

STUDY OF VARIABILITY IN PRODUCTIVITY ELEMENTS OF WINTER TRITICALE COLLECTION

Svetlana LEATAMBORG, ORCID: 0000-0003-4091-1522

svetlana.leadamborg@sti.usm.md

Silvia ROTARI, ORCID: 0009-0007-5122-9373

silvia.rotari@sti.usm.md

Andrei GORE, ORCID: 0009-0002-7356-7289

andrei.gore@sti.usm.md

Institute of Genetics, Physiology and Plant Protection, Moldova State
University, Chisinau, Republic of Moldova

Abstract. *Arid conditions, which are increasingly common in the world, have a negative impact on the development of agricultural crops and pose a great threat to the implementation of potential plant productivity. In this regard, the purpose of this study is to evaluate collection variety samples for economically valuable traits and to select promising genotypes for use in the breeding process. This article presents the results of a study of 36 triticale variety samples of different geographical origins for the main economically valuable traits (plant height, main spike length, number of spikelets per spike, number of grains, grain weight and 1000-grain weight). Analysis of the productivity elements of the studied samples revealed high variability in the number of grains and grain weight per spike, which makes it possible to select valuable genotypes. Promising samples have been identified based on individual productivity traits and their complex for targeted use in selection of parental pairs included in hybridization.*

Keywords: *collection, triticale, variability, vegetation period, yield structure.*

INTRODUCTION

Triticale (x *Triticosecale* Wittmack) is a hybrid of wheat (*Triticum aestivum*) and rye (*Secale cereale*), combining the positive properties of both cereals. Triticale as a new cereal plant has become increasingly well-known in the world due to its adaptability and valuable agronomic properties, and is grown in more than 30 countries. According to FAO, the geography of triticale distribution is quite wide and is cultivated on an area of more than 4 million hectares worldwide, giving an increase to world grain production of more than 15 million tons per year. Poland, France, Germany, Belarus, Russia and Ukraine play the most important role as the largest European breeding centers and producers of triticale grain [1].

The growing interest in the triticale crop is caused by its high productivity, winter hardiness, grain and green mass quality, low susceptibility to a number of diseases, the possibility of cultivation on poor soils - these valuable properties and

qualities acquired by this crop from wheat and rye are important for its use in agricultural production. Triticale is used as a food and forage crop. The crop is of undoubted interest for the bakery, confectionery, starch, brewing, alcohol and other industries [2].

The consequences of climate change in the world (frequent droughts) cause great damage to agriculture, as a result of which the harvest shortfall is many tons of grain of cereal crops and negatively affects the quality of the grain. In this regard, it is important to expand the gene pool, create new primary and secondary triticale with the involvement of new highly productive forms and varieties. In the Republic of Moldova, triticale can be grown in all regions, so the area of distribution should increase every year. [3].

In breeding for resistance to stress factors of the external environment, an important task is to find sources for a particular stress. One of the methods is the evaluation of collection samples and promising varieties in specific soil and climatic conditions capable of realizing their genetic potential [4].

The main goal of triticale breeding at the present stage is the creation of new high-yielding varieties with increased adaptability, resistance to biotic and abiotic stresses, with high feed, technological and baking qualities [5].

The purpose of this study is to evaluate collection samples for economically valuable traits and identify promising genotypes with a complex of valuable traits for their use in the breeding process.

MATERIALS AND METHODS

The experimental part was carried out on the experimental field of the Institute of Genetics, Physiology and Plant Protection of the Moldova State University. The experiment was preceded by black fallow. The object of the research was 36 collection samples of triticale of different genetic and geographical origin (Romania, Bulgaria, Ukraine, Russia, Belarus, Poland, Germany). The winter triticale variety Ingen 93 of the Institute of Genetics, Physiology and Plant Protection was used as a standard. The collection material was assessed by morphobiological indicators (plant height, spikelet length, number of spikelets per spike, number of grains, grain weight and 1000-grain weight). The productivity elements were studied by the method of structural analysis of a sample consisting of 20 plants. The laying of experiments, phenological observations and field records were carried out in accordance with the methods of state variety testing of agricultural crops by the Center for Testing Plant Varieties of the Republic of Moldova. The experimental data were processed mathematically using the Microsoft Office Excel software package.

