%).

Seven samples were selected on the artificial infection background because of their winter-hardiness 15–23% higher and Sclerotinia resistance 20–32% higher than of a recognized variety.

In years 2002 and 2007 winter rapeseed crops were significantly damaged by *Phoma* rot (the long-term average annual level was exceeded by 17–22%). In years 2001 and 2009 no signs of this disease were observed.

Wide variation of vulnerability to pathogens in breeding material allows carrying out the resistant plants screening and using them in the further breeding. Potential double-low breeding material was created with the level of winter-hardiness more than 70%, average seed yield 3.0-3.5 tons per ha and potential seed yield up to 6–10 tons per ha.

We have used erucic-free varieties as a female parent to increase the possibility of erucic-free plants selection during the new material creation. F_1 plants were grown in a greenhouse, F_2 plants were subject of a strict selection in which erucic-free plants were picked out. As a result of selection of winter rapeseed samples with low glucosinolate level and the absence of erucic acid in oil the overall quantity of low-glucosinolate samples has increased from 3% in 1995 to 22% in 1999, and of erucic-free samples - from 51% to 88% respectively. This shows the efficiency of a focused biochemical selection.

As a result of winter-hardy and frost-hardy material selection the winter rapeseed variety ”Severyanin” was created. Average seed yield during 2004–2007 was 4.25 tons per ha, oil content was 46%.

Two new varieties “Laureat” and “Stolichny” have passed the government tests in 2011 and are allowed to be used in agriculture.

The government tests of a promising winter rapeseed variety “VIK- 2” are currently carried out. This variety is characterized by high seed yield of 3.8–4.45 tons per ha, winter-hardiness, improved biochemical seed content and disease resistance.

The tests of a new variety “Garant” start in 2011.

Conclusion. The assortment of winter rapeseed varieties with different ripening periods has been created since 1995. Up to 2.2 tons of oil, up to 1.7–1.8 tons of extraction cake and up to 1.2 tons of raw protein can be obtained from every hectare of crop land. Implementation of these varieties will increase the stability and cost effectiveness of oilseed production in Central Russia and also will expand the crop land coverage. This will allow increasing the production of high-quality edible oil and high-energy fodder additives for livestock farming.