

## **SANA - NEW VARIETY OF SPRING OAT**

Dragan MANDIC, Goran DJURASINOVIC, Iskra MIHIC

Agricultural Institute of Republic of Srpska - Banja Luka, Bosnia and Herzegovina

\*Corresponding author: dragan\_mandic@inecco.net

### **Abstract**

New variety of spring oat is the first registered variety of oat in the Agricultural Institute of Republic of Srpska (RS), Banja Luka. It is an early variety, plant height is 110 cm and has excellent resistance to lodging. It has large, well-filled grain, 1000 kernel weight is about 33 g, a hectoliter mass 50 kg, the grain color is golden yellow. Protein content in the grain is about 14,5%, oil 4,3%, mineral matter 2,77% and 11,3% cellulose. In 2011 and 2012 are conducted the trials of Varietal commission at six locations. Variety Sana achieved higher grain yield and higher protein content than the standard variety Slavuj. Variety Sana achieved maximum yield of 9.412 kg/ha at the site of Sremska Mitrovica and the average yield for two years and locations was 6.725 kg/ha.

**Key words:** oat (*Avena sativa* L.), yield, variety, breeding, quality.

### **Introduction**

Oat originated from Europe, Asia and Africa, but it is imported in Europe as cultivated species and is considered the European corn (Jevti , 1992). It belongs to the botanical family *Poaceae*, genus *Avena* with about 70 systematized species. Cultivated species *Avena sativa* cv. *diffusae* belongs to a group of hexaploid with  $2n=42$  chromosomes. For its ancestors wild forms *Avena fatua* L. and *Avena byzantina* L. are considered. Oat is an old crop, which has multiple purposes as other grain crops. It is used as a grain, green food and as silage for feed about 60%, for industry processing about 30% and for human consumption about 5%. Oat grain is one of the best concentrated food for all kinds of animals, especially horses and the development of young cattle. Dairy cows fed with oat increase milk yield, reduces mortality in poultry and stimulate carrying eggs in laying hens by Rosi *et al.* (1989). Oat has fine and soft straw and husk. It is used as a pure or joint crop, which has the function as supporting crop sowed with peas and beans. With industrial processing of oat following products could be obtained: oat flour, meal, flakes, and various jellies. Nutritional value of these products is large and with easy digestibility. Oat grain has soluble and digestible proteins, rich in vitamins B<sub>1</sub> and B<sub>2</sub>, amino acids lysine and tryptophan, the oil contains mostly unsaturated fatty acids (Maksimovi *et al.*, 1998.). Oat grain contains 385 calories. For example, in the United Kingdom (UK) oat grain is used as oatmeal or cereal for breakfast with milk. It is especially important for growing in mountainous regions where other crops grow weaker. It has modest requirements in terms of mineral nutrition and soil quality. In crop rotation, oat comes behind other crops or as the last crop.

In recent years, the areas under this crop range from 6,5 to 11 hectares in RS. We are proud that 2004 was especially successful in scientific research on oat, two master's theses and a dissertation were defended, which in some way marks a milestone in the work with this very important crop for RS and Bosnia and Herzegovina (BiH). In the last two decades, oat is increasingly used in human nutrition, pharmacy, medicine and cosmetics in the developed world.

### Material and method

At the beginning of 2011, seed and required documentation for a line of spring oat under the symbol BL Z - 101 were submitted to the Department for the recognition and protection of varieties for testing in microtrials in multiple locations and DUS test.

VCU and DUS trials were performed by a unique methodology that is inherent to the plant species at the plots of 5 m<sup>2</sup> in five repetitions. Variety Slavuj was used as a standard, which is one of the most common varieties in production in the Republic of Serbia, and it can be found in sale or in the production in RS.

Oat line BL Z – 101 is created by crossing the varieties Kondor and Astor and bred by pedigree method of selection.

By the Decision No. 320-04-00216/2011-11 from 07.09.2012, the Department for the recognition and protection of varieties, Ministry of agriculture of the Republic of Serbia, introduced this variety named Sana, *Avena sativa* cv. *diffusae* in the the Register of recognized varieties. New varieties are the basis of production, because the ultimate goal of their own creation can be achieved only through production, and it is a complete expression of their potential for yield and quality.

### Results and discussion

New varieties are the basis of production, because the ultimate goal of their own creation can be achieved only through production, and it is a complete expression of their potential for yield and quality (Denić, 2012).

