Scientific Papers. Series A. Agronomy, Vol. LVI, 2013
ISSN 2285-5785; ISSN CD-ROM 2285-5793; ISSN Online 2285-5807; ISSN-L 2285-5785

THE INFLUENCE OF SOIL TYPE AND FERTILIZATION DOSES ON THE YIELD OF WINTER BARLEY

Daniela TRIFAN, Marcel BULARDA, Ioan VIŞINESCU

Agricultural Research and Development Station of Braila, Soseaua Vizirului Km. 9, cod. 810008, Braila, România

Corresponding author email: dana.trifan@yahoo.com

Abstract

Purpose of this study was to establish the most efficient polifactorial combination represented by soil type x dose of fertilizer for cultivation of winter barley Cardinal and Maresal varieties, in order to obtain higher production in terms of quantity and quality, in climate conditions of Braila Plain, which is a very favorable area for this crop.
The three experimental factors had two graduations, namely: A (soil type) with A1 – typical Chernozem and A2 Solonetz, B (variety) with B1 – Cardinal and B2 – Maresal, and C (dose of fertilizer) with C1 – economic optimum dose calculated for chernozem, C2 – economic optimum dose calculated for Solonetz and C3 – unfertilized.
In terms of economic efficiency, the largest profit of studied variants was registered by Maresal variety cultivated on Chernozem, fertilized with optimum dose for Solonetz, followed in descending order by Maresal variety cultivated on Chernozem fertilized with optimum dose for Chernozem and Cardinal variety grown on Chernozem fertilized with optimal dose calculated for Solonetz. The research found that the Maresal variety is more productive than Cardinal variety on both soil type from experience, but Cardinal variety can obtain a high production increase if additional fertilization. We studied also the correlations between soil quality indices and interaction of experimental factors studied, to determine the most efficient systems (soil type x level of fertilization x variety), while Braila Plain.

Key words: *fertilization doses, winter barley, Braila Plain.*

INTRODUCTION

Hordeum vulgare L. species is among the oldest cultivated plants because their seeds have multiple uses: human nutrition (5%), animal feed (70%), obtaining malt (20%) and other uses in industry (5%) (Wang, 2005). In terms of quality, barley grains contain on average: 10.5% protein, 2.8% fat, 4.0% cellulose, 66.2% extractive substances (of which 53% starch), a series of essential amino acids (lysine, tryptophan, arginine), vitamins B1, B2, minerals (K, P, Ca) (Figure 1).
Maresal and Cardinal barley varieties are varieties of high productivity and high quality, timely cultivation Braila Plain, with the possibility to practice fully mechanized technology and obtaining very good economic efficiency. Therefore, the aim of the experience was to identify and choose the best type of soil and fertilizer system, providing increased economic efficiency in achieving higher production of barley, in climate conditions Braila.

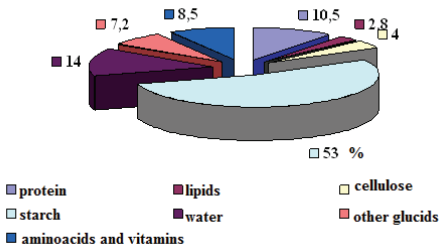

Figure 1. The average chemical composition of barley grains (%)

MATERIALS AND METHODS

Experience carried out between 2009-2011 was three-factorial, type A x B x C, with method of subdivided parcels located in 3 repetitions, each plot with 5000 m^2. These three experimental factors studied were: A = soil type, with sections: a1-typical chernozem, a2-solonetz B = winter barley variety – with sections: Cardinal b1, and b2 Maresal; C = efficient optimal dose of nutrients: c1-DOE calculated for chernozem: N-100 kg / ha P_2O_5-80 kg/ha K_2O-80 kg/ha, c2-DOE calculated for

Solonetz with N-130 kg/ha P_2O_5-110 kg/ha K_2O-100 kg/ha and C3 – unfertilized (Table 1).

Table 1. The organization of experience

V R	a1						a2					
	c1		c2		c3		c1		c2		c3	
	b1	b2	b1	b2	b1	b2	b1	b2	b1	b2	b1	b2
R1	a1 b1 c1	a1 b2 c1	a1 b1 c2	a1 b2 c2	a1 b1 c3	a1 b2 c3	a2 b1 c1	a2 b2 c1	a2 b1 c2	a2 b2 c2	a2 b1 c3	a1 b2 c3
R2	a1 b1 c1	a1 b2 c1	a1 b1 c2	a1 b2 c2	a1 b1 c3	a1 b2 c3	a2 b1 c1	a2 b2 c1	a2 b1 c2	a2 b2 c2	a2 b1 c3	a1 b2 c3
R3	a1 b1 c1	a1 b2 c1	a1 b1 c2	a1 b2 c2	a1 b1 c3	a1 b2 c3	a2 b1 c1	a2 b2 c1	a2 b1 c2	a2 b2 c2	a2 b1 c3	a1 b2 c3

Physical and chemical characteristics of the soil in the two graduations of A experimental factor (a1 – Chernozem and a2-Solonetz) were those shown in Table 2.

