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New High-Yielding Triticale Varieties in Rainfed Areas of Uzbekistan

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Annotation: The article presents data on the study of triticale varieties in rainfed conditions. 6 varieties of triticale with high yield, high drought-heat resistance and productivity were selected.

This study investigates the performance of new triticale varieties under rainfed conditions in Uzbekistan, focusing on yield potential, drought resistance, and heat tolerance. Triticale, a hybrid of wheat and rye, offers high ecological plasticity and productivity, yet its application in arid environments remains underexplored. Addressing this knowledge gap, the research evaluates the agronomic and physiological traits of selected triticale varieties to identify high-yielding and resilient candidates.

The study employed competitive variety trials conducted over three years (2022–2024) at the Gallaaral experimental station. Twelve triticale varieties, including the Sardor standard, were assessed for plant height, 1000-grain weight, biomass accumulation, and protein coagulation temperature. Statistical analyses revealed significant inter-varietal differences in yield and abiotic stress resistance. P1V15 exhibited the highest average yield of 21.9 c/ha, outperforming the Sardor standard (18.4 c/ha), while P61V49 demonstrated superior biomass accumulation at 144.78 g, indicating robust drought and heat adaptability.

Keywords: variety, triticale, selection. rainfed, yield, weight of 1000 grains, drought resistance, heat resistance, biomass.

Introduction. The main requirements for breeding varieties in the conditions of Uzbekistan are yield, productivity, quality, resistance to abiotic and biotic stress.

Triticale is a crop that successfully combines the high ecological plasticity of rye with the yield and quality of wheat (Veverine E.K., 2012).

An analysis of the structure of the triticale yield in comparison with rye and wheat shows that there are varieties that are superior to these crops in many respects: the number of grains in an ear, the weight of 1000 grains, the number of grains, etc.

Triticale, a hybrid of wheat (Triticum) and rye (Secale), is increasingly recognized for its potential to address food security challenges in regions affected by abiotic stresses such as drought and heat. Combining the high ecological adaptability of rye with the yield and grain quality of wheat, triticale has emerged as a versatile crop for rainfed agriculture. With its resilience and high productivity, triticale offers a promising solution for improving agricultural sustainability in arid and semi-arid regions, such as Uzbekistan. However, despite its potential, limited research has been conducted to optimize triticale varieties for such challenging environments, leaving a critical knowledge gap.

Studies comparing triticale's agronomic performance with wheat and rye suggest that specific varieties can outperform these parent crops in terms of yield, biomass, and stress tolerance. Traits such as 1000-grain weight, protein stability, and water use efficiency are essential indicators of adaptability and productivity under rainfed conditions. Previous research has highlighted the need for targeted breeding programs and field trials to identify high-performing varieties. However, there remains a lack of comprehensive studies evaluating triticale's physiological and agronomic responses in Uzbekistan's diverse agro-climatic zones.

This study aims to address this gap by conducting competitive variety trials over three years to evaluate the performance of 12 triticale varieties in terms of yield, abiotic stress resistance, and biomass accumulation. Utilizing rigorous field experiments and statistical analysis, the research focuses on identifying varieties with superior drought and heat tolerance while maintaining high productivity. This approach integrates agronomic assessment with physiological measurements to ensure a holistic evaluation of triticale's potential.

Preliminary findings indicate that certain varieties, such as P1V15 and Dustlik-4, demonstrate significant improvements in yield and resilience compared to the Sardor standard. These results suggest that triticale can be a viable alternative crop for rainfed agriculture, particularly in regions prone to climate variability. The study highlights the importance of developing tailored breeding programs to meet the specific needs of local farmers and agro-ecological conditions.

By contributing to the body of knowledge on triticale's adaptability and performance, this research has significant implications for sustainable agriculture. The identification of high-performing varieties can help enhance food security in Uzbekistan and other regions with similar climatic challenges. Future research should focus on genetic studies and multi-environment trials to further validate these findings and expand triticale's utility in diverse agricultural systems.

Research Method. The triticale varieties Dustlik (4.0 ha), Tikhon (0.5 ha), Sergey (0.5 ha) and Svat (0.5 ha) were sown in the propagation nursery.

In the nursery of a competitive triticale variety trial over three years of study, the varieties P 1 V15 (21.9 c/ha), Dustlik-4 (21.6 c/ha), P61 V49 (21.1 c/ha), P31 V49 (21.1 c/ha), P 91V 15 (20.5 c/ha),

the Sardor standard has 18.4 c/ha (Table 1.).

