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The study of the parent material of spring triticale

G A Mefodyev, L G Sashkarov and V L Dimitriev

Chuvash State Agricultural Academy, Cheboksary, Russia

E-mail: mega19630703@mail.ru

Abstract. New varieties of spring triticale were taken an assessment in the conditions of the Republic of Chuvashia. It's elicited that Saur variety is characterized by the biggest number of productive footstalks with kernel weight per spike and thousand-kernel weight. Variety Rovnya had the least number of productive footstalks. This variety showed minimal number of spikelets in a spike. At the same time, Rovnya had the biggest amount of grains. Variety Ulyana was inferior to all other varieties in kernel weight per spike and thousand-kernel weight. Variety Khaikar true of fact exceeded the standard in the number of productive footstalks, kernel weight per spike and thousand-kernel weight but in the number of spikelets and seeds in a spike was equal to Ulyana. The varieties Saur and Khaikar exceeded the standard in crop yields. Field germination rate turned to be rather low. In fact, Ulyana's seeding rate has not affected the index. It fluctuated from 56,0-56,5%. Seeding density depended on both seed application rate and the variety itself. Number of seedlings with seeding rate growth increased of Ulyana variety from 225 to 339 and 276-372 pcs /m² of Khaikar. However, with increase of the seeding rate the survival capacity and viability of plants decreased. Especially sharp decline was common to the seeding rate of 6 ml of germinating seeds. Optimal seeding rate of triticale varieties in Chuvashia is 5 ml per 1 ha.

1. Introduction

Triticale is synthetic grass cereal produced by hybridization of wheat and rye. It's expected that triticale will combine high yielding potential and good quality of seeds of wheat and persistency to biotic and abiotic stress of rye. Triticale grains can be used for people nutrition and animal feed. Since the last century triticale has been given attention as a potential energy crop. Currently, researches of using of yield biomass in bioenergy production are conducting. The aim of triticale breeding programs focused on improvement of economic features such as: crop yield, biomass, nutrition factors, plants height, also early maturity and a big grain volume. Intensive reproduction and breeding made very fast genetic improvements of triticale seeds. Agronomical advantages and improved qualities of end use of triticale seeds over wheat, achieved as the result of investigations and developments make triticale palatable option for increasing world food production, particularly for stress growth conditions [1].

High content of food fibres in triticale attracts attention to this crop as a possible source of diet food [2]. Protein content of this crop is higher than of a wheat though glutenin fraction is less. Triticale is possible to use in panification and other food products such as pasta or cereal [3]. There is a wide-spaced chemical composition that means potential of triticale as an alternative to crops for different food products and drinks [4]. Cereals considered promising crops that produce biomass in temperate European regions that will be used both for fuel alcohol production and biogas generation [5].



Originally, triticale was created by Rimpau in 1888 by crossing soft wheat and rye and following spontaneous chromosome doubling [6]. Triticale crop in world agriculture is comparatively young and cultivated in production for less than 50 years. Value of the crop is in lucky combination of good qualities of wheat and rye. It's a high-yielding like a wheat and have quality grain high rates. As a rye it's resistant to unfavorable environmental factors. Triticale (\times Triticosecale Wittm) is an amphidiploid created artificially and unites in its genome full chromosome complement of wheat and rye. Now, in general spread, hexaploid types of triticale have higher productivity potential. Despite the fact triticale has a very short developmental history and genomes forming this crop did not pass evolutionary ways of coadaptation intensive breeding with initially sterile hybrid of wheat and rye led to creation of a new crop [6, 7]. Triticale breeding program is widely spread around the world but according to some selectionists and biochemists, triticale mainstreaming is restrained by absence of good technological qualities among its varieties [8, 9].

Originally, triticale appeared in the fields in 1975. Over the last years there is a steady growth of triticale grain production. According FAO, in 2016 triticale was grown in 40 countries in area of 4 157 018 ha. It should be mentioned that 89.45% of world production is concentrated in European countries [10]. Triticale mainstream manufacturers are Poland, Belorussia, Germany, France, China.

In crop yield triticale excels all other crops of the first group. So, in conditions of 2016 average triticale yields was 36.6 hundred kilograms per hectare that is 7.6-50.3% more than another crops yield.

