

INFLUENCE OF WASTES FROM THE PRODUCTION OF ALCOHOLIC BEVERAGES ON THE PRODUCTION AND QUALITY OF AGRICULTURAL CROPS

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Abstract

The paper describes the results of the application of wastes from the production of alcoholic beverages (wine yeast, vinasse and grain mashes) on the productivity and quality of agricultural production. It was established that the application of wine yeast at the rate of 13-26 t/ha provided an increase in grape production (Sauvignon) on an average for seven years of 1.4-2.3 t/ha. The harvest increase at the incorporation of the vinasse in the dose of 300-600 m³/ha was on average for seven years of 0.7-0.8 t/ha. Grain mashes in the dose of 47-94 m³/ha resulted in average crop increase for six years of 1000-1400 kg/ha of grain units. It was found that fertilization with wastes from wine factories has not diminished the quality of the obtained wines. The physico-chemical composition is in line with the requirements for quality wines. The researched wines are distinguished by good organoleptic qualities (7.8-7.9 points) and according to the typicality they correspond to normative acts. The applied grain mashes helped synthesize and accumulate crude protein in grains. The total protein gain collected in six years was 1140-1320 kg/ha.

Key words: wastes, wine yeast, vinasse, grain mashes, productivity, quality of production.

INTRODUCTION

According to the statistical data in the Republic of Moldova from 130 companies producing alcoholic beverages and wines, about 100 thousand tons annually of residual materials are formed annually. Continuously accumulation of residues causes a polluting impact on the environment, soil and surface waters (Duca et al., 2001; Duca, 2011; Gaina, 1990). The origin of the waste is agriculture.

In 100 tons of waste there are 28 thousand tons of organic matter, 180 tons of nitrogen, 82 tons of phosphorus and 257 tons of potassium.

So it will be fair as they return to soil through fertilization. International research in terms of characteristics and use in agriculture of wastes from the production of alcoholic beverages are very few (Nicolic et al., 2006; Luz et al., 2009) and in the Republic of Moldova they are missing.

In this context, it is necessary to solve the waste problem by using them in agriculture as fertilizers. The purpose of the paper is to determine the influence of waste from the production of alcoholic beverages on plant productivity and production quality.

MATERIALS AND METHODS

The research and observations were made on cambic (leached) chernozem from Tehnological-experimental Station „Codru”, located in Codru community, Chisinau municipality, during 2011-2017 years. To test the effect of these wastes on productivity and production quality, two field experiments were organized. Waste was applied in autumn before the soil plough. The statistical processing of the data was done after Dospehov (1990).

RESULTS AND DISCUSSIONS

Productivity of agricultural plants. From the measurements and calculations carried out during all years of experimentation, it was established (Table 1) that the application of the 13 and 26 t/ha of wine yeast provided a significant increase in grape harvest on average (2011-2017) for seven years of 1.3 and 2.3 t/ha, with 14 and 24% more compared to unfertilized control (9.5 t/ha). Significant influence on the productivity of grape plants had vinasse incorporated in the dose of 300 and 600 m³/ha per year. The crop increase on average for

seven years was 0.7-0.8 t/ha or with 7-8% more than the control.

Table 1. Influence of wine waste on the Sauvignon grape harvest obtained on cambic chernozem, t/ha. The Technological-experimental Station „Codru”

Variant	Grapes harvest, years							Average for 7 years		
	2011	2012	2013	2014	2015	2016	2017	harvest, t/ha	Increase compared to the control	
	t	%								
Control	9.8	7.6	10.6	9.8	10.8	7.4	10.4	9.5	-	-
Wine yeast, 13 t/ha	10.8	8.7	11.9	12.0	11.9	8.6	11.7	10.8	1.3	14
Wine yeast, 26 t/ha	10.9	8.8	14.1	13.9	12.8	9.0	13.2	11.8	2.3	24
Vinasse 300 m ³ /ha	10.8	8.7	12.0	10.5	11.7	7.6	10.0	10.2	0.7	7
Vinasse 600 m ³ /ha	10.6	8.5	12.6	10.6	11.8	7.6	10.3	10.3	0.8	8
LSD 0.5%	0.60	0.64	0.94	0.73	0.67	0.92	0.82	0.65	-	-

Table 2 presents the data that highlights the effects of grain fertilization on field crops harvested on cambic chernozem.

