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THE YIELD AND GRAIN QUALITY OF WINTER TRITICALE VARIETY INGEN 93 IN THE MULTIFACTORIAL EXPERIMENT

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Abstract

This article presents the data of an experiment were a winter triticale (X Triticosecale Wittmack) variety Ingen 93 was studied depending on the previous plants (dry pea and vetch + oats), sown in three different sowing terms (8.X., 18.X.,28.X.) and according to three sowing rates - 4.0, 5.0 and 6.0 million seeds/ha. The amount of precipitation was of 556.3 mm, with 64.3 mm (13.1%) higher than the multiannual average quantity of precipitation. In the multifactorial experiment, the greatest influence on the yield of the studied variety was recorded by the previous crop (Factor A) – 99.24%, followed by the sowing rate (Factor C) only 0.76 %, and zero influence by the sowing terms and interaction of factors. In the conditions of 2015, the highest yield of winter triticale variety Ingen 93 was obtained after dry pea - 3353 kg/ha that significantly exceeded the predecessor vetch + oats to 717kg/ha. The highest quality of grain and crude protein content was recorded where dry pea was used as a previous plant. The highest test weight value was obtained after vetch + oats - 707.1 kg/hL, which exceeds the values of test weight after dry pea by 5.2 kg/hL. The largest grains of winter triticale variety Ingen 93 was forming after previous plant vetch + oats, - 49.7g.

Key words*: previous crop, quality of grain, sowing rate, sowing term.*

INTRODUCTION

One of the means to increase the production of high-quality grain for food and feed is a better use of the biological potential of the new crop for grain triticale. This crop very successfully combines high ecological plasticity and yield of winter rye and grain quality of winter wheat. However, the absence of the technology of cultivation of these varieties has prompted us to conduct this study. Seeding in particular represents a substantial input cost in many cereal cropping systems (Spink et al., 2000), but only limited field studies are available for triticale which explored sowing densities together with other agronomic or environmental interactions (Giunta and Motzo, 2004; Bassu et al., 2013).

MATERIALS AND METHODS

The studies were conducted in the conditions of 2015 at The Research Experimental Station "Chetrosu" of SAUM located in the central agro-climatic zone of Moldova. The variety Ingen 93 of winter triticale, bred in the Institute of Plant Physiology and Genetics of Moldova's Academy of Sciences was studied in the experiment. Three sowing terms (8 of October, 18 of October, and 28 of October), two previous plants (dry pea and the mixture of vetch + oats) and three sowing rates (4.0; 5.0 and 6.0 million seeds per 1 ha) were in the experiment. The experiment was held in 3 replications with the plot area of 40 m^2. The content of total nitrogen was determined by Kjeldahl method. Crude protein is calculated by a factor of 5.72. Yields were calculated on 100% purity and 14% humidity. Statistical data processing was carried out the crop by analysis of variance for Dospekhov B. (1984). One thousand-kernel weight (WTK) was obtained as the mean value of 3 replicates of 100 seeds from each plot. Test weight was calculated using a Shopper chondrometer equipped with a 1 L container and reported as kg/hL without reference to the moisture content. The soil of the field is presented by calcic chernozems, strong clay loam, on silty loess. The thickness of humus horizon is 90-100 cm. Humus content in arable layer from 2.70 to 2.92%. Climatic conditions in the 2014-2015 agricultural year

were favourable for plant growth and development of winter triticale. The average air temperature exceeded the seasonal multiannual average (1881 – 2003yrs.) by 0.9 - 2.1°C, and for the whole year by 1.7°C. The amount of precipitation was 556.3 mm, 64.3 mm (13.1%) higher than the multiannual average quantity of precipitation. For the autumn time, the amount of precipitation was 197.4 mm, which is of 86.8 mm higher than the multiannual average quantity of precipitation (110.6 mm). In the spring months, rainfall was of 151.4 mm, that exceeding the norm of 45.3 mm. A significant moisture deficiency was noted in the summer time - 125.3 mm, 56.3 mm less than normal quantity of precipitation (181.6 mm).

RESULTS AND DISCUSSIONS

In the conditions of 2015, the average yield of winter triticale variety Ingen 93 studied after previous plants was 3353 kg/ha after dry pea and 2636 kg/ha after vetch + oats (Table 1). The yield of triticale sown after dry pea were of 717 kg/ha higher than after vetch + oats. This increase was significant, as it is much more than the least significant difference (LSD_{05} - 81 kg/ha). After dry pea as previous crop the higher grain yield of triticale was obtained in the first sowing term (8.X), which amounted to 3399 kg/ha. Reduced yield of winter triticale grain in the second term (18.X - 3346 kg/ha) and the third term (28.X - 3314 kg/ha), was statistically non-significant. After vetch-oats the highest yield of grain was obtained in the second term of sowing (18.X), amounted to 2714 kg/ha, significantly exceeded the first term (8.X) to 120 kg/ha. In the third sowing term was obtained the lowest yield after both predecessors 3314 kg/ha after dry pea and 2560 kg/ha after vetch + oats.

