A NEW REGULATOR OF THE PHYSIOLOGICAL PROCESSES IN GRAPE PLANTS

UN NOU REGULATOR AL PROCESELOR FIZIOLOGICE LA PLANTELE DE VIŢĂ DE VIE

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Abstract. *Studies have been performed on different grape cultivars differing by ecological/geographical origin and biological and technological particular features in the vineyards of the Stăuceni Viticulture/Winemaking College situated in the central zone of the Republic of Moldova in order to establish the influence of a naturally-occurring biologically active substance that belongs to the steroid glycoside class tentatively named Melangoside O (Mo) on the components of grape hydric status, growth and producing capacity. A foliartreatmentwith an aqueous Mo solution has been foundto contribute to the optimization of plant water exchange, which ensures an increase of yields and grape quality indices including in the unfavorable environmental conditions comparing with witness plants. The effects of the Mo action on grape plants are related to the concentration applied and genotypical particular features of plants. Melangoside O is recommended for implementation in viticulture to enhance plant resistance and producing capacity.*

Key words: steroidal glycoside, grapes.

Rezumat. *Cercetările au fost realizate în viile Colegiului viti-vinicol Stăuceni, situat în zona centrală a Republicii Moldova, cu diferite soiuri de viţă de vie (ce diferă după proveniența eco-geografică şi particularităţile biologice şi tehnologice), în scopul evidenţierii influenţei substanţei biologic active de provenienţă naturală, din clasa glicozidelor steroidice – Melangozidei O (Mo) asupra componentelor statusului hidric, creşterii şi productivităţii plantelor de viţă de vie. Se constată că tratarea extraradiculară cu soluţie apoasă de Mo contribuie la optimizarea schimbului de apă al plantelor, ceea ce asigură sporirea recoltei si indicilor calităţii strugurilor,inclusiv în condiţii nefavorabile de mediu, faţă de plantele martor. Efectele acţiunii Mo asupra plantelor de viţă de vie sunt în funcţie de concentraţia în care se aplică şi de particularităţile genotipice ale plantelor. Melangozida O se recomandă a fi aplicată în viticultură în vederea sporirii rezistenţei şi productivităţii plantelor.*

Cuvinte cheie: glicozide steroidice, plantaţie de viţă de vie

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INTRODUCTION

It is a common knowledge that the potential of the producing capacity of crop plants, including grape, in production conditions is manifested, as a rule, only partially due to the action of unfavorable natural and technological factors of growth and development and, in the first place, of that of the hydrothermal regime. Production of stable and high quality yields necessitates physiological studies on the processes that regulate manifestation of the plant producing capacity and resistance potential, development of some operative measures to maintain a sufficient vital proccess level. To achieve this goal, the products based on biologically active substances which in small amounts ensure a high efficacy and are ecologically friendly are widely employed. Steroid glycosides of natural origin have proved to be quite promising(Kirilov A. et al., 2004; Kintea P. et al., 2004). Though, to accept their implementation in different crops, it is imperative to conduct special studies on manifestation of the expected effects depending on plant genotypes, environmental conditions, administration mode and concentration. This work reports our findings on the possibility of employment of a substance belonging to the steroid glycosideclass, furostanolicseries, tentativelynamedMelangoside O (Mo), isolated from *Solanummelongena* L. seeds to optimize the physiological processes occurring in grape plants during the vegetation period.

MATERIAL AND METHOD

The investigation was conducted six years (2005-2010) on different grape cultivars, differing by ecological/geographical origin and biological and technological particular features, namely Chardonnay, Muscat Amber, and Moldova in the vineyards of theStăuceni Viticulture/Winemaking College situated in the central zone of the Republic of Moldova. The experiments were set on microparcels each containing 20 plants, repeated three times. The plants were foliar treated with an aqueous Mo solution at concentrations of 10^{-2} , $5 \cdot 10^{-3}$, 10^{-3} % 10-12 days before full bloom and at the stage of berry fulfillment; the solution consumption was 600-800 l/ha. Water sprayed plants served as witnesses.

Parameters of hydric status components including tissue hydration, saturation deficit, water content in leaf apoplast and simplast, transpiration intensity, coefficient of the hydric status stability using classical (Cushnirenco M.D. et al., 1970) and MNR methods (Carr H.Y., Purcell E.M., 1954; Harciuc O. et al., 2003), sprout growing dynamics, yield and its quality have been evaluated keeping in mind the polyfunctional water role as a medium and indispensable component of vital processes, a factor of their interaction and integrity accomplishment, which, to a large extension, regulates metabolism and to appreciate the activity of the steroid glycoside in the studies on the grape physiological condition.

