

## MULTICOMPONENT BIOREGULATOR "REGOPLANT" IN VITICULTURE

S.P. Ponomarenko<sup>a</sup>, H.M. Kucher<sup>b</sup>

<sup>a</sup> National Enterprise Interdepartmental Science and Technology Center "Agrobiotech" NAS and MES of Ukraine

<sup>b</sup> National Scientific Center "Tairov Wine Making and Wine Growing Institute"

### Introduction

The modern ecological status of Ukraine's agricultural systems notably is influenced by the anthropogenic factors: the use of chemical fertilizers and considerable amount of chemical plant protection products against diseases and pests, climatic changes and other factors, resulting in a significant change of the soil biocenosis, decreasing in plant immunity (Kandybin N.V., Smirnov O.V., 1997; Kitayev O.I., Skriaga V.A., 2010). All these factors created new problems in agricultural production, which require new approaches and the search for new solutions for the recovery of biocenosis in crop growing including grapes.

New natural plant growth regulators with bioprotective effect were created in Ukraine as a part of the 3 international projects (2006-2013) under the program of the Ukrainian Science & Technology Center with the financial support of the USA. Their mechanism of physiological action at the cellular level are disclosed. These biostimulants (Biolan, Stimpo and Regoplant) promote the growth and development of plants, increase a plant resistance to pests, diseases and stress, ensure the genotype safety, increase the yield and production quality. This is achieved by stimulating of the biosynthesis of small regulatory si/miRNA – immune systems of plant protection.

Long-term studies of these products in the cultivation of various crops, including the specially created infective and contaminated by heavy metals and radionuclides fields, have shown high efficiency of their use in the plant production.

In this regard, the development of technological practices of new bioregulators, which are certified in the system «ORGANIC», for the growing of different grape varieties, certainly, is of great scientific and practical interest.

Therefore, **the objectives of research were** to study the effect of bioregulator Regoplant (developer and producer – ISTC Agrobiotech NAS and MES of Ukraine) on the degree of development of grape plants, increase in resistance to disease, stress factors of the environment during the growing season and in autumn-winter period, as well as the possibility of yield gain and improvement of quality.

### Methods of research.

Research was carried out in 2013-2014 in the Physiology Laboratory of the Breeding Department of the NSC Tairov WMWGI and NE Experimental Production Farm "Tairovske". Research was carried out on the industrial variety Cabernet Sauvignon and table varieties Muscat pearly and Zagadka. Agrotechnical methods were generally used in this region. The bushes – two-trunk system, planting scheme – 2.5 x 1.5 m<sup>2</sup>; without covering and irrigation.

The test bushes were selected with equal growth and the elements of fruiting. The bushes were sprayed with water solution of Regoplant at the rate of 100 ml/1000 liters of water per 1 hectare (0.01% solution). Dates of spraying: 7-10 days before flowering (1st), just after flowering (2nd), at the stage of berry development (3rd) and at the beginning of berry maturation (4th).

The spraying of Odesky black variety was carried out on 5 hectares with Regoplant solution at the rate of 50 ml per 1 ha during each chemical treatment according to the accepted schedule of protection; 5 hectares without Regoplant – the Control.

Below calculations were carried out:

- agrobiological indices (length, diameter of vines, volume of growth, maturation of vines, leaf area of bushes);
- physiological indices (accumulation of pigments in the leaf tissues, indicators of plant moisture status, breathing rate);
- crop performance (weight and volume of berries, crushing force, grapes and yield weight per bush, quality of juice, rot growth rate on the grapes);
- physiological status of the vines in the autumn-winter period (tissue water content, content of carbohydrates – sugars, starch);
- bud safety after wintering;
- the degree of bud differentiation in the year of treatment for founding of the crop for next year.

### **The results of research.**

The results are positive in all the matters. Spraying of grape plants with a solution of Regoplant was effective. Sprayings led to stimulation of vine growth and leaf surface development. Thus, vine growth was stimulated in the general direction of the lateral meristem and vine diameter increased. Vine diameter of Cabernet Sauvignon plants increased by 10.7%, Zagadka – by 11.4%, Muscat pearly – by 11.7%. At the same time, the linear growth of vines was practically at the level of Control. The average increase of internode length was observed, which increased in the Control variants by 10-12%. It promoted the better aeration of bushes and inhibited the fungal diseases (Table. 1).

