STUDY ON THE INFLUENCE OF NON-CRYSTALLINE DOLOMITE AND FERTILIZATION ON HARVEST AND WHEAT QUALITY IN THE REGION OF ACID SOILS IN THE WEST OF THE COUNTRY

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Abstract. *According to the data of ICPA Bucharest (2010), the area of acid soils in Romania is 3.424.000 hectares, out of which 1.867.000 hectares represent arable land which needs to be amended by applying calcium amendments. Based on the data gathered by the agricultural chemistry laboratories, Z. BORLAN ET AL. (1969) showed that at the end of 1967 the area of soils needing improvement by applying calcareous amendments represents 1.700.000 hectares, out of which 1.100.000 hectares are arable land and 500.000 ha represent grasslands and non-alpine meadows. Out of the total areas needing amendments, 71.720 hectares are located on the current territory of Caras Severin County, a county in which Vermes commune is located where the research was carried out. The material used for amendments was dolomite which has a content of CaO 32.8%, $CaCO_3$ 58.5%, Mg 0.19%, Mg CO_3 40.9%.The used wheat species was the common wheat (sp. Triticum aestivum L. ssp. Vulgare, erythrospermum variety). The climate of the area according to the Köppen classification is c.f.b.x. The soil on which the study was made is a typical gley soil that is very strongly gleyed. The experiences were bifactorial in which the A factor represented the applied dolomite dose and the B factor was the fertilization level. The synthesis of the obtained results highlights the favourable effect of the dolomite which increased the harvest by 19% in the version amended of 2 t/ha and by 30% in the version amended with 4 t/ha. The nitrogen fertilizers applied on a constant basis of $P_{80}K_{80}$ favourably influenced the harvest that increased together with the applied dose of 12% in the version fertilized with N_{50} and by 36% in the version fertilized with N_{200}. The analysed quality indexes, respectively the mass of 1000 grains (MMB g), standard mass per storage volume (MH kg/hl), protein content (%) and wet gluten content (%) were favourably influenced by the correction of acidity via the application of dolomite and fertilization with NPK, with the values specified in the paperwork. In conclusion, the research results show that the application of dolomite in doses of 2-4 tons/ha is grounded and assures economic increases of the harvest in wheat in areas containing acid soils.*

Key words: *effect of the dolomite in wheat on acid soils.*

INTRODUCTION

Among the materials used for the research of the acid reaction of soils, the dolomite is mentioned by many scientists (IR. STAICU, 1969, GR. OBREJANU AND AL MĂLIANU, 1966, I. SIȘEȘTI, 1958, Z. BORLAN ET AL., 1969).

Dolomite is a mixture of $CaCO_3$ (56%) and $MgCO_3$ (45%). The product is valuable for correcting the acidity of the soil with effects better than calcium carbonate and is also used for assuring the need of magnesium for plant nutrition.

According to the data of agricultural chemistry laboratories in 1967, the area of acid soils needing improvement by applying calcareous amendments is 1.700.000 ha out of which 1.100.000 ha are arable lands and the difference represents grasslands and non-alpine meadows.

The research objective is to improve the dolomite doses under the conditions of differentiated fertilization necessary for the cultivation of the autumn wheat under the conditions of acid soils located in the western part of the country.

The production obtained from these acid soils (considered by COCULESCU (1971) as sick soils) is less by 30-50% regarding the potential of normal soils in terms of physical-chemical and biological features (IR. STAICU, 1969).

MATERIAL AND METHODS

The dolomite used in the research was analysed in Austria, at the Institute für Nachhaltige Pflanzenroduktion of Wien. The analysis bulletin shows that CaO – 32.8%, $CaCO_3$-58.5%, MgO – 19.6%, Mg CO_3 – 40.9%.

The content of heavy metals from the analysed material is low below the limits applicable in the EU.