Increasing the sowing rate from 4.0 to 6.0 million seeds per 1 ha do not contribute significantly to the increase in productivity of phytocoenosis. No significant yield variations have received with respect to the rate of 5.0 million of seeds per 1 ha. The greatest degree of influence on the yield of winter triticale variety Ingen 93 exerted predecessors - 99.24% (Table 2.). The influence of sowing rate was of 0.76%. The sowing dates, double and triple interaction between the studied factors had no impact on the yield of the variety.

Table 1.The yield of winter triticale, variety Ingen 93, kg/ha, 2015

Sowing rate Factor C, m/ha	Previous plant (Factor A)						The average for factor C, LSD_{05} kg/ha C-99	± to the Control
	Dry pea (control B)			Vetch + oats				
	Sowing term (Factor B)							
	8.X (cont. B)	18.X	28.X	8.X (cont. B)	18.X	28.X		
4,0	3402	3255	3167	2516	2669	2484	2916	-88
5,0(Control)	3373	3372	3284	2625	2821	2549	3004	-
6,0	3421	3412	3490	2702	2713	2647	3064	+60
The average for factor A	3353			2636				
LSD_{05} kg/ha, A-81	-717							
The average for factor B	3399	3346	3314	2614	2734	2560		
HCP_{05} kg/ha B-99	-	-53	-85	-	+120	-54		
LSD_{05} kg/ha of the experiment	243							
P%	2,8							
Coefficient of variation, %	4,9							

Table 2. The proportion of factors in the yield formation of winter triticale, variety Ingen 93, 2015

Factor, Portion	Previous crop, A	Sowing term, B	Sowing rate, C	AB	AC	BC	ABC	Total
%	99,24	0	0,76	0	0	0	0	100

The content of crude protein in the grain of winter triticale after dry peas ranged from 12.82% in the first sowing period (8.X) to 14.91% in the third sowing period (28.X) (Table 3). It has been noticed a steady upward trend in the crude protein content from the first sowing period (8.X) to the third sowing period (28.X). In the second sowing term (18.X) the crude protein content of winter triticale kernels was of 13.60%, 0.78% higher than in the first sowing term (8.X - 12.82%). Further delay in sowing resulted in higher crude protein content. In the third sowing term (28.X) the value of this indicator was 14.91%, which is 2.09% higher than in the first sowing term (8.X) and 1.31% higher in the second term (18.X). On average, the crude protein content after dry pea was of 13.78%. After the previous plant vetch

+ oats the dynamics of the crude protein content is different.

From the first sowing period (8.X) to the second sowing period (18.X) decrease in crude protein content was 1.32%, from 15.14 to 13.82%, and comparing to the third (28.X) decreased to 14.81%. The average crude protein content after the previous plant vetch + oats was of 14.59%. If to compare crude protein content by previous plants, then after vetch + oats content was higher of 0.81%. The yield of crude protein with grain harvest after dry pea for grain increases from the first sowing term (8.x) 375.1 kg / ha to 421.1 kg / ha in the third sowing term (28.X). On average, the yield of crude protein after dry pea was of 396.9 kg/ha. After previous plant vetch + oats the yield of crude protein reached the highest value in the first sowing term (8.X) - 341.8 kg/ha, up 6.5 and 17.1 kg/ha more than in the second (18. X) and the third (28.X) terms respectively. In general, after vetch + oats, this index was of 333.9 kg/ha. After the previous plant dry pea the yield of crude protein was higher than after vetch + oats by 63 kg/ha due to higher grain yield, although the content of crude protein in grain is below.

Table 3. The content of crude protein and yield of protein in winter triticale, variety Ingen 93

	Previous plant					
	Dry pea			Vetch + oats		
	Sowing terms					
	8.X	18.X	28.X	8.X	18.X	28.X
Protein content, %	12.82	13.60	14.91	15.14	13.82	14.81
	13.78			14.59		
	-	+0.78	+2.09	-	-1.32	-0.33
± to dry pea	-			+0.81		
Yield of protein, kg/ha	375.1	394.4	421.1	341.8	335.3	324.7
	396.9			333.9		
	-	+19.3	+46.0	-	-6.5	-17.1
± to dry pea	-			-63		

