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GENETIC-STATISTICAL PARAMETERS OF YIELD AND PLANT HEIGHT SIGNS IN WINTER RYE

Genetic and statistical parameters of variability in plant height and crop yield signs in winter rye of Verkhniaky breeding are examined in the article. Revealed is the structure of sign variability with genotype predominant effect for plant height as well as environment sign for crop yield. Four promising genotypes combining both parameters of plant height and high yield were selected.
Keywords: *variability; plant height; yield; winter rye; variation coefficient; regression coefficient*

Introduction. Crops market has established high requirements for today's crop varieties, including winter rye being an important constituent of the grain production. Varieties of winter rye should be characterized, first of all, by high yield [1]. Certain requirements apply to plant height as a sign that is closely related to crops lodging. Some researchers [2, 3] believe that reducing of new plants varieties height is an important factor that contributes to the resistance to crops lodging as a result of redistribution of plastic materials during ontogenesis in favor of part of the harvest. Phenotypic manifestation of these signs depends on the genotypic as well as environmental factors [4], so knowledge of individual variability of these signs is important to choose appropriate methods of genetic-selection improvement of them.

The aim of our research was to determine the genetic-statistical parameters of "plant height" and "yield" signs of breeding materials as well as their phenotypic structure for selecting the best genotypes, which are planned to involve into the breeding process to create short-stem high yield types of winter rye.

Materials and methods. Experiments were performed at Verkhniaky EBS IBCSB NAAS during 2010-2012. We used 33 samples of winter rye of Verkhniaky breeding to investigate variability of plant height and yield, as well as environmental effect. Poly-2 was chosen as check variety. Based on the variance analysis the influence of following factors was revealed: A of genotypes, B of years, and A/B of interaction factors [5, 6]. Genetic-statistical parameters and correlation coefficients were determined using Statistica 6.0 software in interpretation [7].

Results. Two-factor variance analysis of plant height and yield data of winter rye samples showed that there are significant differences between genotypes. The "years" factor was the largest part of variability of "yield" sign in the phenotypic structure of variation, which consisted 74.7%, the "genotype / years" factor consisted 12.0%, the part of "genotype" factor was though significant, but much lower, 9.3%. Opposite to "yield" sign, the genotypic specifics of selection plants had prevailing effect on the plant height that was estimated at 65.4% (Fig. 1).

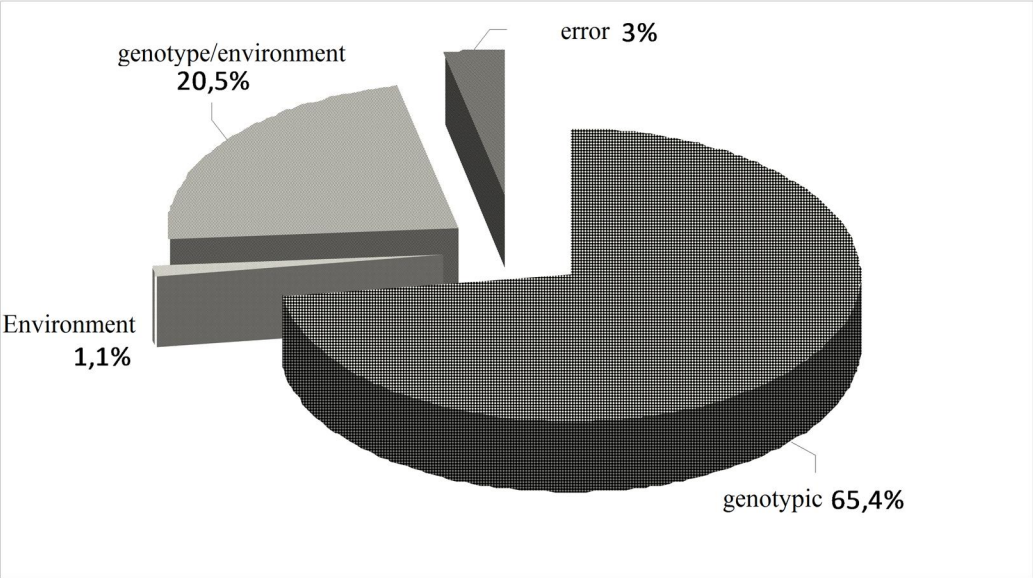

Fig 1. Phenotypic variability structure of "plant height" sign of winter rye genotypes (%), average for 2010-2012

Environment effect was insignificant (1.1%), and interaction "genotype/environment" was 20.5% of the total variability of the sign.