The experiences were bifactorial, with three repetitions, in which the A factor was represented by the dose of calcium and magnesium carbonate (a_1 – without amendments; a_2 – 2t/ha, and a_3 – 4 t/ha of calcium and magnesium carbonate) and the B factor – the dose of nitrogen fertilizers on a constant basis of $P_{80}K_{80}$ ($b_1 – N_0$), $b_2 – N_{50}$, $b_3 – N_{100}$, $b_4 – N_{150}$ and $b_5 – N_{200}$).

The species used in the research was common wheat (Triticum aestivum L ssp vulgare, var erythrosperrum). The preliminary plant was the cultivation of rapeseed for oil.

The quality analyses that were made were: the mass of 1000 grains, the standard mass per storage volume, the protein content and the wet gluten content.

RESULTS AND DISCUSSIONS

The harvesting results obtained in the experimental cycle are mentioned in Table 1.

Table 1

Synthesis of the harvest results obtained in wheat by applying dolomite and fertilization on a typical gley soil in Western Romania

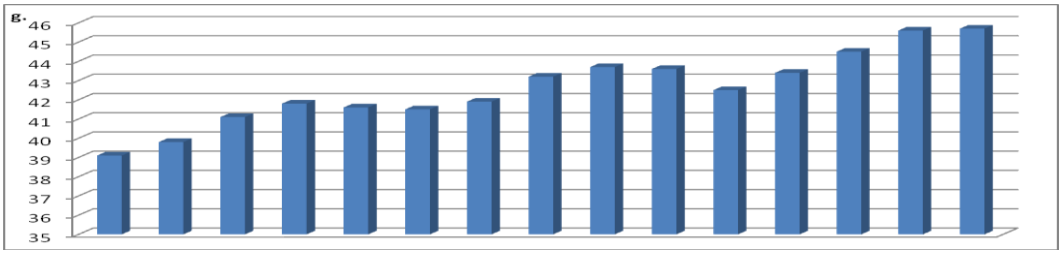
A factor Dolomite dose	B factor – Doses of fertilizers					Average of the A factor			
	N0P80K80	N50P80K80	N100P80K80	N150P80K80	N200P80K80	Harvest kg/ha	%	Difference kg/ha	Significance
Non-amended	3308	3405	3633	4143	4030	3704	100		
2 t/ha	3585	4151	4585	4793	4907	4404	119	700	XXX
4 t/ha	3754	4419	5052	5381	5505	4822	130	1118	XXX

DL5% = 256 kg/ha; DL1% = 383 kg/ha; DL0,1% = 615 kg/ha

Specification	$N_0P_{80}K_{80}$	$N_{50}P_{80}K_{80}$	$N_{100}P_{80}K_{80}$	$N_{150}P_{80}K_{80}$	$N_{200}P_{80}K_{80}$
Harvest kg/ha	3549	3992	4423	4772	4814
%	100	112	125	134	136
Difference kg/ha		443	874	1223	1265
Significance		XXX	XXX	XXX	XXX

The results obtained on a typical gley soil which was very strongly gleyed with moderately acid reaction (pH 5,8) is underlining the favourable effect of the amorphous dolomite originating from Răchitova – Hunedoara, the crop increment in comparison with the untreated version amounting to 19% in case of the 2 t/ha version and to 30% in case of the 4 t/ha. The harvesting differences of 700 kg/ha and 1118 kg/ha respectively are very significant statistically. The nitrogen fertilizers applied in variable doses, on a constant basis of $P_{80}K_{80}$, have raised the crop with increments that grew depending on the dose increasing up to the level of N_{150}, raising the dose at N_{200} is not economically justified. The crop differences, the average for the three grades of the A factor are statistically assured as being very significant.

In figure no. 1 the synthesis results regarding the influence of amorphous dolomite and of fertilising on the mass of 1000 grains (MMB g).