The sprayings with Regoplant stimulated the development of the leaves; leaf surface increased by 10-12%. It is known that the strengthening of growth and development of plants is due to more intensity of photosynthetic activity of the leaf tissues. The obtained experimental data on the content of pigment in leaf tissues showed its higher content in all the experimental variants (10-20%). It differed only in absolute quantities due to their biological features (thickness and density of the lamina). At the end of the vegetation (end of August) the content of pigments in the experimental variants were at a higher level as compared to Control (Table. 2). Furthermore, it is noted that the water content of leaf tissue in the test variants was higher, especially on Cabernet Sauvignon, both in the period of intensive growth and at the end of vegetation. At the same time, the content of retained water was lower than in the Control. We know that this index is a signal of plant response to unfavorable environmental factors, and the summer was characterized by high air temperatures and drought in July-August. We can suppose that spraying of bushes with Regoplant helped to improve protective functions to adverse factors, improving the water retention capacity of leaf tissues which has been higher by 4-9% (absolute values) compared to the Control ( Table. 2).

**Table 1. Impact of Regoplant on the agrobiological indices of grapevine growth and development. National Scientific Center “Tairov Wine Making and Wine Growing Institute”, 2013**

Variant	Length of vines before sprayings	Length of vines at the end of vegetation, cm	Average gain of vines, cm	Average diameter of vines, mm	Volume of vine gain, dm <sup>3</sup>	Length of internode, cm	Vine maturation, %	Area of 1 leaf, cm <sup>2</sup>	Area of leaves on 1 bush, m <sup>2</sup>	Vine leafage, cm <sup>2</sup> /cm	Area of leaves on 1 vine, dm <sup>2</sup>	Volume of 1 vine, cm <sup>3</sup>
Cabernet Sauvignon												
Regoplant	39.25	186.00	146.75	7.42	18.12	5.42	69.27	98.68	9.67	18.19	33.83	63.42
Control	47.71	190.33	142.62	6.94	16.31	4.52	64.47	85.77	8.75	18.95	36.02	53.92
Zagadka												
Regoplant	84.00	241.00	157.00	7.00	8.09	7.72	74.75	133.20	5.57	7.72	41.56	60.40
Control	73.60	228.90	155.30	6.15	5.86	7.20	74.35	121.57	4.91	7.20	38.63	46.12
Muscat Pearly												
Regoplant	61.10	217.10	156.00	7.85	16.07	7.23	88.58	97.80	6.25	13.52	29.34	75.46
Control	63.30	218.00	161.70	6.67	13.21	7.92	74.60	79.15	5.05	9.89	21.57	56.47

**Table 2. Impact of Regoplant on the intensification of physiological and biochemical processes in tissues of grapevine leaves. National Scientific Center “Tairov Wine Making and Wine Growing Institute”, 2013**

Variants	Pigment content, mg/g of fresh weight				Water content in tissues, %	Retained water, %	Water retention capacity, %	Breathing intensity, mg CO <sub>2</sub> per 1 gram	
	ch a	ch b	carotinoid	Total				fresh weight	dry weight
<b>July</b>									
<b>Zagadka</b>									
Test	2.41	0.96	0.78	4.14	71.48	21.71	30.37	0.42	1.39
Control	1.95	0.68	0.70	3.33	70.66	26.91	38.10	0.38	1.23
<b>Muscat Pearly</b>									
Test	2.27	0.79	0.70	3.75	71.25	16,40	23,00	0.32	1.11
Control	1.94	0.62	0.63	3.19	68.07	22.08	32.44	0.29	0.94
<b>Cabernet Sauvignon</b>									
Test	2.52	0.97	0.83	4.32	72.24	15.82	21,89	0.28	1.23
Control	2.22	0.94	0.87	4.03	70.75	18.03	25.48	0.11	0.94
<b>August – September</b>									
<b>Muscat Pearly</b>									
Test	1.44	0.52	0.49	2.45	65.48	22,90	34.98	0.93	2.16
Control	1.41	0.51	0.45	2.37	61.31	25.93	42.30	0.76	1.76
<b>Muscat Pearly</b>									
Test	1.58	0.54	0.50	2.62	64.33	22.22	34.54	0.77	2.09
Control	1.30	0.45	0.45	2.19	63.56	25.93	40.80	0.62	1.65
<b>Cabernet Sauvignon</b>									
Test	1.65	0.61	0.52	2.76	68.27	23.17	33.90	0.78	2.08
Control	1.37	0.42	0.41	2.20	67.30	24.30	36.12	0.61	2.04

