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საქართველოს მეცნიერებათა ეროვნული აკადემიის მოამბე, ტ. 4, №1, 2010
BULLETIN OF THE GEORGIAN NATIONAL ACADEMY OF SCIENCES, vol. 4, no. 1, 2010

Plant Growing

On the Study of Positive Prolonged Effect of Natural Zeolites on Grape Yield

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ABSTRACT. It has been shown that mean grape yield per vine plant increases compared with the control 1.8-2.8 -fold, grape juice sugariness - within 5-27%, while acidity decreases from pH=3.75 to 4.52 according to the type of natural zeolite and corresponding organo-zeolite fertilizer used under vine as well as the prolongation period.

***Key words**: natural zeolites, grape, yield, aftereffect.*

Studies carried out in the last century proved that soil enrichment with natural zeolites contributes to the increase of productivity of various agricultural crops and that simultaneously they are characterized by the after-effect. That is, unlike mineral fertilizers, their annual application is not necessary, but positive effect of these minerals on enhancing plant productivity is manifested for several years [1-3].

Early works dealing with the effect of natural zeolites on grape yield were carried out in Italy [4] and in Georgia [5]. Studies carried out in Georgia [6] showed that application of analcime-containing rocks and organo-zeolite fertilizers prepared on their basis (mixture of zeolite with manure) to the soil has a significant effect on the elevation of grape productivity in the second year of the experiment.

The present paper offers the results of positive aftereffect of application of two types of zeolites on the increase of grape yield: aftereffect of analcime-containing rocks in the second and third year after application of this mineral to the soil and that of phillipsite-containing rock in the second year of the experiment. The influence of aftereffect of organo-zeolite fertilizers made on the basis of the above-mentioned zeolites (mixture of zeolite with manure at the ratio 1:1) was also studied.

Experiments were carried out on a small farm, in the vicinity of Kutaisi (Western Georgia) in a relatively old vineyard of low fructification, planted in 1978. The soil of the trial land plot was red, with pH=4.8, low cation-exchange capacity – 0.09-0.22 meq/g and low fertility.

Local analcime-containing rocks from Gelati (Western Georgia) with the content of the main mineral within 70-80% and cation-exchange capacity 4.54 meq/g [3] and the phillipsite-containing rock of Shukhuti deposit (Western Georgia) with the content of the main mineral within 60-90%, and cation-exchange capacity – 3.3 meq/g [3] – were used in the experiment. Local grape – Tsolikauri – served as the test crop.

Field experiments were carried out in five variants. The first variant (control), when within three years (2006-2008) mineral fertilizers were not added to soil. The object of comparison consisted of five vine plants growing on that land plot.

The second variant, when crushed analcime-containing rock (granulation 1-2 mm), at the ratio – 500 g zeolite per plant was introduced into soil, at placement depth 5-10 cm, five plants in all. Zeolites were applied only in 2006, while the aftereffect of application of zeolites was studied in 2007-2008.

The third variant – when organo-zeolite fertilizers (mixture of analcime with manure) were introduced into soil on the basis of 250 g of crushed zeolite and 250 g manure per plant with the corresponding placement of fertilizer at the depth – 5-10 cm, in all – five plants. Fertilizers were introduced into soil only in 2006, while the aftereffect of these fertilizers was studied in 2007-2008.

The fourth variant – when crushed phillipsite-containing rock (granulation 1-2 mm) was introduced at the ratio 500 g zeolite per plant with corresponding placement at the depth - 5-10 cm, in all, five plants. Fertilizers were introduced into soil only in 2007, while the aftereffect of these fertilizers was studied in 2008.

The fifth variant – when organo-zeolite fertilizers (mixture of phillipsite with manure) were introduced into soil on the basis of 250 g of crushed zeolite and 250 g manure per plant with the corresponding placement of fertilizer at the depth – 5-10 cm, in all – five plants. Fertilizers were introduced into soil only in 2007, while the aftereffect of these fertilizers was studied in 2008.

Mean grape yield per vine plant was defined. Therefore total yield of grape from five plants was calculated in each variant with further recalculation per plant (mean yield per plant). The obtained results are presented in Table 1. Analysis of the obtained data proves the following. In the second variant yield was increased compared with that obtained from the control variant, according to the years: in 2006 – by 76%, in 2007 – (aftereffect) – by 90% and in 2008 (aftereffect) – by 115%.

In the third variant grape yield was increased by 30%, 80% and 160%, respectively. In the fourth variant grape yield was increased by the years, compared with the control, in 2007 it was increased by 42%, in 2008 (aftereffect) by 83%. In the fifth variant – by 36% and 146%, respectively.