RESULTS AND DISCUSSIONS

Analyses of the multiannual experiment results demonstrated a pronounced action of the steriod glycoside Mo on water exchange, growth and producing capacity of grape plants. Essential modifications of the parameters of the hydric status components take place in the Mo treated plants, which, to a large extent, have an adaptive nature, especially during the periods of hydric regime tension. Inhibition of transpiration intensity was observed in the majority of the BAS treated plants at the

stage of berry formation and growth in comparison with the witnesses, with the exception of the plants cv. Moldova treated with a Mo solution 0.005% (table 1) at the stage of berry growth which coincided with the heat period, but water supply was sufficient for the plants in the conditions characteristic of the respective ontogenetic stage.

Table 1

Leaf transpiration intensity in the Mo treated grape plants, mg H_2O/dm^2/hour

Treatment	Cv. Chardonnay	Cv. Moldova
	June 29,2006	June 29,2006
Control	410,03 ±29,30	361,65± 28,13
Melangoside, 0,01%	372,60± 17,93	299,35± 28,30
Melangoside, 0,005%	375,79± 24,90	350,30± 21,43
Melangoside, 0,001%	322,45± 45,70	286,62± 35,18

The particular features of the transpiration intensity, to a large extent, are conditioned by water compartmentalization in simplast and apoplast. The application of the MNR method of water proton relaxation provided data on the content of "free" and "bound" water. The analysis of the data revealed a dependence of transpiration intensity on the level of apoplast hydration, as well as on the content of free water in simplast (table 2). The experimental data summarized in tables 1 and 2 demonstrate that the content of free water in apoplast and simplast (in vacuoles) that was lower in the treated plants conditioned a diminution in the transpiration intensity, which indicates an enhancement of water consumption efficacy.

Table 2

Water compartmentalization in leaf simplast and apoplast of the BAS treated grape plants, % of the total content. June 29, 2006

Treatments	Free water, apoplast	simplast	
		Free water	Bound water
Cv.Chardonnay			
Control	11,96	51,49	36,55
Melangoside 0.005%	8,38	36,70	54,92

An enhancement of the water retention capacity in leaf tissues (water loss during two hours, % of the total water content) was also recorded during this ontogenetic period, especially in the cv. Chardonnay plants treated with Mo at concentrations of 0.01% and 0.005%; in the plants cv. Moldova at a concentration of 0.001% (table 3).

Table 3

Leaf water retaining capacity in the BAS treated grape plants, %

Treatment	cv. Chardonnay		cv. Moldova	
	June 13, 2007	August 14, 2007	June 13, 2007	August 14, 2007
Control	10,18 ± 0,58	17,12 ± 0,89	8,82 ± 0,38	9,10 ± 0,37
Melangoside, 0,01%	5,60 ± 0,04	14,55 ± 0,63	8,44 ± 027	9,21 ± 0,65
Melangoside, 0,005%	6,35 ± 0,09	16,9 ± 0,01	8,57 ± 0,13	6,14 ± 0,03
Melangoside, 0,001%	9,06 ± 0,23	14,47 ± 1,06	7,34 ± 0,19	6,90 ± 041

A tendency towards enhancement of leaf tissue capacity to retain water under the influence of the used BAS was also observed on the background of the favorable conditions of humidity and temperature that are necessary for a normal proceeding of the processes characteristic of the respective ontogenetic stage.

Modifications of the water exchange components induced by the BAS action resulted in the optimization of the plant hydric status, especially in the stress conditions. The hydration of grape plant tissues was established at a level that was, in general, higher in comparison with the witness plants. Table 4 shows the data on the water content in the leaves at the stage of growth and berry fulfillment in 2007 when the climatic conditions exceeded multiannual mean values, but had no impact, to a larger extent, on the intensity of water exchange in the grape plants, yet, the values were recorded, which were slightly reduced in comparison with those characteristic of this ontogenetic stage. In these conditions, the application of BAS contributed to the maintenance of water content in leaves at a level that was higher in comparison with the witness in the cv. Chardonnay plants, with the exception of the treatment Melangoside 0.01%. This tendency was less pronounced in the cv. Moldova plants, with the exception with the treatment Melangoside 0.005%.