Genetic-statistical parameters of signs under investigation stipulated in Table 1 give the possibility to consider about the individual variability of genotypes, and the type of variation number distribution.

Table 1

Genetic-statistical parameters of plant height and yield signs for winter rye genotypes of Verkhniaky origin (average 2010-2012)

Sign parameters	Sign rate	Error	Confidence interval	t-criterion	
				estimated	table
Plant height, cm					
Middle	129.6	1.3	2.6	97.2	1.9
Median	128.3	1.6	3.2	77.3	1.9
Average deviation	13.1	0.9	1.8	14.0	1.9
Coefficient of variation	10.1	0.7	1.4	13.9	1.9
Coefficient of asymmetry	0.5	0.2	0.4	1.8	1.9
Coefficient of excess	1.5	0.4	0.9	3.1	1.9
Accuracy of the experiment	1.0	0.7	0.14	13.9	1.9
Yield, t/ha					
Middle	5.42	0.07	0.15	70.8	1.9
Median	5.97	0.10	0.19	62.3	1.9
Average deviation	1.32	0.05	0.11	24.4	1.9
Coefficient of variation	24.3	1.01	2.08	23.1	1.9
Coefficient of asymmetry	-0.89	0.14	0.28	-6.30	1.9
Coefficient of excess	-0.43	0.28	0.56	-1.52	1.9
Accuracy of the experiment	1.41	0.06	0.12	23.0	1.9

According to the data stipulated in the Table 1, middle rate of "plant height" was 129.6 cm. Distribution of empirical and theoretical rates of the sign basically coincided and approached to normal, however a slight coefficient of asymmetry (0.5 cm) and coefficient of excess (1.5 cm) marked.

Average rate for "yield" sign in the experiment genotypes group was 5.42 ton/ha. Asymmetry and excess indicated a slight discrepancy between the results and the normal distribution (the coefficients were 0.89 and 0.43, respectively). Yield appeared to be a more variable sign because the coefficient of variation was 24.3% versus 10.1% for "plant height" sign.

Determining the correlation between plant height and yield (based on three years) showed that these signs are not related (r = -0.07), but in some years correlation rate of relation varied: in 2010 the rate was -0.33, in 2011 0.02, and in 2012 +0.28. It means that relation between these signs was weak and varied from small positive rates to small negative rates (Fig. 2).

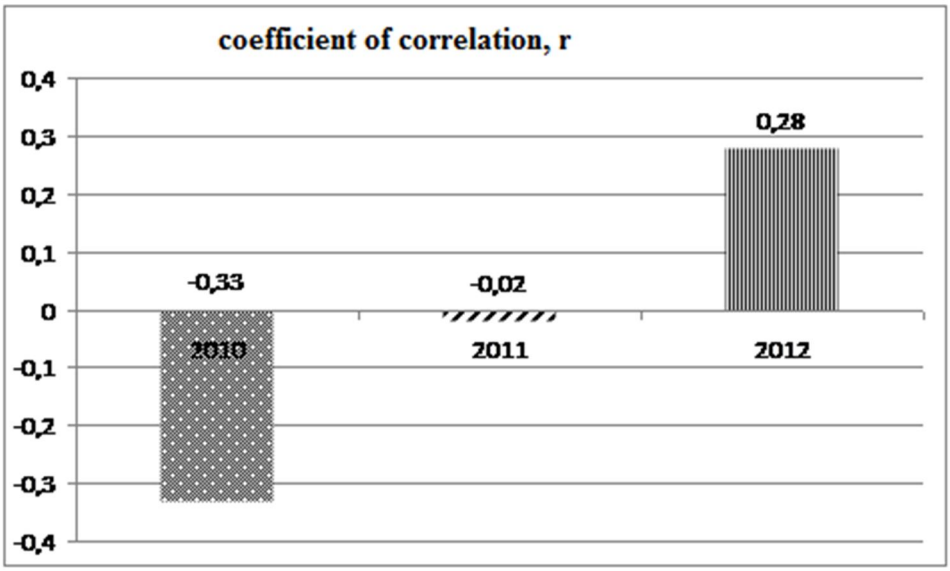

Рис. 2. The variability of the coefficient of correlation between plant height and yield (average 2010-2012)

