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RESEARCH ABOUT INFLUENCE OF SOWING DENSITY AND SOWING TIME FOR PRODUCTION LEVEL OF WINTER BARLEY IN NORTH BARAGAN PLAIN CONDITIONS

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Abstract

Sowing density is very important to ensure the optimum nutrition at the area of crop plants, in order that the production of quality of barley. On the other hand, the time of sowing is very important in how the plants resistant to the environment in winter and to the attack of pathogens and pests, by spring. Experience presented in this paper, shows how sowing density and sowing time influences the production of barley, of Cardinal variety in the climatic conditions of the agricultural year 2012 - 2013, Chiscani Experimental Center, the Agricultural Research and Development Station of Braila on a typical chernozem soil type. For this, we used seven experimental factor graduations for sowing density and five experimental factor graduations for sowing time. During the vegetation were made biometric measurements on plant height, number of leaves per plant, number of grains per ear, grain weight per ear and yield of each experimental plot at harvest. Based on the results, and analysis of variance were performed for the two experimental factors and correlations were established between the experimental factors and biometric measurements. Synthesis results show that the experience of winter barley crop in the climatic conditions of Braila, the best sowing density is 550 g.s/m2 and optimum sowing period is 3-20 October.

***Key words**: sowing density, sowing time, winter barley, Braila Plain.*

INTRODUCTION

Sowing time is essential, late sowing leading to significant reduction of plant density, and therefore to decrease the production of grains. Barley crop technology recommended 20 September to 10 October like optimal sowing time in conditions of our country, for winter barley should form 3-4 brothers, to accumulate in the node tillering, large amounts of sugars, and to develop strong embryonic root system and to start the formation of coronary root. The main objective of this study is to find out the optimum sowing time and density sowing of winter barley in the climatic conditions of North Baragan Plain.

MATERIALS AND METHODS

The field experiment was located in Agricultural Research and Development Station of Braila-Chiscani Experimental Center, organized in subdivided parcels method that it included 7 variants with 3 repetitions for sowing density and 5 variants with 3 repetitions for sowing time, the area for a variant being 180 m^2. The experience included two experimental factors: V (sowing density) and E (sowing time), the cultivated variety of barley was Cardinal and the graduations of the experimental factors were the following (Figure 1.):

- V1 – 200 g.s./m^2; E1- sowing time I (3 Oct. 2012);
- V2 – 250 g.s./m^2; E2-sowing time II (12 Oct. 2012);
- V3 – 350 g.s./m^2; E3-sowing time III(23 Oct. 2012);
- V4 – 450 g.s./m^2; E4-sowing time IV (12. Nov 2012);
- V5 – 550 g.s./m^2; E5-sowing time V (22 Nov 2012);
- V6 – 650 g.s./m^2;
- V7 – 750 g.s./m^2.

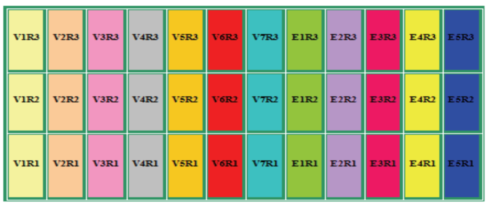

Figure 1. Placing the experience of sowing density and sowing time in winter barley

Different sowing densities were performed on October 3, 2012, and the sowing density for different periods was set at 550 g.s./m^2.

For setting up the experiments the following biological material was used: winter barley variety "Cardinal" with the following indices:

- Biological category – PB II;
- Physical purity [%] – 99%;
- Moisture [%] – 12,6;
- Total germination [%] – 75%;
- 1000 grain weight [g] – 40.9 g;
- Sanitary condition - good.

Laboratory analysis methods were:

1. Determination of physico-chemical properties in soil:
   - pH of the soil - the potentiometric method, with digital pH meter, an aqueous suspension soil: water 1:2.5.
   - CTSS - the total content of soluble salts - conductometric method by using digital Conductivity in aqueous extract soil: water 1: 5.
   - Mineral elements content in soil (N, P, K) were determined by the Photometric the aqueous extract of the soil to water of 1: 5.
   - Soil humus content - determined by titrimetric method.
2. Determination of physiological and chemical indices in plants:
   - Dry matter content of the plants - by the gravimetric method - drying in the oven.
   - Content of nitrogen, phosphorus and potassium in plants using the photometric method, analyzing the aqueous extract of the leaves at winter start (12.07.2012), at spring start, at earing.
   - Evaluation of production - Gravimetric method at harvesting.
   - Determining productivity elements of experimental variants after harvest (MMB - Gravimetric method, MH – with the Granomat, yield - Gravimetric method).

