THE INFLUENCE OF THE FOREGOING PLANT AND OF THE SOWING DENSITY ON THE YIELD AND QUALITY OF DURUM WHEAT TRITICUM TURGIDUM (L.) THELL, subsp. TURGIDUM conv. DURUM (DEST.)M.K.

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Abstract. *The study was carried out in Banat's lowland, on the plain between the rivers Mureș and Bega. According to the map of climate types existing on the territory of Romania, the area where the researches were carried out belongs to the moderate continental climate type, the sector of climate province with Mediterranean influences. According to Köppen, this area is part of the e.f.b.x. climate province. The soil of the experimental filed is a typical carbonate light chernozem, moderate eroded, with a light alkaline reaction (pH 8,2), having an argillaceous texture. The studies variety is Grandur. The crop results for the four seeding densities and for the crop rotation wheat – repeated culture show an average crop of 5499 kg/ha, for the crop rotation wheat after corn an average crop of 6114 kg/ha, and for the crop rotation soy - wheat an average crop of 6300 kg/ha. As regarding the seeding densities, the largest crop - 6277 kg/ha (the average for the three foregoing plants) - was obtained when seeding 650 germinable grains/m^2. An increase of density up to 750 germinable seeds /m^2 is not justifiable. The plant loss results determined in the area the researches were carried out were of between 10/14% from plant sprouting and until the end of winter, the variety Grandur being a variety adapted to this region. The mass of 1000 grains varied between 38.7 and 41.6 g, and the hectolitre mass between 77.7 and 80.9 kg/hl. The gross protein value was high, exceeding 15% for the crop rotation soy – wheat when seeding 450, 550 and 650 germinable seeds/m^2, and the wet gluten content was of between 28.5 – 29.4% for the same seeding density variants.*

Key words: *Durum wheat, crop rotation and crop density.*

INTRODUCTION

The variety Durum wheat (Triticum turgidum (L.)), subsp. Turgidum, conv. Durum (Desf.) M.K., is rich in protein of a quality different of that specific for bread wheat, which is why it is used in pasta industry and in grain processing industry.

In the last years, the worldwide surface seeded with Durum wheat varied between 18 - 23 millions of ha, which means 9 - 10% of the surface cultivated with wheat. The worldwide production is of about 30 millions of tones.

This species is the most pretentious one as compared to Triticum aestivum when it comes to the climate conditions they are cultivated in and to the soil fertility, as they prefer fertile soils, rich in calcium and with a good water/air ratio. As the cultivation areas extend to the North (of the most favourable area), the production of the performant Durum wheat varieties reduces with 180 kg/100 km (M. BERCA, 2013). The countries cultivating this species on the largest surfaces are Canada, USA, Australia, China and Russia. In Europe, Italy, Turkey, Spain and France occupy the first places in cultivating Durum wheat.

The surface cultivated with Durum wheat decreased from over 12.000 ha in year 201 to less than 5.000 ha in the last years, although our country has favourable conditions for such cultures in its southern areas.

MATERIAL AND METHODS

The main goal of the researches carried out in the years 2014 and 2015 was to determine the influence of Durum wheat plants density on the crop results and on the quality of seeds under the pedo-climatic conditions in Banat Plain, Variaş area, situated on the first terrace of Mureş River.

The biologic material used for the experiment was the variety named Grandur. The type of soil used for the experiment was a typical chernozem.

The experiments were two level factorial with three repetitions and the following graduation of the factors:

A factor – the foregoing plant

a_1 – wheat – repeated culture – Mt;

a_2 – cord seeds – the cereal widely cultivated in this area;

a_3 – soy – leguminous plant, a very good foregoing plant for wheat, if early harvested.

B factor – the seeding density (number of germinable seeds /m^2);

b_1 – 450 germinable seeds/m^2 ;

b_2 – 550 germinable seeds/m^2 ;

b_3 – 650 germinable seeds/m^2 ;

b_4 – 750 germinable seeds/m^2 ;

The germinative bed preparation was done by processing the basic ploughing (done with the plough with star harrow at a depth of 18-22 cm after harvesting the foregoing plant) with the cultivator.

