Research Article

Relationships between Quantitative Traits of Common Wheat /*Triticum aestivum* l

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Abstract

The experimental study was conducted during the period 2015-2017 year. They studied the relationship between quantitative signs defining the productivity of common wheat, using ten crosses between Bulgarian and foreign varieties and lines of wheat [*Triticum aestivum* L.], characterized by contrasting signs that determine the productivity of wheat. The parameters are analyzed: the height of the plants, the number of the productive stalks of the plant, length of the spike, spikelets spike number, grain spike number, weight of the grain in spike and the mass of 1000 grains. On the basis of principal components analysis (PCA), correlation analysis and Path- coefficients draw conclusions about the impact of signs on the productivity studied combinations winter common wheat. It was found that on the productivity of the spike most heavily influenced by the characteristics number of spikes in the main spike and weight of grain from the main spike on average - number of productive stems from a plant and weight of 1000 grains and low - length of the main spike, number of grains in the main spike and height of the stem. To obtain high and stable productivity of spike F1 hybrids most important is the coefficient of correlation between the length of the spike with a number of spikes in spike, and for F2 - length with the number of grains in spike.

Keywords: Wheat; Yield; Quantitative Characters; Correlation; Principle Component Analysis (PCA); Productivity

Introduction

The productive potential of winter cereal crops is quite variable depending on the specific growing conditions [1-3]. In a market economy increasingly appears to be an examination of the potential productive capacity of varieties of winter wheat. Research is needed on the mutual influence of the structural elements of productivity and the correlation between them. Dependencies between quantitative signs that have a direct impact on the productivity of wheat have been studied by many authors [4-13]. They do not give a complete picture of the impact of these signs in building productive spike. To answer this problem explored which elements of productivity of spike play a decisive role on it and are transmitted with greater force in subsequent generations.

Material and Methods

The survey was conducted during the period 2015 - 2017 year, we have studied the relationship between quantitative signs defining the productivity of common wheat, using the standard regimen parents - hybrids F1, consisting of 10 crosses between Bulgarian and foreign varieties and lines of wheat [*Triticum aestivum* L.],

characterized in contrast signs defining the productivity of wheat. Included are one simple and nine complex combinations [250/96-12 x Enola] x Odeskaya 162-1; [Zheng 8761 x Todora] x Krasnodarskaya 99; [Xinong Da Shui x Kristal] x СИМ 328; [V 8164 x Todora] x Jubilejnyj 100; [256/95-402 x Enola] x Exspress; [179/98-3 x Enola] x Ep.1243/92; [359/99-1-4 x Todora] x DH240/03-3; [Xinong Da Shui x Enola] x СИМ/05-49; [Zheng 8761 x Todora] x Dragana and 256/95-402 x Prostor. From any hybrid combination marked and analyzed individual plants in the traditional way to explore the relationships and the influence of signs on the productivity of spike as well as their combination. Analyzed are the signs: the height of the stem [HOS], the number of the productive stalks of the plant [NPT], length of the spike [LOS], spikelets spike number [NSS], grain spike number [NGS], weight of the grain in spike [WGS] and the mass of 1000 grains [MTG]. The links between the studied parameters in parental components and their descendants, and what is the share in shaping the productivity of spike each studied sign is attached method of main components [PCA] where based on the decomposition of the variance can be determined structures factor experiment. In order to clarify the relationship between the various

components is attached quantitative correlation analysis to assess the direct effects. In this sense, Path-analysis allows to determine the extent of indirect effects between random variables X and Y. Path-coefficients [14] are obtained as a solution to the system: $\Sigma P_i R_{ij} = R_i$, k, I = 1, k-1, where rij e correlation coefficient between random variables X_i and X_j, i, j = 1, k.