Table 1 Main indicators of triticale on rainfed soil in competitive variety testing (Gallaaral, 2022-2024).

Sort	Plant height, cm.				Weight of 1000 grains, g.				Harvest, c/ha			
	2022 year	2023 year	2024 year	x	2022 year	2023 year	2024 year	x	2022 year	2023 year	2024 year	x
Sardor, st	79,4	85,6	89,6,	84,8	31,0	31,2	32,8	31,7	18,2	18,5	18,4	18,4
P 19 V-34	79,4	85,6	89,6	84,8	31,0	38,8	34,8	34,9	18,5	21,5	19,2	19,7
Dustlik	77,6	78,4	77,6	77,8	31,0	32,2	32,8	32,0	21,4	21,5	21,9	21,6
P 22 V-35	87,9	97,5	98,2	94,5	32,0	37,2	32,0	33,7	20,5	19,0	22,1	20,5
P 91 V-15	80,5	86,0	90,0	85,5	31,0	37,6	32,8	33,8	21,5	19,5	20,5	20,5
P 61 V-49	83,6	93,5	93,6	90,2	32,0	39,6	29,4	33,7	21,5	22,8	19,1	21,1
P 31 V-49	79,4	94,2	96,2	90,0	31,0	40,7	32,8	34,8	19,5	22,5	21,2	21,1
P 14 V-34	77,4	92,1	93,8	87,7	33,0	36,0	32,4	33,8	19,0	21,8	19,5	20,1
P1 V-15	76,5	83,0	87,0	82,1	33,0	36,0	30,0	33,0	21,2	21,0	23,5	21,9
P 13 V-17	84,5	84,6	84,0	84,3	33,0	40,4	34,0	35,8	20,8	19,8	21,2	20,6
Tikhon	66,2	66,2	62,5	64,9	32,0	35,1	32,1	33,1	21,5	19,2	21,5	20,7
Sergey	65,4	65,2	64,0	64,8	32,0	33,1	28,0	31,0	18,2	21,2	21,5	20,3
Svat	67,0	66,5	65,2	66,2	32,0	33,0	34,3	33,1	18,2	20,0	20,4	19,5

According to the tabular data, it can be seen that the weight of 1000 grains on average over three years of study varied among varieties from 31.0 g (Sergius) to 34.8 g (P14V34), for the standard 31.7 g (Sardor); yield - from 19.5 c/ha (Svat) to 21.9 c/ha (P1V15), the standard has 18.4 c/ha (Sardor).

According to the temperature of coagulation of water-soluble proteins in the leaves and the content of total water in triticale plants, fluctuations in characteristics are observed over the years (Table 2).

Table 2 Variability of coagulation temperature of water-soluble leaf proteins and total water content of triticale varieties KSI on rainfed soil (Gallaaral, 2022 – 2024).

D	Sort	Coagulation temperature of water-soluble proteins, °C				Total water content in leaves, %			
		2022 year	2023 year	2024 yera	x	2022 year	2023 year	2024 yera	x
1	Sardor, st	61,0	59,5	58,2	60,2	72,83	73,83	63,66	70,10
2	P 19 V-34	59,5	61,0	62,0	60,2	70,74	73,94	60,54	69,07
3	Dustlik-4	61,5	60,5	59,5	61,0	71,90	74,58	63,44	69,97
4	P 22 V-35	62,0	60,0	59,0	61,0	69,72	74,68	60,86	68,42
5	P 91 V-15	61,0	60,5	59,5	60.7	72,63	75,46	61,35	69,81
6	P 31 V-49	62,0	61,0	62,0	61,5	67,44	76,25	63,21	68,96
7	P 61 V-49	62,5	59,0	57,2	60.7	67,91	73,63	65,72	69,08
8	P 14 V-34	62,0	60,0	61,0	61,0	68,03	74,39	65,07	68,96
9	P 1V-15	62,5	60,0	61,0	61,2	66,88	74,45	64,40	68,57
10	P 13 V-17	59,2	61,5	62,5	61,5	67,45	72,27	63,11	67,69
11	Tikhon	59,0	59,0	59,0	59,0	69,72	76,25	66,09	71,17
12	Sergey	58,2	60,0	61,0	60,0	72,87	73,46	66,62	70,04

The table data illustrates that the coagulation temperature of water-soluble leaf proteins on average over three years ranged from 59.0 °C (Tikhon) to 61.5 °C (P31V49), for the standard 60.2 °C (Sardor)

Based on the accumulation of total wet biomass, triticale varieties Tikhon, Dustlik-4, Plot 22 VAR 35, Plot 61 VAR 49 were identified (Table 3).

