COMPARATIVE RESEARCH ON PRODUCTIVITY OF NEW *TRITICUM DURUM* DESF. VARIETIES UNDER INCREASING NORMS OF NITROGEN FERTILIZATION

СРАВНИТЕЛНО ИЗПИТВАНЕ ПРОДУКТИВНОСТТА НА НОВИ СОРТОВЕ ТВЪРДА ПШЕНИЦА ПРИ НАРАСТВАЩИ НОРМИ НА АЗОТНО ТОРЕНЕ

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Abstract: *A field experiment was carried out on the experimental field of Cotton and Durum Wheat Research Institute, Chirpan, during the period 2004-2006. The following varieties were studied: Progres; Neptun 2; Beloslava; Saturn 1 and Vozhod under four norms of nitrogen fertilization – N_0, N_6, N_{12}, N_{18} kg.da^{-1} – applied only once in the early spring, having had cotton predecessor. For the two years of research, as well as for the period on the average, the applying of increasing nitrogen norms changes considerably the grain yield of all durum wheat varieties. N_{12} norm proved to be the optimum whereas the further increasing of the norm results in decreasing of the yield. Vozhod variety proved to be the most productive, while the least productive was Beloslava variety.*

Резюме*: Опитът е проведен в опитното поле на Института по памука и твърдата пшеница – Чирпан през периода 2004-2006. Изпитани са следните сортове твърда пшеница: Прогрес, Нептун 2, Белослава, Сатурн 1 и Възход при четири норми на азотно торене - N_0, N_6, N_{12}, N_{18} kg.da^{-1} внесен еднократно рано напролет, при предшественик памук. И през двете години от изследването, както и средно за периода, изпитването на нарастващи азотни норми изменя значително добива на зърно при всички сортове твърда пшеница. N_{12} се очертава като оптимална и по-нататъшното и увеличение води до намаляване на добива. Като най-високодобивен може да се излъчи сорт Възход, а най-нисък добив е получен от сорт Белослава.*

Key words: *durum wheat, nitrogen fertilization, productivity*
Ключови думи: *твърда пшеница, азотно торене, продуктивност*

INTRODUCTION

Cultivation of Triticum Durum Desf. is based in the first place on the qualities of its grain such as vitreousity and high content of amino acids and carotids, adding amber colour to the grain and to the flour as well.

The main deficiency of durum wheat is its low productivity. Thus the main aim of modern selection and agrotechnics is developing of more productive and of higher quality varieties of this cultivation.

Nitrogen fertilization is the main agricultural method used to increase the yield of industrial crops. Durum wheat is highly responsive to mineral fertilization.

The presented research is made on the basis of sowing-circulation with cotton with medium supplied soil. N_{12} fertilization proved to be economically effective, increasing the yield by 80.60% in relation to not fertilized. Thus the net income increases by 139-161%, and the prime cost of unit production decreases by 14-19% (Lalev et al., 2000). Some other authors recommend fertilization of 9 - 12 kg/da^{-1} for the same agro-climatic region (Panayotova and Dechev, 2003).

The yield and qualitative indexes of Durum wheat proved to be highly dependent on the nitrogen fertilization. The high positive correlation between nitrogen fertilization under increasing norms and vitreousity, protein content and wet gluten content is determined (Panayotova and Kolev, 1993; 1997). The increasing nitrogen fertilization is not significant for the hectolitre mass of the grain (Kolev and Terziev, 1994).

The aim of the research is to test and investigate the responsiveness of some new varieties of different origin to the increasing nitrogen norms, regarding grain yield and its components.

MATERIAL AND METHODS

A field experiment was carried out on the experimental field of Cotton and Durum Wheat Research Institute, Chirpan, during the period 2004-2006. The type of the soil was chernozem smolnica, having had cotton predecessor.

The following varieties were studied: Standard - Progres; Neptun 2; Beloslava; Saturn 1 and Vozhod under four norms of nitrogen fertilization – N_0, N_6, N_{12}, N_{18} kg.da^{-1} – applied only once in the early spring. Grain yield was estimated on plots of 10m².

Mathematical processing of data on the base of dispersive analysis was used to determine the results.