Results and Discussion

In analyzing the data from the application of principle component analysis (PCA) on parental components was found that the highest direct effects there under signs number of spikes in the main spike (0.83), number of productive brothers of plant (0.71) and length of the main spike (0.49). The highest direct effects in F1 hybrids were found in signs length of main spike (0.84), number of productive stems from a plant (0.73) and number of spikes in the main spike (0.52). In the second hybrid generation tendency for the effect of direct effects is maintained as in the F1 hybrids. The highest direct effects were observed in the length of main spike (0.79), number of productive stems from a plant (0.68) and number of spikes in the main spike (0.61) (Table 1).

Characters	Direct effects	Indirect effects	Direct effects	Indirect effects	Direct effects	Indirect effects
	Parental forms		Hybrid combinations F_1		Hybrid combinations F_2	
HOS	0,383	0,124	-0,077	-0,142	-0,068	-0,142
NPT	0,710	0,379	0,730	0,504	0,682	0,444
LOS	0,492	-0,655	0,844	-0,436	0,793	-0,198
NSS	0,835	-0,282	0,516	-0,142	0,616	-0,342
NGS	0,371	-0,307	0,364	-0,625	0,165	-0,645
WGS	-0,623	-0,746	-0,482	-0,626	-0,602	-0,629
MTG	-0,420	-0,184	-0,497	0,175	-0,597	0,030

Table 1: PCA components in custody, first and second generation hybrid.

Upon formation of productivity in selected source selection material highest proportion acquire the weight of the grain from the main spike (20%), followed by signs mass of 1,000 grains (18%) and length of the main spike (17%) and most a small proportion of the trait height of the stem (8%). In the first generation at high severities in the formation of yield of wheat is the attribute number of spikes in the main spike (25%), followed by the weight of the grains of the main spike (19%), number of productive stems of plants (17%) and mass of 1000 grains (14%). Least impact on productivity in the F1 hybrid has the feature height of the stem (4%).

Upon formation of productivity in F2 hybrids most strongly influenced by signs weight of grain from the main spike and number of spikes from the main spike (20%), followed by the proportion of the mass of 1000 grains (17%) and number of productive brothers from the main spike (15%). Least is the influence of the attribute height of the stem (4%) (Figure 1).

From studies by principle component analysis studied parental forms and their hybrids, finds that the hybrid generations trends are the same and overlap. The calculated correlations of varieties

Figure 1: China hydrology basic database system structure [4].

and hybrids included in this study indicate the nature of the relations between the structural elements of productivity of common wheat. Impressed different force of manifestation of correlation coefficients in varieties and lines of winter wheat, which are distinguished by their nature, reflected in the relationship between the elements of productivity (Table 2).

Higher is the correlation coefficient between the number of spikes in the spike and the number l' productive stems of plant (0.73), and the length of the main spike (0.62) due to a direct effect. Manifested a correlation between the number of grains in the main spike and length of the main spike has an average warranted (0.49), while between the number of grains in the main spike and

	NPT	LOS	NSS	NGS	WGS	MTG	Path - coefficients
HOS	0,19	-0,26	0,28	0,29	-0,15	-0,29	0,14
NPT		-0,05	0,73***	0,09	-0,84***	-0,18	0,49
LOS			0,62***	0,49*	0,08	-0,14	-0,85
NSS				0,53**	-0,38*	-0,14	-0,40
NGS					0,25	-0,18	-0,37
WGS						0,40*	-0,77
MTG							-0,21

Table 2: Correlation coefficients on indicators for parental components.

* - Warranted an accuracy of 95.0%, ** - warranted an accuracy of 99.0%, *** - warranted an accuracy of 99.9%.

number of spikes in the main spike it is higher (0.53) with the same level of mathematical warranted. A clear correlation with good mathematical warranted is that between the weight of the grain from the main spike and number of productive stems from the plant, but negative (-0.84). In all crosses between the length of the

main spike and number of grains in the main spike there from poor to well-defined positive correlation (0.35 and 0.63). The attribute weight of grain from the main spike is the largest variability (VC% from 2.78 to 10.35% in F1), but at the same time relatively well correlated with the mass of 1000 grains (Table 3).

