PROVISIONAL TECHNOLOGY OF CAPITALIZATION OF LIQUID WINE YEASTS AS FERTILIZERS FOR GRAPEVINES

Andrei SIURIS[1], Artur GOLBAN[2]

e-mail:siurisandrei@mail.ru

Abstract

The paper describes a provisional technology of capitalization of liquid wine yeasts as fertilizers for grapevines. Every year in the country from 100 wine enterprises are accumulated about 16,000 tons of liquid wine yeasts. They are discharged into the environment (what is prohibited), causing damage to aquatic basins and soil. As a result of the scientific investigations, has been found that liquid wine yeasts must be included in the agricultural circuit by using them as a fertilizers.

Key words: capitalization, liquid wine yeasts, fertilizers, grapevines, technology

Wine yeasts represent waste from the wine industry which are formed as a result of the fermentation process of the grape juice. At the fermentation, about 10-15% of the semolichid wine yeasts, with a specific yellow-brick color (in the case of white wines) and red-sour cherry (in the case of red wines) are formed. In addition to yeast biomass, there are also: pulp particles, skins, clusters, seeds, sand, soil, proteins, ethyl alcohol and other soluble substances in wine.

Currently, in the wine factories, depending on the existing equipment, ethyl alcohol is extracted by distribution. Afterwards the yeasts are discharged into the environment (which is forbidden), causing damage to aquatic basins and soil. Every year in the country from 100 wine enterprises are accumulated about 16000 tons of liquid wine yeasts. The subject of the use of liquid wine yeasts is not very investigated (Gemtos *et al*, 1999, Tejada *et al*, 2009).

The aim of this scientific paper is to highlight the fertilizing potential of liquid wine yeasts and to implement a technology by which it is performed in the form of a bio-ecological fertilizer with beneficial effects on plants, soil, finished products, the environment with a high economic profitability.

MATERIAL AND METHOD

As study material was used the waste from the wine factories - the liquid wines yeasts. The provisional technology of exploiting the last was described on the basis of the researches carried out at the "Codru" Technological and Experimental Station in Chisinau during the years 2011 - 2016 (Siuris *et al*, 2013, Plămădeală *et al*, 2016).

The experience was performed in three repetitions. The surface of a plot was 55 m^2 (4.6x12m). In the study were used liquid wine yeasts from IM S.A. "Vismos" from Chisinau.

The incorporation into the soil of the yeasts was carried out by distributing the liquid jet uniformly over the surface of the parcel via the hose. Then the experimental plots were cultivated. Every year for laboratory analyzes were collected soil samples from certain points fixed on the plot.

The chemical and physico-chemical analyzes of the soil, grape and wine yeasts were performed according to the standards adopted or homologated from the Republic of Moldova.

The statistical processing of the data was done by the method of dispersion and correlation with the use of MS Excel program.

REZULTS AND DISCUSSIONS

a. The characteristic of liquid wine yeasts

They have a high content of water - 95.2% (*table 1*). The average pH value is 3.8 units. The dry residue varies from 15 to 85 g/l, constituting on average 46 g/l. From the primary elements, the total potassium content prevails with the average value of 0.75%. The total nitrogen and total phosphorus content is on average 0.21 and 0.10% respectively. They contain a huge amount of organic substance (1.3-6.7%). Concentration of bivalent calcium and magnesium cations is on average 240 and 92 mg/l. Sulfates predominate in

[1] Institute of Pedology, Agrochemistry and Soil Protection ”Nicolae Dimo”, Rep. of Moldova
[2] The State Agrarian University of Moldova, Rep. of Moldova

the anion composition. Their concentration is on average 0.34 g/l and chlorine 0.13 g/l. N-NH4-121, g/l, and N-NO3 is 13 mg/l of nitrogen. One cubic meter of liquid wine yeasts contains 10.3 kg NPK with a ratio of 1: 0.5: 3.6.

From the exposed above information we can state that wine liquid yeasts must be included in the agricultural cycle by using them as fertilizers. Liquid wine yeasts do not meet the requirements in force to be used as a source of irrigation according to the necessity of water for plants (*table 2*).