Statistical methods for interpreting results were used.

The content of nutrients in plants, in various stages of vegetation was graphically represented by comparing the five sowing time and seven different sowing densities.

Productivity elements were interpreted statistically by the analysis of variance and correlation method.

RESULTS AND DISCUSSIONS

Rising date, in the experience of different densities was on 11/10/2012, while in the experience of different sowing time was as following:

- E1 – 11.10.2012;
- E2 – 21.10.2012;
- E3 – 4. 11. 2012;
- E4 – 23.11.2012;
- E5 – did not rise by the start of winter.

At the start of winter, biometric measurements were performed for all variants of different densities, the results being represented in Figure 2.

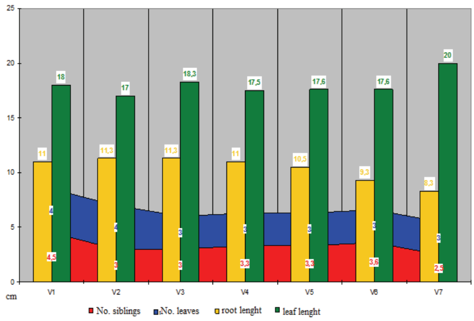

Figure 2. Results of biometric measurements performed for each variant, on the entry into winter (29/11/2012)

It was found that the experimental variant with 200 g.s./m^2 in the winter had the highest number of siblings, together with a large number of leaves, while the density 750 g.s. /m^2 version, recorded a small number of brothers and leaves, and the leaves had the largest length compared with other experimental variants (Figure 3).

Figure 3. Pictures of Cardinal barley plants sown at different densities at the entrance to winter (29.11.2012)

Dry matter content in plant, on entering the winter showed that the highest content of dry matter in roots was recorded in variant V5 (550 g.s./m^2), while the variant V4 (450 g.s/m^2) showed a low dry matter content, both in roots (20.04%) and in leaves (16.50%) (Figure 4).

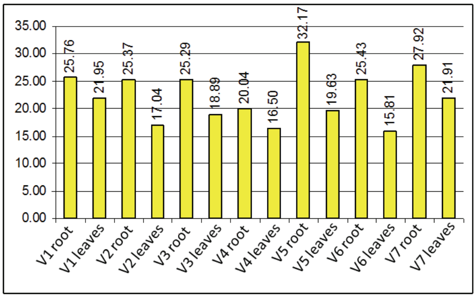

Figure 4. The dry matter content of barley plants Cardinal at the entrance to winter - CE Chiscani

Legend:

v1	200 g.s./m^2	v4	450 g.s./ m^2
v2	250 g.s./ m^2	v5	550 g.s./ m^2
v3	350 g.s./ m^2	v6	650 g.s./ m^2
		v7	750 g.s./ m^2

For the winter's end, the dry matter content of the plants is shown in Figure 5, were we see a significant decrease in the percentage of the dry matter of plants in all experimental variants, reversing the ratio of dry matter of the root and the leaves, which in the winter was higher in roots and at the end of the winter it became larger in leaves due to the excessive moisture in the soil, caused by the melting snow and leaf damage by partial wilting due to late frosts.

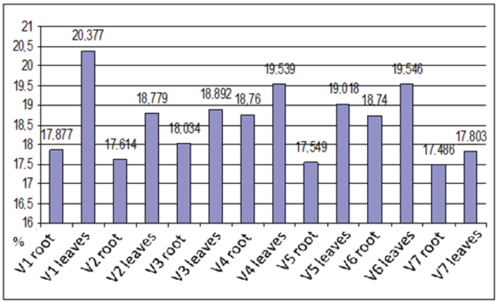

Figure 5. Dry matter content of barley plants at out of winter - CE Chiscani

The nutrients N, P, K, in various forms (nitrogen nitrate, nitrite, nitrite nitrogen, nitrite, phosphorus, phosphate, phosphorus pentoxide, potassium, potassium oxide) were analyzed in the 1:5 aqueous extract from the leaves of plants, the graphical representation being shown in Figure 6, the entry in the winter, and in Figure 7, at the end of winter.

