Some valuable characters of naked oat

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Comparative analysis of a wide diversity of oats was initiated because of a profound interest in using these forms in breeding practice, backed up by the development of plant immunological, biochemical, and other research. Thoroughly-evaluated initial material is of special importance for crop breeding. The collections of the Vavilov Institute of Plant Industry (VIR) represent global cultivar and botanical diversity encompassing over 14 thousand (12,000 cultivated and 2,000 wild) oat accessions. The size of the institute's collection keeps increasing, due to the addition of the most interesting breeding, genetic, and botanical material from the main centers of origin and diversity of these crops, and from the countries which demonstrate a high level of research in the sphere of breeding and diverse utilization of the crops (Loskutov, 1999).

Theoretical investigations currently underway at the VIR Department of Genetic Resources of Oat, Rye, and Barley are concentrated on the development of methods to use the selected germplasm efficiently and on revealing patterns in the variation and inheritance of the main traits of importance for breeding. The results of this research, along with the available initial materials, facilitate the solving of such problems in oat breeding as resistance to the main diseases, earliness, semi-dwarfness, grain quality (in terms of the content of protein, lysine, fat, individual fatty acids, starch, antioxidants, etc.) and grain productivity (Loskutov, 2007).

The results of comparative studies of the naked and hulled oat forms have shown that many of their agronomic characters are substantially different.

A comprehensive phytopathological evaluation of oat diversity facilitates the selection and utilization of new genetic sources and donors of resistance, thus broadening the genetic basis of any newly created oat cultivars. Sources of resistance to the main oat pathogens and pests, including crown and stem rusts, various leaf blights, smuts, and *Fusarium* fungi, have been found. The resistance to *Fusarium* of oat accessions was evaluated based on three parameters: percent of *Fusarium* infected kernels, the presence of DNA from trichothecene-producing fungi, and toxin (DON, T-2 toxin) accumulation. There was no clear correlation between kernel infection, fungal DNA level, and mycotoxin accumulation for any particular germplasm. But, in the group of oats relatively resistant to invasion by pathogens, the number of lines accumulating low amounts of DNA and mycotoxin was significantly higher than the number of lines in the moderately and highly susceptible groups. All genotypes tested were relatively resistant to all components of the disease (Gavrilova *et al*., 2008; Gagkaeva *et. al*., 2013). All naked oat forms, as compared with husked oats, were found to possess high values of the biochemical parameters evaluated. Therefore, changes in the chemical

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composition of the grain may explain why the naked oats have a higher degree of biochemical protection from the parasite compared to the hulled oats with their primarily mechanical protection.

From the point of view of nutritional and fodder qualities, biochemical characteristics of oat grain are of the highest importance. In terms of biochemical composition, grain of the naked form differs significantly from that of the hulled form in that it has a higher content of protein (about 20%) and starch (more than 45%). Recently, the list of biochemical components adding to the high nutritional value of oats has come to include oil content, fatty acid composition, β-glucan, tocopherols, sterols, avenanthramides, and other components. At present, this analysis of the collection has been the most promising one and has resulted in the identification of interesting initial material (Loskutov, 2007; Loskutov & Rines, 2011).

The studied set of naked oat accessions was found to contain increased amounts of oil. Some accessions, e.g., local oats from China, Mongolia, Great Britain, and the cv. 'Vyatsky Golozerny' from Kirov Province, had over 8% oil in the kernel. As for the fatty acids, it should be noted that almost all studied accessions showed the content of oleic acid, the most valuable one, to be at the same level as that found in sunflower oil (over 40%). In some accessions, this parameter exceeded 43%. In addition, it should be noted that two accessions, namely a landrace from Mongolia and cv. Vyatsky Golozerny, had the highest contents of palmitic, oleic, and linoleic acids.

The highest content of sterols was recorded for local oats from China and Mongolia, and the highest quantity of tocopherols was found in a local Mongolian landrace. Therefore, a study of oat kernel chemical composition has shown that a landrace of naked oat from Mongolia collected by a VIR collecting mission in 1921 is exceptional in terms of its content of oil, individual fatty acids, tocopherols, and sterols. Another study, this time on the resistance to *Fusarium* against an artificial background, also identified that same landrace of naked oat from Mongolia, which can be used as a unique source in oat breeding.

Cereals are an inexhaustible source for improving functional foods. The gluten-free diet for celiac patients is based on functional foods that prevent pathological changes in people genetically predisposed to this disease. Such a diet can be improved by including oats in it. However, there exist contradictory opinions on the existence of antibodies to oat proteins in celiac patients' blood, and, consequently, the toxicity of oat proteins.

Proteins of most oat cultivars react with antibodies from most patients almost as strongly as with wheat proteins. However, we found that several accessions, including one hulled cultivar and two hull-less cultivars from Russia and the UK, are distinguished by their unusual reactions. These proteins do not react with antibodies from half of celiac patients. This means that the immunogenic properties of these proteins differ from those of other cultivars. It is possible that the proteins of the selected cultivars are non-toxic for some celiac patients. This discovery may help to individualize the diets of celiac patients, and make the search for cereal cultivars for producing functional foods for celiac diets more worthwhile (Alpatyeva *et al*., 2006).

At present, the requirements of agricultural production are changing and, primarily, the new cultivars created have to be qualitatively diverse, leaving the question of productivity in the background. The VIR collections contain the material required for

creating cultivars of naked oat that can be used for producing food with good dietary and nutritional qualities.

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