According to Russian Statistics Committee in 2016 in Russian Federation general planting acreage of triticale was 223078 ha. Spring triticale accounted for only 6% of acreage planted with triticale. Little triticale acreage planted with spring triticale may be explained by insufficient studies of its biology and agricultural features in specific soil and climate conditions. Poor variability of spring triticale crops plays negative role. Spring triticale varieties began to be added to State Register only since 2000 and now the list contains only 14 varieties. Most of these registered varieties (57,1%) bred by Federal State Funded Research Institution «National Center of Grain named after P.P. Lukyanenko» and Federal State Funded Research Institution «Vladimir Scientific-Research Agricultural Institute». Therefore, it is necessary to intensify breeding work in creating of new varieties.

In the Republic of Chuvashia triticale was grown on the area of 2,6 thousand ha. Moreover, it was only winter triticale. The investigations carried out earlier have shown perspective of spring triticale in conditions of Chuvashia [11]. In this regard, in 2015 began breeding of the crop in the Chuvash State Agricultural Academy at the Department of agriculture, crop production, selection and seed-breeding. In breeding of any agricultural crop as well as spring triticale discovery and study of a new source material is always of a great interest. Quality of source material always determines effectiveness of breeding work. That is why the main aim of our work was comparative valuation of new spring triticale varieties in conditions of the Chuvash Republic.

2. Experimental part

Investigations of spring triticale varieties were conducted since 2015 in Educational research and practice center «Studencheskiy» of Federal State Funded Research Institution of Higher Education «Chuvash State Agricultural Academy». Soil of the parcel is middle loamy and dark gray. Topsoil of the parcel had acidity close to neutral. Humus level was low, exchangeable potassium-higher, labile phosphorus-high. Experiment was started in six-fold frequency and presented by 4 varieties.

Plot area was 6 m² with seeding rate of 6 ml of germinating seeds. Primary seeds were used for seeding-down. Seeding-down was held in the first half of May, harvest in the end of August. Varieties Saur and Khaikar were bred in Don Zonal Agricultural Research Institute, variety Rovnya in Vladimir Scientific-Research Agricultural Institute, variety Ulyana in Research and Practical Centre of National Academy of Sciences of Belarus in agriculture. In 2018 varieties Saur, Khaikar and Rovnya are registered in State register of selective breeding results allowed in use. Variety Ulyana was taken as a control sample as it is included in register of varieties recommended for production in the Chuvash Republic.

3. Results and considerations

Rovnya variety differs from other varieties by its short stature. The height of crops of Ulyana, Saur and Khaikar varieties was more than 90 cm while that of Rovnya variety was only 67,7 sm. The crop yield of Saur and Khaikar varieties statistically exceed the yield of the standard Ulyana variety, especially Saur variety.

The minimal yield was common to Ulyana variety and was estimated at 36,8 hundred kilograms per hectare. This index of Rovnya variety was higher than that of the standard but the differences were not statistically reliable. Saur variety has given 79,2 hundred kilograms per hectare, i.e. 32,7% more than Khaikar variety. The study of the structural elements of the crops has shown that the varieties are drastically different in the number of productive footstalks, kernel weight per spike, and thousand-kernel weight. The differences in the number of spikelets per spike and the number of kernels per spike among the varieties are not statistically reliable.

Saur variety is characterized by the biggest number of productive footstalks, kernel weight per spike, and thousand-kernel weight. Rovnya variety had the least productive footstalks of all the varieties. This variety also showed the smallest number of spikelets per spike and, in contrast, the biggest number of kernels per spike. Ulyana variety was inferior to all other varieties in kernel weight per spike and thousand-kernel weight. Khaikar variety exceeded the standard in the number of productive footstalks, kernel weight per spike, and thousand-kernel weight, while keeping up with Ulyana variety in the number of kernels and spikelets per spike.

The yield of any variety mostly depends on the elements of the harvest structure. These indexes are interconnected with the field germination capacity of seeds, survival capability and viability of crops. This principle is also common to triticale. It is necessary to use scientifically grounded seed application rates to obtain heavy yields.

Sprouting density depended both on the seed application rate and the variety itself. The higher were the seed application rates, the greater was the sprouting of Ulyana variety from 225 to 339 and 276 – 372 per square meter for that of Khaikar variety. Sprouting density turned to be rather low. Ulyana variety's seed application rate did not show any significant influence on this index. It fluctuated within 56.0–56.5%. Khaikar variety's rate was higher and with the increasing the figures of application rate up to 6 ml of germinating seeds it dramatically decreased (table 1).

Table 1. Influence of the seed application rate on the sprouting.

