Turkish Journal of Agricultural and Natural Sciences
Special Issue: 2, 2014

TÜRK
TARIM ve DOĞA BİLİMLERİ
DERGİSİ

TURKISH
JOURNAL of AGRICULTURAL
and NATURAL SCIENCES

www.turkjans.com

Study of the productivity elements of spring barley using correlation and path-coefficient analysis

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Abstract

The study was conducted in the Institute of Agriculture - Karnobat, during the period 2010-2012. Explored are the connections between some elements of productivity in 45 spring barley varieties by applying correlation and path coefficient analysis. Analyzed are the characteristics productive tillers, spike length, number of grains, number of spikelets, grain weight per spike, 1000 grain weight. Though correlation and path coefficient analysis, it was revealed that among different characters which showed positive significant association with grain yield, are productive tillers, grain weight per spike and 1000 grain weight. Maximum direct contribution to productivity was made by weight per spike, followed by productive tillers. Therefore, these traits can be used as selection criteria to increase plant yield in barley.

Key words: spring barley, yield components, correlation and path coefficient analysis

Introduction

The study of connections and dependencies between the productivity elements by means of correlation and path-coefficient analysis helps to establish accurate and reliable criteria to select high-yielding forms in the process of breeding spring barley. The correlations can be used as criteria for efficiency in phenotype selection. Together with the path-coefficient analysis, the correlations were widely applied in the breeding investigations of a number of authors. They report that to one extent or another there are interdependencies between the yield formation elements (Ganusheva, 1992; Dimova and Rachovska, 2001; Dechev, 2004; Popova et al., 2007; Dyulgerova, B., 2012; Dimitrova-Doneva et al., 2014). In his studies Gluhovtsev, V., (1982) recorded a moderate positive correlation between number and weight of grain per spike, whereas Ganusheva and Dimova (1990) established that greatest effect on grain weight per plant had the number of grain per plant and 1000-grain weight. The correlation and path-coefficient analysis performed by Dimitrova-Doneva et al. (2014) showed that the highest positive direct effect on barley yield had number of grain per spike and 1000-grain weight.

The aim of our study was to establish the correlation interdependencies between yield formation elements, their direct and indirect effect on the yield with the purpose of specifying properties whose selection will bring greater efficiency in the breeding work on spring barley.

Material and Methods

The study was conducted at the Institute of Agriculture in Karnobat, Bulgaria, in the period 2010-2012, on leached vertisols soil type. Subject of study were 45 accessions of spring barley with different geographical origin. The field experiment was set in three replicates, with inter-row distance of 30 cm, and in-row distance of 5 cm. 10 randomly taken plants from each replicate were taken and for each replicate were read: productive tillering, spike length (cm), number of spikelets per spike, number of grains per spike, number of sterile spikelets per spike, grain weight per spike (g) and 1000-grain weight (g). Yield from the accessions was also recorded.

The phenotypic correlations and path-coefficients were calculated on the grounds of mean values for the traits for the three studied years. The results were statistically processed by means of the software packets Microsoft Excel^{xp} and SPSS 12.0.

Table 1. Phenotypic correlations of productivity elements in 45 spring barley specimens

Traits	Direct effect	Indirect effect							Total indirect effect
		1	2	3	4	5	6	7	
1. Number of productive tillers	**0.766**	-	-0.004	-0.471	0.683	-0.017	-0.42	-0.022	-0.252
2. Spike length	0.043	-0.004	-	0.713	-0.813	-0.138	0.134	0.128	0.019
3. Total number of spikelets	**1.12**	-0.322	0.027	-	-1.172	-0.295	0.287	0.162	-1.313
4. Number of grains	-1.362	-0.384	0.026	**0.963**	-	0.011	**0.503**	0.132	**1.25**
5. Number of sterile spikelets	-0.597	0.021	0.01	0.554	0.025	-	-0.293	0.093	0.41
6. Grain weight per spike	**1.145**	-0.281	0.005	0.281	-0.598	0.153	-	-0.156	-0.596
7. 1000-grain weight	-0.277	0.061	-0.02	-0.653	**0.647**	0.199	**0.643**	-	**0.878**

** Correlation is significant at the 0.01 level
* Correlation is significant at the 0.05 level

Results and discussion

The phenotypic correlations between the productivity elements of the studied accessions of spring barley are presented in Table 1.

It is seen from the presented correlation coefficients, which reflect the dependencies between the investigated traits, that most effective on the yield were productive tillering (*r*= 0.513), grain weight per spike (*r*= 0.549) and 1000-grain weight (*r*= 0.601). There was no proven interdependency between yield and the other 4 traits. High positive correlation was observed between number of spikelets per spike and number of grains per spike (*r*= 0.860) and between spike length and number of spikelets per spike (*r*= 0.637) and moderately strong correlational dependency between spike length and number of grains per spike (*r*= 0.597) and between 1000-grain weight and grain weight per spike (*r*= 0.562) and between number of sterile spikelets and the number of spikelets per spike (*r*= 0.495). Similar correlations were found by Popova and Valcheva, (2012) during their study of 21 accessions of two-row barley resistant to loose smut.

Negative but statistically reliable correlation coefficients were observed between productive tillering and number of grains per spike (*r*=-0.501), between 1000-grain weight and number of spikelets per spike (*r*= -0.583), between number of grains per spike and 1000-grain weight (*r*= -0.475) and between 1000-grain weight and spike length (*r*= -0.462), which means that the higher the number of spikelets and grains per spike are, the lower 1000-grain weight will be.

The results from the path-coefficient analysis, which demonstrate the direct and indirect effect of the studied traits on productivity are given in Table 2.

Table 2. Direct and indirect effect of productivity elements on 45 spring barley specimens

Traits	Number of productive tillers	Spike length,	Total number of spikelets	Number of grains	Number of sterile spikelets	Grain weight per spike	1000-grain weight
Grain yield	.513(**)	-0.011	-0.194	-0.113	-0.187	.549(**)	.601(**)
Number of productive tillers		-0.101	-.421(**)	-.501(**)	0.028	-.367(*)	0.08
Spike length			.637(**)	.597(**)	0.232	0.117	-.462(**)
Total number of spikelets				.860(**)	.495(**)	0.251	-.583(**)
Number of grains					-0.018	.439(**)	-.475(**)
Number of sterile spikelets						-0.256	-.334(*)
Grain weight per spike							.562(**)

The highest positive direct effect on barley productivity in our study was from grain weight per spike (1.145), number of spikelets per spike (1.120) and productive tillering (0.766). The number of grains per spike had a high positive indirect effect on productivity (1.250), which is best expressed through grain weigh per spike (0.503) and the number of spikelets per spike (0.963). High positive indirect effect on productivity had 1000-grain weight (0.878). The indirect effect was best expressed mainly through number of grains per spike (0.647) and grain weight per spike (0.643). With highest direct negative effect were the number of spikelets per spike (-1.362) and the number of sterile spikelets per spike (-0.597), whereas high indirect negative effect was seen in the number of spikelets per spike (-1.313) and grain weight per spike (-0.596).

Conclusions

The productivity of the studied accessions of spring barley was in statistically proven positive interdependence with productive tillering, grain weight per spike and 1000-grain weight. Strongest direct effect on productivity had the number of spikelets per spike, grain weight per spike and productive tillering. On the grounds of the obtained results from the correlation and path-analysis, it was established that in order to increase the productivity of spring barley, it is recommended mainly to control the traits of grain weight per spike, number of spikelets per spike and productive tillering. The other traits had an indirect effect.

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