RESULTS AND DISCUSSIONS

Numerous selection and genetic studies have proven the need to create an identified gene pool of cultivated plants, as well as the importance of choosing the source material, which is the basis for obtaining new forms and varieties of agricultural crops. Based on the results of the studies, the main economically valuable traits of breeding interest were determined. A triticale collection consisting of 36 variety samples was studied for the following biological properties and economic traits: length of the vegetation period, winter hardiness, drought resistance, resistance to diseases, lodging and productivity.

In terms of the length of the growing season for our conditions, medium early and medium genotypes (255-260 days) are of interest. These groups include samples from Romania, Bulgaria and Poland, Germany (Amol, Haiduc, Stil, L.Ir.Bulgaria, Presto, LT 76872, Agendus, etc.). Late groups include forms from Ukraine and Russia (Salanda, Cernobrivet, Buchet, L.16441-5, AD 1128, etc.). In terms of the length of the growing season, the collection of winter triticale was divided into 3 groups: medium early (length of the growing season up to 255 days), medium (256-260 days) and late (261-267 days) (Table 1).

Table 1. Distribution of triticale collection by maturity groups

Maturity groups	Length of vegetation period, days	Number of samples	%	Name of samples
Medium early	255 and Less	10	27,8	Amol, Haiduc, Stil, Mezin, Negoiu, Oda, L.Ir.Bulgaria, Presto, LT 76872, и др
Medium	256-260	18	50,0	Marchian, Salanda, Cernobrivet, Eltei, Canar, Atlet, Tulus и др
Late	261 –267	8	22,2	Buchet, AD1128, L.16441-5, Duet, B-7, и др
St.	259			Ingen 93

The obtained data show that out of 36 genotypes of the collection, 10 samples belong to the mid-early group, which is 27.8%. This group of triticale ripened 2-4 days earlier than the standard variety Ingen 93. It mainly included forms and varieties created in Bulgaria, Romania and Poland. The mid-season group includes 18 samples, which is 50%. They ripen at the same time as the standard variety or 2-3 days later than the previous group and included samples from Ukraine, Romania, Germany, etc. The late-ripening group included 8 samples or 22.2%. They ripened at least 3-8 days later than the standard and these are mainly samples from Ukraine and Russia. Samples and varieties of triticale of the early and mid-season groups were widely used in hybridization.

In genetic and selection studies of triticale, great importance is attached to the variability of traits, determined not only by the genotype, but also by environmental conditions. The degree of variability of traits reveals the norm of the genotype's reaction in different environmental conditions [6]. Table 1 presents experimental data on the productivity traits of collection samples of winter triticale (plant height, length of the main spike, number of spikelets per spike, number of grains per spike, weight of grains per spike, weight of 1000 grains).

Lodging of plants significantly reduces the yield and complicates mechanical harvesting, therefore the plant height trait is of great importance. Analysis of the plant height of the studied variety samples shows that the values varied widely - from 96 (Agendus) to 139 cm (95W73-2-1), the variation coefficient fluctuated from 1.5 to 3.8%, with an average value of 2.3%. The following samples were the shortest (96-100 cm): Agendus, Tadeus, Oda. The main components of the yield structure are the length of the spike the number of grains in the spike, the productivity of one spike and the weight of 1000 grains. Our studies have shown that the values for the main spike length trait in the variety samples ranged from 9.6 to 15.3 cm. The variability of this trait varied from 2.4 to 13.4%, and the average value was 6.94%.