**Table 3. Impact of Regoplant on grape yield and quality. National Scientific Center “Tairov Wine Making and Wine Growing Institute”, 2013**

Variant	Amount of clusters per bush, pcs.	Average yield from 1 bush, kg	Average weight of 1 cluster		Weight of 100 berries		Volume of berries, cm <sup>3</sup>	Crash force, kg/cm <sup>2</sup>	Sugar in juice, g / 100 cm <sup>3</sup>	Acidity, g/dm <sup>3</sup>
			g	%	g	%				
<b>Muscat pearly</b>										
Test	17.80	6.14	345 ± 14.6	129.20	357	111.20	360	-	14.20	6.10
Control	15.70	4.20	267 ± 15.4	100	321	100	315	-	12.80	5.50
<b>Zagadka</b>										
Test	9.75	8.80	902 ± 11.4	120.60	756	118.00	720	1.875	19.30	3.80
Control	10.20	7.63	748 ± 24.0	100	639	100	610	1.645	17.20	3.80
<b>Cabernet Sauvignon</b>										
Test	26.70	5.02	188 ± 9.70	132.00	179.50	142	180	-	21.40	7.60
Control	26.00	3.69	142 ± 5.60	100	126.40	100	120	-	20.20	7.70
<b>Odesky black</b>										
Test	34.90	5.74	164.50	114	205	105	210	-	16.80	6.40
Control	35.70	5.14	144.00	100	195	100	200	-	16.20	6.80

**Table 4. Impact of Regoplant on the quality of wine materials. National Scientific Center “Tairov Wine Making and Wine Growing Institute”, 2013**

Variant	pH	Alcohol, % vol.	Titratable acids, g/dm <sup>3</sup>	Amine nitrogen, mg/dm <sup>3</sup>	SO <sub>2</sub> (free), mg/dm <sup>3</sup>	Phenolic substances, mg/dm <sup>3</sup>	Coloring substances, mg/dm <sup>3</sup>	Organic acids, g/dm <sup>3</sup>			Degustation evaluation, points
								tartaric	malic	lactic	
<b>Cabernet Sauvignon</b>											
Test	3.57	11.00	6.60	88.00	22.40	1110.00	264.00	2.03	0.36	4.15	7.98
Control	3.62	10.70	6.80	98.00	25.60	821.00	243.00	1.77	0.60	4.74	7.97
<b>Odesky black</b>											
Test	3.34	10.00	6.20	81.00	25.60	2290.00	486.00	3.41	0.08	3.74	7.99
Control	3.44	8.70	6.60	112.00	32.00	2232.00	465.00	2.65	0.12	3.52	7.97

This improvement of water retaining in leaf tissue and more intensive metabolic process (breathing and accumulation of pigments) have influenced on the yield performance. Increase in the yield was noted on all the tested varieties with Regoplant spraying. Increase in the yield per bush was calculated by weight of bunches, as we have left their number on the bushes the same. Increase in weight of bunches was noted on the all tested grades both due to increasing in the weight and volume of berries in bunch, and due to increasing in their quantity in the bunch (Table. 3).

The harvest time in September was rainy, it caused the development of mold on the berries, especially for Zagadka variety; but bushes of this variety sprayed with Regoplant had rot percentage by 50% lower than in the Control. It was also noted the decrease of berry damage by oidium under the influence of Regoplant (oidium this year was rampant).

