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Azotomineralnotrofni Mikro-organisms in the Vineyard Soil

V. Bogdanovic
Faculty of Agriculture, Belgrade-Zemun, Yugoslavia

J. Ziberoski
Faculty of Agriculture, Skopje, R Macedonian

A. Nakalamic, N. Markovic, B. Lalevic, I. Kljujev
Faculty of Agriculture, Belgrade-Zemun, Yugoslavia

Abstract: Nitrogen is an element necessary for micro-organisms, plants and animals because it is a component part of or takes part in the biosynthesis of organic substances (albumins - proteins and proteids, carbohydrates - glicidi and fat substances - lipids) and macromolecules biocatalysts (ferments, vitamins, fito and cytohormones).

In the course of a year a vine (*Vitis vinifera* L.) produces about 20 tons of organic substances per a hectare (root, shoot, leaves and grapes) which is, calculated as dry substance, about 8.000 kg/ha. In order to synthesize that quantity of organic substances, about 4000 kg of carbon is reduced from atmospheric CO_2 from the atmosphere, for the production of which is used about 100 kg/ha of soil nitrogen in its mineral form. If the biomass produced by annual biochemical activity of micro-organisms is added as well, the nitrogen amounts are considerably larger. To provide nitrogen in the form of plant assimilative is, therefore, of a great importance for a successful wine growing production.

Plants use nitrogen through the root system but only in it's mineral form dissolved in water forming NH_4 and NO_3. These nitrogen forms reach the soil mainly in three ways, these being: biochemical activity of soil micro-organisms - ammonification, nitrification (nitrite and nitrate) and the addition in the form of nitrogen mineral fertilizers. There is the fourth way as well - soil microflore in nitrogen fixation process, with the micro-organisms able to create ferment nitrogenase. Since there is no nitrogen in minerals and rocks, i.e. in the mineral part of the soil, the supply of plant nitrogen assimilative for the plants nutrition is very important, because the total contents of pedosphere contains 99% of its organic form the one not usable for the plants nutrition. Unlike plants, the soil micro-organisms can use

nitrogen from the organic forms as well, these being fresh organic residues and humus. These micro-organisms are called azotoheterotrofni. However, together with plants, the mineral nitrogen form in the soil i.e. adsorption complex (1%), is used by the soil micro-organisms (azotomineralnotrofni), too.The organisms using NH_4OH are called ammonium, NO_2 nitrite and NO_3 nitrate.

It is important to point out that the available quantities of the mineral nitrogen forms are used as food both to plants and these groups of micro-organisms. When these assimilative lack, there is a competitive relation between the plants and micro-organisms in the soil considering the great presence of the micro-organisms in 1g of soil, they have the advantage, thus leaving the plants in shortage of these assimilative.

Key words: azotomineralnotrofni, micro-organisms, nitrogen, Rossasoil, soil, vineyard.

Introduction

This paper analyses the data about the results concerning the presence of azotomineralnotrofni micro-organisms in the vineyard soil, the micro-organisms being the ones that use nitrogen from inorganic forms, which is very important for the vine nutrition with nitrogen plant assimilative, thus preventing the competitive relations for the same nitrogen forms between the above mentioned group of micro-organisms and vine.

The provision of nitrogen plant assimilative for the vine greatly depends on the presence of azotoheterotrofni micro-organisms in the soil. This physiological group of the micro-organisms coming from the organic remains of plant origin (when broken down they reach the soil in the form of albumin - proteins, peptones, amides, amino acids, karbamidi, and chitin) as well as from humus, i.e. from lignin - protein nucleus produces mineral nitrogen assimilative for the vine nutrition. Therefore the azotoheterotrofni micro-organisms are of a great importance, since they directly provide for mineral nitrogen forms from the above mentioned ingredients, in the first place NH_4. If NH_4 is not used by the vine and ammonia micro-organism, when it is oxidized through nitrites to nitrates by nitrification bacteria (nitrite and nitrate) in the nitrification processes ant thus is produced the nitrogen form most favorable for the nutrition of the vine and other plants.

