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EFFICIENCY OF VITREOUS PHOSPHATO-POTASSIUM FERTILIZERS ON AUTUMN CROPS

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Abstract

Vitreous fertilizers are new type of fertilizers, made of a vitreous matrix with low and controlled solubility in water (made of macro elements useful for plants, K, P, Mg) in which are introduced microelements (Mo, B, V, Fe) necessary to the growth and development of plants. The quantity of microelements as oxides is 1-5%.

The use of vitreous fertilizers offers many advantages: avoid underground water pollution; do not release acid anions in soil, like Cl^- or SO^{2-}, harmful for plants there is no risk of soil burning when they are incorrectly dosed; in a single type of fertilizer can be embedded almost all useful elements for plants; the facility to regulate the pH of soil by the pH of glass matrix; a controlled rate of solubility in water, that can adjust easily by changing the composition of glass.

Vitreous fertilizers were utilized in autumn plants (autumn wheat, barley), and the results are presented in the paper.

INTRODUCTION

Ideas like **"Sustainable agriculture"** are equally important in Romania and the European space. By comparison with intensive agriculture that utilizes synthetic fertilizers and pesticides in order to assure the necessary of the agricultures in nutrients and to control bad plants diseases and damages, **"the new technologies"** are oriented to the diminution of chemical interventions, reduction of the pollutant impact of agricultural activities on the environment and to release of agricultural products of superior biological quality. Today, Agricultural Policy at the European level sustains farms, processing and commercialization of modern products. It is a process in full development in Romania and of big interest for all that are involved, one way or the other, in areas of production-processing-commercialization-consumption of agricultural products.

In this context, this paper deals with the optimization of nutrient in the system soil-water-plant, by using the vitreous fertilizers from potassium-phosphate glasses

containing microelements (VFM) with controlled solubility in condition of using natural resources and efficient using of amendments, according with the principles of developing sustainable agriculture regarding the European Directive about "Plant production protection" (Dir. 91/414/EEC).

Vitreous fertilizers are a new category of fertilizers which are made from a glass matrix with slow and controlled solubility in water, made up of macro useful elements such as potassium, phosphorus, magnesium, to which micronutrients (molybdenum, boron, zinc, iron, etc.) necessary for growth and development of plants are added. This type of fertilizer is made from a glassy matrix that includes micronutrients [1-3]. The elements of which glass matrix is formed are network forming oxides (P_2O_5, B_2O_3, SiO_2) and network modifiers (K_2O, CaO, MgO) that are both macro and micronutrients [4].

MATERIAL AND METHODS

The first research was conducted in a mono-factorial experience in 3 sequences of 4 variants, for wheat Dropia, according to Figure 1, on the black earth of location of Albesti Paleologu in autumn 2007.

R1		V1	V2	V3	V4	
R2		V2	V3	V4	V1	
R3		V3	V4	V1	V2	

Fig. 1. Experimental scheme with 4 variants in 3 sequences for Dropia wheat

Variant V1 represents the unfertilized witnesses. Variant V2 is fertilized with a classic fertilizer, nitrogen, phosphorus and potassium NPK (15.15.15). It was used a quantity of 160 kg classic fertilizer per hectare. Variant V3 is fertilized with vitreous fertilizer, whose composition is shown in Table 1. It was used a quantity of 80 kg vitreous fertilizer per hectare. V4 version is fertilized with mixed fertilizer having equal parts of classic and vitreous fertilizers. It was used an amount of 120 kg combined fertilizer per hectare, formed by 80 kg of NPK and 40 kg vitreous fertilizer, respectively.

Crops were sown on 15.10.2007 and harvested on 25.06.2008.

Table 1

Oxide composition of fertilizer used in field crops

Component	Quantity [weight %]
P_2O_5	40
K_2O	30
MgO	17
CaO	5
Al_2O_3	2
B_2O_3	2
V_2O_5	4

Given the yields achieved, the most constant behavior occurred in the variety of wheat Dropia. This was the reason why Dropia wheat variety was selected for further testing.

The Dropia wheat crops was grown on the black earth of Albesti Paleologu, Prahova, in mono-factorial experience in 4 sequences with 5 variants as shown in figure 2. The dimensions of each variant were 10 square meters area. The compositions of vitreous fertilizers are presented in Table 2.

Table 2

Vitreous fertilizers recipes used in Albeşti-Paleologu 2008-2009

Code	P_2O_5 mol %	MgO mol %	K_2O mol %	B_2O_3 mol %	Fe_2O_3 mol %	ZnO mol %
AG2	41.84	22.45	35.71	-	-	-
AG2.1	32.08	16.98	26.42	24.52	-	-
AG2.2	40	21.05	32.63	-	6.32	-
AG2.3	38	20	32	-	-	10

Crops were sown on 10.10.2008 and harvested on 22.06.2009.

