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ҚАЗАҚСТАН РЕСПУБЛИКАСЫ
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Х А Б А Р Ш Ы С Ы

ВЕСТНИК

НАЦИОНАЛЬНОЙ АКАДЕМИИ НАУК
РЕСПУБЛИКИ КАЗАХСТАН

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NAS RK is pleased to announce that Bulletin of NAS RK scientific journal has been accepted for indexing in the Emerging Sources Citation Index, a new edition of Web of Science. Content in this index is under consideration by Clarivate Analytics to be accepted in the Science Citation Index Expanded, the Social Sciences Citation Index, and the Arts & Humanities Citation Index. The quality and depth of content Web of Science offers to researchers, authors, publishers, and institutions sets it apart from other research databases. The inclusion of Bulletin of NAS RK in the Emerging Sources Citation Index demonstrates our dedication to providing the most relevant and influential multidiscipline content to our community.

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НАН РК сообщает, что научный журнал «Вестник НАН РК» был принят для индексирования в Emerging Sources Citation Index, обновленной версии Web of Science. Содержание в этом индексировании находится в стадии рассмотрения компанией Clarivate Analytics для дальнейшего принятия журнала в the Science Citation Index Expanded, the Social Sciences Citation Index и the Arts & Humanities Citation Index. Web of Science предлагает качество и глубину контента для исследователей, авторов, издателей и учреждений. Включение Вестника НАН РК в Emerging Sources Citation Index демонстрирует нашу приверженность к наиболее актуальному и влиятельному мультидисциплинарному контенту для нашего сообщества.

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COMPARATIVE ASSESSMENT OF VARIETIES OF THE SPRING TRITICALE

Abstract. The relevance of the studies is justified by the fact that in the Chuvash Republic, the triticale was grown on an area of 2.6 thousand hectares, mainly winter varieties. In recent years, research has focused on selection work with spring triticale. The determination and study of the new basic material are always relevant because the quality of the basic material always determines the efficiency of the selection work. The aim of the work was to carry out a comparative assessment of new varieties of spring triticale in the conditions of the Chuvash Republic.

An assessment of new varieties of spring triticale in the conditions of the Chuvash Republic was carried out. It is revealed that the Saur variety is characterized by the largest number of productive stems, weight of kernels from spike and thousand-kernel weight. The number of productive stems was the lowest in the Rovnya variety. This variety showed the minimum values and the number of spikelets in the ear. At the same time, in the Rovnya variety, the number of kernels in the spike was the largest. The Ulyana variety was inferior to all other varieties by the kernel weight from 1 spike and by thousand-kernel weight. The variety of Khaikar significantly exceeded the standard for the number of productive stems, kernel weight from 1 spike and the 1000-kernel mass, and the number of spikelets and kernels in the spike was at the level of Ulyana. The Saur and Khaikar varieties significantly outperform the standard. Field germination of seeds was rather low. In the Ulyana variety, the seeding rate did not have a significant effect on this indicator. It ranged from 56.0 to 56.5%. The density of shoots depended on both the seeding rate and the variety. The number of plantlings with an increase in the seeding rate increased in the Ulyana variety from 225 to 339 and in the Khaikar variety – 276 to 372 pieces/m^2. However, with the increase in the seeding rate, the survival ability and preservation of plants decreased. A particularly sharp decrease was characteristic of the seeding rate of 6 million germinated seeds. The optimal seeding rate of varieties of spring triticale in the conditions of the Chuvash Republic is 5 million germinated seeds per 1 hectare.

Keywords: spring triticale, variety, spike structure, seeding rate, survival ability, preservation, yield.