Unless biochemical activity of micro-organisms provides the soil with nitrogen plant assimilative in a favorable form and sufficient quantities during vegetation, wine grower must bring mineral nitrogen fertilizers in. They make the production more expensive, since the production of theirs calls for energy disbursement, these technologies including direct environmental pollution as well as pedosphere and hydrosphere pollution done by indirectly unused nitrates which also have cancerous effects. Because of all the above facts, in order to have a complete insight concerning the above mentioned, the producer - wine grower must know which quantities of nitrogen fertilizers are to be brought in to achieve a profitable vineyard yield. This has been the main research aim in this work.

Materials and methods

These researches have been conducted in a two-year old vineyard with the use of Rossa soil fertilizers during which the presence of soil micro-organisms using mineral nitrogen form - azotomineralnotrofni was being determined. The determination of azotomineralnotrofni micro-organisms has been conducted in laboratory conditions with the standard methodology on starch ammonia agar, which is practice in all the laboratories in the world as well as in our country. These micro-organisms use starch to take energy, carbon and phosphorous for their own metabolism and mineral nitrogen forms are taken from ammonium sulfate and kalium nitrogen. If the produced ammonia is not used by plants and amonski micro-organisms the remaining ammonia succumbs to nitrification processes, i.e. to its oxidation through nitrite to nitrate, in the course of which nitrifiksion performed the processes of biosynthesis, i.e. the reduction of CO2 into its own organic substances - carbohydrates, owing to released chemical energy in the process of nitrification oxidation.

The sowing of the tested samples has been conducted with the standard methodology, with the method of dilution in six repeats which is used to calculate the average , with the method of dilution in six repeats which is used to calculate the average in thousands per 1g of absolutely dry soil sample. The soil samples have been taken in a usual way from the depths of a microbiological profile 0-30, 30-60 and 60-90 cm for three seasons: spring, summer and autumn, from the two-year old vineyard, the ownership of The Agricultural Faculty (Zemun) at the location "Radmilovac", with the sort Riesling on the layer Berlandieri x Riparia Kober 5BB. The experimenter vineyard was set for intensive two rows growth in 1994 with 3.333 vine plants per hectare, the growth form being two-armed, asymmetrical cordon. Before the grapevine grafts were sown in 1993, the plot concerned had been subjected to vegetation fertilization.

Rosasoil is an attested fertilizer, imported from Germany, used in four variants, these being: 500, 1000, 2000 and 3000 kg/ha. The control variant has not included the use of neither Rosasoil nor any other organic nor mineral fertilizers.

Results and discussion

According to the attest of the imported Rosasoil, it includes the following ingredients: organic substance 80-90%, total nitrogen 78%, P_2O_5 1.25%, K_2O 3.5%, MgO 1.5% and CaO 1.5%. This leads us to a conclusion that Rosasoil is an organic substance of unknown nature as well as the degree of decomposition i.e., yet there is no data about the presence of micro flora in Rosasoil which could be certainly used as a reliable indicator of its quality.

The experimental vineyard has been set on a typical Cambisol, and deeptillage of the plot was conducted in 1992 at the depht of 60-70 cm. The soil has the following chemical features: the environmental reaction, i.e. pH in the samples of 0-30 and 30-60 cm is 6.5 and in the samples of 60-90cm is 5.4. The 0-30 cm samples contain 3.3% of humus and 0.21% of total nitrogen. The 30-60 cm

samples hold 2.11 of humus and 0.19% of total nitrogen, while the 60-90 cm samples contain the smallest amount of humus 1.88% and total nitrogen 0.16%.

The presence of azotomineralnotrofni micro-organisms in these researches involved a special observation and their determining according to the physiological groups of the soil micro-organisms, these being bacteria, aktinomicetes and fungus.The achieved results are convincing and point out that azotomineralnotrofni micro-organisms (the users of mineral nitrogen form) consist of 90% bacteria, 7% aktinomicetes and only 3% fungus considering the total association of these micro-organisms which is very favorable for the supply of the mineral nitrogen form.