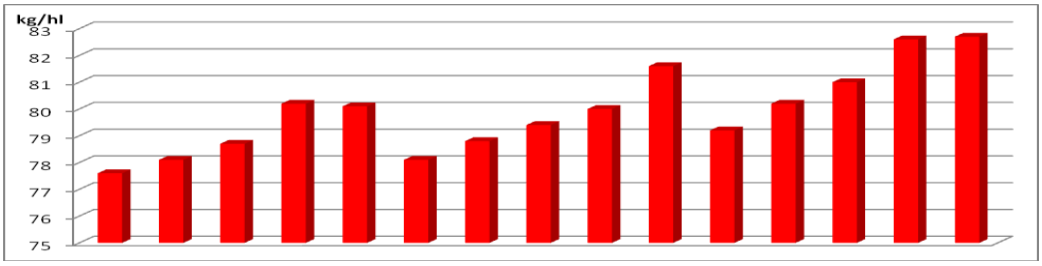


MMB g	39,1	39,8	41,1	41,8	41,6	41,5	41,9	43,2	43,7	43,6	42,5	43,4	44,5	45,6	45,7
N dose	N_0	N_{50}	N_{100}	N_{150}	N_{200}	N_0	N_{50}	N_{100}	N_{150}	N_{200}	N_0	N_{50}	N_{100}	N_{150}	N_{200}
Doomite dose	Neamendat					2t/ha					4 t/ha				
$\bar{X}$	40,68					42,78					44,34				
Diferența g						2,10					3,66				

Fig.1. MMB g variation depending on the dolomite dose and on the nitrogen dose applied on a constant basis of $P_{80}K_{80}$

It's resulting that the mass of 1000 grains has been favourably influenced by the studied factors, augmenting depending on the nitrogen dose, on all three areas, from 40,68 g on the dolomite-free soil, to 42,78 g on the area with 2 to/ha dolomite and 44,34 g, on the area with 4 t/ha dolomite.

Figure no. 2 is presenting the evolution of the hectolitres' mass (MH kg/hl)

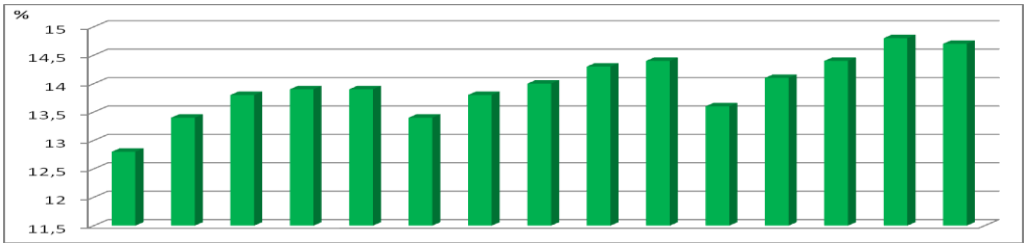


MH kg/hl	77,6	78,1	78,7	80,2	80,1	78,1	78,8	79,4	80,0	81,6	79,2	80,2	81,0	82,6	82,7
N dose	N_0	N_{50}	N_{100}	N_{150}	N_{200}	N_0	N_{50}	N_{100}	N_{150}	N_{200}	N_0	N_{50}	N_{100}	N_{150}	N_{200}
Dolomite dose	Unamended					2t/ha					4 t/ha				
$\bar{X}$	78,94					79,58					81,14				
Difference kg/hl						0,64					2,20				

Fig.2. MH variation in kg/hl g depending on the dolomite dose and on nitrogen dose applied on a constant basis of $P_{80}K_{80}$

The nitrogen fertilisers have favourably influenced the hectolitres' mass on all three areas, non-amended, amended with 2 t/ha and respectively 4 t/ha. Depending on the fertilizers' doses, the average value of the hectolitres'mass is very close on the area with 2 t/ha of dolomite in comparison with the amended one, and has risen with more than 2 kg/hl, on the area with 4 t/ha of dolomite.

Figure 3 shows the influence of non-crystalline dolomite and fertilization on the content of raw protein (%).