The seeding was done between October 10th and 15th, with the cereal seeder, at a distance of 12.5 cm between the rows and a seeding depth of 4 – 5 cm, not deeper because Durum wheat has a short coleoptile and therefore not so much power of penetration than common wheat. The fertilization was uniformly done, with $N_{150}P_{80}K_{80,}$ the fertilizers containing phosphor and potassium being applied under the autumn ploughing, in form of superphosphate respectively of potassium salt.

The fertilizers containing nitrogen were applied in two stages - N_{60} when preparing the germinative bed and N_{50} in spring, before the plants build their straw - in form of ammonium nitrate.

The weeding was done with the herbicide Secator Progress 0.15 l/ha, applied together with the fungicide Falcon N60 EC in a dose of 0.6 l/ha during the phase of straw elongation.

RESULTS AND DISCUSSIONS

Table 1 presents the synthesis of the crop results obtained during the experimental years.

Table 1.

Synthesis of the crop results obtained on Variaş in the years 2014 and 2015

A factor Foregoing plant	**B factor – germinable seeds /m^2**				**A factor average values**			
	450	**550**	**650**	**750**	**Yield kg/ha**	**%**	**Difference kg/ha**	**Signification**
Wheat	5136	5359	5767	5737	5499	100		
Corn	5544	6053	6459	6403	6114	111	615	XXX
Soy	5872	6207	6606	6516	6300	115	801	XXX

DL5%= 101 kg/ha
DL1%= 167 kg/ha
DL0,1%= 314 kg/ha

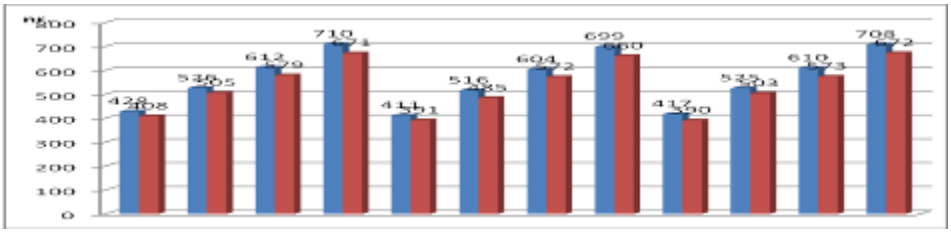
B factor average values

Specification	450	550	650	750
Yield kg/ha	5517	5873	6277	6218
%	100	106	114	113
Difference kg/ha		356	760	701
Signification		XXX	XXX	XXX

DL5%= 105 kg/ha DL1% = 144 kg/ha DL0,1% = 196 kg/ha

Analyzing the influence of the foregoing plant on the crop there can be noticed from the average values for the four seeding densities that the best foregoing plant was soy, variant in which the wheat production was of 6300 kg/ha. Comparing this variant with the reference one, respectively with the crop rotation wheat after wheat, the variant wheat after soy produced a 15% bigger yield. The yield difference of 801 kg/ha is very significant. The early harvested corn (a semi-early hybrid was used) proved to be a better foregoing plant as compared to the variant wheat after wheat. The obtained yield for this variant (corn – wheat), as average value for the seeding densities, was of 6114 kg/ha, that is 11 % bigger than the yield obtained for the reference wheat after wheat variant. The yield difference of 615 kg/ha is statistically ensured as being very significant.

As to the influence of density on the average yield obtained for the three foregoing plants, it results that the yield increased as the density increased from 450 germinable seeds /m^2 to 650 germinable seeds /m^2. When surpassing this threshold by increasing the density to 750 germinable seeds /m^2 the yield had a decreasing tendency.