On the grounds of the achieved results it can be concluded that azotomineralnotrofni micro-organisms develop in this Eco system in all three seasons and all three depths of micro biological profile, which is shown in Table 1. The same conclusion follows for the control variant sample, too. In all four variants with Rosasoil, in all three seasons, it has been calculated that the general average for the presence of azotomineralnotrofni micro-organisms is 1.068 x 103, which is less for 45% comparing the same indicator with the control where it is 1.939 x 103.

Tab. 1. The Presence of Azotomineralnotrofni Micro-organisms in the Soil of a Two-year-old Vineyard (in 000 per 1g of absolutely dry sample)

the quantity of Rosasoil fertilizer (kg/ha)	the sample depth (cm)	sample No.	spring (sp)		summer (s)		autumn (a)		average (sp, s, a)
			%H_2O	No. Azmntr.	%H_2O	No. Azmntr.	%H_2O	No. Azmntr.	
500	0-30	1	10	2.879	15	1.258	12	556	1,564
	30-60	2	16	1.250	12	1.609	16	283	1.047
	60-90	3	12	920	14	213	14	170	434
	Average			1.683		1.027		336	1.015
1.000	0-30	4	11	1.517	16	2.371	14	977	1.622
	30-60	5	12	1.330	16	787	16	443	853
	60-90	6	15	576	15	1.000	13	236	604
	Average			1.141		1.386		552	1.026
2.000	0-30	7	12	2.773	14	1.322	14	1.000	1.698
	30-60	8	12	614	13	2.602	15	279	1.165
	60-90	9	12	955	14	471	16	557	661
	Average			1.447		1.465		612	1.175
3.000	0-30	10	15	1.279	14	1.563	16	2.378	1.740
	30-60	11	12	977	12	625	13	202	601
	60-90	12	11	1.843	13	552	14	276	890
	Average			1.366		913		952	1.077
control (without fertilization)	0-30	13	12	4.636	15	663	17	1.573	2.291
	30-60	14	13	2.747	15	1.326	16	1.213	1.762
	60-90	15	15	3.954	15	279	14	1.057	1.763
	Average			3.779		756		1.281	1.939

The achieved results concerning the presence of azotomineralnotrofni micro-organisms according to the variants of the used Rosasoil and to the seasons show great similarity, so to speak with insignificant varying. However, taking the

results into consideration according to the depth of micro biological profile with the Rosasoil variant it is clear that these micro-organisms are present in the greatest number in the surface samples (0-30 cm) without great aberrations according to the variants. In the samples of the micro biological profile 30-60 cm, this physiological group of micro-organisms (azotomineralnotrofni) takes the second place, right after the surface one, and the smallest number of them is in the 60-90cm samples. When it is referred to the presence of azotomineralnotrofni micro-organisms in the samples of the variant indicating the control, the same conclusion has been reached: the greatest number appears in the surface samples 0-30 cm and their presence is the same in the samples of 30-60 and 60-90 cm. These micro-organisms appear in the greatest number with all five experimental variants and amount 2.291 x 103 with the control in the samples 0-30 cm.

Having analyzed the results of the spring research of this physiological group of azotomineralnotrofni micro-organisms for all three depths of the micro biological profile, it is clear that their number is the greatest with the control amounting 3.779 x 103, while with the Rosasoil variant it amounts 1.409 x 103 which is 63% less than with the control. On the basis of the results achieved in these researches according to the seasons it is obvious that azotomineralnotrofni micro-organisms are present in the greatest number in spring comparing the other two seasons.

Having the results analyzed during summer it is clear that the presence of azotomineralnotrofni micro-organisms with the Rosasoil variant is 1.198 x 103 which is 59% more than with the control, where their presence is 756 x103. As for the presence of these micro-organisms, there are no great aberrations in the first three Rosasoil variants, while in the fourth, with the greatest quantity of this fertilizer (3000 kg/ha), the presence is the smallest amounting 913 x 103. This implies that the quantity of this fertilizer makes no influence on these micro-organisms during this season, and the fourth variant almost approximates to the control. Comparing the other two seasons, the smallest number of these micro-organisms is in summertime period.