Research in the years 2012-2017 has shown that grain mashes fertilization has led to a statistically significant increase in crop yields. The grain mashes applied annually at doses of 47 and 94 m³/ha (equivalent to N₁₂₀ and N₂₄₀) resulted in a crop increase on average for 6 years of 1001-1384 kg/ha of grain units or 32-44% compared to the unfertilized control.

Table 2. Influence of cereal crop fertilization on crop yields, kg/ha. The Technological-experimental Station „Codru”

Variant	Crop production						Average for 7 years, grain units		
	2012, sunflower	2013, winter wheat	2014, sunflower	2015, corn	2016, winter wheat	2017, soy beans	harvest, kg/ha	Increase compared to the control	
	kg	%							
Control	1230	3818	1170	2515	6100	1830	3125	-	-
Grain mashes 47 m ³ /ha	1840	5673	1790	3473	6700	2373	4126	1001	32
Grain mashes 94 m ³ /ha	2070	6183	1980	3750	7300	2568	4509	1384	44
LSD 0.5%	223	520	172	653	573	241	528	-	-

Qualitative indices of agricultural production

For the oenological researches regarding the quality of the wine from the experienced vineyard plantation, grapes from all three variants were harvested. The content of sugar and acids in the extracted juice was determined yearly (Table 3).

The analyzes performed (2011-2017) show that the sugar content in grapes from the fertilized variants was in average 203-212 g/dm³ with an acid accumulation of 7.0-7.6 g/dm³.

Table 3. Sugar content and acids accumulation in Sauvignon grapes, at application of waste from the production of alcoholic beverages. Technological-experimental Station „Codru” on average for 2011-2017 (ISPHTA data)

Variant	Grapes harvest, kg	Sugar content, g/dm ³	Acids accumulation, g/dm ³
Control	50	204	7.8
Vinasse (K ₄₅₀), 300 m ³ /ha per year	50	212	7.2
Vinasse (K ₆₀₀), 600 m ³ /ha per year	50	212	7.5
Wine yeast (N ₁₀₀), 13 t/ha per year	50	203	7.0
Wine yeast (N ₂₀₀), 26 t/ha per year	50	210	7.6

In February-March 2012-2016 in the Laboratory of „Strong drinks and by-products” of ISPHTA, physico-chemical research on the quality of the obtained wines was carried out. In wine samples were determined alcohol concentration, mass concentration of volatile acids, mass concentration of sulfuric acid, pH of wines. The obtained results are presented in Table 4.

Table 4. Physico-chemical indices of white wines of the Sauvignon variety. On average for the years 2012-2016 (ISPHTA data)

Indices and unit of measure	Fertilization variant				
	Control	Vinasse (K ₄₅₀), 300 m ³ /ha per year	Vinasse (K ₆₀₀), 600 m ³ /ha per year	Wine yeast (N ₁₀₀), 13 t/ha per year	Wine yeast (N ₂₀₀), 26 t/ha per year
Alcohol, % vol	12.57	13.46	13.42	12.99	11.68
Titrate acidity, g/dm ³	5.3	5.5	4.8	5.8	5.4
Volatile acidity, g/dm ³	0.37	0.38	0.49	0.32	0.29
Sulfur dioxide, mg/dm ³	35.2	40.32	26.62	30.72	47.32
Free sulfur dioxide, mg/dm ³	11.52	17.92	14.08	15.36	14.08
pH	3.1	3.2	3.1	3.1	3.2
Organoleptic note	7.87	7.87	7.83	7.85	7.84

Due to their advanced carbohydrate content, the wines have a strength of over 13% vol. The concentration of sulphur dioxide and free sulphur dioxide is 30.7-47.3 mg/dm³ and 14.1-17.9 mg/dm³, respectively. The pH is equal to 3.1-3.2 units.