Introduction. Triticale is an artificial grassy herb derived from the hybridization of wheat and rye. There was a hope that triticale would combine high yield potential and good quality of wheat grain, as well as resistance to biotic and abiotic stresses of rye. Grains of triticale can be used to feed people and livestock. Since the last century, the triticale has been given considerable attention as a potential energy culture. Today, research is currently underway on the use of biomass yields in the production of bio-energy. The aim of the triticale cultivation program is mainly focused on improving economic characteristics, such as grain yield, biomass, nutritive factors, plant height, and features such as early maturity and large grain volume. Intensive reproduction and selection made very rapid genetic improvements in the quality of triticale seeds. Agronomical advantages and improved properties of the end use of triticale grains over wheat, achieved as a result of the research and development, make triticale an attractive option for increasing world food production, in particular, for stressful growth conditions [1]. The high content of dietary fibers together with spring triticale attracts close attention to this culture as a possible source of valuable food raw materials for dietary nutrition [2]. The protein content of this culture is higher than that of wheat, although the fraction of glutenins is smaller. Triticale can be used in the production of bread and other food products, such as pasta and flakes for breakfast [3].There is a wide variation in the chemical composition of triticale, which indicates the potential of triticale as an alternative to cereals for various

foods and beverages [4]. Cereal crops are considered promising that produce biomass in temperate regions of Europe that will be used for both fuel alcohol and biogas production[5].

For the first time triticale was obtained by Rimpau in 1888 when crossing soft wheat and rye, and a subsequent spontaneous doubling of chromosomes [6]. The triticale culture in world agriculture is relatively young and is grown in production for less than 50 years. The value of this culture lies in the successful combination of the positive properties of wheat and rye. Like wheat, it is high-yielding and has high grain quality indicators. As rye, it is resistant to unfavorable environmental factors.Triticale (×Triticosecale Wittm.) Is an amphidiploid created artificially and combines in its genome complete chromosome sets of wheat and rye. Now, hexaploid forms of triticale with a higher potential for productivity are mainly widespread. Despite the fact that the triticale has a very short history of development and the genomes that form this culture, have not gone through evolutionary ways of co-adaptation, intensive selection work with the initially sterile hybrid between wheat and rye led to the creation of a new economically important culture within one century [6, 7]. The selection program for triticale is widely deployed in many countries of the world, but, according to some plant breeders and biochemists, the widespread introduction of triticale is constrained by the absence of varieties with good technological properties [9].

Triticale first appeared in the fields in 1975. In recent years, there has been a steady increase in the production of triticale grain. In 2016, according to FAO, triticale was grown in 40 countries around the world on an area of 4,157,018 hectares. It should be noted that 89.4% of world production is concentrated in European countries [10]. The leading producers of triticale are Poland, Belarus, Germany, France, China.

As for yield, triticale exceeds all other cereals of the first group. So, in the conditions of 2016, the average yield of triticale in the world was 36.6 c/ha, which is 7.6-50.3% higher than the yield of other cereal crops.

According to Rosstat, in 2016 in the Russian Federation, the total area of triticale crops was 223,078 hectares. The share of spring triticale accounted for only about 6% of the area occupied. The small area of triticale crops, especially spring crops, is explained by the insufficient knowledge of its biology and the specific features of agricultural technology in concrete soil and climatic conditions. A poor choice of varieties of spring triticale plays a negative role in this. The varieties of spring triticale began to be included in the State Register only since 2000 and to date, there are only 14 varieties in this list. Most of these registered varieties (57.1%) were grown at the National Center for Grain named after P.P. Lukyanenko "and at Vladimir Scientific Research Institute of Agriculture. In this regard, it is necessary to strengthen the selection work for the creation of new varieties.

In the Chuvash Republic, triticale was grown on an area of 2.6 thousand hectares, with only winter triticale. The investigations carried out earlier by us showed the promise of spring triticale in the conditions of Chuvashia [11]. In this regard, in 2015, in the Chuvash State Agricultural Academy, in the Department of Agriculture, Plant Growing, Breeding and Seed Production, the selection work began with this culture. In the selection of any crop, as well as spring triticale, the identification and study of a new basic material are always relevant. The quality of the basic material always determines the efficiency of the selection work [12]. Therefore, the main aim of our work was a comparative assessment of new varieties of spring triticale in the Chuvash Republic.