Variety	Seed application rate, ml of germinating seeds per 1 hectare	Seeds per square meter	Sprouts per square meter	Sprouting density, %
Ulyana	4	400	225	56.3
	5	500	280	56.0
	6	600	339	56.5
Khaikar	4	400	276	69.0
	5	500	342	68.4
	6	600	372	62.0
Least Significant Difference (LSD) ₀₅	-	-	26	3.9

Ulyana variety's density of crops before harvesting increased from 168 to 250 PCs. / m² with an increase in the seeding application rate. At the same time, when the seeding rate increased from 4 to 5 million germinating seeds, the density of crops before harvesting increased, and further increase in the seeding rate led to a decrease in this index. The survival capability and viability of crops of Ulyana variety at all standards of seeding was about the same. These figures of Khaikar variety were higher. However, with the increase in the rate of seed sowing, the survival and viability of crops decreased. Particularly sharp decrease was typical for the seeding rate of 6 million germinating seeds (table 2).

Table 2. Influence of the seed application rate on the survival capability and viability of crops.

Variety	Seed application rate, ml of germinating seeds per 1 hectare	density of crops before harvesting, PCs. / m ²	Survival capability, %	Viability, %
Ulyana	4	168	42.0	74.7
	5	208	41.6	74.3
	6	250	41.7	73.8
Khaikar	4	218	54.5	78.9
	5	259	51.7	75.6
	6	242	40.3	65.0
LSD ₀₅	-	20	3.2	2.8

One of the main indicators that determine the biological yield of any crop is the number of footstalks that carry a full-fledged spike. The increase in seeding rate of Ulyana variety led to a significant increase in the density of productive footstalks. At the same time, other varieties revealed other principles. For example, the maximum density of productive footstalks of Khaikar variety is revealed for seeding rate of 5 million germinating seeds. At the same time, Khaikar variety had more productive footstalks than Ulyana variety. Productive tilling capacity of both varieties did not depend on the seeding rate and ranged from 1.2 to 1.4 (table 3).

Table 3. Influence of seed application rate on the footstalk structure.

Variety	Seed application rate, ml of germinating seeds per 1 hectare	Footstalks, PCs. / m ²				Tilling capacity	
		productive	regrowth	undergrowth	overall	total	productive
Ulyana	4	220	26	18	264	1.6	1.3
	5	245	42	11	298	1.4	1.2
	6	328	52	2	382	1.5	1.3
Khaikar	4	288	78	26	392	1.8	1.3
	5	351	69	11	431	1.7	1.4
	6	342	70	10	422	1.7	1.4
LSD ₀₅	-	23	11	5	25	0.3	0.2

The analysis of the yield showed that an increase in the seeding rate from 4 to 5 million germinating seeds is followed by a significant increase in the yield of grain, especially of Khaikar variety. Ulyana variety's further increase in seeding rate did not lead to a significant change in yields. However, there was a significant decline in this index of Khaikar variety (table 4).

Thus, significant differences between the varieties were identified in the number of productive footstalks, kernel weight per spike, and thousand-kernel weight. Saur and Khaikar varieties' yield significantly exceed the standard. The optimal seeding rate of spring triticale varieties in the Chuvash Republic is 5 million germinating seeds per hectare.

Table 4. Influence of the seed application rate on the yield.

Variety	Seed application rate, ml of germinating seeds per 1 hectare	Yield, hundred kg/ hectare	Abnormalities	
			hundred kg/ hectare	%
Ulyana	4	28.3	-	-
	5	32.2	3.9	13.8

	6	33.2	4.9	17.3
Khaikar	4	37.0	-	-
	5	54.5	17.5	47.3
	6	43.4	6.4	17.3
LSD ₀₅	-	-	3.2	

4. Conclusion

Saur variety was characterized by the greatest number of productive footstalks, kernel weight per spike, and thousand-kernel weight. The number of productive footstalks of Rovnya variety was the lowest. This variety also showed the minimum number of spikelets per spike. At the same time, Rovnya variety's number of kernels per spike was the largest. Ulyana variety is inferior to all other varieties in the kernel weight per spike, and thousand-kernel weight. Khaikar variety significantly exceeded the standard in the number of productive footstalks, kernel weight per spike, and thousand-kernel weight, while its number of spikelets and kernels per spike was equal to Ulyana variety. Saur and Khaikar varieties' yield significantly exceed the standard. The optimal seeding rate of spring triticale varieties in the Chuvash Republic is 5 million germinating seeds per hectare.

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