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PRODUCTIVITY OF THE WINTER DURUM WHEAT IN POLYFACTORIAL EXPERIENCES

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Abstract

The aim of this research was to assess the influence of some technological elements upon productivity and quality of winter durum wheat (Triticum turgidum L. var. durum), during of four agricultural years (2010-2014). Climate conditions were very different in the years of experiments. Two varieties of winter durum wheat were studied in most of the years. There were three sowing terms and three densities sown on two previous plants in this field experiment. There were recorded the data: the average yield, TKW, Hardness index and gluten content. In the conditions of the years relatively favourable after humidity, with long and warm autumn and in the years less favourable with insufficient wetting of seedbed, the maximum average yield of winter durum wheat reached 3275-4900 kg/ha by sowing from the optimal - acceptable terms until the late term with the sowing density of 4-6 m seeds/ha. In the conditions of an unfavourable year with extreme drought conditions associated with heat during the growing period, the maximum average yield of winter durum wheat was of 746-1157 kg/ha by sowing in the late term of sowing at the density of 5-6 m seeds/ha. The quality of grains (the hardness index, gluten content, and other indices) as a rule is inversely proportional to the level of average production.

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

INTRODUCTION

The winter durum wheat due to its biological particularities and requirements for environmental factors require different attitude to the term and sowing density and as well to other technological processes in comparison with winter common wheat. Kirkegaard et al. (2008) carried out a survey of the literature on the effects of break crops, that is, crops interrupting the sequence of continuous wheat, and showed mean yield benefits of up to 20% or more, the magnitude of response depending on site, weather conditions, and other aspects of crop management. Sowing date is one of the most important management factor affecting cereal production and quality (McLeod et al., 1992). In a given region, the optimum sowing date depends mainly upon the timing of rainfall (Jackson et al., 2000). In most cases, delaying sowing beyond the optimum period reduces wheat yields (Bassu et al., 2009). The research concerning the assessing the influence of some technological elements upon productivity and quality of winter durum wheat grains were carried out at the Chetrosu Research Station of the State Agricultural University of Moldova in 2011-2014.

MATERIALS AND METHODS

The climatic conditions in the years of experiments were different. Thus, the agricultural year 2010-2011 was less favourable as compared to the value of multi-annual average (440.9 mm and 492.0 mm respectively), and primarily in the period of months February - March, but in June fell down two-month norm. The 2011-2012 agricultural year was unfavorable, with extreme conditions, dry, associated with spring scorching, the quantities of precipitation were of 324.4 mm (492.0 mm is value of multiannual average). Especially dry were the autumn months, the spring months and the early summer month. Only in the month of May, the quantity of precipitation was double, comparing to the norm. The 2012-2013 agricultural year was also less favorable, with the annual quantity of precipitation of 443.3 mm. The driest months were October, November, May and June. Only

in the month of December fell down two monthly norms of the precipitations. The 2013-2014 agricultural year was relatively favorable with the annual quantity of precipitation of 430.2 mm. The months of September and May were the wettest months; the months of October, November and June were drier months than usual. In the field experiments there has been studied the role of previous plant (dry pea and mixture of oats and vetch), the sowing terms: the optimal (III decade of September), the acceptable (I decade of October) and the late (II and III decade of October) and the sowing density (basically 4-5-6 million seeds/ha) on the average yield and to the quality of winter durum wheat grains. The average yield in our paper is the mean value of the yield (kg/ha) from sowing densities and/or from sowing terms. One thousand-kernel weight 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. Gluten content according to the State Standard 27839-88. In the most of the years they were studied two varieties of winter durum wheat: Hordeiforme 335 and Auriu 273. As the witness (W) served the variety Hordeiforme 335 sown after pea in the optimum term or optimum -acceptable at the density of 5 million of seeds/ha. The soil of the field is presented by a calcic chernozems.

RESULTS AND DISCUSSIONS

The yield of winter durum wheat was different depending on the climate, the variety, the previous crop as well as the sowing term and the sowing density (Table 1).