	NPT	LOS	NSS	NGS	WGS	MTG	Path - coefficients
HOS	-0,10	-0,39	0,07	0,37	0,14	0,03	-0,18
NPT		0,32	0,24	0,08	-0,75***	-0,29	0,48
LOS			0,62***	0,35	-0,19	-0,43*	-0,22
NSS				0,27	-0,30	-0,37	-0,31
NGS					0,26	-0,18	-0,60
WGS						0,49**	-0,65
MTG							0,05

Table 3: Correlation coefficients of performance of first-generation hybrid.

* - Warranted an accuracy of 95.0%, ** - warranted an accuracy of 99.0%, *** - warranted an accuracy of 99.9%.

A negative correlation was found between the weight of the grain from the main spike with a number of productive stems of plant (-0.75 and -0.73) and between the length of the main spike with a mass of 1,000 grains (-0.43 and -0.52). Moderate to strong is the correlation length of the main spike with a number of spikes in the main spike (0.62 and 0.40), and from weak to moderate a correlation between the number of productive brothers of plant and number of spikes in the main spike (0.24 and 0.40) (Table. 4).

Signs number of productive stems from a plant and number of grains in the main spike are connected to it when making the selection, you will need to look for plants with more brothers and beans and a mass of 1,000 grains around 45-55g. The calculated correlations productivity height of the stem are negligible to weak. The height of the stem is in a weak negative correlation with the number of productive stems of plants, the length of the main spike and positively correlated with the number of the grains and in spikes in

	NPT	LOS	NSS	NGS	WGS	MTG	Path - coefficients
HOS	-0,18	-0,21	0,21	0,06	0,09	0,03	-0,19
NPT		0,36	0,40*	0,01	-0,73***	-0,15	0,64
LOS			0,40*	0,63***	0,08	-0,52**	-0,46
NSS				0,28	-0,14	-0,18	-0,12
NGS					0,33	-0,29	-0,61
WGS						0,20	-0,66
MTG							0,15

Table 4: Correlation coefficients of performance during the second hybrid generation.

* - Warranted an accuracy of 95.0%, ** - warranted an accuracy of 99.0%, *** - warranted an accuracy of 99.9%.

the main spike, the weight of the grains of the spike and the weight of 1000 grains. This shows that the height of the stem is controlled by genes independent of the genes that control the other components of productivity.

The correlation of the height of the stem with the weight of the grains of the spike and the mass of 1000 grains is unstable. So the selection on the height of the stem must be done within certain limits under which the plant will develop best biological potential of cultural productivity. The length of the spike does not show a significant correlation with the grain weight spike.

Correlation with the number of grains in the spike is positive, and with the mass of 1000 grains - negative. The relationship of the number of spikes in the main spike with the number of nipples in spike and height of the stem is weak and weighing of grain from the main spike and mass of 1000 grains is negative. The number of grains in the main spike is positively correlated with average weight of grain from the main spike and negatively with the mass of 1000 grains. The mass of 1000 grains are positively correlated with average weight of the grains of spike. So, if we compare the contribution of the mass of 1000 grains in increasing the weight of the grains of this spike with the number of the grain spike, it is seen that the second indicator affects less on the productivity of the spike.

Since the elements of the structure of productivity (the length of the main spike, number of spikes in the main spike, number of grains in the main spike and weight) are interconnected with clearly manifested correlation. It was found that the indirect effects of ambient winter wheat most important for the formation of the productivity of the spike have a number of productive stems of plant (0.48 to 0.64), followed by the mass of 1000 grains (0.05 to 0.15). In another study signs Phat - coefficients are negative high value.

Conclusion

On the productivity of the spike most heavily influenced by signs number of spikes in the main spike and weight of grain from the main spike average - number of productive stems from a plant and weight of 1000 grains and low - length of the main spike, number of grains in the main spike and height of the stem.

To receive a high and stable productivity of spike F1 hybrids most important is the coefficient of correlation between the length of the main spike with a number of spikes in the main spike, and for F2 - length with the number of grains in the main spike.

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Volume 3 Issue 1 January 2019