Material and methods. The studies of spring triticale varieties have been carried out since 2015 at the Studenchesky scientific and practical center of the Chuvash State Agricultural Academy. The soil of the site is medium-loamy dark gray. The arable layer of the plot had an acidity close to neutral. The humus content was low, exchangeable potassium - increased, mobile phosphorus - high. The experiment was laid in sixfold replication and is represented by 4 varieties. The plot area is 6 m^2.The seeding rate is 6 million germinated seeds. The seeds of the first reproduction were used for seeding. Sowing was carried out in the first half of May, gathering - in late August. The Saur and Khaikar grades are grown at the Don Zonal Research Institute of Agriculture, the Rovnya variety - at the Vladimir Scientific Research Institute of Agriculture, the Ulyana variety - at the Scientific and Practical Center of the National Academy of Sciences of Belarus for Agriculture. Of these, the Saur, Khaikar and Rovnya varieties are included in the state register of breeding achievements permitted for use as for 2018. The Ulyana variety was taken as a control, as it is included in the register of varieties of agricultural crops recommended for production in the Chuvash Republic.

Results and discussion. The variety of Rovnya differs from other varieties by a short stalk. The height of the plants in the varieties Ulyana, Saur and Khaikar was higher than 90 cm, while in the Rovnya variety it was only 67.7 cm. According to the yield of the Saur and Khaikar varieties, they significantly exceed the standard Ulyana variety, especially the Saur.

The minimum yield was typical for the Ulyana variety and it was 36.8 centner/ha. In the Rovnya variety, this indicator was higher than that of the standard, but the differences were not reliable. In the Saur variety from 1 hectare, 79.2 c/ha was obtained, which is 32.7% higher than that of the Khaikar variety. The study of the structural elements of the yield showed that significant differences between the varieties were identified by the number of productive stems, kernel weight from the spike, 1000-kernel weight. According to the number of spikelets in the spike and the number of grains in the spike among the varieties, the differences are not reliable.

The Saur variety was characterized by the largest number of productive stems, the mass kernels from the spike and 1000-kernel weight. The number of productive stems was the lowest in the Rovnya variety. This variety showed the minimum values and the number of spikelets in the spike. At the same time, in the Rovnya variety, the number of grains in the spike was the largest. The Ulyana grade was inferior to all other varieties by the mass of kernels from 1 spike and by 1000-kernel weight. The Khaikar variety significantly exceeded the standard in the number of productive stems, kernel weight from 1 spike and the 1000-kernel weight, and the number of spikelets and kernels in the spike was at the level of the Ulyana.

First of all, the yield of any culture depends on the elements of the yield structure. These indicators are closely interrelated with the field germination of seeds, survival ability and preservation of plants. This pattern is also characteristic of the triticale. To obtain high yields, it is necessary to apply scientifically based seeding rates

The density of plantlings depended on both the seeding rate and the variety features. The number of plantlings with an increase in the seeding rate increased in the Ulyana variety from 225 to 339, and the Khaikar variety - from 276 to 372 pieces/m^2. Field germination of seeds was rather low. In the Ulyana variety, the seeding rate did not have a significant effect on this indicator. It ranged from 56.0 to 56.5%. In the Khaikar variety, it was higher and with an increase in seeding rates of up to 6 million germinated seeds, it declined significantly (table 1).

Table 1 – Effect of the seeding rate on field germination

Variety	Seeding rate, million germinated seeds per 1 ha	Seed sown per 1 m^2, pcs.	Density of plantling, pcs./m^2	Field germination, %
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
$НСР_{05}$	–	–	26	3.9

The density of plant standing before harvesting in the Ulyana variety increased from 168 to 250 pieces/m^2 with an increase in the seeding rate. At the same time, in Khaikar variety, when the seeding rate was increased from 4 to 5 million germinated seeds, the density of plant standing before harvesting increased, and a further increase in the seeding rate led to a reduction in this index. Preservation and survival ability of plants in the Ulyana variety at all seeding rates was approximately the same. In the Khaikar variety, these indicators were higher. However, with the increase in the seeding rate, the survival ability and preservation of plants were reduced. A particularly sharp reduction was typical for the seeding rate of 6 million germinated seeds (table 2).

One of the main indicators determining the biological yield of any crop is the number of stems bearing a full spike (table 3).