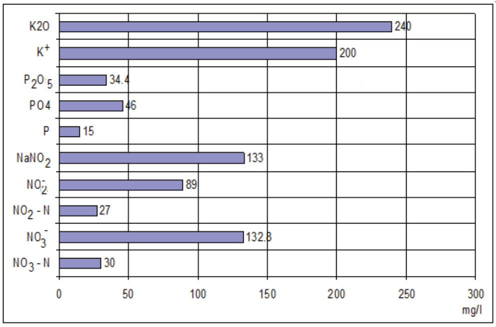

Figure 6. The contents of mineral elements in barley plants at the start of winter (29/11/2012)

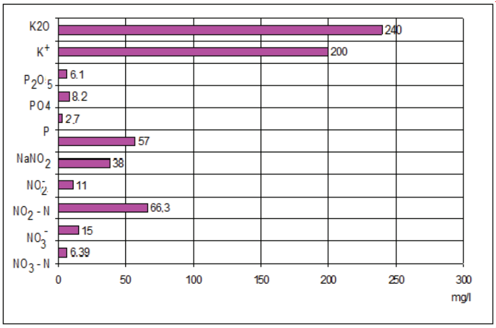

Figure 7. The contents of mineral elements in barley plants at the end of winter (03/07/2013)

It is noted that the output of the standard N and P content was lower than the aqueous extract of the leaves: water of 1:5, the barley plants, and the pH of the extract was slightly acidic.

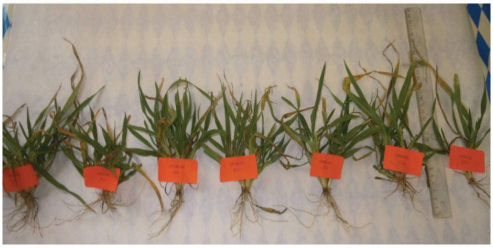

Figure 8. Pictures of Cardinal barley plants sown at different densities at the end of winter (03/07/2013)

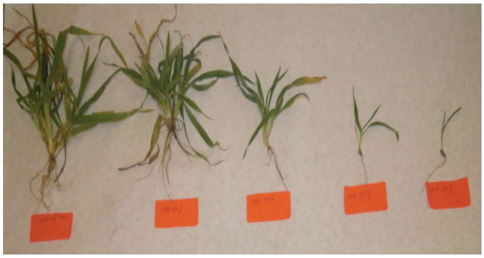

Figure 9. Pictures of Cardinal barley plants sown at different times at the end of winter (7.03.2013)

As shown in Figure 9, at the end of winter, barley sown at different times present different degree of tillering, the strongest degree of tillering being at the barley sown in the sowing time I and II, the sowing time III had two brothers in average, the sowing period IV had a brother on average and the barley from sowing period V didn't have any.

Regarding the average density of plants and the average number of siblings for each experimental variant, the results of determinations were centralized in Tables 1 and 2.

Table 1. The average number of siblings and plant density for the sowing density experimental factor at the end of winter

Determination	V1 200 g.s./m^2	V2 250 g.s./ m^2	V3 350 g.s./ m^2	V4 450 g.s./ m^2	V5 550 g.s./ m^2	V6 650 g.s./ m^2	V7 750 g.s./ m^2
Average Number siblings / pl	14	9	8	8	9	7	5
Average No. plants / m^2	140	232	184	272	352	324	404

Table 2. The average number of siblings and plant density for the sowing time experimental factor at the end of winter

Determination	Sowing time determinations and values				
	E1 3.X	E2 12. X	E3 23.X	E4 12.XI	E5 22.XI
Average Number siblings / pl	8	7	3	-	-
Average No. plants / m2	272	336	384	100	260

Results of the tests show that the seed sown in the fourth period began to germinate before the first frost and a lot of plants were lost. Instead, the seeds sown in the fifth sowing time have been preserved in the soil and germinated at the start of spring and they rises. Optimal plant density out of the winter was recorded in version V5 for the sowing density experimental factor - 550 g.s./m^2 and in E3 variant experimental for the sowing period factor - seeding at 23/10/2012. The worst results out of plant density at the end of winter were recorded in variant V1 (200 g.s./m^2) - 140 plants/m^2, for the sowing density experimental factor and in E4 variant (sowing time 4 - 12/11/2012) - 100 plants/m^2.