RESULTS AND DISCUSSION

As far as the climate is concerned, the region of Chirpan is characterized with comparatively mild winter and hot summer, with droughts especially during August and September which are the driest months of the year.

The autumn of 2004 and 2005 has indexes to the climatic norm for the region (Figure 1). January 2005 is warm with the average monthly temperature 2.3° C higher compared to the climatic norm. The periods of the beginning of vegetation as well as of the ripening of the grain have values close to the average values for a long standing period.

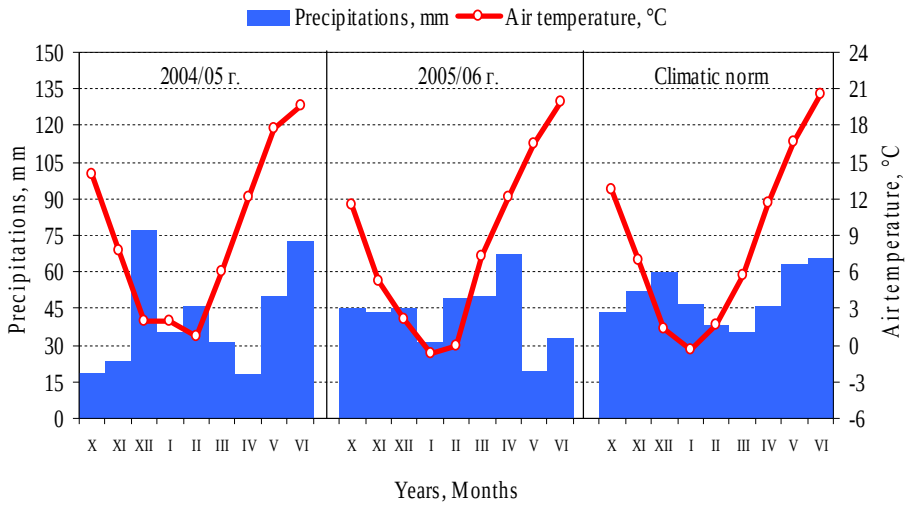

Figure 1. Precipitations and air temperature during the vegetation of Durum wheat during the period of research

In 2005 distribution of precipitations during the vegetation is uneven by month. The autumn is comparatively dry while the amount of precipitations in December is by 17.6 mm higher compared to the climatic norm for the month. The amount of precipitations in April is 18.1 mm which is 27.9 less compared to the long standing period. The period of the grain has values close to the climatic norm while the amount of precipitations in June is 6.5 mm higher in comparison with the typical for the region amount.

The amounts of precipitations are evenly distributed during the autumn of 2005. The autumn of precipitations in April is 67.2 mm which is 21.2 mm higher compared to the long standing period. The period of the ripening of the grain is characterized with low values compared to these of the climatic norm.

May 2006 is characterized with low precipitations – just 19.2 mm compared to the typical for the region norm.

In 2005 average yield of the tested varieties Durum wheat, regardless of nitrogen fertilization, varies from 463.2 kg/da^{-1} of Beloslava variety to 506.2 kg/da^{-1} of Saturn 1 variety (Table 1). The ranking of the studied varieties regarding their average productivity and regardless nitrogen fertilization factor is: Saturn 1 > Vozhod > Neptun 2 > Progres > Beloslava.