The rate of "plant height" and "yield" signs varied depending on the genotype and year's climatic conditions. However, those genotypes, which combine real low rate of plant height and high yield, had breeding preference to create short-stem (resistant to lodging) and productive kinds of plants. There were four genotypes with this combination of signs. They are the samples numbered as 71, 72, 73, and 75. The rates of their signs are given in Table 2. All of these samples distinguished with reliable shorter plant height and higher yield compared with control samples.

Table 2

Average rates of plant height and yield for the best winter rye genotypes (average 2010 - 2012)

No	Genotypes	Years			Average rate for A factor
		2010	2011	2012	
Plant height, cm					
1	71	120.0	116.7	115.0	117.2*
2	72	118.3	102.7	130.0	117.0*
3	73	125.0	96.0	118.3	113.1*
4	75	100.0	95.0	121.7	105.6*
5	Control	118.3	135.0	136.7	130.0
Yield, ton/ha					
1	71	4.92	6.27	6.44	5.88*
2	72	4.32	6.10	6.72	5.71*
3	73	5.78	6.16	6.85	6.27*
4	75	5.31	6.18	6.63	6.04*
5	Control	2.19	5.43	6.23	4.62

***Note:** * –LSD for 5% of importance level*

Analyses of plant height and yield of each genotype showed that they have specific reaction to climatic conditions. Ecological and genetic characteristics of breeding materials has allowed to detect the stability of manifestation depending on year of cultivation. Thus, the genotypic effect of selected genotypes for plant height was negative (-12.3...-24.0 cm), indicating the stability of the phenotypic manifestation within three years of experiment. The yield of the same samples was high (5.71...6.27 ton/ha) also compared with the controls (4.62 ton/ha). Coefficient of regression was below one (0.46...0.87), indicating the ecological stability of this sign.

Conclusions. Based on the experimental data of plant height and yield, the genotype, environment and genotype-environmental interactions significantly effected phenotypic manifestation of the signs. Genotype made predominant contribution to the phenotypic variation of the plant height sign (65.4%), and yield made predominant contribution to the phenotypic variation of the year sign (74.7%). Correspondence between empirical and theoretical distribution of the sign rates with a small coefficient of asymmetry and excess was discovered. The more variable sign was yield compared to the plant height (coefficient of variation was 24.3% vs. 10.2%). Variability of correlation between yield and plant height by years was revealed. Genotypes of winter rye plants with combination of such signs as short height of plants and increase in yields were differentiated. Four genotypes were the best (numberedasy 71, 72, 73 and 75), which are involved into the breeding process for creating component-pollinators of winter rye heterosis hybrids.

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Анотація

Мазур З.О., Корнєєва М.О., Навроцька Е.Е.

Генетико-статистичні параметри ознак урожайності і висоти рослин озимого жита

У статті досліджено генетико-статистичні параметри мінливості ознаки висота і урожайність селекційних матеріалів жита озимого верхняцької селекції. Встановлена структура мінливості ознаки з переважаючим впливу генотипу – для висоти рослин і середовища – для врожайності. Відібрано 4 перспективні генотипи з поєднанням понижених параметрів висоти рослин і підвищеної врожайності.

Ключові слова: *мінливість, висота рослин, урожайність, жито озиме, коефіцієнт варіації, коефіцієнт регресії*

Аннотация

Мазур З.А., Корнеева М.А., Навроцкая Э.Э.

Генетико-статистические параметры признаков урожайности и высоты растений озимой ржи

В статье исследованы генетико-статистические параметры изменчивости признаков высоты растений и урожайность у селекционных материалов озимой ржи верхняцкой селекции. Установлена структура изменчивости с преобладающим влиянием генотипа – для высоты растений и среды – для урожайности. Отобраны 4 перспективные генотипа с сочетанием пониженных параметров высоты растений и повышенной урожайности

Ключевые слова: *изменчивость, высота растений, урожайность, озимая рожь, коэффициент вариации, коэффициент регрессии*