R4		V4	V5	V2	V3	V1	
R3		V5	V3	V4	V1	V2	

R2		V3	V1	V5	V2	V4	
R1		V1	V2	V3	V4	V5	

Fig. 2. Experimental scheme with 5 variants in 4 sequences for Dropia wheat V1 - Variant unfertilized; V2 - variant fertilized with AG2 (P_2O_5-MgO-K_2O); V3 - variant fertilized with AG2.1 (P2O5-MgO-K2O-B2O3); V4 - variant fertilized with AG2.2 (P_2O_5-MgO - K_2O-Fe_2O_3); V5 - variant fertilized with AG2.3 (P_2O_5-MgO-K_2O-ZnO)

RESULTS AND DISCUSSION

Winter cereals grown in 2007 are presented in different stages of vegetation in Figures 3 and 4.

Fig. 3. Winter wheat during the period of fellowship, in which the vitreous fertilizers were applied

Fig. 4. Autumn wheat obtained with vitreous fertilizer (in April)

The products of autumn crops obtained in these experiments are presented in Table 3 and Figure 5 for 2007-2008 Dropia wheat and Table 4 for Dropia wheat 2008-2009.

Table 3

Influence of vitreous fertilizer on Dropia wheat production in 2007-2008

Variant	Medium production (kg/ha)	Vol. production (%)	Difference from standard sample
V1	2200	100	0
V2	3400	155	1200
V3	3600	164	1400
V4	4700	214	2500

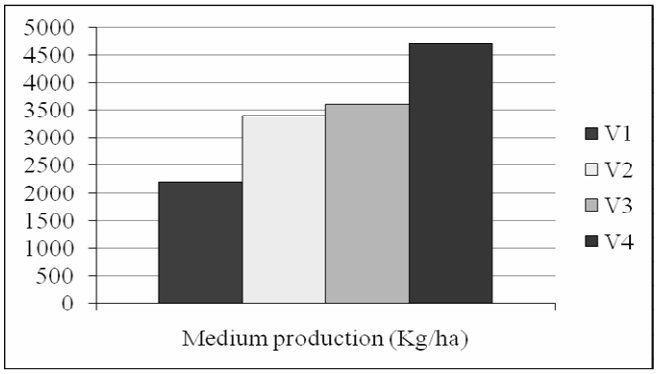

Fig. 5. Medium production of Dropia wheat per ha for the four experimental variants 2007-2008

Table 4

Influence of vitreous fertilizer on Dropia wheat production in 2008-2009

Variant	Medium production (Kg/ha)	Vol. Production (%)	Difference from standard sample
V1	3350	100	0
V2	4933	147	1583
V3	4090	82	740
V4	4677	114	1327
V5	4581	97	1231

CONCLUSIONS

1. All the variants in which vitreous fertilizers were used presented growths comparable with the unfertilized variant. The Dropia wheat crop 2007-2008, in the variant with vitreous fertilizer together with the classical one,

produced an increase of 2500 kg/ha in comparison with the unfertilized variant (2200 kg/ha).

2. The variant fertilized with vitreous fertilizer showed an increase of only 1400 kg/ha. The variant fertilized with classical one had a smaller production increase in comparison with the variants using vitreous fertilizers, of 1200 kg/ha. In comparison with the unfertilized variant, the use of vitreous fertilizer was 9% more efficient then the classical one.
3. In the Dropia wheat 2008-2009, it can be observed that all variant that used receipts with vitreous fertilizers were superior to the not fertilized one. The best production achievement was registered for the variant with AG2 basically receipt showing an increase of 1600 kg over the unfertilized one. AG2.1 boron receipt registered 700 kg over unfertilized one. AG2.2 iron receipt showed 1300 kg over unfertilized one. AG2.3 zinc receipt had 1200 kg over unfertilized one. The using of vitreous fertilizers, comparatively to unfertilized sample showed 22-47% increased efficiency, for all tested variants.
4. Unlike classical fertilizers, which are used only 35-40% by plants, vitreous fertilizers are totally absorbed, which protects the soil from pollution. On the other side, vitreous fertilizers used quantities was at least two times smaller than in the case of classical ones, which implies decreasing of production costs and very significant reduction of pollution, due to time reduction of using apparatus. At the same time, the soil pressing grade is significantly reduced. The use of vitreous fertilizers showed it efficiency, together with the classical ones, but also at using them without the classical ones.
5. The results presented in this paper were registered after the first two years of testing the vitreous fertilizers for autumn crops. We consider these results as preliminary, their validation following in the next year of experiments, and completed by the spring ones.

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