Table 1

Grain yield depending on the variety and nitrogen norm

Variety	N norm	2005		2006		Average	
		kg.da^{-1}	± D	kg.da^{-1}	± D	kg.da^{-1}	± D
Progres	0	363.4	-	330.6	-	332.0	-
	6	525.4	162***	421.0	90***	473.2	141*
	12	531.5	168***	577.1	227***	554.3	222***
	18	495.7	132***	485.2	155***	490.5	158**
Neptun2	0	384.2	21^{NS}	327.8	-3^{NS}	356.0	24^{NS}
	6	514.8	151***	573.9	243***	544.4	212***
	12	541.1	178***	577.8	247***	559.5	227***
	18	499.9	137***	584.4	254***	542.2	210***
Belosl.	0	362.5	-1^{NS}	250.4	-80**	306.5	-26^{NS}
	6	487.6	124***	453.9	123***	470.8	139**
	12	531.5	168***	549.5	219***	540.5	209***
	18	471.1	108***	504.4	174***	487.8	156**
Saturn1	0	420.7	57**	330.7	0^{NS}	375.7	44^{NS}
	6	531	168***	535.1	205***	533.1	201***
	12	549.9	187***	564.3	234***	557.1	225***
	18	523.1	160***	590.9	260***	557.0	225***
Vozhod	0	347.3	-16^{NS}	321.9	-9^{NS}	334.6	3^{NS}
	6	531.5	168***	576.6	246***	554.1	222***
	12	557.1	194***	582.6	252***	569.9	238***
	18	512.5	149***	608.0	277***	560.3	228***
GD	5%	38.7		47.7		91.4	
	1%	51.5		63.5		125.0	
	0.1%	67.1		82.7		169.6	

*,**,***- Statistical authenticity of the differences for P=5,1 и 0,1%. NS – non significant differences

The results from the two-factor dispersive analyses prove the differences compared to the control variety Progres only in Saturn 1 variety for level P=1%.The differences in the other varieties are not proved statistically. Thus the thesis of the small influence of genotype on the productivity is determined (Table 2). During the first year of the research the applying of increasing nitrogen norms changes considerably the grain yield of all Durum wheat varieties. As it was expected the lowest is the yield of all not fertilized varieties.

Applying of 6, 12 and 18 kg/da^{-1} N results in increasing of the yield compared to N_0 as follows:

- Progres – 144.6%- N_6, 146.3% - N_{12} and 136.4% - N_{18};
- Neptun 2 – 133.9% - N_6, 140.8% - N_{12} and 130.1% - N_{18};
- Beloslava – 134.5% - N_6, 146.6% - N_{12} and 129.9% - N_{18};
- Saturn 1 – 126.2% - N_6, 130.7% - N_{12} and 124.3% - N_{18};
- Vozhod – 153.0% - N_6, 160.4% - N_{12} and 147.6% - N_{18};

During 2005 the highest are the yields of all studies varieties N_{12} fertilization. According their productivity the studied varieties rank as fallows: Vozhod > Saturn 1 > Neptun 2 > Beloslava > Progres. The applying of the highest norm N_{18} results in increasing of the yield compared to not fertilized variants but it results in decreasing of the productivity compared to N_{12} variant of all varieties on the average of 46.1 kg/da^{-1}. The results from two-factor dispersive analysis confirm the strong influence of the nitrogen fertilization factor on the yield.

The differences in comparison with not fertilized variants are as follows: 142.5 kg/da^{-1} – N_6, 166.6 kg/da^{-1} – N_{12} and 120.5 kg/da^{-1} – N_{18}, proved under level P=0.1%. Under N_{12} the addition to the yield is 24.1 kg/da^{-1} compared to N_6, while the difference between the norms N_{18} and N_{12} is 46.1 kg/da^{-1} in favour of N_{12} (Table 2).

In 2006 the average yield varies from 440.0 kg/da^{-1} for the Beloslava variety to 522.3kg/da^{-1} for the Vozhod variety (Table 2), excluding nitrogen fertilization factor. Regarding the applied nitrogen fertilization the ranking of the studied varieties regarding their productivity is as follows: Vozhod > Neptun 2 > Saturn 1 > Progres > Beloslava. Neptun 2 and Vozhod prove differences compared to the control variety Progres. Saturn 1 proves them at level P=1%, while for Beloslava they are non significant.

During the second year of research the influence of increasing nitrogen norms on the yield is confirmed too for all studied varieties. Again the lowest is the yield of not fertilized variants. Applying of fertilization 6.12 and 18 kg/da^{-1} N results in increasing of the yield in comparison with N_0 as follows:

- Progres – 127.3% – N_6, 174.6% – N_{12} and 146.8%– N_{18};
- Neptun 2 – 173.6% - N_6, 174.8% - N_{12} and 176.8% - N_{18};
- Beloslava – 137.3% - N_6, 166.2% - N_{12} and 152.6% - N_{18};
- Saturn 1 – 161.9% - N_6, 170.7% - N_{12} and 178.7% - N_{18};
- Vozhod – 174.4% - N_6, 176.2%- N_{12} and 183.9%- N_{18};

The yield of the studied varieties is the highest under N_{12} and N_{18} fertilization. Respectively the yield is the highest under N_{12} fertilization for the standard variety Progres and Beloslava variety, while under N_{18} fertilization it is the highest for all the other varieties.