Table 4

Water content in the leaves of the BAS treated plants, %

Treatment	cv. Chardonnay		cv. Moldova	
	June 13, 2007	August 14,2007	June 13, 2007	August 14, 2007
Control	70,00 ± 0,95	62,46 ± 0,25	72,40 ± 0,16	67,93 ± 0,03
Melangoside, 0,01%	70,52 ± 0,10	60,42 ± 0,47	72,81 ± 0,04	69,31 ± 011
Melangoside, 0,005%	71,69 ± 0,14	63,63 ± 007	73,20 ± 0,02	67,97 ± 0,18
Melangoside, 0,001%	71,72 ± 0,73	62,16 ± 0,19	72,11 ± 0,04	68,19 ± 0,16

Table 5

Saturation deficit in the leaves of the BAS treated grape plants (%)

Treatment	cv. Chardonnay		cv. Moldova	
	June 29,2006	August 1,2006	June 29,2006	August 1,2006
Control	10,15 ± 0,44	10,54 ±1,98	7,75 ± 0,89	9,92 ± 0,53
Melangoside, 0,01%	8,90 ± 0,46	9,08 ±o,23	4,64 ± 0,30	7,90 ± 0,57
Melangoside, 0,005%	6,63 ± 0,38	9,86 ± 0,56	7,16 ± 0,41	7,35 ± 0,21
Melangoside, 0,001%	6,61± 0,28	8,06 ± 0,46	7,02 ± 0,27	10,70 ± 1,43

The modification of the saturation deficit values, as a rule towards diminution depending on the plant genotype, ontogenetic stage, and environmental conditions proves a beneficial action of the steriod glycoside in the studies on the grape water exchange (table 5).

The optimization of water exchange and its stabilization in the unfavorable environmental conditions caused a coordinated evolution of the growth and development processes in the grape plants. In general, the Mo treated plants were characterized by a higher producing capacity and enhanced yield quality in comparison with the witness plants (table 6).

Table 6

The BAS influence on the producing capacity and yield quality of grape plants (year 2005)

Treatments	Yield per bush, kg	Weight of a grape bunch,g	Weight of 100 berries, g	Sugar content, %	Acid content g/l
cv. Muscat Amber					
Control	7,2	189,5	193,96	14,8	10,1
Capsicoside 0,001%	9,03	220,2	210,83	15,1	8,6
Melangoside 0,01%	7,03	219,7	244,54	15,0	8,4
Melangoside 0,005%	9,2	191,7	249,21	15,3	8,4
Melangoside 0,001%	7,8	185,7	221,86	15,7	8,1
cv. Chardonnay					
Control	3,8	51,1	129,23	17,8	10,4
Capsicoside 0,001%	4,03	66,6	138,5	18,1	9,6
Melangoside 0,01%	4,4	90,5	147,99	19,9	9,8
Melangoside 0,005%	5,63	83,7	163,62	18,95	10,5
Melangoside 0,001%	5,33	93,3	165,6	19,3	9,5

Table 7

The BAS influence of the producing capacity and yield quality of grape plants, the year of 2007

Treatments	Yield per bush, kg	Weight of a grape bunch, g	Weight of 100 berries,g	Sugar content, %	Acid content, g/l
cv. Moldova					
Control	4,7	127,76	293,09	17,2	7,57
Melangoside 0,01%	5,22	118,99	295,29	16,4	7,37
Melangoside 0,005%	6,45	138,15	294,49	18,2	7,6
Melangoside 0,001%	3,53	84,28	231,08	17,8	8,07
cv. Chardonnay					
Control	8,0	90,4	107,09	22,5	5,7
Melangoside 0,01%	4,48	67,0	95,7	22,7	5,3
Melangoside 0,005%	7,64	92,07	115,52	23,3	5,2
Melangoside 0,001%	9,56	119,0	132,80	21,3	6,1

At the same time, the results of yield records indicate that the dependence of the producing capacity of the BAS treated grape plants on both genotype and plant physiological condition and product concentration was more pronounced in conditions of extreme (critical) climatic conditions during the vegetation period. In the plants cv. Moldova, Mo administration contributed to the yield enhancement by 11-37%, the concentration of 0.005% being more efficient; Mo at a concentration of 0.001% caused a negative effect (table 7). In the plants cv. Chardonnay, a positive effect was recorded at a product concentration of 0.001%, while the Mo treatment at a concentration of 0.01% accounted for a negative effect in the plants (table 6).

A tendency towards inhibition of the sprout growth processes was observed in the plants of both cultivars treated with Melangoside O, with the exception of the concentration of 0.005%, the application of which produced a weakly pronounced effect on sprout growth stimulation in the plants cv. Moldova. The employment of the product also ensured a normal sprout maturation.

CONCLUSIONS

1. Foliar treatment of grape plants with the steroidal glycoside Melangoside O results in optimization and enhancement of hydric status stability, including in the unfavorable environmental conditions, which ensures an intensive evolution of vital processes, enhancement of producing capacity and plant resistance to rehydration (draught, heat).

2. The effects of the Melangoside O action on grape depend on the concentration employed and genotypical particular features of plants.

3. The Melangoside O concentrations of 0.005% and 0.001% prove to be more active physiologically.

4. The experimental results allow Melangoside O to be recommended for employment in viticulture to enhance plant resistance and producing capacity.

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