Data of the Table show that the highest increase of grape yield takes place in the period of aftereffect and not in the year of introduction of zeolites and organo-zeolite fertilizers into soil. This is mostly characteristic of the cases of application of organo-zeolite fertilizers, although in the first year of application of organo-zeolite fertilizers their effect was expressed weaker than when only zeolites were added to soil (Table 1). Apparently this is connected with lesser amount of the zeolite applied per vine plant.

The increase in the yield of grape in the period of aftereffect can probably be explained by the influence of two factors. First – this is the soil conditioning in the zone of plant rhizosphere, which is better manifested in the case of introduction of analcime-containing rock into the soil than at the introduction of phillipsite-containing rock. The first zeolite is characterized by greater cation-exchange capacity – 4.54 meq/g, while the phillipsite is characterized by lower cation-exchange capacity – 3.31 meq/g. [3].

The second, more significant factor is creation of favorable microbial landscape, especially the increase of number of nitrogen-fixing microorganisms thanks to the influence of zeolites and organo-zeolite fertilizers. The latter more effectively contribute to the creation of favorable microbial landscape in the soil [7]. Since both processes require a definite period of time, namely the results of aftereffect should be reflected more vigorously than those of the application of the above-stated zeolites and organo-zeolite fertilizers in the first year.

It was also found that application of zeolites and organo-zeolite fertilizers has a certain effect on the quan-

Table 1.

Effect and aftereffect of natural zeolites on grape yield and some quality indices of grape juice

N	Variants	Mean yield per plant in g			Sugar content, g/100g			Acidity, pH		
		2006	2007	2008	2006	2007	2008	2006	2007	2008
1	Control, soil without mineral fertilizers	520	630	725	18.4	18.4	18.1	4.0	4.0	3.75
2	Soil enriched with analcime-containing rock, 500 g/plant	920	1200	1560	21.5	22.5	22.5	4.4	4.5	4.3
3	Soil enriched with organo-zeolite fertilizer (250 g analcime+250 g manure per plant)	700	1140	1890	21.5	23.3	22.9	4.4	4.52	4.4
4	Soil enriched with phillipsite-containing rock, 500 g/plant		900	1330		20.6	20.5		4.2	4.05
5	Soil enriched with organo-zeolite fertilizer (250 g phillipsite+250 g manure per plant)		858	1785		21.6	21.5		4.3	4.2

titative indices of grape juice. In particular, juice sugar content is increased within 5-27% and acidity decreases from pH=3.75 to 4.52, depending on the zeolite type and corresponding organo-zeolite fertilizers.

Thus, it has been proved that soil enrichment with natural zeolites and organo-zeolite fertilizers made on their basis contribute to a significant increase of grape yield in infertile vineyards. This positive effect is manifested within two-three years. As a consequence, the necessity of using costly and deficient mineral fertilizers falls off, significantly reducing grape price (selling price) and decreasing the hazard of environmental pollution with nitrogen-containing substances.

მემცენარეობა

ბუნებრივი ცეოლითების დადებითი პროლონგირებული ეფექტი ყურძნის მოსავალზე

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სტატიაში დადგენილია, რომ ვენახში შეტანილი ბუნებრივი ცეოლითის ტიპზე, შესაბამის ორგანო-ცეოლითურ სასუქზე და პროლონგირების დროზე დამოკიდებულებით ყურძნის მოსავლიანობა საკონტროლო ვენახთან შედარებით იზრდება 1,8-2,8-ჯერ, ყურძნის წვენის შაქრიანობა 5-27%-მდე, ხოლო მჟავიანობა მცირდება pH=3,75-დან 4,52-მდე.

REFERENCES

1. *H. Minato* (1968), Koatsugasu, **5**: 536-547.
2. *K. Torii* (1978), In: Natural Zeolites: Occurrence, Properties, Use. Eds. L. Sand, F. Mumpton: Elmford, New York, 441-450.
3. *F.A. Mumpton* (1999), Proc. Natl. Acad. Sci. USA, **96**: 3463-3470.
4. *N. Burriesci, S. Valente, C. Zipelli, J.C.J. Bart* (1984), Zeolites, **4**: 373-375.
5. *M. Gamisonia, T. Andronikashvili, V. Aplakov* (2006), Proc. Georg. Acad. Sci. Chemical series, **32**, 3-4: 448-450.
6. *T. Andronikashvili, M. Gamisonia, L. Eprikashvili* (2006), Annals of Agrarian Science, **6**, 2: 15-19.
7. *T.G. Andronikashvili, M.A. Kardava, M.K. Gamisonia* (1997), Proceedings of Sofia Zeolite Meeting 95: Sofia-Moscow, 111-112.

Received April, 2009