Wine, the raw material of Sauvignon white grape variety is relatively clear, the color is of pale straw with greenish tones, flavor and taste are simple, pure with moderate acidity and residual sugar and organoleptic note with a value of 7.8-7.9 points. So it has been found that fertilization with waste from wine factories has not diminished the quality of the obtained wines. The physico-chemical composition is in

line with the requirements for quality wines. The researched wines are distinguished by good organoleptic qualities and, according to their typicality, correspond to the normative acts.

A higher protein content (Table 5) was established annually in the harvest of cereals treated with grain mashes at a dose of 47-94 m³/ha (equivalent to N₁₂₀-N₂₄₀).

Since the application of grain mashes has not only increased the concentration of the vital substances in the crop but also favored the increase of its mass, it has been obtained that

the mass of harvested protein and fat has increased considerably compared to the control. The protein mass collected in six years increased in comparison with the control with 1141-1320 kg/ha. As regards the fat content index, a significant increase was observed. The value of sunflower fat growth (2012) was 248-344 kg/ha (42.6-42.7%), and in 2014 also for sunflower 266-358 kg/ha (48.7%). The current year (2017) was grown soybean. The value of the fat increase was 135-176 kg/ha (22.6-22.7%).

Table 5. Quality indices of the main crops fertilized with grain mashes

Indices and units of measurement	Variant		
	Control	Grain mashes (N ₁₂₀), 47 m ³ /ha anual	Grain mashes (N ₂₄₀), 94 m ³ /ha anual
Sunflower, 2012			
Protein content, %	16.2	16.3	16.2
Amount of protein, kg/ha	199	300	335
Protein increase, kg/ha	-	101	136
Fat content, %	43.7	42.7	42.6
The amount of fat, kg/ha	538	786	882
Fat increase, kg/ha	-	248	344
Winter wheat, 2013			
Protein content, %	7.9	11.2	10.0
Amount of protein, kg/ha	302	635	618
Protein increase, kg/ha	-	333	316
Sunflower, 2014			
Protein content, %	14.2	17.3	18.4
Amount of protein, kg/ha	166	309	364
Protein increase, kg/ha	-	143	198
Fat content, %	51.8	48.7	48.7
The amount of fat, kg/ha	606	872	964
Fat increase, kg/ha	-	266	358
Grain corn, 2015			
Protein content, %	5.15	5.46	5.58
Amount of protein, kg/ha	250	288	342
Protein increase, kg/ha	-	38	92
Winter wheat, 2016			
Protein content, %	8.0	11.3	10.5
Amount of protein, kg/ha	306	641	649
Protein increase, kg/ha	-	335	343
Soy beans, 2017			
Protein content, %	30.8	31.8	31.1
Amount of protein, kg/ha	564	755	799
Protein increase, kg/ha	-	191	235
Fat content, %	22.1	22.7	22.6
The amount of fat, kg/ha	404	539	580
Fat increase, kg/ha	-	135	176
Total protein gain collected in six years, kg/ha	-	1141	1320

CONCLUSIONS

The use of wine yeast as fertilizer provided a significant increase in the production of grapes (Sauvignon) on average for seven years of 1.4-2.3 t/ha. The harvest increase at the incorporation of vinasse on average for seven years of 0.7-0.8 t/ha. Grain mashes provided

average crop increase for six years of 1001-1384 kg/ha of grain units or 32-44% of the unfertilized control.

It has been found that fertilization with waste from wine factories has not diminished the quality of the obtained wines.

The physico-chemical composition is in line with the requirements for quality wines.

The wines distinguish by good organoleptic qualities and, according to their typicality, correspond to the normative acts.

The applied grain mashes helped synthesize and accumulate crude protein in grain production. The total protein gain collected in six years consisted of 1141-1320 kg/ha.

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