АНАЛИЗ И ОЦЕНКА НА ПЕРСПЕКТИВНИ ЛИНИИ ПШЕНИЦА ПО ОСНОВНИ ПРИЗНАЦИ, СВЪРЗАНИ С ПРОДУКТИВНОСТТА
ANALYSIS AND EVALUATION OF PERSPECTIVE WHEAT LINES FOR BASIC TRAITS RELATED TO PRODUCTIVITY

Дочка Димова*, Дияна Светлева, Тоня Георгиева
Dochka Dimova*, Diyana Svetleva, Tonya Georgieva

Аграрен университет – Пловдив
Agricultural University – Plovdiv

***E-mail: dimova511@yahoo.com**

Abstract

During the 2012-2014 period 6 new breeding lines were studied in the experimental field of the *Department of Genetics and Plant Breeding* of the Agricultural University by using a block design with 3 replications and a plot size of 10 m^2. The aim of the investigation was to evaluate the new lines for some important traits such as yield and yield stability, using the *Sadovo1* as a standard. Applying biometric and ANOVA analyses and determining the stability index, it was found that the breeding lines 12501009 and 12504709 were perspective for future selection.

Key words: wheat, ANOVA, yield stability.

INTRODUCTION

The goal of any breeding program is to create varieties with high productive potential, good quality indicators and adequate resistance to diseases and pests.

Wheat is the crop that plays a crucial role in feeding of the world's population and the breeding is directed to creation of new genotypes combining traits that identify them as high-yielding and high-qualiteted with good plasticity and stability, regardless to the changing environmental conditions.

Boyadjieva (1987) indicates that the yield of wheat and its components, that determine it, are quantitative traits, influenced significantly by changing of environmental conditions.

To clarify the importance of quantitative traits, related to productivity, various approaches and methods of evaluation were used - as variation (Genchev al., 1975; Dimova et al., 2002), correlation, path-coefficient (Deshev et al., 2013; Kachakova et al., 2014; Popova et al., 2013); dispersional (Fowler and Cohen, 1982); cluster, principal components analysis (Rachovska et al., 2002) and others.

Each of these methods has contributed to more precise and accurate assessment of the investigated traits of plants and to determine their role and importance in the breeding process for creation of high-yielding and high-quality genotypes.

The determination of phenotypic stability of the studied breeding lines is of particular importance in view of their practical use - as donors in future breeding programs or their direct offering for variety testing.

The purpose of this article is to evaluate six new wheat breeding lines by yiealds, stability of yields and some basic elements related to productivity, comparing them to the Bulgarian integrated standard variety Sadovo 1, with a point to their further use.

MATERIALS AND METHODS

Competitive variety trials with six promising wheat breeding lines and variety Sadovo 1, used as standard, were held in the period of 2012-2014 at the Experimental base of Department “Genetics and Plant Breeding”. A block scheme in three replicates with harvest plot size of 10 m^2 was used.

Over the years, samples from thirty plants from each variant were taken to perform biometrical analysis. The traits: plant height, total tillering, length of the main spike, number of grains and grain weight of the main spike, grain weight of the whole plant and mass of 1000 grains were analyzed. Data from each variant were statistically elaborated and the parameters - arithmetic average, their errors and coefficients of variation were determined. The significance between the traits, of studied breeding lines and standard variety Sadovo 1, was evaluated by the criteria «t» of Student.

Variation analysis was applied to the found yields by years and the average total yields for the period. Levels of significance were proof and the estimated percentage yield was compared to the standard. To make a more comprehensive assessment of the breeding lines by their realized yield and its stability through the years of study, the parameter of Kang (1993), known as Yield stability, was applied. Computer program IPCSSVKYSI (Interactive program for calculating Shuklas stability variance and Kangs yield stability index -Ysi) was used.

RESULTS AND DISCUSSION

The results of the conducted biometrical analysis on studied genotypes by described traits are presented in Table 1. For each of the variants through to their traits were estimated arithmetic average, their error, the degree of variation and the signifinace of the respective differences, to the standard cultivar Sadovo1. Found variation coefficients showed that more variable in the studied genotypes are traits - number of grains and weight of grains in spike.

Regarding the trait height of the plant, lines 12103010 and 12701010 are with sgnificantly higher plants than those of variety Sadovo 1. Breeding line 12704010 has highth of the plants as the level of the standard, while breeding lines 12205010, 12504709 and 12501009 have significantly lower height.

Tillering is one of the major components which affects the final yield in common wheat. Its magnitude largely determines the formation also of the other traits associated with formation of grain production. That is why it is one of the traits, which is kept scientific team focused to provide purposeful selection and the evaluation of studied genotypes is essential.

Our reported results indicated that only breeding lines 12504709 and 12501009 have shown significantly greater number of tillers, compared to the standard. The same pattern was recorded to the other traits - length of the spike, number and weight of the grains per spike, grain weight per plant and weight of 1000 grains.