The primary objective and task of breeding was the creation of the first national oat variety with high genetic yield potential, and preferably good quality, because it is known that it is very difficult to combine the two most important characteristics and one genotype. It was achieved in this variety. In addition to these two features, this variety has other excellent agronomic traits, primarily earliness and resistance to lodging.

There are very favorable environmental conditions for the cultivation of oat in the largest part of BiH, and RS. When it comes to the requirements of oats to the soil, climate and mineral nutrition, this is very grateful and modest crop. According to Okiljević (1996) in the first production area in RS (Banja Luka region, Posavina, Semberija, Bira ) up to 63% of the land has acidic to very acidic reaction. The most economical way to use these soils is through sowing acidophilic plants, like oats. This plant species is tolerant to excess manganese and aluminum in the soil (Ubavić, 1996).

For most grain crops including oats, it is important to have the gene for earliness, in addition to other important agronomic traits. It was shown that early-maturing varieties of oat avoid temperature and drought stress. Earliness is closely linked with the sowing dates, so varieties planted in the early sowing dates provide safe and quality yield. Resistance to lodging is also one of the important features that the newer varieties should have, and this trait is closely related to production technology, primarily the amount of nitrogen fertilizers and quantity of seed for sowing. Resistance to lodging is a quantitative trait that depends on the environmental conditions, soil and applied agricultural technology. Resistance to lodging depends on the anatomical structure of the stem, conductive and mechanical tissues, thickness of the lower internodes, the development of foliage, root system, resistance to agents of several diseases that attack the stem and root, as well as the accumulation of some mineral elements, particularly calcium in stalk.

Oat grain quality is measured by the amount of nutrients, particularly proteins, which are contained in the core. According to Moule (1964) grain shell contains 30% cellulose and about 40% pentosans. According to the same author, the percentage of the core varies from 65 to 70% at the finest varieties of oat. This is a quantitative trait, and can range from 3 to 4% depending on the environmental factors. The largest part of the oat proteins belong to the

globulin 55%, glutelins about 21 – 27% and albumin around 9 – 20%. Oat oil contains plenty of linoleic acid, which is essential in the human diet (Pržulj *et al.* 2011). Soluble oat dietary fibers are beta glucans, which content varies from 25 - 70 g/kg. The level of beta glucans can be increased by breeding to this characteristic, and the use of appropriate agricultural technology (Peterson, 1991). According to the results of the Commission for registration of varieties (Table 1) the grain of variety Sana contains about 14,52% of crude proteins, which is significantly higher compared to the standard variety with 11,69%.

Table 1. Physical, chemical and technological characteristics of Sana variety compared to standard Slavuj

Characteristic		Novi Sad	
		Sana	Slavuj
Chemical characteristics			
1.	Dry matter content (%)	89.41	89.53
2.	The content of organic matter	86.64	86.84
3.	The content of nitrogen-free extracts (NFE)	56.5	56.9
4.	Crude protein content	14.52	11.69
5.	The content of crude fat	4.32	5.54
6.	The content of crude fiber	11.31	12.73
7.	Ash content	2.77	2.69

An important feature, since the yield is largely dependent on it, is the resistance to lodging. This is a quantitative trait that depends on the environmental conditions, soil and applied agricultural technology. Resistance to lodging depends on the anatomical structure of the stem, conductive and mechanical tissues, thickness of the lower internodes, the development of foliage, root system, resistance to agents of several diseases that attack the stem and root, as well as the accumulation of some mineral elements, particularly calcium in stalk. During the tests (Table 2) variety Sana had an average stem height 98,5 cm and resistance to lodging with grade 1, meaning resistant to lodging.

Table 2. Heading date, plant height and lodging

Place	Year	Heading		Plant height (cm)		Lodging (grade 1 – 9)	
		Sana (date)	+/- days of standard	Sana	Slavuj	Sana	Slavuj
Novi Sad	2011.	30.05.	- 4	103.1	99.2	1	1
	2012.	25.05.	- 2	95.4	92.8	1	1
		-	- 3	99.25	96	1	1
Kikinda	2011.	28.05.	- 8	120	124	1	1
	2012.	29.05.	0	107	112	1	1
		-	- 4	113.5	118	1	1
Kruševac	2011.	27.05.	- 8	113	94.8	7	7
	2012.	05.05.	4	110	95	1	1
		-	- 2	111.5	94.9	4	4
Pan evo	2011.	02.06.	0	84	96	4	3
	2012.	01.06.	0	101	107	1	1
		-	0	92.5	101.5	2.5	2
Sremska	2011.	28.05.	- 8	102	106	1	1