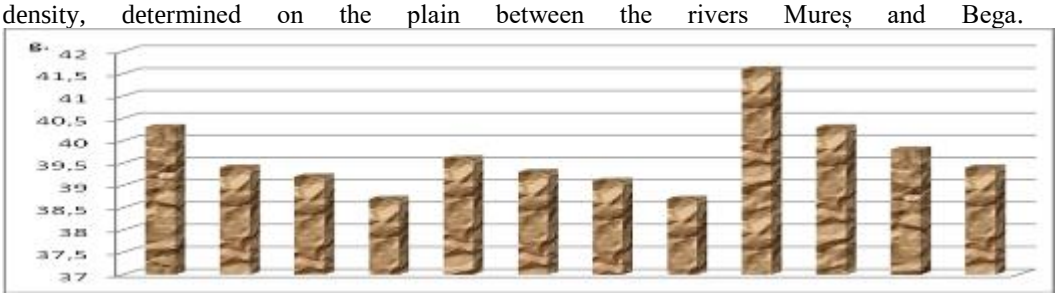
No. of sown seeds /m^2	450	550	650	750	450	550	650	750	450	550	650	750
No. of plants at the beginning of winter	428	526	612	710	411	516	604	699	417	525	610	708
No. of plants at the end of winter	408	505	579	671	391	485	572	660	390	503	573	672
% of plants remained in vegetation related to the no. of sown germinable seeds	90.7	91.9	89.1	89.5	86.9	88.2	88.0	88.0	86.7	91.5	88.2	89.6
% of plants in vegetation depending on crop rotation and sowing density	90.3				86.1				89.0			
Foregoing plant	WHEAT				CORN				SOY			

Fig. 1 The influence of crop rotation and of sowing on the percentage of plants remained in vegetation

The average results of the experimental years regarding the loss of plants during winter underline the fact that under the climate conditions influenced by the Mediterranean

climate, with mild winters, the percentage of losses during winter was low, of between 10 – 14%, according to the studied factors. The average percentage of plants remained in vegetation according to the foregoing plant varied between 90,3% for the crop rotation wheat after wheat, of 86,1% for the crop rotation wheat after corn and of 89,0% for the crop rotation wheat after soy. As to the Grandur variety used for this research, the results underline its very good resistance during winter and its adaptability to the conditions present on the plain between the rivers Mureș and Bega.

Figure 2 shows the MMB variation according to the foregoing plant and to the sowing density, determined on the plain between the rivers Mureș and Bega.



Germinable seeds /m^2	450	550	650	750	450	550	650	750	450	550	650	750
MMB g	40.3	39.4	39.2	38.7	39.6	39.3	39.1	38.7	41.6	40.3	39.8	39.4
Average g	39.4				39.1				40.3			
Foregoing plant	WHEAT				CORN				SOY			

Fig. 2. MMB variation determined according to the crop rotation and to the sowing density

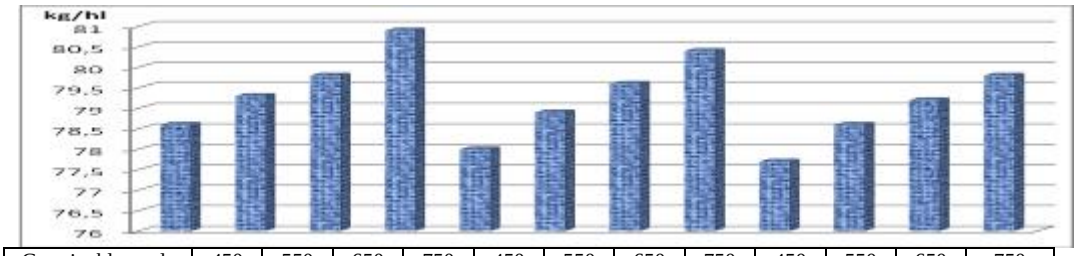
The studied variety was launched in production by taking into consideration the improver's specification according to which the MMB value varies between 40-42 g.

Because of the lack of humidity and of the high temperatures during the seed filling time registered in the experimental years 2014 and 2015, MMB was significantly lower.

After all three foregoing plants MMB presented decreasing tendencies when increasing plant density.

The highest average value for the four sowing density was of 40,3 g, registered for the crop rotation wheat after soy, and the lowest value was obtained for the crop rotation wheat after corn.

Figure 3 presents the results regarding the evolution of the hectolitre mass according to the studied experimental factors



Germinable seeds /m^2	450	550	650	750	450	550	650	750	450	550	650	750
MH kg/hl	78.6	79.3	79.8	80.9	78.0	78.9	79.6	80.4	77.7	78.6	79.2	79.8
Average kg/hl	79.6				79.2				78.8			
Foregoing plant	WHEAT				CORN				SOY			

Fig. 3. Hectolitre mass variation according to crop rotation and sowing density

The hectolitre mass values according to the foregoing plant were closed, the difference between the variant in which the foregoing plant was wheat, for the crop rotation wheat after corn the value was 0.4 kg/hl lower, and in the variant wheat after soy the difference was of 0.8 kg/hl.