Table 2. Characteristics of two types of soils

Agriculture Year	Chernozem		Solonetz	
Specification/Horizon	Am	AC	Ao	Btna
Depth (cm)	0-40	40 - 80	0-40	40-90
Pattern	L	L	LN	AL
Specific Density (g/cm^3)	2,60	2,55	2,51	2,54
Aparent Density (g/cm^3)	1,165	1,038	1,017	1,101
Total Porosity (PT%)	55,19	59,29	59,48	56,65
pH in water	7,5	7,88	8,34	9,15
Carbonates ($CaCO_3$%)	10,2	12,5	6,5	7,3
Humus (%)	3,36	2,5	3,84	2,97
Mobile Phospforus (ppm)	62	61	47	45
Soluble salts (1:5) mg per 100 g de soil	113	125	160	184
Soil Base saturation degree (V%)	89,2	90,1	100	100
Nitrogen index (IN)	2,8	2,65	2,78	2,58

The fertilized variants were fertilizer in both experimental years with different doses, depending results of soil analysis, given Yara Mila complex fertilizers with N-8 P_2O_5-24 K_2O-24 MgO-2 SO_3-5 B-0.05 Fe-0.05 Mn-0.1 Zn-0.02 in plots with chernozem soil type with quantity of 340 kg/ha, resulting: N = 27 kg/ha, P_2O_5 = 82 kg/ha, K_2O= 82 kg/ha, and in plots with Solonetz type of soil amount of 450 kg/ha, resulting N = 27 kg/ha, P_2O_5 = 82 kg/ha, K_2O = 82 kg/ha. The difference of Nitrogen was completed in stage of vegetation with 220 kg/ha NH_4NO_3, resulting 73 kg/ha N, in plots of chernozem and with 290 kg/ha NH_4NO_3, resulting 97 kg/ha N in plots of solonetz.
The results were statistically processed using MS Excel, ANOVA, and Average tests.

RESULTS AND DISCUSSIONS

Yields obtained ranged between 3650 kg/ha and 6560 kg/ha for variants placed on typical chernozem and between 3610 kg/ha and 6110 kg/ha for variants placed on solonetz type of soil (Table 3).

Table 3. Yields obtained for each combination of experimental factors

Nr. crt.	Variant			Absolute yield kg/ha		Media R
	A	B	C	2009 - 2010	2010 - 2011	
	CZ a1	Cardinal b1	DOEcz c1	5700	5560	5630
			DOEsn c2	6210	6110	6160
			NF c3	3980	3850	3915
		Mareşal b2	DOEcz c1	5920	5710	5815
			DOEsn c2	6560	6410	6485
			NF c3	3810	3650	3730
	SN a2	Cardinal b1	DOEcz c1	5520	5430	5475
			DOEsn c2	6060	5970	6015
			NF c3	3810	3720	3765
		Mareşal b2	DOEcz c1	5690	5540	5615
			DOEsn c2	6110	6090	6100
			NF c3	3620	3610	3615
Media V				5249,2	5137,5	5193,3

Calculating absolute and relative differences between experimental variants for each year experimental and control group (average yield obtained) were found following differences (Table 4):

- very significant positive differences for the following: a1b1c2, a1b2c2, a2b1c2 and a2b2c2 in both experimental years;
- significant positive differences distinct variants a2b2c1 a1b1c1 and, in 2010, while in 2011 we obtained a significant positive difference distinct a1b2c1 only version;
- significant positive differences a2b1c1 versions in 2010 and a1b1c1 and a2b2c1 variations in 2011;
- negative highly significant differences compared to the control variants obtained a1b1c3, a1b2c3, a2b1c3 and a2b2c3 in both experimental years;
- significant difference from the control obtained a2b1c1 version in 2011.

In Figure 2 were summarized results of production differences using AVERAGE test.