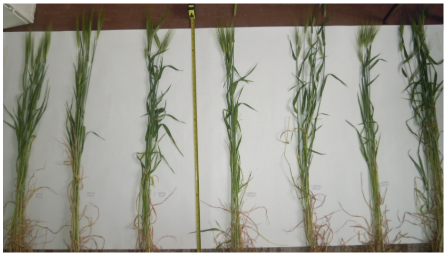

Figure 10. Images of the barley plants of the following experimental different densities on 13.05.2013

Average plant height was different in the experimental variants, both during the growing season (Figures 10 and 11) and physiological maturity (Figure 12), variants with the largest size being V5 (550 g.s/m^2) - 98.33 cm, V7 (750 g.s/m^2) - 95.33 cm and V1 (200 g.s/m^2) – 94.67 cm for the planting density experimental factor; for the sowing period, the highest average plant size was recorded in variant E2 (age II - 12/10/2012) - 86.37 cm, followed by variant E1 (age II - 10/03/2012) - 81cm.

Figure 11. Images of barley plants of different variants from the sowing time experiment, on 13/05/2013

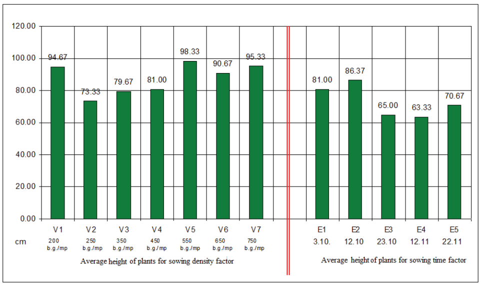

Figure 12. Average height of barley plants at physiological maturity for the two experimental factors

Thus, most barley plants were 81cm in height, followed in descending order by 88cm and 74cm plants (Figure 13).

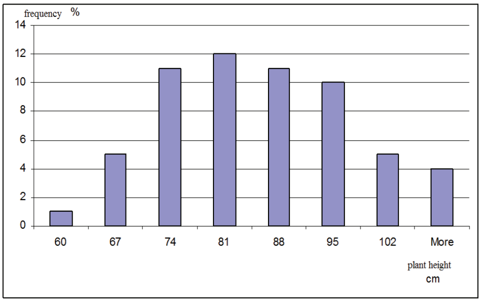

Figure 13. Histogram for barley plant height in the experience with different sowing densities and sowing times

Measurements on the average length of ear, showed that the highest values were recorded at E3 variant (III sowing time - 23/10/2012), followed in descending order by E5 (sowing time V), E4 (sowing time IV), V1 (d = 200 g.s./m^2) and V2 (d = 250 g.s./m^2) (Figure 14), but the highest frequency on the average ear length was of 6.3 cm, as shown in the histogram of Figure 15.

However, it was observed that ears with higher average length had a greater number of shriveled grains than smaller ears variants length, recording a lower yield than those. In Figure 16 are showed the average values of plant height, number of grains per ear and yield for each experimental variant, observing that the best performance was obtained in V5 variant (550 g.s./m^2 sowing density) and for sowing period, the highest yield was obtained in E2 variant (second sowing time - 12.10.2012).

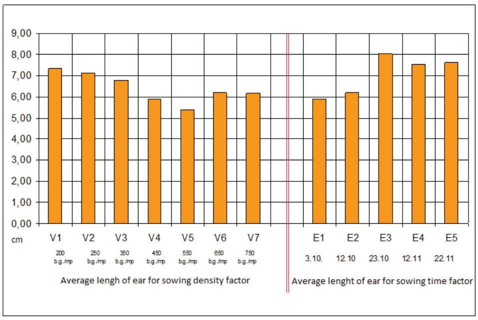

Figure 14. The average length of the ear of barley at physiological maturity in the experience with different densities and sowing times