Table 1

The chemical composition of liquid wine yeasts from the wine factories from the Republic of Moldova. 10 samples collected and analyzed in the years 2010-2017

The analyzed ingredient and the unit of measurement	x	min	max	S	V,%	Sx	Sx%	Δx (+,-)
pH	3,8	3,1	4,5	0,66	17,5	0,3	7,2	0,7
Dry residue, g/l	46,0	15	85	29	63,0	12,1	26,4	29
Fix residue, g/l	12,0	7	21	7,7	66,0	3,2	27,6	8
Organic substance, %	34,0	13	67	27,9	82,1	11,6	34,2	28
Total nitrogen, %	0,21	0,08	0,58	0,2	100	0,08	40,0	0,2
N-NH_4, mg/l	121	98	188	59	49	25	20,0	59
N-NO_3, mg/l	13	4,02	21,0	8	63	3,3	26,0	8
Total phosphorus, %	0,1	0,03	0,21	0,07	66,3	0,03	27,5	0,07
Total potassium, %	0,75	0,07	0,77	0,61	82,0	0,25	34,0	0,60
Humidity, %	95,2	91,4	97,5	2,2	2,3	0,9	0,95	2,3
Ca^{+2}, mg/l	240	60	340	99	41	41	17	99
Mg^{+2}	92	37	171	52	56	22	23	52
Na^{+}, mg/l	471	301	630	158	34	66	14	158
K^{+}, mg/l	4188	399	6427	2085	50	869	21	2085
Cl^{-}, mg/l	131	83	138	28	22	12	9	28
SO_4^{--}, mg/l	340	118	451	117	34	49	14	117

Remark: x – arithmetic mean value; min- the minimum value found; max – the maximum value found; S – standard deviation of the average; v – coefficient of variation; Sx – average precision in absolut sizes; Sx% - the relative precision of the average; Δx – the confidence interval of the mean 95%

Table 2

The quality indices of liquid wine yeasts

The method name	The essesnce of the method, me/l	The quality index
Budanov M.	$\frac{Na^+}{Ca^{2+}+Mg^{2+}} \le 0.7$	1.1
Mojeico A. și Vorotnic T.	$\frac{Na^+ \cdot 100}{Ca^{2+}+Mg^{2+}+Na^+ + K^+} \le 58\%$	13.9
The Stebler Coefficient	$\frac{288}{5cl} \le 0.18$	15.6
SAR	$\frac{Na^+}{\sqrt{\frac{Ca^{2+}Mg^{2+}}{2}}} \le 3$	6.6
The magnesium coefficient	$Pmg = \frac{Mg^{2+}}{Ca^{2+}+Mg^{2+}} \cdot 100 \le 50\%$	38.5

Prior to application of liquid wine yeasts, samples must be taken and major characteristics analyzed: moisture, total nitrogen content, phosphorus, potassium, organic substance and necessarily the aqueous extract to determine the amount of soluble salts.

b. The technology of capitalization of liquid wine yeasts

Period and conditions of administration. Typically, the removal of wine from the yeasts is taking place at the end of the fall, in the winter and partly in the spring. The period of incorporation of the liquid wine yeasts is spring, before the beginning of vegetation. It is recommended to keep

them in three pots during the cold season. It is not recommended to incorporate liquid wine yeasts in winter when the soil is frozen. At incorporation them in the soil the temperature should not exceed 30^0C, in order not to cause thermal shocks to plants, but especially soil microorganisms. The favorable weather conditions for incorporation are sunless and windless days. In vine plantations, liquid wine yeasts can be distributed using the MBU-2000 machine. It works in aggregate with the MTZ-80, MTZ-100, T-70B tractors. It automatically loads with a special pump. Up to the land the liquid wine yeasts can be transported from the wine factories with the help of the machines of a higher load: РЖТ-8, РЖТ-16, МЖТ-10, МЖТ-16, МЖТ-23.