The studied varieties rank according their productivity as follows: Vozhod > Saturn 1 > Neptun 2 > Progres > Beloslava. The results of the two-factor analysis confirm the strong influence of nitrogen fertilization factor on the industrial yield. The differences in comparison with not fertilized variants are – 213.6 kg/da^{-1} under N_6 - 257.4 kg/da^{-1} under N_{12} and 241.7 kg/da^{-1} under N_{18}, proved for level P=0.1% under N_{12} fertilization the addition to the yield

compared to N_6, is 43.8 kg/da^{-1}, while the difference between the norms N_{18} and N_{12} is 15.7 kg/da^{-1} in favour of N_{12}.

Table 2

Yield and main influence of the factors

Factor A – Variety

Factors	2005		2006		Average	
	kg.da^{-1}	± D	kg.da^{-1}	± D	kg.da^{-1}	± D
Progres	479.0	-	472.2	-	475.6	-
Neptun2	479.5	+0.5^{NS}	516.0	43.8***	497.8	22.2^{NS}
Beloslava	463.2	-15.8^{NS}	440.0	-2.2**	451.6	-24.0^{NS}
Saturn1	506.2	+27**	505.3	33.1**	505.8	30.2^{NS}
Vozhod	487.1	+8.1^{NS}	522.3	50.1***	504.7	29.1^{NS}
GD 5%		19.4		23.9		45.7
1%		25.8		31.8		62.5
0.1%		33.5		41.3		84.8
Factor B – Nitrogen Norm						
N_0	375.6	-	312.9	-	344.3	-
N_6	518.1	+142.5***	526.5	213.6***	522.3	178.0***
N_{12}	542.2	+166.6***	570.3	257.4***	556.3	212.0***
N_{18}	496.1	+120.5***	554.6	241.7***	525.4	181.1***
GD 5%		17.3		21.3		40.9
1%		23.0		28.4		55.9
0.1%		30.0		37.0		75.9

*,**,***- Statistical authenticity of the differences for P=5, 1 and 0,1%. NS – non significant differences

The results of the average yield for the two years of the research show that, for all studied Durum wheat varieties, the yield is the highest under N_{12} fertilization, while under the highest norm N_{18} it decreases. The lowest is the yield of not fertilized variants. Vozhod proved to be variety with the highest productivity – 569.9 kg/da^{-1}. The rest Durum wheat varieties rank according to their productivity as follows: Neptun 2 (559.5 kg/da^{-1}) > Saturn 1 (557.1 kg/da^{-1}) > Progres (554.3 kg/da^{-1}) > Beloslava (540.5 kg/da^{-1}) (Table 1).

The influence of the variety factor is not strongly expressed and it is not statistically proved when summarizing the data from the two years of research, whereas the opposite is true for the nitrogen fertilization factor, which is proved at the highest level of P=0.1%. Regarding the nitrogen fertilization factor the average yield for the two years is the highest under N_{12} fertilization (556.3 kg/da^{-1}) and according to expectation the yield of the not fertilized variants is the lowest (344 kg/da^{-1}). The increasing of N_{18} norm results in statistically proved increasing the yield, compared to N_0 by 181 kg/da^{-1}, but the differences in accordance to N_{12} is 31 kg in favour of the lower norm.

CONCLUSIONS

For the two years of research, as well as for the period on the average, the applying of increasing nitrogen norms changes considerably the grain yield of all Durum wheat varieties.

The lowest is the yield of not fertilized variants. Applying of 6, 12 and 18 kg/da^{-1} N results in increasing of the yield compared to N_0. The N_{12} norm proved to be the optimum

whereas the further increasing of the norm results in decreasing of the yield. The influence of variety factor is less strongly expressed and is not proved when summarizing the data from the two years of research.

Vozhod variety proved to be the most productive, while the least productive was Beloslava variety.

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