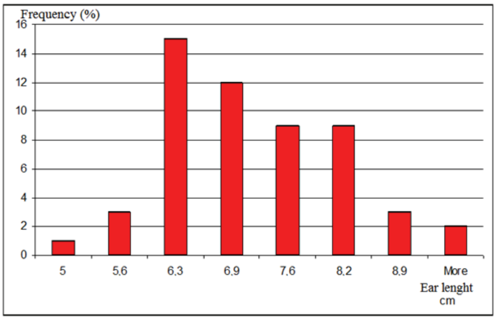

Figure 15. Histogram for the average ear length of barley in the experience with different densities and sowing times

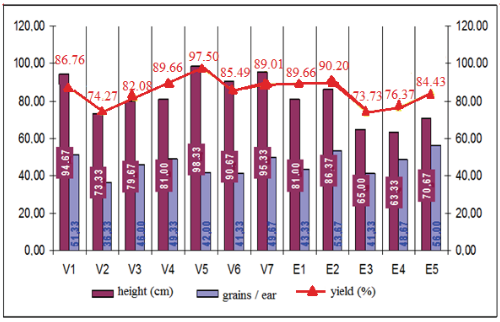

Figure 16. Graph with average values of plant height, number of grains per ear and yield in the experience

The greatest yields in the experience were obtained in the variants V5 (D = 550 g.s/m^2) with 6166kg/ha, followed in descending order by version V4 and E1 (D = 450 g.s/m^2 sowing time I = 10/03/2012) with 4726kg/ha and E2 variant (sowing time II = 12/10/2012) with 4518kg/ha (Figure 17).

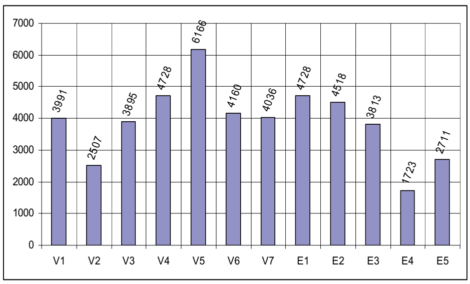

Figure 17. Average production per experimental variant, expressed in standard humidity of 14%

The significances of differences in production compared to the control, represented by the average of the experience were summarized in

Table 5.4, where it can be see that the variant V5 (D = 550 g.s/m^2) showed a highly significant positive output gap (2251 kg/ha) compared to the average of the experience, followed by variant V4 (D = 450 g.s/m^2) and E1, with a distinct significant positive difference (813 kg/ha).

The lowest yields, with very significant negative differences from the control were obtained in the E4 variant (sowing time IV) with a difference of 2192 kg/ha, V2 (D = 250 g.s/m^2) with a difference of 1408 kg/ha and E5 with the difference of 1204 kg/ha.

Thus, we can say that in the climatic conditions of the year 2012 - 2013 in the Chiscani, Braila County, the most recommended barley sowing densities are 550 g.s/m^2 and 450 g.s/m^2 and sowing period should not be later than October 20.

Table 3. Interpretation of the results of production by analysis of variance for different sowing times and densities for winter barley

Variant	Absolute production	Relative production	Differences		Significance
			Abs.	Rel.	
V1	3991	101.94	76	1.94	-
V2	2507	64.04	-1408	-35.96	ooo
V3	3895	99.49	-20	-0.51	-
V4	4728	120.77	813	20.77	**
V5	6166	157.50	2251	57.50	***
V6	4160	106.26	245	6.26	-
V7	4036	103.09	121	3.09	-
E1	4728	120.77	813	20.77	**
E2	4518	115.40	603	15.40	*
E3	3813	97.39	-102	-2.61	-
E4	1723.3	44.02	-2192	-55.98	ooo
E5	2710.6	69.24	-1204	-30.76	ooo
Control	3915	100	-	-	-

DL5% = 474.4 kg/ha; DL1% = 644.8 kg/ha; DL 0.1% = 863.6 kg/ha

The most resilient barley plants over the winter were sown in the first period (October 3) at a density of 550 g.s./m^2 this experimental variant achieving very significant production increases from the average experience (Figure 18).

To substantiate the results obtained in the experience, the test for the correlation between the biometric measurements, the experimental factors and the tests carried out, so that they may be associated with agro-technical measures in order to obtain the highest possible yields.