**Table 5. Impact of Regoplant on the bud safety in winter. National Scientific Center “Tairov Wine Making and Wine Growing Institute”, 2013**

Variant	Quantity of live buds after wintering, %	
	primary buds	secondary buds
<b>Cabernet Sauvignon</b>		
Regoplant	62.50	80.00
Control	47.00	55.30
<b>Zagadka</b>		
Regoplant	73.00	83.80
Control	48.70	47.30
<b>Odesky Black</b>		
Regoplant	89.10	95.10
Control	75.70	85.30

The table variety Zagadka had a higher strength of berry skin. The strength of its crushing was increased by 11.6% compared to the Control. It is very important for the transportation of table grapes and for a longer period of their keeping period.

But the most important thing is that after the treatments with Regoplant the berry juice condition is improving. It is especially important for the industrial varieties. The content of sugars in the juice for Cabernet Sauvignon increased by 1.2 g/100 cm<sup>3</sup>; for Odesky Black – by 1.6 g/100 cm<sup>3</sup>.

In addition to research on test plots the farm tests of Regoplant were carried out in the research vineyard Tairovske on the Odesky black variety on 10 hectares. The 1<sup>st</sup> plot (test) with an area of 5 hectares was sprayed with the mix of chemicals against diseases and pests of grapes + biostimulant Regoplant (50 ml/ha). The 2<sup>nd</sup> plot (control) with an area of 5 hectares was sprayed with the same mix without Regoplant at the same terms. The bushes normally developed. The number of bushes infected by oidium was in the range of 2-3% on the test plot and 12-14% on the control. The yield on the test plot was 8.76 t/ha, on the control – 8.108 t/ha. The sugar content of the juice on the test plot was 17.8 g/100 cm<sup>3</sup> and 16.2 g/100 cm<sup>3</sup> on the control plot, the acidity of the juice was 6.4 g/dm<sup>3</sup> (test) and 6.8 g/dm<sup>3</sup> (control).

Wine tasting of Cabernet Sauvignon and Odesky Black from the test plots, treated with the solution of Regoplant, has showed higher quality of these samples compared to control. They had more intensive bouquet, flavor, extract content, especially Odesky black variety, that obtained 7.99 points against 7.97 points on the control sample. Chemical analysis of tested and control samples has showed that the alcohol content in control was 10.7% (Cabernet Sauvignon) and 8.7% (Odesky black), and in test samples 11% and 10% (0.3-1.3% higher). Indices of titratable acidity and amine nitrogen in test samples, on the contrary, were lower, especially for samples of Odesky black. Index of extract content in the wine (phenols) for test samples was

higher than the control, especially for Cabernet Sauvignon. Wine materials of both varieties also had a high concentration of coloring substances. These varieties in their biological characteristics always have more intensive of wine color, but the test samples had coloring substances by 20 mg/dm<sup>3</sup> more (table 4). These facts specify direction for the research widening in the field of biological or organic wine materials.

In winter 2013-2014 the analysis of bud safety after the winter frosts was carried out. It has showed a positive effect of treatments with Regoplant on the status of buds and shoots.

### **Summary**

Spraying of vegetating grapevine with a solution of biostimulant Regoplant stimulate physiological processes in leaf tissues. The synthesis of assimilates and water retention improve.

Spraying of vegetating grapevine with Regoplant change agrobiological development indices: shoot growth intensifies, their diameter, total buildup and leaf surface increase.

Regoplant has a positive effect on the yield and quality of grapes: it upgrades the average weight of grapes by 11-18%, strength of skin of table varieties, sugar content of juice by 0.6-2.1 g/100 cm<sup>3</sup> depending on the biological characteristics of varieties.

Improving of quality indices of juice of industrial varieties influences on the wine material quality. Composition, flavour indices and extract content improve.

The conclusion of the taste panel: recommendation for Regoplant to use in the wide production of grapes.

### **References**

1. Kandybin N.V. Production of biological products: problems of formation / N.V. Kandybin, O.V. Smirnov // Plant protection and quarantine. - 1997. - #8. - P. 16-19.
2. Kitayev O.I., Skriaga V.A. at al. Impact of complex products on the yield of apple tree / News of Agrarian Sciences. 2010, #11, p. 22-25.