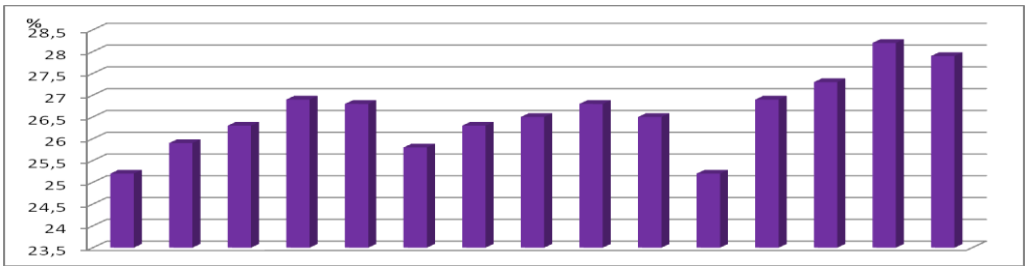


Protein %	12,8	13,4	13,8	13,9	13,9	13,4	13,8	14,0	14,3	14,4	13,6	14,1	14,4	14,8	14,7
Dose of N	N_0	N_{50}	N_{100}	N_{150}	N_{200}	N_0	N_{50}	N_{100}	N_{150}	N_{200}	N_0	N_{50}	N_{100}	N_{150}	N_{200}
Dolomite dose	Non-amended					2t/ha					4 t/ha				
$\bar{X}$	13,56					13,98					14,32				
Difference %						0,42					0,76				

Fig.3. Variation of raw protein content (%) depending on the dolomite dose and the nitrogen dose applied on a constant basis of $P_{80}K_{80}$

This results in a sensible trend of positive influence of the protein content given by the application of dolomite. An obvious influence is due to the nitrogen dose on all three agricultural areas.

Figure 4 shows the influence of dolomite applied in variable doses and of fertilization on the content of wet gluten.



Wet gluten %	25,2	25,9	26,3	26,9	26,8	25,8	26,3	26,5	26,8	26,5	25,2	26,9	27,3	28,2	27,9
Dose of N	N_0	N_{50}	N_{100}	N_{150}	N_{200}	N_0	N_{50}	N_{100}	N_{150}	N_{200}	N_0	N_{50}	N_{100}	N_{150}	N_{200}
Dolomite dose	Non-amended					2t/ha					4 t/ha				
$\bar{X}$	26,22					26,38					27,10				
Difference %						0,16					0,88				

Fig.4. Variation of wet gluten content (%) depending on the dolomite dose and the nitrogen dose applied on a constant basis of $P_{80}K_{80}$

We can see an increase of the wet gluten content together with the increase of the nitrogen dose in the range of N_0-N_{150} doses and close values at the level of the N_{200} dose with the ones of the N_{150} dose. On average in nitrogen doses, by applying dolomite, the content of wet gluten increased by 0.16% - 0.88% in the researched range with 2 t/ha and 4 t/ha respectively.

CONCLUSIONS

The non-crystalline dolomite is a valuable mineral with a high content of calcium and magnesium and with a low content of heavy metal below the applicable European norms which has a special relevance for the improvement of acid soils in which the harvests are lower with 30-50% than the potential of normal soils.

The application on a typical gley soil with a moderately acid reaction (pH 5.8) increased the harvest of autumn wheat by 19% in the version with 2 t/ha and by 30% in the version with 4 t/ha.

The nitrogen fertilizers applied in variable doses on a constant basis of $P_{80}K_{80}$, on average on the mentioned dolomite levels, increased the wheat harvest by 12% (N_{50} version) and by 34% (N_{150} version).

Increasing the nitrogen dose of N_{200} has no good reasons as the harvest was closer than the harvest fertilized with N_{150}.

The mass of 1000 grains in the researched range increased from 40.68 g per non-

amended area to 44.34 in the area with dolomite of 4 t/ha and the standard mass per storage volume increased from 78.94 kg/hl to 81.14 kg/hl.

The raw protein content increased from 13.56% to 14.32% and the wet gluten content increased from 26.22% to 27.10%.

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