Table 2 – Effect of the seeding rate on the survival ability and preservation of plants

Variety	Seeding rate, million germinated seeds per 1 ha	Density of plantling before harvesting, pcs./m^2	Survival ability, %	Preservation, %
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
HCP_{05}	–	20	3.2	2.8

Table 3 – Effect of the seeding rate on the structure of the plant stand

Variety	Seeding rate, million germinated seeds per 1 ha	Number of stems, pcs. per 1 m^2				Tilling capacity	
		Productive	Unfertile stems	Undergrowth	Total	General	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
HCP_{05}	–	23	11	5	25	0.3	0.2

In the Ulyana variety, an increase in the seeding rate led to a significant rise in the density of productive stems. At the same time, other patterns were revealed in other varieties. For example, in the Khaikar variety, the maximum density of the productive stem is revealed at the seeding rate of 5 million germinated seeds. At the same time, the Khaikar had more productive stems than the Ulyana. Productive tilling capacity in both varieties did not depend on the seeding rate in general and ranged from 1.2 to 1.4 (table 3).

The yield analysis showed that an increase in the seeding rate from 4 to 5 million germinated seeds is accompanied by a reliable rise in the grain yield, especially in the Khaikar variety. In the Ulyana variety, a further increase in the seeding rate did not result in significant change in yield. However, in the Khaikar variety, there was a significant reduction in this indicator (table 4).

Thus, significant differences between varieties are revealed by the number of productive stems, the weight of kernels from the spike and the thousand-kernel weight. The Saur and Khaikar varieties significantly exceeded the standard. The optimal seeding rate of varieties of spring triticale in the conditions of the Chuvash Republic is 5 million germinated seeds per 1 hectare.

Table 4 – Effect of the seeding rate on yields

Variety	Seeding rate, million germinated seeds per 1 ha	Yield, centner/ha	Beviation	
			centner/ha	%
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
HCP_{05}	–	–	3.2	

Conclusion. The Saur variety was characterized by the largest number of productive stems, kernel weight from the spike and 1000-kernel weight. The number of productive stems was the lowest in the Rovnya variety. This variety showed the minimum values and the number of spikelets in the spike. At the same time, in the Rovnya variety, the number of kernels in the spike was the largest one. Ulyana variety was inferior to all other varieties by the kernel weight from 1 spike and by 1000-kernel weight. The Khaikar variety significantly exceeded the standard for the number of productive stems, kernel weight from 1 spike and the thousand-kernel weight, and the number of spikelets and kernels in the spike was at the level of Ulyana. Saur and Khaikar significantly exceeded the standard. The optimal seeding rate of spring triticale varieties in the conditions of the Chuvash Republic is 5 million germinated seeds per 1 hectare.

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Чуваш мемлекеттік ауыл шаруашылығы академиясы, Чебоксар, Чуваш Республикасы, Ресей,
Қазақ мал шаруашылығы және азық өндірісі ғылыми-зерттеу институты, Алматы, Қазақстан