Table 1. The yield of winter durum wheat depending on climatic conditions and some techniques of cultivation. 2011-2014 yr., kg/ha

Indicators		Previous crop	
		Dry pea	Mixture of oats and wetch
2010-2011 ag. yr.			
Avarage yield	after terms	2592 – 3275	2800 – 3683
	after densities	3108 – 3500	3275 – 3917
The variant of maximum average yield	after terms	Dolphin, late	Hordeiforme 335, acceptable
	after densities	Hordeiforme 335;6.5 m	Hordeiforme 335; 6.5 m
2011-2012 ag.yr.			
Avarage yield	after terms	823 – 1157	706 – 1138
	after densities	774 – 843	658 – 746
The variant of maximum average yield	after terms	Hordeiforme 335; late	Auriu – 273; late
	after densities	Hordeiforme 335; 5 m	Hordeiforme 335; 6 m
2012-2013 ag.yr.			
Avarage yield	after terms	2574 – 4900	1652 – 3886
	after densities	4187 – 4900	3414 - 3982
The variant of maximum average yield	after terms	Hordeiforme 335; optimum	Auriu – 273; late
	after densities	Hordeiforme 335; 5 m	Hordeiforme 335; 4 m
2013-2014 ag.yr.			
Avarage yield	after terms	3843 – 4383	3606 – 4259
	after densities	3843 – 4627	3914 – 4436
The variant of maximum average yield	after terms	Auriu 273; late	Auriu 273; late
	after densities	Auriu 273; 6 m	Auriu 273; 4 m

The average yield was the lowest in the agricultural year 2011-2012, an unfavorable year with extreme conditions and a higher yield in other years, relatively favorable or less favorable. Thus the average yield in the year 2011, a less favorable year, after dry pea as a previous plant, the yield of grain varied within the 2592-3275 and 3108-3500 kg/ha, and after the mixture of oats and vetch - 2800-3683 and 3275-3917 kg/ha (3175 kg/ha at the W.) after the terms and respectively after the sowing densities. The maximum average yields were recorded at the varieties Dolphin and Hordeiforme 335, sown in the late term and the acceptable term and at an increased sowing density (6.5 million seeds /ha). The exceedances from the witness were significant, except the variety Dolphin (LSD_{05} - 557 and 73

kg/ha respectively for the sowing terms and the sowing densities). In the 2011-2012 agricultural year, an year with extreme humidity conditions, the average yield was of 823-1157 and 774-843 kg/ha after pea and 706-843 and 658-746 kg/ha and after mixture of oats and vetch (843 kg/ha at W) by the terms and the sowing densities respectively. The average maximum yields were recorded in the variants of the late sowing term, where exceedances were significant compared to the witness (LSD_{05} -54 kg/ha). After the sowing densities in most cases the witness significantly exceeded other variants. In the years with condition like this (drought associated with heat) the priority should be given to the late sowing terms and to the greater sowing densities. In the 2012-2013 agricultural year, the less favorable (drought pronounced May-June) , the average production of winter durum wheat varied within the limits of 2574-4900 and 4187-4900 kg/ha (after pea) and 1652-3886 and 3414-3982 kg/ha (after mixture of oats and vetch) respectively at the terms of sowing and sowing densities (W = 4900 kg/ha). In most of cases the witness significantly exceeded other variants (LSD_{05} = 170 and 123 kg/ha for the sowing terms and the seeding densities respectively). In the 2013-2014 agricultural year, a relatively favorable year, the average production of winter durum wheat was increased compared to previous years and amounted to 3843-4383 and 3843-4627 kg/ha (after peas) and 3606-4259 and 3914-4436 kg/ha (mixture of oats and vetch) respectively for terms and sowing densities W = 3843 kg/ha). The maximum average yield was recorded at the variety Auriu 273 sown after the both previous crops in the late term of sowing (LSD_{05} = 170 kg/ha) and also to this variety after sowing densities of 6 and 4 m seeds/ha respectively after pea and mixture of oats and vetch (LSD_{05} = 128 kg/ha).

Table 2. Quality of winter durum wheat, 2011 – 2014 yrs.

Variant		TKW, g	Test weight kg/hL	Hardness index, %	Gluten content, %
2010-2011					
Previous crop – dry pea	Dolphin, the late term of sowing	41,8	776	83	37,1
	Hordeiforme 335, 6 million	41,4	779	76	30,5
Witness (W)		44,8	750	78	35,1
Previous crop - mixture of oats and wetch	Hordeiforme 335, the acceptable term of sowing	44,4	777	85	38,0
	Hordeiforme 335, 6.5 million	43,5	776	80	29,5
2011-2012					
Previous crop – dry pea	Hordeiforme 335, termenul târziu de semănat	38,4	782	83	34,3
	Hordeiforme 335, 5 m	39,5	773	90	35,4
Witness (W)		39,5	773	90	35,4
Previous crop - mixture of oats and wetch	Auriu 273,the late term of sowing	40,8	765	88	32,8
	Hordeiforme 335, 6 million	39,2	778	79	31,1
2012-2013					
Previous crop – dry pea	Hordeiforme 335, the optimum term of sowing	44,9	719	47	25,1
	Hordeiforme 335, 5 million	44,9	719	47	25,1
Witness (W)		44,9	719	47	25,1
Previous crop - mixture of oats and wetch	Auriu 273, the late term of sowing	44,7	-	47,5	24,1
	Hordeiforme 335, 4 m	43,9	726	44,5	24,0
2013-2014					
Previous crop – dry pea	Auriu 273, the late term of sowing	39,2	772	77	28,1
	Auriu 273, 6 million	39,1	779	82	28,8
Witness (W)		40,4	771	92	30,8
Previous crop - mixture of oats and wetch	Auriu 273, the late term of sowing	41,2	759	90	31,2
	Auriu 273, 4 million	41,3	750	79	30,2

