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THE PHYSIOLOGY - BIOCHEMICAL CHARACTERISTICS OF FUROLAN EFFECT ON SUSTAINABILITY THE SPECIES VITIS VINIFERA TO THE PHYLLOXERA

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Abstract

To increase the biotic stress immunity were studied the usage of elicitors, for example, Furolan, in the cultivation of own-rooted plants Vitis vinifera. It is one of the promising directions of reducing pesticide effect to the vineyards. It was established that this nanotechnologycal method has allowed reducing the defeat of the grape roots such as louses and diseases. It is established that the grape harvest increased by 21.4 % (without background treatments) due to the increase in the mass of clusters by 31.1 % and profitability of production increased by 17.8 %, improved crop quality in comparison with the control. Effectiveness to the agricultural procedure was not inferior to the standard of comparison Fastak.

Key words: *clean technology, grapes, elicitor Furolan, productivity, phylloxera*

1. INTRODUCTION

The using of a large number of chemical substances to protect of own-rooted plants during the cultivation of the species Vitis vinifera to reduce diseases and pests, including the root form of phylloxera, reduces the quality of the harvest and wine, which is associated with the presence of residual quantities of pesticides. One of the promising directions to reduce the pesticide effect is increasing the immunity to biotic stressors.

To solute this problem it has two ways: a selective way, and the usage of a new technological methods, including processing plants of grapes by micro doses of elicitors [1].

Phylloxera, brought to Europe from America, belongs to the family of aphids and is a dangerous pest of grapes. The ability of phylloxera to rapid reproduction makes it terrible scourge of viticulture. The death of the root system the almost all varieties and hybrid forms of the species Vitis Vinifera after damage of the phylloxera root forms connected with the secondary pathological process, caused by phytopathogenic microorganisms, which leads to the death of a grape plant.

Plant varieties and hybrid forms of the species Vitis Vinifera have no resistance genes against the phylloxera, but carry the genes of resistance to the process of rotting roots [2].

Pathogens (biotrophes) and viruses are using the resources of the living plant cells, removing them from the protection system. One of the ways to solve this problem is to activate the grape plant immune system to creating conditions which is unfavorable for the power of the parasite and the development of phytopathogens [1].

To reach the goal we used as inductors protective reactions the abiogenic elicitors - low-molecular immunomodularity compounds, which are analogues of natural substances or containing in the structure of their components.

These compound include the Furolan which has created in the Kuban state technological University. Furolan is an acetal, contains in its structure furan cycle, which accounts for its low toxicity for plants and animals. It is easily hydrolyses at pH below 6 that the treatment of vegetating plants in doses of 2 to 10 g/ha causes the lack of residues in products and environments [3].

The main target of this work is to study the influence perspective ecologically pure elicitor Furolan on physiology-biochemical parameters of resistance to defeat the root form the phylloxera and productivity own-rooted plants of the species Vitis vinifera.

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2. MATERIALS AND METHODS

Studies were performed in 2013 in small-plot experiments in farm "Primorskaya", the settlement of Primorsky Temryuk district of the Krasnodar region. The abiogenic elicitors were tested on the own-rooted Bianca grape. The age of the plantation is 8 years. It is cultivated in own-rooted culture. Forming - hi-stem unilateral cordon. The scheme of landing bushes - 4 x 2,5 m, the fourfold repetitiveness. The repetitions has 5 plants [4].

The lignin contention in the grape roots was determined by the gravimetric method, its metabolic precursor of chlorogenic acid, amino acids glycine, proline, abscisic acid, cations CA - by capillaceous electrophoresis instrument Kapel-105M [5-6]. Anatomy-morphological studies were performed according to the methodology using a light microscope "Olympus BX 41" [7]. By treatment grape plants by Furolan in the dose of 10 g/ha in the period of the first laying pests followed two treatments with an interval of 14 days each backpack sprayer CHAMPION PS 257 in the form of water solutions. Liquid flow - 1000 l/ha Background processing by fungicides is not conducted. As a control were taken plants without treatment drugs, the comparison standards were plants, treated Fastac EC BASF at a dose of 360 g/ha.