Remaining breeding lines showed values of the level or the standard variety Sadovo 1 or significantly lower, than it.

In Table 2 are presented data from reported yields (kg/da) per years and the average for the all period. The results of the dispersional analysis showed that the breeding lines 12501009 and 12504709, for the three years of investigations, demonstrated significantly higher yields. Increasement of the average for the period, compared to the standard variety Sadovo 1, was from 17% to 25%.

For breeding lines 12205010 and 12103010, the reported yields were closed to the variety Sadovo 1 and differences were nonsignificant to him. Proven lower were the yields of breeding lines 12701010 and 12704010.

Yields found for each variant, replicate and year are elaborated by two-factorial analysis of variance. The results presented in Table 3 showed the causes of variability and significance of the respective influences. It is proven the influence of conditions in years, differences between studied genotypes and interactions between them. It is reasonable to evaluate studied genotypes not only by yields but also by stability of its manifestation during the years of study.

In Table 4 are presented the results of the conducted analysis where is determined the index of stability (Ysi) of genotypes.

Breeding line 12501009 is distinguished not only by demonstration of higher yield, than the standard variety Sadovo 1, but also with the highest index of stability (Ysi = 8+). Line 12504709 also demonstrates higher yield, but it has an index of stability of the level of the standard variety Sadovo 1 (Ysi = 3 +). Relatively stable expression of yield, during the years of study, presents the breeding line 12205010 (Ysi = 2+).

Line 12103010 showed, for the average of studied period, yields of the level of standard variety and is characterized by a low level of stability (Ysi = - 8). Environmental conditions have bigger influence on this breeding line, than on 12704010 (Ysi = - 2), where the yield is significantly lowest.

CONCLUSIONS

1. Breeding lines 12501009 and 12504709 had the highest comprehensive evaluation by reported yields, elements characterized the yields, and yield stability. After further investigations on grain quality they can be presented for State variety testing.

2. Line 12205010 showed values of the level of the complex standard variety Sadovo 1 and can be used as a donor in future breeding programs.

3. Breeding lines 12103010, 12704010 and 12701010 have low adaptive capacity, significantly lower yield, which is strongly influenced by climatic conditions during the years of study.

Table 1. Biometrical characterization of some traits related to productivity (average for the studied period)

Variants	Indica-tors	Height of the plant, cm	Number of tillers	Length of main spike, cm	Number of grains in spike	Weight of the grains per spike, g	Weight of the grains per plant, g	Mass of 1000 grains, g
Sadovo 1 (control)	x Sx S%	118,60 1,95 11,62	5,30 0,08 10,67	8,10 0,06 5,23	32,90 0,62 13,30	1,37 0,02 10,30	5,12 0,08 11,04	42,50 0,86 14,30
12103010	x Sx S%	132,40^{+++} 2,35 12,55	5,20$^{n.s.}$ 0,10 13,50	8,30$^{n.s.}$ 0,11 9,36	33,00$^{n.s.}$ 0,83 17,78	1,39$^{n.s.}$ 0,05 25,40	5,21$^{n.s.}$ 0,09 12,21	41,00$^{n.s.}$ 0,95 16,38
12205010	x Sx S%	116,70 1,28 7,75	5,40$^{n.s.}$ 0,09 11,78	8,50$^{n.s.}$ 0,09 7,48	33,20$^{n.s.}$ 0,79 16,82	1,41$^{n.s.}$ 0,04 20,05	5,33$^{n.s.}$ 0,10 13,26	42,20$^{n.s.}$ 0,99 16,58
12504709	x Sx S%	98,90^{---} 1,16 8,29	7,80^{+} 0,14 12,68	10,40^{+} 0,19 12,90	52,40^{+++} 0,81 10,92	3,17^{+} 0,05 11,15	7,45^{+} 0,15 14,23	53,50^{+++} 1,02 13,47
12501009	x Sx S%	96,20^{---} 1,25 9,18	7,10^{+} 0,12 11,94	11,80^{++} 0,18 1078	59,60^{+++} 1,12 13,28	3,62^{+} 0,06 11,71	8,25^{++} 0,17 14,56	55,40^{+++} 0,98 12,50
12704010	x Sx S%	119,40$^{n.s.}$ 1,74 10,30	5,00$^{n.s.}$ 0,10 14,10	7,90$^{n.s.}$ 0,15 13,42	30,90^{-} 0,79 18,07	1,25$^{n.s.}$ 0,02 11,31	4,98$^{n.s.}$ 0,08 11,35	39,80$^{—}$ 0,62 11,55
12701010	x Sx S%	120,80^{+} 1,96 11,47	4,90$^{n.s.}$ 0,09 12,90	7,90$^{n.s.}$ 0,20 17,80	31,40$^{n.s.}$ 0,82 18,46	1,33$^{n.s.}$ 0,03 15,94	5,10$^{n.s.}$ 0,10 13,86	39,90$^{—}$ 0,86 15,24