Table 4. Statistical interpretation yields obtained by analysis of variance (ANOVA test)

Variant	Repetition	Absolut yield	Differents		Semnification
			Abs.	Rel.	
a1b1c1	2010	5700	506,7	9,76	**
	2011	5560	366,7	7,06	*
a1b1c2	2010	6210	1016,7	19,58	***
	2011	6110	916,7	17,65	***
a1b1c3	2010	3980	-1213,3	-23,36	000
	2011	3850	-1343,3	-25,87	000
a1b2c1	2010	5920	726,7	13,99	***
	2011	5710	516,7	9,95	**
a1b2c2	2010	6560	1366,7	26,32	***
	2011	6410	1216,7	23,43	***
a1b2c3	2010	3810	-1383,3	-26,64	000
	2011	3650	-1543,3	-29,72	000
a2b1c1	2010	5520	326,7	6,29	*
	2011	5430	236,7	4,56	-
a2b1c2	2010	6060	866,7	16,69	***
	2011	5970	776,7	14,96	***
a2b1c3	2010	3810	-1383,3	-26,64	000
	2011	3720	-1473,3	-28,37	000
a2b2c1	2010	5690	496,7	9,56	**
	2011	5540	346,7	6,68	*
a2b2c2	2010	6110	916,7	17,65	***
	2011	6090	896,7	17,27	***
a2b2c3	2010	3620	-1573,3	-30,29	000
	2011	3610	-1583,3	-30,49	000
Martor	media	5193,3	0	0,00	-

DL5% = 296,64 DL1% =419,35 DL 0,1% =598,68

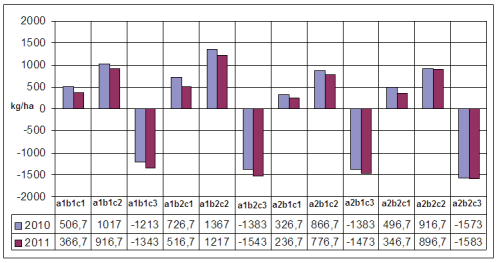

Figure 2. Yield differences recorded for each experimental variant, compared to the control (average yield)

The results of laboratory analysis about quality index of yield for each experimental variant were summarized in Table 5.

Table 5. The results of quality index of yields

Variant	Repetition	Absolute yield	Quality characteristics			
			MMB	MH	G	P
a1b1c1	2010	5700	43,6	67,4	97	99,1
	2011	5560	43,4	67,1	97	99,3
a1b1c2	2010	6210	43,8	69,9	98	99,3
	2011	6110	44,2	67,8	97	99,2
a1b1c3	2010	3980	38,6	54,4	90	98,1
	2011	3850	38,1	53,7	90	98,0
a1b2c1	2010	5920	43,8	67,7	98	99,3
	2011	5710	42,9	66,8	97	99,0
a1b2c2	2010	6560	45,1	71,3	99	99,7
	2011	6410	44,9	70,2	98	99,6
a1b2c3	2010	3810	38,2	53,9	90	98,0
	2011	3650	37,7	52,3	89	97,9
a2b1c1	2010	5520	43,1	67,2	97	99,0
	2011	5430	42,9	66,1	94	98,6
a2b1c2	2010	6060	43,4	69,5	98	99,0
	2011	5970	43,6	67,5	98	99,1
a2b1c3	2010	3810	38,0	53,7	90	97,7
	2011	3720	37,6	52,1	90	97,6
a2b2c1	2010	5690	43,5	67,3	97	99,2
	2011	5540	43,3	67,0	97	99,2
a2b2c2	2010	6110	43,7	69,8	98	99,5
	2011	6090	44,1	70,2	98	99,6
a2b2c3	2010	3620	37,2	51,9	89	97,3
	2011	3610	36,4	50,2	89	97,1
Control	Average	5193,3	41,7	63,1	94,8	98,8

MMB = the weight of a thousand grains MH = the weight of hectoliter grains

G = germination P = physical purity test

The results were summarized in figure 3, where it can observe a fluctuating evolution of the weight of thousand grains (MMB) and weight of hectoliter graine (MH) indices for experimental variants, variants that low for a1b1c3; a1b2c3; a2b1c3 and a2b2c3, on both soil types for both varieties in unfertilized sole. In contrast, the highest values of quality indices of production variants were obtained a1b1c2, a1b2c2, a2b1c2 and a2b2c2, experimental variants placed on both soil types, with both varieties of barley studied fertilized with DOE (optimal economic dose).