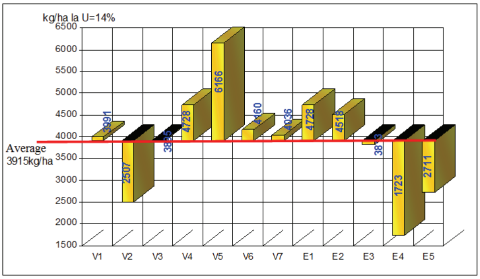

Figure 18. The differences in the experimental variants yields, compared to the control (average experience)

In Figure 19 it can be noticed a synthesis of the correlations between sowing density and some biometric measurements, observing a positive correlation between sowing density and number of leaves, yield production and plant height, and a negative correlation between sowing density and length and weight of ear. Between the sowing period and the biometric values at physiological maturity of winter barley were recorded positive correlations for ear length, ear weight, grain weight per ear and number of grains per ear, but negative correlations were recorded for plant height, the production yield and the number of leaves per plant.

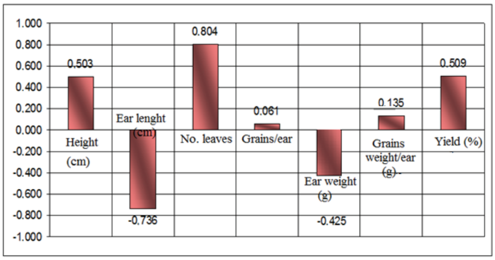

Figure 19. Correlations between sowing density and biometric measurement values at physiological maturity of winter barley

It can be concluded therefore that the extension of sowing in autumn favors growth in barley ear length, number of grains per ear, but many grains are shriveled in plants sown later and the production yield is even lower, as sowing period goes later than October 20 (Figure 20).

Summary for graphs of the correlations established between the experimental factors and biometric measurements made at physiological maturity are shown in Figure 21.

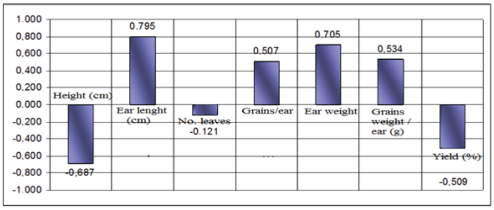

Figure 20. Correlations between sowing time and biometric measurements at physiological maturity of winter barley

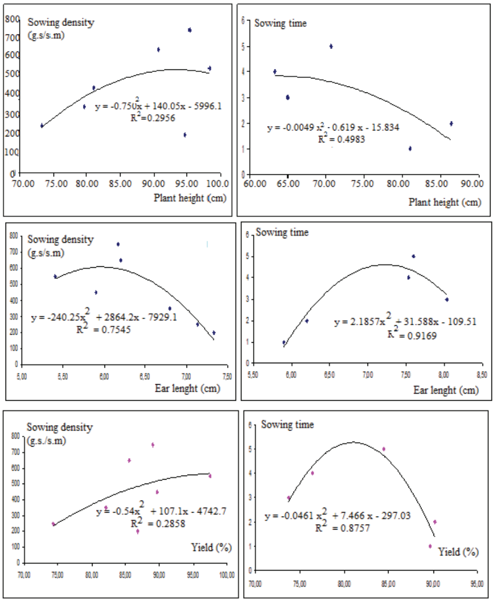

Figure 21. Correlations established between the experimental factors and biometric measurements at physiological maturity of winter barley

CONCLUSIONS

The sowing density and sowing time are very important for obtaining higher production from cereal grains sown during fall.

In the climatic conditions of the 2012 – 2013 agricultural year, the best results on winter barley were obtained in variants cultivated during the October 3 – 22 period, with seeding density of 550 g.s./m^2, which had an average of 6166 kg/ha, followed by 450 g.s./m^2 density, with an average production of 4728 kg/ha and the second period, with average production of 4518 kg/ha.

Significant positive correlations were recorded between sowing density and height of barley plants, number of leaves, grain weight per ear and yield of production and between the sowing period and ear length and weight as well as number of grains per ear.

Significant negative correlations were recorded between seeding density and ear length and weight and between sowing period and plant height and yield production.

Synthesis results of the experience show that the culture of winter barley in the climatic conditions of Braila, the better seeding density is 550 g.s/m^2 and optimum sowing period is 3-20 October.

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