3. RESULTS AND DISCUSSION

As the results of our studies it was established that the Furolan and Fastac had a positive impact on productivity development and, as a consequence, crop varieties Bianca (table. 1).

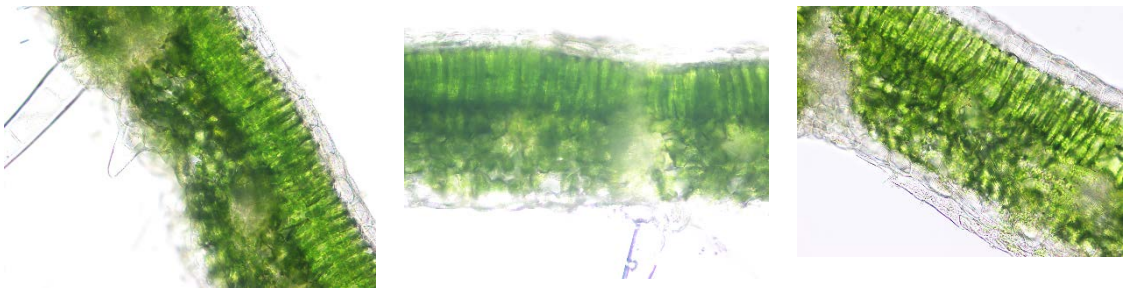
Table 1 - Impact of drugs Furolan and Fastak on productivity development grape variety Bianca

A variant of the experience	leaf surface to escape, cm^2	the number of clusters, units/escape	Leaf surface, sm^2/bunch
Control option	1740,06	1,8	966,7
Fastak	1866,4	1,7	1097,9
Furolan	2298,3	2,0	1149,2

Deviations from control significant at P = 0.05

Fastac and Furolan has contributed to the formation of larger area of leaf surface (by 7.3 and 23.1 %, respectively) on the escape, and per a bunch (13,6 and 18.9 %, respectively) in comparison with control.

The results of the microscopy grape leaves in August shown in Fig. 1



Control option Fastak Furolan

Fig. 1 – Micro photo of the cross section of leaf plate of grapes Bianca

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It has established that Furolan has creased the index of Palisades in comparison with the control variant and drug Fastac that makes the best photosynthetic activity and increases yields and quality (table. 2).

Table 2 - Biometrical parameters of the sheet plate of grapes Bianca

A variant of the experience	parameters sheet plate, micron			the index of palisade
	the thickness of a sheet plate	palisade layer thickness	the thickness of the spongy layer	
Control option	144,3	65,2	67,7	0,96
Fastak	137,0	61,7	64,4	0,95
Furolan	136,7	65,2	60,6	1,07

Deviations from control significant at P = 0.05

The evidence of greater photosynthetic activity in variants Furlan and Fastac also confirmed by the increase of the content of pigments in leaves of grapes (Fig. 2).