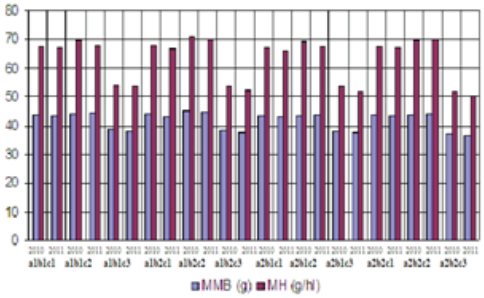

Figure 3. Graphic with indices of quality for experimental variants

Economic efficiency was calculated using the difference between incomes and expenses recorded per hectare for each combination of experimental factors. For this, we used technological currency, first by calculating the mechanical work expenses and materials used for each experimental variant and the proceeds according to the production recorded each variant was calculated profit per hectare.

The results of comparative economic efficiency recorded in the two years of the study were summarized in Figure 4. Comparing the results obtained with the control (mean variants), it has been observed that the biggest profit was recorded version a1b2c2 with a difference compared to control 664 lei/ha in 2010 and 457 lei/ha in 2011, followed in descending order of variants a1b2c1 and a1b1c2.

The lowest results on the yield compared to the control were recorded by a2b1c3 variant, which is Cardinal variety, cultivated on Solonetz and unfertilized (with a difference-98 lei/ha in 2010 and-10 lei/ha in 2011) followed by a1b2c3 variant, which is Marshal variety grown on chernozem unfertilized (with a difference-97 lei/ha in 2010-46 lei/ha in 2011).

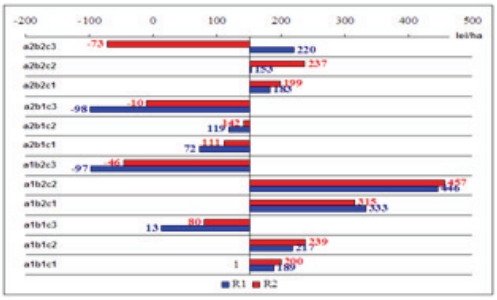

Figure 4. Chart of economic efficiency achieved by each experimental variant, compared with the control (average of variants)

CONCLUSIONS

Because of the agricultural use, there is a continuous decrease in soil nutrient content, so the study of the influence of soil type and fertilization doses are required for any crop.

a1b1c2, a1b2c2, a2b1c2 and a2b2c2 experimental variants, that means both varieties grown in both soil and fertilized with economic optimum dose for Solonetz have obtained very significant positive differences compared to the control (average of experience) in both experimental years, both on the quantitative and quality indicators on production.

Very significant negative differences compared to the control were obtained by a1b1c3, a1b2c3, a2b1c3 and a2b2c3 variants, respectively both varieties of barley grown on two soil types fertilized in both experimental years for quantitative and qualitative indices.

In terms of economic efficiency, the highest profit was recorded by a1b2c2 variant, which is Maresal variety grown on chernozem, fertilized with optimum dose for Solonetz followed in descending order of a1b2c1 variant (Maresal variety cultivated on chernozem, fertilized with optimal dose for chernozem) and a1b1c2 variant (Cardinal variety cultivated on chernozem, fertilized with optimum dose for Solonetz).

The lowest economical efficiency was recorded by a2b1c3 variant (Cardinal variety cultivated Solonetz, unfertilized) and a1b2c3 variant (Maresal variety cultivated on chernozem unfertilized), which shows that doses of fertilization influences a greater increase production and economic efficiency than soil type.

REFERENCES

Axinte M., Roman Gh.V., Borcean I., Muntean L.S., 2006. Fitotehnie. Editura "Ion Ionescu de la Brad" Iasi.

Berca M., 2011. Transformarea moderna a Agriculturii, Editura Ceres, Bucuresti.

Bîlteanu Gh., 1998. Fitotehnie, vol I – Cereale si leguminoase pentru boabe. Editia a doua. Editura Ceres, Bucuresti.

Blaga Gh., Filipov F., Rusu I., Udrescu S., Vasile D., 2005. Pedologie. Ed. Academic Pres., Cluj-Napoca.

Munteanu L., Borcean I., Axinte M., Roman Gh., 2001. Fitotehnie. Ed. Ion Ionescu de la Brad, Iasi.

Sin Gh. si colab., 2000. Tehnologii moderne pentru cultura plantelor de camp, Ed. Ceres, Bucuresti.

Stefan M., 2011. Fitotehnie – curs pentru invatamant la distanta. Craiova.

Wang J., 2005. China: Beer and Malting Barley. Bi-Weekly Bulletin, Vol. 18, No. 10, Market Analysis Divixion, Agriculture and Agrifood Canada, Winnipeg, Manitoba. Im Internet: www.agr.gc.ca/mad-dam.

Wayne S.C., 1995. Crop production – Evolution, History, and Technology. John Wiley& Sons, Inc., New York, SUA.