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THE EFFECT OF $CACO_3$ ON THE K CONTENT IN OAT LEAF

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Abstract

Acid soils have characteristic morphological properties and they undergo the process of gleying. They are also poor in water content, aeration and texture. Being of comparatively poor structure, the acid soils are deficient in alkalis and in organic matter so they are generally extremely acid. The current study was focused on liming as a soil amendment measure as well as on determining the oat leaf content of K in the cultivar Mediteran. Soil pH was 5.01 in 2007 and 5.11 in 2008. The variants used included increasing Ca rates compared to the control (the treatments were as follows: T1, T3 and T4 + control – without liming). The trial was conducted under the controlled conditions. The leaf content of K was determined during the flowering and full maturity phenophases. Gleying was performed using atomic absorption spectrophotometry. The content of K in oat leaf was the highest prior to liming with 4 g $CaCO_3$ in 2008 over the flowering phenophase (1.634% dry organic matter) and the lowest in the control variant over the same phase in 2008 (being 0.721% dry organic matter).

Key words: *oat, liming, pseudogley, leaf, calcium*

Introduction

The most limiting factors of plant cultivation on the pseudogley type of soil are considered to be its acid reaction, low content of humus as well as poorly contained phosphorus, potassium, calcium and nitrogen. Such soils also contain considerable amounts of mobile bonds of aluminum that are toxic to plants (Foy, 1984). The detrimental effects of aluminum and its presence were corroborated by the findings of Babovic (1960). In addition, Bartlett and Riceo (1972) found the solubility of the aluminum and iron hydroxides to be rather low at pH from 5.0 to 5.5, whereas, above these values, their content was none even in their modified form. One such measures is a more massive introduction of the recently released wheat, which have shown a high production potential even under stressful climatic conditions, and the significant measure is to increase and improve the soil fertility level (Dencic et al., 2006). The research results reveal more than 60% of acid soils accounting for low productivity soils and simultaneously acting as a highly limiting factor of plant production (Djalovic et al., 2010).

Materials and methods

The soil sample for the current research was taken from the region of Ivanjica being characteristic of acid soils and of the plant production being made rather difficult. The experiment lasted two years (2007 and 2008). It was done with five replications, with the experimental variants having increasing Ca rates ($CaCO_3$ added to already prepared soil) + the control one. Lime granulation was 0.3 mm. The trial variants were, as follows:

T_1 – control + 0.1% $CaCO_3$ of the soil weight per vegetation container

T_3 – control + 0.3% $CaCO_3$ of the soil weight per vegetation container

T_4 – control + 0.4% $CaCO_3$ of the soil weight per vegetation container.

At which, the control variant was the sample without any $CaCO_3$ added.

The experiment was carried out under the controlled conditions, with the potassium content in oat leaves, the cultivar Mediteran, being monitored over the flowering phenophase and the full maturity one. The pH value was measured, amounting to 5.01 in 2007 and to 5.11 in 2008. Leaves were first dried at 60°C for 11 hours and then annealed at 550°C for 12 hours. The sample was destroyed and then turned into its base solution.

As for potassium contained in leaf, its analysis was made through the absorption spectrophotometry. The obtained results were processed statistically using the method of variance using Dunett's test.

Results and discussion

The average content of potassium in oat leaves over the different developmental stages in 2007 and those in 2008, and depending on the liming rate, is given in the Table1.

Table 1. The average K content (% dry matter)

Liming rate	Developmental phase			
	Flowering		Full maturity	
	2007	2008	2007	2008
T_1	1.301	1.309	1.106	1.100
T_3	1.491	1.503	1.206	1.104
T_4	1.529	1.634	1.206	1.193
Control	0.730	0.721	0.737	0.733

$D_{0.05}$=0.0143 $D_{0.01}$=0.0186

Based on the data given in the Table 1, the lowest potassium content could be spotted in the control variant over the flowering phenophase in 2008 (0.721% dry matter) and the highest one in the liming variant with 4 g $CaCO_3$ applied throughout the flowering phenophase in 2008 (1.634% dry organic matter).

Potassium is the most necessary element for the growth of the individual plant organs. Thus, the research work of Saric (1983) and Radovanovic's (1995) done with maize, indicated that potassium presence was, as follows: 45% leaf, 32% stem, 4% root and 14% kernel.

The analysis of variance of the average potassium content in leaf along with the modes underway denoted to all the modes to highly significantly influence the K content in the oat leaves (Table 2). Also, the interaction effects among all the regimes underway could be found to be statistically highly significant. The analysis of interaction effects showed that K content in oat leaf had a changeable trend as the result of soil liming, which subsequently led to its indicative deviations which could not be disregarded at all.

Table 2. The analysis of variance of the average K content

The sources of variation	Degrees of freedom	Square means	F- exp.	Significance
Liming (A)	3	3.001	21404.193	**
Developmental stage (B)	1	1.006	7582.971	**
Year (C)	1	0.000208	1.482	Non-significant
Interaction AB	3	0.138	985.493	**
Interaction AC	3	0.000582	4.180	**
Interaction BC	1	0.000935	6.652	**
Interaction ABC	3	0.00158	11.253	**
Error	75	0.000140		

Namely, even though the general trend of the liming regimes denoted that K content in oat leaf increased with the increase in soil liming, K content and liming did not show such an interaction throughout all the developmental phases and study years so that higher liming rates gave rise even to a decrease in K content of oat leaves (Foy, 1984). This interaction effect should be taken into account when determining higher soil liming rates for oat crop.

However, irrespective of the liming rate and study year, K content in oat leaf was found to decrease from flowering phenophase to the full maturity one. The interaction effect between the developmental phases and modes underway, seemed to be the consequence of the small variations among the samples analysed.

It should be stressed that the deviations of K content from its basic trend were not significant compared to the lawfulness reached.

Thus, regardless of developmental stage and liming, the average K contained in oat leaf was lower than the allowable analytic deviation and therefore was not significant.

As pointed out by Jelenić (1985), the presence of K in wheat straw was found to range from 0.50 to 1.50% dry matter.

Conclusion

Based on the obtained results, it could be concluded that:

- the highest K content was reported in 2008 in the flowering phenophase (1.643% dry organic matter) with liming using 4 g + $CaCO_3$,
- the lowest K content was reported in 2008 in the flowering phenophase in the control variant amounting to 0.721% dry matter,
- K content also showed a decreasing trend in the control variant from the flowering to the full maturity phenophase, whereas liming brought about an opposite trend.

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