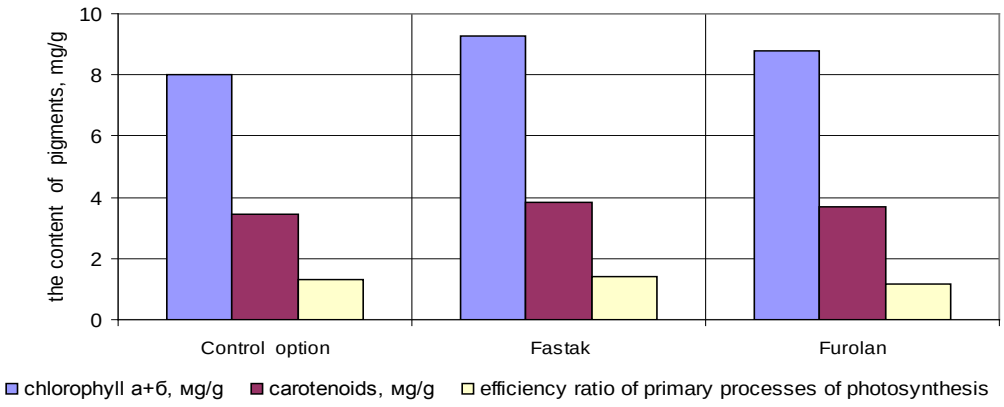


Fig. 2 - Characteristics of photosynthesis in leaves of grapes Bianca

The Fastac has decreased, and Furolan – has increased the efficiency of primary processes of photosynthesis (Capps) in leaves of grapes Bianca.

More active photosynthetic activity in versions with application of studied this substances has improved both productivity and the quality of the grapes.

The results of determination the influence of Furolan and Fastac on productivity and the quality of the grapes are given in table 3

Table .3 - Influence the Furolan and Fastak on productivity and quality of grapes Bianca

A variant of the experience	Grape bunchs mass, g	Productivity, kg/bush	The content of sugar in the juice of berries, g/dm^3	The titratable acidity in the juice of berries, g/dm^3
Control option	103	2,06	22,0	8,3
Fastak	138	2,62	24,1	8,4
Furolan	135	2,50	22,5	8,0

Deviations from control significant at P = 0.05

Furolan has increased the weight of the bunch in the variety Bianca by 31.1 % and productivity - by 21.4 %, in comparison with the control. The sugar-acid index in control is 2,65 and options Fastac and Furolan - 2,87 and 2,81, respectively, which is characterized by improved quality of berries in comparison with the control variant.

To detect physiology -biochemical regularities of influence of abiogenic elicitor Furolan on the sensitivity of the species Vitis Vinivera to the defeat of the root form of phylloxera for the first time to plant grapes we set the main physiological-biochemical criteria (lignin content in the roots, phenol carbonic acids in leaves and roots of the vine) (table. 4)

Table. 4 - Contents of chlorogenic acids in the leaves and roots and lignin in the roots of the vine,

A variant of the experience	The content of chlorogenic acid, mg/kg		The lignin content,%
	in leaves	in roots	
Control option	127,7	52,6	2,06
Fastak	160,3	19,3	2,81
Furolan	216,3	2,7	14,91

Deviations from control significant at P = 0.05

In August, the highest content of chlorogenic acid, a predecessor of lignin in plant leaves of grapes is contained in versions with application of elicitor, and in the roots - in control version that characterizes less spending it in this case in the roots on the synthesis of lignin.

More contents of the chlorogenic acids in leaves and lignin in the roots of grapes creates unfavorable conditions for the defeat of their phytopathogens and phylloxera. This is confirmed by the detection of education of bills root forms of phylloxera. The results of determination of the impact of drugs on the sustainability and growth of the root system of plants grape Bianca to the defeat of the root form of phylloxera given in table. 5.

Table. 5 - Impact of drugs on the sustainability and growth of the root system of grapes Bianca to the defeat of the root form of phylloxera

A variant of the experience	The length of the roots diameter of more than 1 mm/bush, cm	The number of suction roots in length 2 cm/cm root diameter greater than 1 mm, pieces	The amount of damage pieces/cm length root
Control option	66,7	0,12	0,95
Fastak	80,3	0,18	0,27
Furolan	128,0	0,14	0,27

Deviations from control significant at P = 0.05

It is established that the number of bills (damage) of the root form of phylloxera, per 1 cm root diameter exceeding 1 mm in the options Fastac, Furolan was less than 3.5 times in comparison with control, developing roots in the horizon 0-45 cm was better that characterizes most of their safety and the best plants of grapes. The best state of the root system options drugs Furolan and Fastac contributed to increasing the yield of own-rooted grape varieties Bianca 21.4 - 27,2 %, respectively, in comparison with the control.