Dosing of liquid wine yeasts. The application rate for liquid wine yeasts is calculated on the basis of the total nitrogen content, which must not exceed 170 kg N/ha for a season. It is calculated according to the formula:

D = 170: 10N = 17: N, where

D- dose of liquid yeasts with natural moisture, t/ha;

170 - maximum permissible nitrogen dose in a half, kg N/ha;

N-total nitrogen content in liquid yeasts,% N of the mass with natural moisture;

10 - factor for recalculation of liquid yeasts in kilograms in tonnes.

For example, when applying liquid yeasts containing 0.28% total nitrogen, the dose will be 60 t/ha (17: 0.28).

Determination of the liquid wine yeasts spread. Knowing the application rate and the mass of liquid wine yeasts loaded in the dispenser, is calculated the area where these will be distributed by the following formula:

S = 10000 · M: D, where

S- land area, m2;

M - the mass of liquid wine yeasts in the distributor, t;

D - dose of liquid wine yeasts, t / ha;

10000 - coefficient of recalculation of hectare in square meters.

For example, the application rate of the liquid wine yeasts is 60 t / ha, in the MVU-2000 machine is 2 t load, then the load must be distributed over 333 m2 (10000 · 2: 60).

The technique of distributing liquid wine yeasts. Prior to spreading liquid wine yeastd, the liquid fertilizer spreader is adjusted to the calculated norm and the first and second loads are checked on the ground. The next machine begins to distribute the liquid yeasts from where the previous cargo has finished. Between the ends of the strips between the machines there must be no holes or overlaps of liquid yeasts over a distance of more than 1 m.

Preparatory incorporation of liquid wine yeasts. Important is the incorporation of liquid wine yeasts without delay. Immediately after distribution, the fertilized soil is cultivated at a depth of 6-12 cm (PTW-1.5 in aggregate with tractor T-54 B, T-74, DT-75, T-70B). This process ensures minimization of ammonia losses in the yeast, obtaining a more uniform incorporation in the soil mass, and also prevents the formation of a petrified crust caused by the introduced liquid and would not allow the blocking of the soil respiration processes.

The economic efficiency of application of liquid wine yeasts. The expenses for the application of liquid yeasts arises from the expenses for gas oil (74%), machine damping (17%) and engineer's salary (9%). For a load of the МВУ-2000 machine, the average cost is 116 lei (56 lei / t; 2t), at a distance of 0.2-0.7 km. The cost of making a benchmark for the price of 2014 is on average MDL 1,000 ($ 67 or $ 56). For example, the calculation factor for 1 t of liquid fertilizer at a dose of 55-80 t / ha at a distance of 0.2-0.7 km is 0.058 (58: 1000). Having the data on the cost of grape spore from liquid wine yeasts and the costs for its application, it can be analyzed from economic point of view the activity of liquid wine yeasts as a fertilizer (*table 3*).

Table 3

The efficiency of application the liquid wine yeasts as a fertilizer for grapevines at a dose of 60 t / ha at a distance of 0.2-0.7 km

Specification of indicators and measurement unit	Size
1. The spore in grape harvest in four years from 60 t / ha liquid wine yeasts, kg	5600
2. The total value spore for four years, (5600 kg·4,00 lei/kg), lei	22400
3. Total expenses for four years (40 lei/t·240 t), lei	9600
4. Net income (22400-13920) lei/ha	12800
5. The specific income for 1 ton of liquid wine yeasts (8480:60), lei	213
6. Specific income for 1 expended leu (8480:13920), lei	1,33
7. Return on expense (8480·100:13920), %	133

Remark: The price of application liquid wine yeasts - 40 lei/t, 1 kg of Sauvignon grapes - 4,0 lei

CONCLUSIONS

Liquid wine yeasts have on average 95.2% water and 6.7% organic substances. One m^3 of liquid wine yeasts contains 10.3 kg NPK with a ratio of 1: 0.5: 3.6. They can only be used as a fertilizer to capitalize the nutrients they contain. When applying liquid wine yeasts at grapevines in amount of 60 t/ha we get a net income of 3200 lei/ha per year with a profitability of 133%.

Liquid wine yeasts, with its variety of nutrients and the enormous amount of organic matter it contains, must be included in the agricultural circuit by using them as a liquid organic fertilizer.

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