According to the density, the hectolitre mass increased in the researched field from 450 to 750 germinable seeds /m^2, with 1.3 kg/hl for the crop rotation wheat after wheat, with 2.4 kg/hl for the crop rotation wheat after corn and with 2.1 kg/hl for the crop rotation wheat after soy.

Germinable seeds /m^2	450	550	650	750	450	550	650	750	450	550	650	750
% protein	14.9	14.4	14.3	13.8	14.7	14.6	14.5	13.6	15.5	15.3	15.1	14.6
Average content %	14.35				14.34				15.12			
Foregoing plant	WHEAT				CORN				SOY			

Fig.4. Protein content variation (%) according to crop rotation and sowing density

The protein content was high at all experimental variants, being of between 14.34% for the crop rotation wheat after corn and 15.12% for the crop rotation wheat after soy. This happened because of the nitrogen remained in soil after this foregoing plant. The density influenced the protein content, which decreased significantly as the number of sown germinable seeds /m^2 increased.

Germinable seeds/m^2	450	550	650	750	450	550	650	750	450	550	650	750
% wet gluten	28.3	27.8	27.4	27.1	27.9	27.6	26.9	26.4	29.4	28.9	28.5	27.8
Average content %	27.65				27.20				28.65			
Foregoing plant	WHEAT				CORN				SOY			

Fig.5. Wet gluten content variation (%) according to crop rotation and sowing density

The wet gluten content was high for all variants, with an amplitude, according to the foregoing plant, of between 27.20% for the crop rotation wheat after corn and 28.65% for the crop rotation wheat after soy.

The sowing density for the studied limits had a negative influence when increasing the density from 450 to 750 germinable seeds /m^2.

CONCLUSIONS

The variety Durum wheat (*Triticum turgidum (L.)* Thell, subsp. Turgidum, conv. Durum (Desf.) M.K.– GRANDUR – created in 2005 and mentioned in the official list of varieties in the year 2015, is a valuable variety, adapted to the conditions of Banat Plain, resistant in winter and against drought, intense heat and plant diseases, having a good potential of producing high quality crops.

The two level factorial experiments with three repetitions, where the A factor was the foregoing plant and the B factor the sowing density, corresponded to the aimed goal.

The synthesis results obtained during the two years were of between 5136 kg/ha for the variant wheat sown repeatedly after wheat with a density of 450 germinable seeds /m^2 and 6606 kg/ha for the crop rotation wheat after soy, with a density of 650 germinative seeds /m^2.

Regarding the foregoing plants, the best results were obtained for the crop rotation wheat after soy, the increase in yield being of 15% when compared to the crop rotation wheat after wheat, followed by the crop rotation wheat after corn, where the increase in yield was of 11% when compared to the crop rotation wheat after wheat.

The sowing density of 450 germinable seeds/m^2 proved to be insufficient, the yield increasing until the density of 650 germinable seeds/m^2, for this variant obtaining a yield increase of 14%. An increase in density to 750 germinable seeds /m^2 is not justifiable, as the crop results in this case are lower than in the variant in which the density was of 650 germinable seeds/m^2.

The percentage of losses during winter was of between 9.7% and 13.94% under the climatic conditions of the two years and by taking into consideration the experimental factors studied, which shows the good resistance of Grandur variety during winter.

The mass of 1000 seeds varied only in small margins according to the foregoing plant and to the sowing density, this characteristic being stable for the studied variants. The Variation appeared in the variant wheat after wheat crop rotation was of between 40.3 g (400

g.s./m^2) and 38.7 g (750 g.s./m^2), for the crop rotation wheat after corn the variation was of between 39.6 g (400 g.s./m^2) and 39.1 g (750 g.s./m^2), and of 41.6 g (400 g.s./m^2) and 39.4 g (750 g.s./m^2).

The hectolitre mass values according to the foregoing plant were closed (79.6 kg/hl after wheat, 79.2 kg/hl after corn and 78.8kg/hl after soy.

The average raw protein content for the studied densities was of 14.35% after wheat, of 14.34% after corn and of 15.12% after soy.

The wet gluten content varied according to the foregoing plant between 27.65% after wheat, 27.20% after corn and 28.65% after soy.

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