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MAZUR Z. O., Candidate of Agricultural Sciences,
Verkhniaky EBS
KORNIEIEVA M.O., Candidate of Biological Sciences,
Institute of Bioenergy Crops and Sugar Beet NAAS of Ukraine

ADAPTIVE ABILITY OF WINTER RYE FOR DEVELOPING HETEROSIS IN HYBRIDS

The article deals with variation of yield performance in fertility restoring lines as dependant on the cultivation conditions. According to adaptive breeding goal, it is necessary to determine the ecological flexibility and stability of economically valuable traits. Selected and introduced to the selection process were the best samples to create high-adaptive heterotic hybrids of winter rye.
Keywords: *winter rye, yield, genotype, flexibility, sustainability.*

Introduction. Nowadays the development of high-yielding hybrids of winter rye based on cytoplasmic male sterility (CMS) is an advanced breeding method. The State Register of Plant Varieties of Ukraine has registered only three hybrids with CMS component of national selection. Creating CMS hybrids is constrained largely with lack of linear hybrid components that meet the complex agronomic traits. In the last decade a collection of female parent components (CMS lines, sterility-fixers) and male parent lines that are fertility restorings who serve components hybridization was created at the Verkhniaky Experimental Breeding Station [1, 2].

In order to optimize grain production in relation to agro-climatic zones CMS hybrids of winter rye must meet strict requirements. Among them is not only high performance but also their environmental sustainability and stability [3, 4]. The reason is that, unlike in the evolution process, in breeding motive forms predominate over stabilizing, thereby increasing resistance to regulated factors and reducing resistance to unregulated environmental factors [5]. That is why, along with agronomic characteristics studying adaptive ability of winter rye line is of gaining practical significance.

Our goal was to examine the sustainability and flexibility of winter rye fertility restoring lines in respect to weather and climatic conditions over the years of cultivation and select the best genotypes for heterotic breeding purposes.

Materials and methods. Experiments were carried out in 2010-2012 at the Verhniaky Experimental Breeding Station which is within the Institute of Bioenergy Crops and Sugar Beets network. Experiment covered 32 winter rye hybrids marked with high ability of fertility restoration in the first generation. As a control variety, served Veleten (number 33) of Verkhniaky breeding. Yield was determined in the station strain testing using the randomisation method and quadruple repetition. Adaptive ability of the lines was studied by the method of O.V. Kilchevskyi, L.V. Khotylova [6].

Results and discussion. Analysis of yield (factor A) showed that under changing weather and climatic conditions over the years of growing (factor B) phenotype changing, i.e. they were featured a specific response to environmental conditions (Table).

Thus, 9 genotypes (71-77, 80, 81) for three-year's data significantly exceed a mean value of yield (5.41 t/ha). But among them were the samples (71, 79, 80), which exceeded the yield observed for three years and genotypes that showed high variation of yield for the years. It illustrates their different reactions to the condition of cultivation during the years.

Factor B (years) significantly influenced the phenotypic expression of yield. In 2010, the average yield of all the samples was the lowest and amounted to 3.81 t/ha. Years 2011 and 2012 were similar in terms of cultivation, and the set of numbers showed similar values (respectively 6.2 and 6.23 t/ha), but some genotypes differed in their response.

Table

Variation of yield in winter rye samples, t/ha (2010-2012)

№	Genotypes	years			mean valua of factor A
		2010	2011	2012	
1	51	3,23*	6,56*	5,73	5,17*
2	52	3,05*	6,15*	5,76	4,99*
3	53	2,76*	6,60*	6,43*	5,25
4	54	3,33*	6,29*	6,28*	5,30
5	55	3,84*	6,11*	6,55*	5,50
6	56	4,26*	6,35*	5,83	5,48
7	57	4,01*	6,33*	6,32*	5,55
8	58	3,37*	6,52*	5,77	5,22
9	59	3,72*	5,32	6,12*	5,05*
10	61	3,81*	6,40*	5,29	5,17*
11	62	3,13*	6,60*	6,57*	5,44
12	63	2,76*	6,33*	5,76	4,95*
13	64	3,36*	6,65*	5,73	5,25
14	65	3,35*	6,95*	5,77	5,35
15	66	2,78*	5,88	6,03*	4,89*
16	67	3,39*	5,83	5,84	4,98*
17	69	4,45*	5,97*	5,97*	5,47
18	70	4,55*	5,98*	5,99	5,51
19	71	4,92	6,27*	6,44*	5,88*
20	72	4,32*	6,10*	6,72*	5,71*
21	73	4,80*	6,19*	6,13	5,72*
22	74	5,78	6,18*	6,75*	6,27*
23	75	5,31	6,18*	6,63*	6,04*
24	76	5,43	6,19*	6,76*	6,12*
25	77	4,98	6,09*	6,85*	5,98*
26	79	4,23	5,97*	6,21*	5,47
27	80	4,40*	6,33*	6,37*	5,70*
28	81	4,42*	6,80*	7,31*	6,18*
29	82	3,38	6,21*	6,21	5,27
30	83	2,68*	6,13*	6,49*	5,10*
31	84	3,46*	6,12*	6,16*	5,25
32	87	2,26*	5,77	6,55*	4,86*
33	control	2,19*	5,43	6,24*	4,62
mean valua of factor B		3,81*	6,21*	6,23*	5,41

- *- reliable deviation from mean at 5% signiticance level*

Based on analysis of variance determined was a share of each factor influence on the phenotype. Thus, the largest share belonged to factor "years" (74.7%) and the interaction of genotype/environment was estimated at 12.0% of phenotypic variation. The difference between tested genotypes was significant, and share of genotype made up 9.3% (Figure 1).