Important components of the yield are productivity elements, such as the number of spikelets and grains in the spike and their weight. The number of spikelets in the main spike ranged from 24.8 pcs (Negoiu) to 37.6 pcs (Salanda). The variation in this feature is from 3.1 to 11.8% with an average value of 7.0%. The number of grains from the main spike ranged from 41.3 (Roudkrider) to 86.9 pcs (Tulus), the variation coefficient was 6.8 - 27.3%, and the average value was 15.0%. Spike productivity varied from 2.0 g (Roudkrider) to 3.8 g (Duet), the variation coefficient was 8.0 - 26.1% (average 18.1%). The weight of 1000 grains is the most important indicator of the yield structure and the usefulness of seeds, its value depends on the weather conditions during the period of earing and wax ripeness. The weight of 1000 grains was within the range of 33.1 g (Agendus) to 52.8 g (L.16441-5). The coefficient of variation for this feature varied from 4.6 to 15.6%, with an average value of 10.0%. In terms of productivity, the best forms were from Germany (Duet), Ukraine (Salanda) and Russia (L.16441-5, 95W73-2-1, L.12).

The variability of the main breeding-valuable traits of triticale collection variety samples was within 1.5-29.5%. Among the productivity elements, the most stable traits were: spike length 3.8-13.4% ($V_{cp}=6.9\%$) and number of spikelets 3.1-11.8% ($V_{cp}=7.0\%$). The lowest variability was observed for plant height 1.4-3.8% ($V_{cp}=2.3\%$). High variability was observed for the number of grains per spike 6.8-27.3% ($V_{cp}=15.0\%$) and grain weight per spike 8.0-29.5% ($V_{cp}=18.1\%$). Variability of economically valuable traits is important for breeding work, as it allows identifying and using the most valuable genotypes to create new varieties of triticale.