Mitrovica							
	2012.	30.05.	- 3	104	98	1	1
		-	- 5.5	1'3	102	1	1
Sombor	2011.	25.05.	- 2	80	85	1	1
	2012.	21.05.	- 6	69	72	1	1
		-	- 4	74.5	78.5	1	1
	2011.	-	- 5.0	100.4	100.8	2.5	2.3
	2012.	-	- 1.2	97.7	96.1	1.0	1.0
2011 – 2012.	-	-3.1	99.0	98.5	1.8	1.7	

1000 kernel weight is variety trait, that is caused by genetic factors. It varies widely by climate, soil and agro-technical conditions of production. Based on the results of several authors 1000 kernel weight ranged from 22 g to 33 g (varieties with very coarse-grain). The best indicator of fertility is the number of grains per panicle, where it is established a positive correlation coefficient of  $r = 0,67$  (Moule, 1964). Sana variety had in average 55 seeds per panicle, which is in accordance with the values that have other varieties of oats. According to research (Nožini, 2008), seven varieties of oats (Željka, Lov en, Slavuj, Rajac, Flemingsregent, NS golozrni and Vesna) average 1000 kernel weight was 28,3 g in the three-year average, and also the average value for the same characteristic in mentioned varieties grown at three different locations (Banja Luka, Drini and Novi Sad) was 28,1 g. The modern type of oat variety is a shorter stem in the range 70 – 110 cm, with lower tillering, a large number of grains per panicle, with thicker internodes. The number of grains per panicle varies under the influence or environmental factors, and sowing date has a crucial role for this feature. The highest number of seeds in spring oats was achieved by sowing in the second half of February, which means that oats can be sown earlier if weather and soil conditions permit. Later sowing gives more sterile spikelets at the base of the wiper or the smaller total number of grains per panicle.

In agricultural production, variety is a basic mean for the production of organic matter, which is used in human and animal nutrition. Creation of high-yielding, adaptive and stable varieties intended for production is one of the important tasks in scientific and research work in agriculture.

Tab. 3. Grain yield (kg/ha) of new variety Sana according to the results of the Commission for varieties from Belgrade in 2011

No.	Variety	Localities						x
		Kikinda	Kruševac	Novi Sad	Pan evo	Sremska Mitrovica	Sombor	
6507	Slavuj	8108	6787	7240	-	8840	7534	
6725	Sana	8247	6454	9273	-	8270	7709	

Tab. 4. Grain yield (kg/ha) of new variety Sana according to the results of the Commission for varieties from Belgrade in 2012

No.	Variety	Localities						x
		Kikinda	Kruševac	Novi Sad	Pan evo	Sremska Mitrovica	Sombor	
6507	Slavuj	8108	6787	7240	-	8840	7534	7702
6725	Sana	8267	6706	8299	-	9412	7930	8123

Tab. 5. Average grain yield (kg/ha) of new variety of spring oat Sana according to the results of the Commission for varieties from Belgrade in 2011/12

No.	Variety	Localities						x
		Kikinda	Kruševac	Novi Sad	Pan evo	Sremska Mitrovica	Sombor	
6507	Slavuj	7360	6787	7086	3367	7336	5677	6507
6725	Sana	7772	6454	8022	3158	7474	5551	6725

For all localities and years of testing, variety Sana had higher yield in average than standard variety Slavuj for 0,218 t/ha. The highest average yield for the two years of researching this variety had in the locality of Novi Sad from 8022 kg/ha and the lowest at the locality of Pan evo from 3,158 kg/ha. Based on only these two data we can conclude that this variety, as well as others, can achieve a high genetic potential only in good ecological conditions, particularly soil. According to our two-year research at the locality of the Agricultural Institute, this variety has achieved yield of over 7 t/ha.

### Conclusion

Based on two years results related to the amount of grain yield and other important agronomic traits of variety Sana and standard variety Slavuj, we can derive the following conclusions: Sana is a variety of spring oats intended for grain production, tolerant to lodging and high yielding potential. Compared with the standard variety, during the two years of testing at six locations Sana gave significantly higher grain yields of excellent quality, so that the average content of crude protein was 14,52%, 1000 grain weight about 33 g. This variety is early-maturing, according to the average location/year three days earlier than standard varieties. It possesses good flexibility, because it shows little variation in terms of some morphological and agronomic traits in breeding at different locations.

It is reasonable to expect that this variety enter into seed production and occupy an important place in the production of feed in order to better and on poorer quality soils.

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