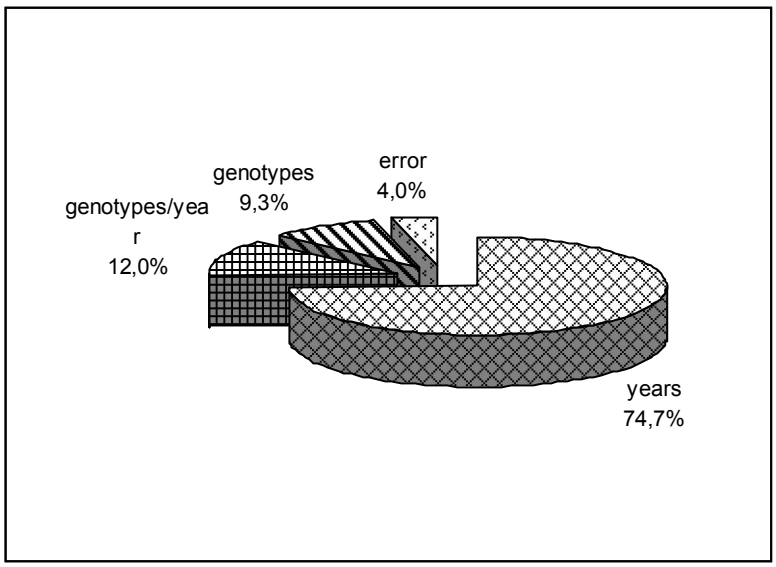

Figure 1. The structure of phenotypic variation of yield in winter rye genotypes,% (2010-2012)

By response to growing conditions we have determined regression coefficients (b_i) in all the samples under study. Breeding value is known to have the samples, which are characterized by positive genotypic effect, i.e. significantly higher positive value of yield deviation from the mean of the population. There were six such genotypes. Five of them had their regression coefficients less than1; they were less responsive to changing environmental conditions, i.e. they showed environmental sustainability. Sample number 81showed plasticity, its regression coefficient b_i was 1.09 (Fig. 2).

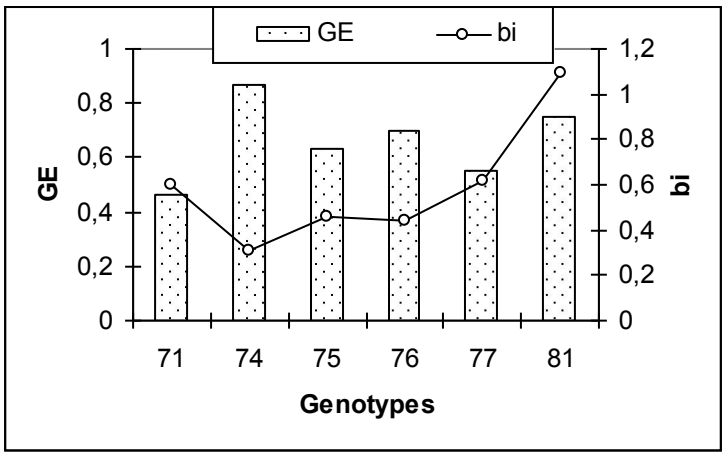

Figure 2. Genotypic potential and plasticity of genotypes of winter rye, 2010-2012 years

Conclusions. On the basis of method developed by O.V. Kilchevskyi and L.V. Khotylova the ecological flexibility and sustainability of 33 of fertility restoring lines of winter rye were determined. Selected were 5 lines with stable response and high performance properties, and one highly flexible line, which were involved in the process of creating the experimental hybrid combinations based on CMS.

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Анотація

Мазур З.О., Корнєєва М.О.

Адаптивна здатність генотипів озимого жита для створення гетерозисних гібридів

У статті йдеться про мінливість показників урожайності ліній-відновлювачів фертильності залежно від умов років вирощування. У зв'язку із завданнями адаптивної селекції вказується на необхідність визначення екологічної пластичності і стабільності за господарсько цінними ознаками. Виділено кращі селекційні зразки, які введено у селекційний процес зі створення високоадаптивних гетерозисних гібридів озимого жита.

Ключові слова: *озиме жито, урожайність, генотип, пластичність, стабільність*

Аннотация

Мазур З.А., Корнеева М.А.

Адаптационная способность генотипов озимой ржи для создания гетерозисных гибридов

В статье обсуждается изменчивость показателей урожайности линий-восстановителей фертильности в зависимости от условий года выращивания. В связи с задачами адаптационной селекции указывается на необходимость определения экологической пластичности и стабильности хозяйственно-ценных признаков. Выделены лучшие селекционные образцы, которые введены в селекционный процесс по созданию высокоадаптивных гетерозисных гибридов озимой ржи.

Ключевые слова: *озимая рожь, урожайность, генотип, пластичность, стабильность*