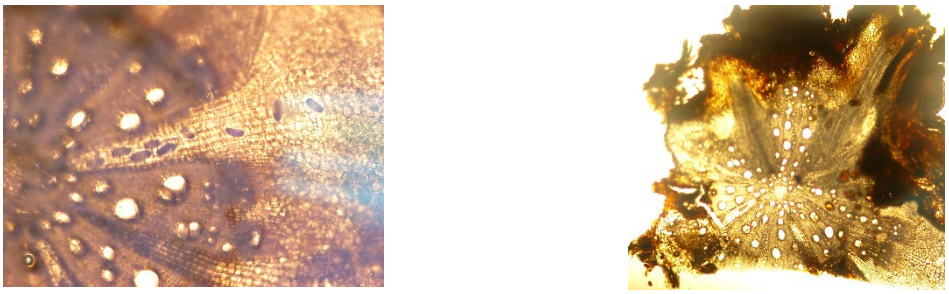
The definition of microflora on the roots in June showed that the plants of grapes in the variant with the Furolan more resistant Alternaria (defeat 0 %) and fungi of the genus Mucor (defeat 0 %) in comparison with the control (the defeat of Alternaria and Mucor - 20 %) and option with the medication Festac (defeat Alternaria - 40 % and Mucor - 20 %). In November, the roots of plants of grapes in the variant with Furolan were more resistant to

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damage by fungi of the genus Aspergillus (lost 5 %) and Penicillum (defeat 0 %) in comparison with the control (the defeat of 20 % and 10 %, respectively) and drug Festac (lost 15 % and 5 %, respectively.

Thus, Furolan, showing alistore properties, reduces the defeat of the roots of own-rooted grape varieties Bianca root form of phylloxera.

Anatomy-morphological research of the grape roots had found penetration of the larvae of phylloxera in the parenchyma of the root (Fig. 3).



larvae of phylloxera in the parenchyma of the root education nodules

Figure 3 - Micrograph of larvae of phylloxera in the parenchyma of the root and education nodules in the control variant of the experiment

When conducting the anatomic-morphological studies on cross-section of root detected the formation of nodules, which hinders the absorption of nutrients, up to its complete cessation. Subsequently, nodules, isolated groups of the roots and causes their death [7].

Identified different levels of education nodules, respectively, and the extent of damage root, depending on experience, which is expressed in points on a 4-point scale:

0 - no nodules

1 - 25 % of the surface of the root filled nodules;

2 -50 % the root surface filled nodules;

3 -75 % of the surface of the root filled nodules;

4 - 100 % of the surface of the root filled nodules (table. 4).

The degree of damage to the roots of the vines in the control variant of the experiment is estimated at 4 points. In case Tastak - 2 points and Furolan - 1 point.

Metabolome assessment of immunity of plants of grapes to stemming the phylloxera has allowed to establish that it is due to the increase in the roots of the content of the amino acids glycine, part of the GRP-protein and Proline - part PRP protein - special structural proteins that increase cell wall when exposed to pathogenic (Fig. 4).

It should also be noted that the Proline has osmoprotective properties and increases resistance cells to dehydration, and, as a consequence, plant resistance to abiotic stressors. When exposed to stress factors (BAS, pathogenic and others) in the cytosol of cells increases the content of Ca^{2+} and abscisic acid (ABA), activating the cascades protective metabolic reactions (Fig. 5).

Processing plants of grapes by Furolan and Fastac increases the content of Ca^{2+} cations and abscisic acid (ABA) in grape leaves in comparison with the control.

The increase in the content of ascorbic and phenol carbonic acids (chlorogenic and coffee) options drugs Furolan and Fastac increases resistance cell membranes to oxidative stress (Fig. 6).