Regarding the results of the research in autumn, the presence of the azotomineralnotrofni micro-organisms with the Rosasoil variant is 613 x 103, which is 52% less than with the control where it is 1.281 x 103.

The above mentioned shows that the presence of azotomineralnotrofni micro-organisms with the Rosasoil variants is smaller that with the control (not fertilized with Rosasoil) in the autumn samples for 52%, in the spring samples for 63%, while in the summer samples the presence is 59% greater that with the control.

Conclusion

The experimental researches of the vineyard soil samples bring us to the following conclusions:

- The soil has mildly acid reactions, pH being about 6.5 in the samples of 0-30cm and 3.30% of humus contents and 0.21% of total nitrogen.

- The general average of the presence of azotomineralnotrofni micro-organisms for all the Rosasoil variants and all three seasons is 1.073 x 103 which is 45% less than the control.

- The presence of azotomineralnotrofni micro-organisms in the spring samples was the greatest with the control 3.779 x 103, and 63% smaller with all four Rosasoil variants according to the depth of micro biological profile. The presence in the autumn presence is 52% smaller (with the control it is 1.281 x 103), while in the summer ones it is 59% greater comparing the control (1.198 x 103). This means that the presence is the greatest in the spring, slightly smaller in the summer and considerably smaller in the autumn samples.

- The greatest presence of azotomineralnotrofni micro-organisms according to the depth of micro biological profile is in the 0-30cm samples, it is smaller in the 30-6-cm samples and the smallest in the 60-90cm samples, the same being found out with the control variant as well.

- The micro biological population of azotomineralnotrofni micro-organisms consists of 90% bacteria, 7% aktinomicetes and 3% fungus. The relation among the physiological groups of the micro-organisms is favorable which greatly influences the supply of mineral nitrogen plant assimilative for the vine nutrition. Original scientific work.

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AZOTOMINERALNOTROFNI MIKROORGANIZMI U ZEMLJIŠTU VINOGRADA

-originalni naučni rad-

V. Bogdanovic
Poljoprivredni fakultet, Belgrade-Zemun

J. Ziberoski
Poljoprivredni fakultet, Skopje

A. Nakalamic, N. Markovic, B. Lalevic, I. Kljujev
Poljoprivredni fakultet, Belgrade-Zemun

Rezime

Azot je neophodan makroelemenat za sva živa bića na Zemlji: mikroorganizme, biljke i životinje, jer ulazi u sastav veoma značajne grupe organskih materija tj. Belančevina-proteina i složenih belančevina proteida.

Cilj ovoga rada bio je ispitivanje uticaja đubriva "Rosasoil" na zastupljenost azotomineralnotrofnih mikroorganizama koji koriste mineralni oblik azota, u zemljištu dvogodišnjeg vinograda. "Rosasoil" je atestirano đubrivo uveženo iz Nemačke a korišćen je u četiri varijante, i to: 500, 1.000, 2.000 i 3.000 kg/ha. Kontrola je bila parcela koja nije đubrena ni ovim niti bilo kojim organskim ili mineralnim đubrivom. Uzorci su uzimani sa tri dubine mikrobiološkog profila, i to: 0-30, 30-60 i 60-90 cm. Zastupljenost pomenutih mikroorganizama određivana je na skrobno-amonijačnom agaru.

Istraživanja su pokazala da azotomineralnotrofne mikroorganizme čine 90% bakterije, 7% aktinomicete i 3% gljive od ukupne asocijacije tj. zajednice ovih mikroorganizama, što je veoma pozitivno za obezbeđivanje mineralnih oblika azota.

Takođe je utvrđeno da je za 45% manji opšti prosek zastupljenosti azotomineralnotrofnih mikroorganizama kod varijanti sa đubrenjem u odnosu na kontrolu. Najveća zastupljenost ovih mikroorganizama zabeležena je u uzorcima od 0-30, zatim 30-60, a na kraju od 60-90 cm. U prolećnim i jesenjim uzorcima najveća zastupljenost azotomineralnotrofnih mikroorganizama bila je kod kontrole, a u letnjim je ova zastupljenost za 59% veća kod varijanti sa đubrenjem u odnosu na kontrolu.