Determination of WTK of winter triticale kernels variety Ingen 93 has shown the variability of this indicator depending on the studied elements of technology. After dry pea the weight of 1000 kernels was of 47.0 g, which is by 2.7 g less than after vetch + oats (Table 4). After dry pea, the weight of 1000 kernels by sowing terms did not change significantly, accounting for 46.85 g in the first sowing term (8.X) and 47.1 grams in the second (18.X) and third sowing terms (28.X). An important physical indicator of winter triticale kernels is test weight, which characterizes the ability of the grains to occupy a certain amount of storage space. The average test weight of the experience of winter triticale grain was of 704.7 kg/hL (Table 5). On average, after vetch + oat the test weight was 707.1 kg/hL, which is of 5.2 kg/hL exceeds the value of this index after dry pea (702.3 kg/hL). After dry pea this indicator tends to decrease from the early sowing term (8.X) to the middle term with 704.3 kg/hL, to 699.4 kg/hL. After vetch + oats test weight increases from the early sowing term (8.x) to the middle term of 704.7 kg/hL up to 712.4 kg/hL.

Table 4. The weight of thousand kernels of winter triticale, variety Ingen 93

Sowing rate Factor C, m/ha	Previous plant (Factor A)						The average for factor C	± to control C
	Dry pea (control) A			Vetch + oats				
	Sowing terms (factor B)							
	8.X (control B)	18.X	28.X	8.X (control B)	18.X	28.X		
4,0	44.6	49.4	50.0	51.6	50.0	49.7	49.2	+1.3
5,0 (control C)	46.2	43.5	48.4	50.2	49.9	49.4	47.9	-
6,0	49.6	48.5	43.0	49.3	48.1	49.1	47.9	0
Average for previous plant	47.0			49.7				
± to dry pea	+2.7							
Average for sowing terms	46.8	47.1	47.1	50.4	49.3	49.4		
± to the first term	-	+0.3	+0.3		-1.1	-1.0		

Table 5. Test weight of winter triticale kernels, variety , Ingen 93, kg/hL

Sowing rate, Factor C, m/ha	Previous plant (Factor A)						Average for factor C	± to Control C
	Dry peas (Control) A			Vetch + oats				
	Sowing term (Factor A)							
	8.X (Control B)	18.X	28.X	8.X (Control B)	18.X	28.X		
4,0	704.6	698.9	703.7	702.0	715.0	704.1	704.7	-0.3
5,0 (control)	705.1	704.9	702.9	703.6	714.7	698.6	705.0	-
6,0	707.3	695.9	703.4	708.6	707.6	709.0	705.3	+0.3
Average for previous plant	702.3			707.1				
± to dry pea	+5.2							
Average for sowing terms	704.3	699.4	703.3	704.7	712.4	704.2		
± to the first term	-	-4.9	-1.0	-	+7.7	-0.5		

The effect of sowing rate on the change in test weight was not significant and depending on sowing rate was of 704.7 - 705.3 g/l. Thus, it has established the dynamics of reducing the test weight of kernels of winter triticale variety Ingen 93 from early sowing period (8.X) to the middle (18.X) sown after dry pea. After another studied predecessor vetch + oats on the contrary, an increase in the test weight from the early sowing period (8.X) to the middle sowing period (18.X) was noticed. Thus, the studied elements of the technology of cultivation of winter triticale had a different effect on the yield and quality of grain and physical indicators of variety Ingen 93.

CONCLUSIONS

After dry pea as a previous plant, the highest grain yield of winter triticale variety Ingen 93 was obtained in the first sowing term (8.X) at the sowing rate of 6.0 million/ha, accounting 3471 kg/ha. After vetch + oats, the highest grain yield was obtained in the second sowing term (18.X) at the rate of 5.0 million/ha, accounting for 2821 kg/ha. In the conditions of 2015, the highest yield of winter triticale variety Ingen 93 was obtained after dry pea - 3353 kg/ha that significantly exceeded the predecessor vetch + oats to 717 kg/ha. On the productivity of winter triticale the largest share of the impact of falls on the previous plant - 99.24%. Other factors and their interaction had no significant influence on the formation of grain yield. The highest content of crude protein was obtained after dry pea sown in the third term (28.X) - 14.91%, and after vetch - oats sown in the first term (8.X) - 15.14%. In general, after vetch + oats the crude protein content was higher than after dry pea as the previous plant with 0.81%. The yield of crude protein from the grain after dry pea was higher than after vetch + oats with 63 kg/ha. Larger grains of winter triticale variety Ingen 93 was forming after previous plant vetch + oats, - 49.7g. After dry pea, the weight of 1000 kernels increased from the early sowing period (8.X) to late sowing period (28.X), while after vetch + oats contrary, the weight reduction to the late sowing period was noticed. The highest test weight value was obtained after vetch + oats - 707.1 kg/hL, which exceeds the values of test weight after dry pea by kg/hL. After dry peas grain the test is reducing from the early sowing period (8.X) to the middle sowing period (18.X), while after vetch + oats on the contrary, is increased. The study of sowing rate of winter triticale had no significant effect on the change of physical characteristics of seed - test weight and WTK.

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