ЖАЗДЫҚ ТРИТИКАЛЕ СОРТТАРЫН САЛЫСТЫРМАЛЫ БАҒАЛАУ

Аннотация. Чуваш Республикасында 2,6 мың. га табиғи алқапқа тритикаленің күздік сорты артық өсірілгендіктен, зерттеудің өзектілігі жүргізілген тәжірибемен негізделген. Соңғы жылдары зерттеулер жаздық тритикалемен селекциялық жұмыстар жүргізуге бағытталған. Бастапқы жаңа шикізатты анықтау және зерттеу әрқашан да өзекті болып табылады, өйткені бастапқы шикізаттың сапасы әрдайым селекциялық жұмыстың ұтымдылығын айқындайды. Чуваш Республикасы жағдайында жаздық тритикаленің жаңа сорттарын салыстырмалы түрде бағалау жүргізілетін жұмыстың мақсаты болды. Чуваш Республикасы жағдайында жаздық тритикаленің жаңа сорттарын бағалау жүргізілді. Саур сорты өнімді сабақтарының көп мөлшерімен, масақтан түсетін дән салмағымен және салмағы 1000 тұқымымен сипатталады. Өнімді сабақтарының ең аз мөлшері Ровнясортында байқалды. Бұл сорт масақтағы дәндерінің саны бойынша да ең төменгі көрсеткішті көрсетті. Осы ретте Ровнясортында масақтағы дәндерінің саны өте жоғары болды. Ульянасорты 1 масақтағы дән салмағы және 1000 тұқым салмағы бойынша басқа сорттармен салыстырғанда тиісінше төмен болды. Өнімді сабақтар саны бойынша 1 масақтағы дән салмағы және 1000 тұқым салмағы бойынша Хайкар сорты стандарт талабынан басым болды, ал масақтағы дәні мен масақтар саны бойынша Ульянасортына пара-пар келді. Түсімділігі бойынша Саур жәнеХайкар сорты стандарт талаптарынан басымдылық көрсетті. Егістік алқаптарда тұқымның өсіп-өнуі едәуір төмен болды. Ульянасортында себу нормасы аталмыш көрсеткішке айтарлықтай әсерін тигізбеді. Ол 56,0–56,5% шамасында ауытқыды. Өскіннің тығыздығы тұқымды себу нормасына және сортына байланысты болды. Тұқымды себу нормасын арттырғанда Ульянасортында 225-ден 339-ға дейін және Хайкар сортында 276–372 дана/м^{2}өскін мөлшері еселеніп көбейді. Бірақ-та тұқымды себу нормасын арттырғанда өсімдіктің өміршеңдігі және сақталуы төмендеді. Әсіресе себу нормасы 6 млн. тұқым өскіні үшін кенеттен төмендеу тән қасиет болды. Чуваш Республикасы жағдайында тритикаленіңжаздық сортын 1 га-ға 5 млн. тұқым өскінін себу қалыпты норма болып есептеледі.

Түйін сөздер: жаздық тритикале, сорт, масақ құрлымы, себу нормасы, өміршеңдігі, сақталуы, түсімділігі.

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СРАВНИТЕЛЬНАЯ ОЦЕНКА СОРТОВ ЯРОВОГО ТРИТИКАЛЕ

Аннотация. Актуальность проведенных исследований обоснована тем, что в Чувашской Республике тритикале выращивалось на площади 2,6 тыс. га, преимущественно озимые сорта. В последние годы исследования направлены на селекционную работу с яровым тритикале. Выявление и изучение нового исходного материала является всегда актуальным по причине того, что качество исходного материала всегда определяет эффективность селекционной работы. Целью работы являлось проведение сравнительной оценки новых сортов ярового тритикале в условиях Чувашской Республики.

Проведена оценка новых сортов ярового тритикале в условиях Чувашской Республики. Выявлено, что сорт Саур характеризуется наибольшим числом продуктивных стеблей, массой зерен с колоса и массой 1000 семян. Число продуктивных стеблей был наименьшим у сорта Ровня. Этот сорт показывал минимальные значения и по числу колосков в колосе. В то же время, у сорта Ровня число зерен в колосе было наибольшим. Сорт Ульяна уступал всем другим сортам по массе зерен с 1 колоса и по массе 1000 семян. Сорт Хайкар достоверно превосходил стандарт по числу продуктивных стеблей, по массе зерен с 1 колоса и по массе 1000 семян, а по числу колосков и зерен в колосе был на уровне сорта Ульяна. Сорта Саур и Хайкар по урожайности достоверно превосходят стандарт. Полевая всхожесть семян оказалась довольно низкой. У сорта Ульяна норма высева не оказала существенного влияния на данный показатель. Она колебалась в пределах 56,0–56,5%. Густота всходов зависела как от нормы высева семян, так и от сорта. Количество всходов с увеличением нормы высева семян увеличивалось у сорта Ульяна от 225 до 339 и 276–372 шт./м^2 у сорта Хайкар. Однако с увеличением нормы высева семян происходило уменьшение выживаемости и сохранности растений. Особенно резкое уменьшение было характерно для нормы высева 6 млн. всхожих семян. Оптимальной нормой высева сортов ярового тритикале в условиях Чувашской Республики является 5 млн. всхожих семян на 1 га.

Ключевые слова: яровое тритикале, сорт, структура колоса, норма высева, выживаемость, сохранность, урожайность.

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