In the condition of this year, a year relatively favorable, the priority is given to the peas as a previous plant, the seedbed being well supplied with moisture and nutrients (primarily N_2). To the concern of sowing term in a long autumn, warm and well supplied with moisture, the priority is given to the later term of sowing. But to the variety Auriu 273, the average production within acceptable sowing term has not been significantly exceeded by the variant of the average production level of the late sowing terms. Regarding the sowing density, the priority is given to the density of 6 m (after peas for grain). The divergence after level of average yield between the sowing densities in the case of the mixture of oats and vetch as the previous plant of the variety Hordeiforme 335 is insignificant and significant enough at the variety Auriu 273. Perhaps the favorable conditions of this year, in this case, the denisity of productive strains was offset by a higher productive twinning of plants, higher in the variants with lower sowing densities. This year has proved more productive variety Auriu 273.

The quality of kernels of winter durum wheat in general was inversely proportional to average production levels in various years. But in a big portion of the variants of maximum average yield, the most indices of grain quality were satisfactory until the level of the witness or even have exceeded (Table 2). Thus, the values of quality main indices were higher in the 2010-2011 agricultural year, an unfavorable year, when the average yield was the lowest (except TKW). At the opposite pole was located the 2012-2013 agricultural year, when the average yield was higher, the most of kernel quality indices (except TKW) were reduced, but almost satisfactory. The kernels were slightly small and the content of gluten in kernels was slightly lower. The 2013-2014 agricultural year was relatively favorable and the average yield was the highest, the content of gluten in kernels exceeded their values from 2011 and 2012. The 2010-2011 agricultural year, a less favorable year with a level of average production quite satisfactory, the quality indexes of grains in the variants of maximum average yield were good enough in many cases exceeded the witness. The content of gluten in grains was at the level of the 2011-2012 agricultural year or even higher. The hardness index of grains is directly proportional with the quantity of gluten in them.

CONCLUSIONS

In the conditions of the years relatively favorable after humidity, with long and warm autumn and in the years less favorable with insufficient wetting of seedbed, the maximum average yield of winter durum wheat reached 3275-4900 kg/ha by sowing from the optimal - acceptable terms until the late term with the sowing density of 4-6 m seeds/ha. In the conditions of an unfavorable year with extreme drought conditions associated with heat during the growing period, the maximum average yield of winter durum wheat was of 746-1157 kg/ha by sowing in the late term of sowing at the density of 5-6 m seeds/ha

The quality of grains (the hardness index, gluten content, and other indices) as a rule is inversely proportional to the level of average yield. In our experiences in the most of the variants of maximum average yield, the indicators of grains quality were from the satisfactory to the near level witness or even exceeding it.

REFERENCES

Bassu S., Asseng S., Motzo R., Giunta F., 2009. Optimising sowing date of durum wheat in a variable Mediterranean environment, Field Crops Research, Vol. 111, 109-118.

Jackson L.F., Dubcovsky J., Gallagher L.W., Wennig R.L., Heaton J., Vogt H., Gibbs L.K., Kirby D., Canevari M., Carlson H., Kearney T., Marsh B., Munier D., Mutters C., Orloff S., Schmierer J., Vargas R., Williams J., Wright S., 2000. Regional Barley and Common and Durum Wheat Performance Tests in California. University of California, Agronomy Progress Report No. 272, Davis, http://agric.ucdavis.edu/crops/cereals/2000/oct2000.htm

Kirkegaard J., Christen O., Krupinsky J., Layzell D., 2008. Break crop benefits in temperate wheat production. Field Crops Research, vol.107, no. 3, 185–195

McLeod J.,G., Campbell C.A., Dyck F.B., Vera C.L., 1992. Optimum seeding dates of winter wheat in southwestern Saskatchewan, Agronomy Journal, vol. 84, 86-90.