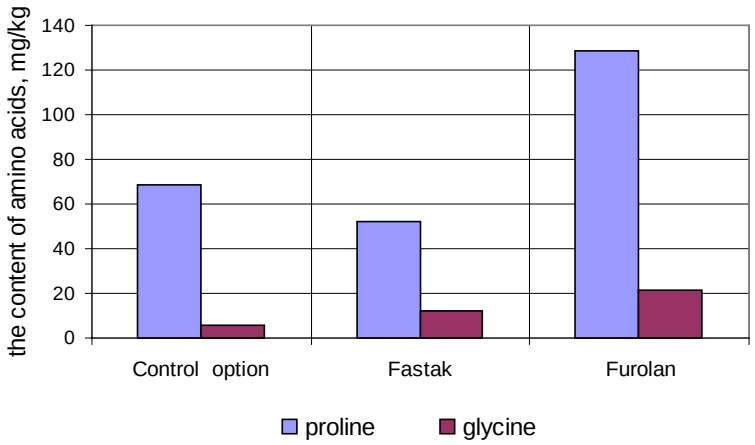


Figure 4 – The content of proline and glycine in the leaves of grapes Bianca

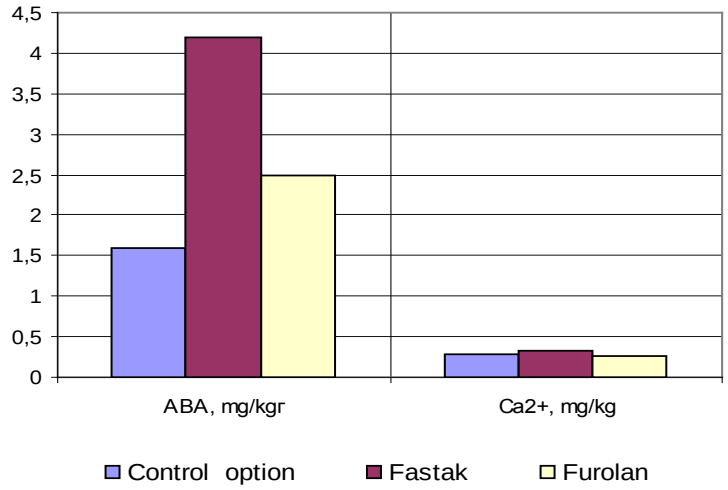


Fig. 5 - the Content of Ca2+ and ABA in the leaves of grapes Bianca

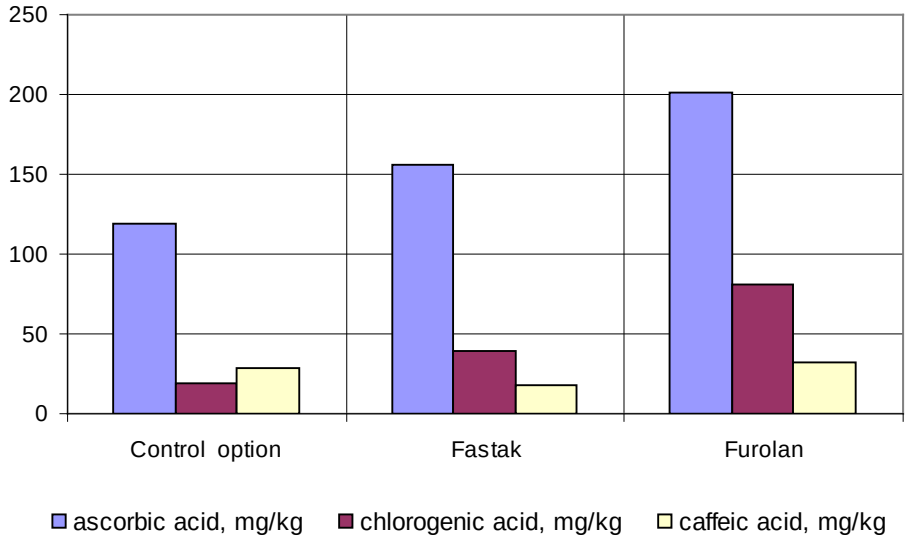


Fig. 6 - the Content of ascorbic and phenol carbonic acids in leaves of grapes Bianca

Thus, the best results to fight with infection of plants grape root form phylloxera achieved by processing their by Furolan, which in its effectiveness is not inferior to the pyrethroid Fastac.

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