Table 2. Productivity elements of collection samples of winter triticale

Sample	Height of plants		Length of main spike		Number of spikelets in main spike		Number of grains in main spike		Weight of grains from main spike		Weight of 1000 grains	
	X, cm	V, %	X, cm	V, %	X, pcs	V, %	X, pcs	V, %	X, g	V, %	X, g	V, %
Obrii Mironov.	115	1,5	14,9	7,7	33,6	11,6	54,0	20,1	3,0	22,1	47,3	8,7
Marchian	122	3,8	13,4	5,6	31,4	7,4	64,6	16,4	2,9	20,1	44,4	14,6
Salanda	120	2,3	14,9	4,4	37,6	3,1	75,8	10,9	3,7	17,9	48,4	10,8
Buchet	122	2,4	14,0	8,9	32,5	5,5	72,1	17,8	3,0	19,9	41,5	4,6
Cernobriv.	120	2,0	12,2	4,4	29,8	6,5	51,0	15,1	2,2	14,9	43,9	8,9
Eltei	109	2,9	14,1	8,3	32,1	7,7	59,1	17,3	2,6	22,0	44,4	14,6
Amol	111	2,3	12,1	3,8	29,3	6,5	68,2	6,8	2,5	8,0	37,3	5,1
Haiduc	102	2,1	11,5	7,7	30,8	10,1	64,2	9,6	3,0	14,2	46,2	10,3
Stil	108	3,2	12,0	7,5	29,7	11,0	84,1	11,7	3,5	19,7	41,9	11,3
Mezin	106	1,5	9,8	8,8	24,8	11,8	54,9	14,4	2,4	18,5	42,8	11,2
Negoiu	105	2,0	10,1	5,9	24,8	6,8	65,4	23,3	2,8	23,6	43,5	14,7
Oda	97	3,1	10,7	7,4	28,6	9,1	59,0	16,3	2,4	19,7	40,1	11,1
Canar	118	2,7	15,3	6,6	33,0	7,7	78,9	10,7	3,0	13,3	37,9	9,5
L. Ir. Bulg	130	2,5	12,1	8,9	27,7	5,1	57,4	27,3	2,3	29,5	40,0	8,7
161/88-233	121	2,0	12,2	4,4	31,7	3,3	67,2	9,1	2,8	14,9	41,0	9,6
LT 76872	123	2,1	13,6	5,4	32,7	5,6	71,5	12,5	2,5	15,8	34,7	8,2
188TR 5021	125	2,6	13,3	6,9	31,4	9,4	68,0	17,1	2,3	26,1	34,1	10,4
Castor	123	2,3	11,3	7,3	30,8	7,0	55,5	15,9	1,9	17,5	34,4	11,4
Atlet	124	2,3	14,0	8,6	32,8	9,3	64,4	13,4	2,8	18,1	42,9	11,4
Tril	113	2,0	11,7	9,7	29,7	7,1	57,8	7,6	2,6	10,9	45,3	6,9
Titan	119	3,0	15,3	6,6	31,9	7,5	76,9	11,4	3,1	9,5	40,6	6,0
Rozovscoe	125	2,3	13,9	6,3	30,5	5,2	70,3	16,7	2,7	19,2	37,9	8,2
Roudkrider	137	2,1	9,6	4,7	26,5	7,2	41,3	18,5	2,0	12,6	43,7	12,4
Linia 12	125	3,5	12,3	13,4	31,2	9,6	64,3	13,7	3,1	18,6	48,5	14,6
Linia 16441-5	133	3,2	12,6	8,7	29,6	5,8	47,9	22,6	2,5	25,4	52,8	8,6
95W73-2-I	139	1,4	12,0	7,4	30,9	6,2	70,9	16,9	3,5	18,6	49,7	4,9
AD 1467	135	2,2	13,9	7,9	31,1	5,1	77,2	15,3	3,5	18,9	44,9	11,9
Presto	138	2,3	10,2	4,1	31,2	4,5	61,8	12,5	2,8	22,7	45,1	10,3
AD 1128	139	2,1	10,4	6,3	31,3	8,1	61,9	13,9	2,4	19,2	39,2	8,8
Agendus	96	3,1	10,7	2,4	27,4	3,5	61,5	16,1	2,0	17,7	33,1	6,6
Tulus	102	1,7	14,6	4,7	34,8	6,9	86,9	9,5	3,4	14,5	39,1	10,8
Tadeus	97	2,7	13,7	4,3	33,4	3,2	62,1	13,3	2,3	16,1	37,9	14,6
Duet	123	1,7	14,0	7,5	35,3	5,7	76,3	10,7	3,8	13,9	49,9	15,6
B - 7	122	1,5	12,5	9,1	34,2	6,0	79,7	23,9	3,5	22,5	43,9	13,7
Linia 2405	106	1,5	14,7	8,5	31,7	7,6	66,8	13,3	2,6	14,3	38,5	4,6
Ing. 93 (st)	99	1,7	12,1	10,0	30,2	8,2	52,5	18,5	2,4	16,1	39,3	7,6
Cv (%) cp.		2,3		6,9		7,0		15,0		18,1		10,0

CONCLUSIONS

A comprehensive assessment of collection samples of triticale of different geographical origins was carried out based on the main structural elements of productivity. As a result of studying the main economically valuable traits, forms with a whole complex of economically valuable traits were identified, which will be used in

further selection as genetic sources for creating new varieties with specified traits. In terms of productivity, the best samples were from Germany (Duet), Ukraine (Salanda) and Russia (L.16441-5, 95W73-2-1, L.12). Highly productive forms were identified from Romania (Haiduc, Oda), Poland (Presto), Ukraine (Obrii Mironovskii, Buchet) and Russia (95W73-2-1, AD1467). Analysis of the variation coefficients showed that the greatest variability in triticale variety samples is inherent in the number of grains and the weight of grains per spike. Low variability is characteristic of plant height.

Samples and varieties of early-ripening and mid-ripening triticale with high productivity potential were included in hybridization and the resulting hybrid forms are at various stages of the selection process.

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