$t_{p\ 5\%} = 1,65$ $t_{p\ 1\%} = 2,54$ $t_{p\ 0,1\%} = 3,49$

Table 2. Data analysis for yields by years and average for the period

Variants	2012		2013		2014		Average for the studied period	
	kg/da	%	kg/da	%	kg/da	%	kg/da	%
12501009	586^{+++}	130^{+++}	544^{+++}	125^{+++}	569^{+++}	122^{+++}	566^{+++}	125^{+++}
12504709	535^{+++}	119^{+++}	510^{+++}	117^{+++}	540^{+++}	115^{+++}	528^{+++}	117^{+++}
Sadovo 1 (control)	450	100	435	100	468	100	451	100
12205010	$449^{n.s.}$	$98^{n.s.}$	455^{+}	$104^{n.s.}$	$458^{n.s.}$	$98^{n.s.}$	$454^{n.s.}$	$101^{n.s.}$
12103010	$435^{n.s.}$	$97^{n.s.}$	428	$98^{n.s.}$	440^{--}	94^{-}	$434^{n.s.}$	$96^{n.s.}$
12701010	410^{---}	91^{--}	380^{---}	87^{---}	418^{---}	89^{---}	403^{---}	89^{---}
12704010	396^{---}	88^{---}	365^{---}	88^{---}	410^{---}	88^{---}	390^{---}	86^{---}
$GD_{P\ 5\%}$ $GD_{P\ 1\%}$ $GD_{P\ 0,1\%}$	18,46 24,48 39,55	4,55 7,86 9,54	19,58 25,96 42,73	5,33 8,47 11,5	17,95 21,35 29,65	5,10 7,95 10,03	20,72 26,33 38,56	6,15 7,33 9,18

Table 3. Results of conducted dispersion analysis

Reasons for variation	Fg df	SQ SS	S^2 MS	F
Total	20	211973,5		
Conditions in the years	2	2560,5	1280,25	$21,54^{++}$
Genotypes	6	224620,5	37436,75	$93,73^{++}$
Interaction	12	4792,5	399,37	$6,72^{++}$
Heterogeneity	6	4302,50	717,08	$8,78^{++}$
Errors	6	490	81,66	

Table 4. Evaluation of genotypes by yield and stability

Genotypes	Yields kg/da	Ranking by yields	Correction of yields	Correction of rank	Variance of stability	Factor of stability	Index of stability YS(I)
Sadovo 1 (control)	451	5	- 2	3	2,4317	0	3^{+}
12103010	435	3	- 3	0	534,50	- 8	- 8
12205010	454	4	- 2	2	- 38,92	0	2^{+}
12504709	528	6	3	9	802,12	- 6	3^{+}
12501009	566	11	3	14	886,91	- 5	8^{+}
12704010	390	1	- 3	- 2	- 52,69	0	- 2
12701010	403	2	- 3	- 1	661,38	- 8	- 9
Average for the conducted experiments - 460,86 $LSD_{P\ 5\%}$ = 6,12							

REFERENCES

Boyadjeva, D., 1987. Prouchvane na osnovnite komponenti na produktivnostta pri pshenitcata chrez korelacionen i Path-analis. Genetika i selekcia, год. XX, кп. 1, 22–28.

Genchev, G., E. Marinkov, V. Yovcheva, A. Ognyanova, 1975. Biometrichni metodi v pastenievadstvoto, genetikata i selekciata. Zemizdat, Sofia.

Desheva, G., S. Kachakova, 2013. Korelacionni zavisimosti mezdu osnovnite strukturni elementi na dobiva pri sortove obiknovena pshenitca. Rastenievadni nauki, 50, 5–8.

Dimova, D., G. Rachovska, N. Ganusheva, 2002. Harakteristika na novoselekcionirani linii pshenitca. Rastenievadni nauki, 39, pp. 255–260.

Fowler, J. and L. Cohen, 1982. Practical statistics for Field biology. J. Wiley and Sons. P0191 UD, England, p. 172.

Kachakova, S., G. Desheva, 2014. Korelacionni zavisimosti mezdu osnovnite strukturni elementi na dobiva pri somaklonalni linii obiknovena zimna pshenitca. Екologia i zdrave, Plovdiv, pp. 177–180.

Kang, M.S., 1993. Simultaneous selection for yield and stability; Consequences for growers. Agron. J., 85; pp. 754–757.

Popova, Z., N. Ganuscheva, M. Marcheva, G. Ganeva, 2013. Korelacionni zavisimosti mezdu structurnite elementi na dobiva na itroducirani obrazci tvurda pshenica. Agrarni nauki – AU, IV 12, pp. 25–29.

Rachovska, G., D. Dimova, B. Bojinov, 2002. Prilozenie na klasternia analis i analiza na osnovnite kompponenti za ocenka na selekcionni materiali ot zimna obiknovena pshenitca. Ubileina nauchna sessia, Sadovo.