Table 3 Variability in the accumulation of total biomass of KSI triticale varieties in the heading phase on rainfed soil (Gallyaaral, 2024)

D	Sort	Weight total raw biomass of 10 plants, g	Weight of ears from 10 plants		Root weight from 10 plants	
			g	Proportion of elk ears, %	g	Proportion of roots, %
1	Sardor, st	100,90	23,92	23,7	13,98	13,8
2	Plot14VAR34	76,10	20,90	27,4	8,58	11,2
3	Dustlik-4	123,92	33,34	26,9	19,90	16,0
4	Plot22VAR35	132,50	35,94	27,1	21,74	16,4
5	Plot91VAR15	108,92	27,66	25,3	17,40	15,9
6	Plot31VAR49	109,58	27,16	24,7	16,14	14,7
7	Plot61VAR49	144,78	37,48	25,8	23,10	15,9
8	Plot19VAR34	108,04	28,02	25,9	14,48	13,4
9	Plot1VAR15	122,26	35,18	28,7	17,50	14,3
10	Plot13VAR17	110,10	32,56	29,5	15,64	14,2
11	Tikhon	123,86	26,70	21,5	22,50	18,1
12	Sergey	114,62	26,16	22,8	12,54	10,9

Tabl data show that the accumulation of total wet biomass ranged from 76.10 g (Plot14 VAR34) to 144.78 g (Plot61 VAR49) for varieties, and 100.90 g for the standard (Farhod); the share of ears as a percentage of the total biomass is from 21.5% (Tikhon) to 29.5% (Plot13 VAR17), for the standard it is 23.7% (Farkhod).

Result and Discussion

The study's findings emphasize the potential of triticale as a resilient crop for rainfed agriculture in Uzbekistan. Through competitive variety trials conducted over three years (2022–2024), significant variations were observed among 12 triticale varieties in terms of yield, abiotic stress resistance, and physiological traits. These results underline triticale's adaptability and its potential to address challenges posed by drought and heat stress in arid and semi-arid regions.

The results reveal that certain varieties, such as P1V15, achieved the highest average yield of 21.9 c/ha, surpassing the Sardor standard (18.4 c/ha). Varieties like P61V49 demonstrated superior biomass accumulation, with a total of 144.78 g, indicating their robustness under stress conditions. Traits such as 1000-grain weight and protein coagulation temperature also varied significantly, reflecting differences in stress tolerance and productivity. The ability of triticale varieties to maintain performance under rainfed conditions highlights their suitability for resource-limited farming systems.

Despite these promising results, knowledge gaps persist regarding the genetic and molecular mechanisms underlying triticale's stress resistance. The absence of extensive multi-environment trials limits the broader applicability of these findings to other agro-climatic regions. Moreover, the relationship between physiological traits, such as water-soluble protein stability, and yield performance warrants further exploration to optimize triticale breeding strategies.

Future research should prioritize genetic studies to identify markers associated with drought and heat tolerance. Advanced techniques such as genomic selection and gene editing could enhance the precision of breeding programs. Additionally, expanding field trials across diverse environments would validate the adaptability of high-performing varieties and provide insights into their long-term sustainability under varying climatic conditions.

The implications of these findings extend beyond agronomic benefits. The development of high-yielding, stress-tolerant triticale varieties could significantly contribute to improving food security in Uzbekistan and similar regions. Furthermore, the integration of these varieties into local cropping systems would support sustainable agricultural practices, reduce reliance on resource-intensive crops, and enhance resilience against climate variability.

The study also underscores the need for practical interventions, such as farmer education and the development of support systems to encourage the adoption of triticale cultivation. Collaborative efforts between researchers, policymakers, and local communities will be critical to ensuring the successful implementation of these findings.

Conclusions. In a competitive triticale variety trial, the varieties Dustlik-4, P14V34, P22V35, P1V15 were selected for yield and components of resistance to abiotic stress.

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