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ORIGINAL ARTICLE

Influence of pre-planting and while-planting agricultural measures on the growth, development, and productivity of young grape plantations under conditions of the south of Ukraine

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The article presents resumptive long-term data on the application of adsorbents and complex chelated fertilizers on young plantations of technical grapes of the Bastardo Magaratsky variety. As a result of research, the positive effect of mentioned substances was established and proved, which was manifested in an increase in the volume of one-year growth and acceleration of the output of the selected type of formation; an increase in the power of the root system, and this, in turn, contributed to the better overcoming of drought; an increase in yield at the beginning of entry into fruiting and the quality of berries. Thus, the application of absorbents and chelated fertilizers helps increase the adaptability of grape bushes to adverse environmental conditions, which periodically develop under conditions of the south of Ukraine. This has been felt more and more acutely in recent years.

Keywords: Grapes, root system, yield, chelated fertilizers biochelate and poly-feed, maximarin absorbents.

Introduction

Grapes are a relatively specific perennial crop, which has high plasticity in adaptation to soil and climatic conditions and a significant regenerative capacity, due to which high annual plant productivity is maintained (Vlasova, 2009). However, as with all perennial crops, to create long-term, highly productive plantations, it is important to ensure and create optimal conditions while planting because mistakes made during planting are mainly incorrigible. During the creation of new grape varieties, specialists must create conditions for plants to meet agroecological factors that fully correspond to the biological characteristics of grapes (Sherer & Zelenyanskaya, 2011). Due to the long frost-free period, the abundance of warm and light and low soil humidity, it is possible to grow high-quality grapes to produce wine materials and high-category wines. However, in recent years, one of the negative factors that affects the development of the grape plant has been drought, which does not allow full use of factors such as warmth, light, and nutrients, which negatively affects the development and cropping capacity of grapes. Nevertheless, grapes differ from other crops in their increased resistance to drought, primarily due to the strong development and deep penetration of the root system of grapes. However, as production experience and scientific research show, there is a decrease in shoot growth, yield, the laying of fruit formations worsens, and sometimes the death of bushes in arid years.

The main way to prevent drought in grape cultivation is to arrange irrigation systems (Litvinov & Polyakov, 1975; Vlasova, 2009; Yaroshuk, Yaroshuk & Bejbulatov, 2012). The presence of irrigation provides an increase in the coefficient of the useful effect of abiotic factors and due to this, growth (an increase in plant biomass) and fruiting (the size of the yield and its quality) of grapes are significantly enhanced. However, in the south of Ukraine, there is a problem of irrigation water shortage, the vast majority of sources have increased mineralization and harmful salt content. That is why there is a need to take measures to combat the lack of water and the preservation of moisture in the soil. According to sources of literature and scientific research, one of the ways to preserve moisture in the soil is by applying absorbents (Bejbulatov, 2009; Yaroshuk, Yaroshuk & Bejbulatov, 2012; Ishenko, Savchuk & Hrenovskov, 2018).

To realize the potential of plant productivity, nutrition plays an essential role in agriculture, significantly affecting the realization of the biological potential of grapes. Recently, water-soluble complex fertilizers with trace elements in the form of chelates have become increasingly used, and viticulture is no exception (Veliksar & Kucevickaya, 1982; Bejbulatov, 2010), but in most cases, on nonirrigated plantations, they are used for outside the roots fertilization (Wallace, 1983; Schreiner, 2016). Using chelated fertilizers in the technology of preparing seedlings for planting has not yet been thoroughly studied.

Thus, the joint application and study of the effect of absorbents and chelated fertilizers on the plant when planting vineyards is a very relevant issue. Therefore, the purpose of our research was to study both the individual effect of absorbents and in combination with chelated fertilizers on the growth, development, and productivity of grape plants when laying an industrial vineyard in conditions of the south of Ukraine.

Materials and Methods

Experiments were carried out for five years in the subsidiary enterprise 'Agro-Koblevo' of Berezansky district, Mykolaiv region, on the technical variety of Bastardo Magaratsky grapes grafted on the Riparia × Rupestris 101-14, the plant placement scheme is 3 × 1.0 m. The soil cover of the experimental plot is represented by slightly saline dark chestnut soils on the loess.

The climate of the Mykolaiv region is warm and arid. The territory of the subsidiary company 'Agro-Koblevo' is located in the southern part of the Berezansky district and, according to the agroclimatic zoning scheme of the region, belongs to the III southern temperate hot and very arid agroclimatic district. The experiments were carried out according to the following scheme:

Variant 1-control (soaking seedlings in water); variant 2-enveloping the roots with 'MaxiMarin' gel; variant 3-planting seedlings with two tablets of "MaxiMarin"; variant 4-soaking seedlings in a solution of 'Biochelat' and enveloping the roots with 'MaxiMarin' gel; variant 5-soaking seedlings in a solution of 'Biochelat' and planting with two tablets of "MaxiMarin"; variant 6-soaking seedlings in a solution of 'Poly-feed' and enveloping the roots with 'MaxiMarin' gel; variant 7-soaking seedlings in a solution of 'Poly-feed' and planting with two "MaxiMarin" tablets; variant 8-soaking seedlings in a "Poly-feed" solution; variant 9-soaking seedlings in &

The seeds prepared for planting variants 1-3 were soaked for one day in the water. In the variants in which complex chelated fertilizers of the trademarks 'Biochelat' and 'Poly-Feed' were used, the seedlings were soaked in 10% and 5% solution, respectively.

Absorbents were applied directly during planting. The roots of seedlings in the variants where the gel was supposed to be used were immersed in the 'MaxiMarin' gel before planting. When using the tablet form of the 'MaxiMarin' adsorbent, they were placed at the bottom of the planting hole under the seedling's root system.

When conducting research, we used methods that are generally accepted in viticulture (Metodicheskie rekomendacii po agrotehnicheskim issledovaniyam v vinogradarstve Ukrainy, 2004). The results obtained were statistically processed using variance analysis.

Results and Discussion

All studies conducted in viticulture provide for mandatory accounting of the parameters of the leaf apparatus development and the one-year growth of bushes because they are the leading indicators that characterize the state of grape plant development and serve as indicators of the influence of techniques used by researchers.

Analyzing the effect of the studied substances (absorbents and fertilizers) on the biometric indicators of the Bastardo Magaratsky variety, it can be noted that there was a slight difference between the number of leaves and the diameter of the leaf blade on average per shoot by the variants of the study. However, due to the development of a different number of 1-year shoots, in all variants of the experiment, this led to a significant difference in the leaf surface area of the bush and the volume of one-year growth (Table 1). The average number of leaves per shoot ranged from 14.6 pieces in the control variant to 17.9 pieces in the variant using the absorbent 'MaxiMarin' in the form of a tablet. At the same time, the diameter of the leaf blade ranged from 11.8 cm (control) to 14.24 cm (variant 5).

Significant differences in the research variants, as already noted, were in the number of developed shoots per bush and ranged from 8.3 pieces in the control variant to 18.3 pieces in the variant with the application of absorbents 'MaxiMarin' in combination with water-soluble complex fertilizers 'Poly-Feed'.

Thus, the smallest area of the leaf surface of the bush was recorded in the control variant and amounted to 1.32 m^2. Variants using only water-soluble complex fertilizers with trace elements in the form of chelates 'Biochelat' and 'Poly-Feed' exceeded the control by 0.22 m^2 and 0.55 m^2, with the SSD05 indicator (the lowest significant difference) -0.19 m^2, which is a significant excess.

The leaf surface area in the variants with a separate application of 'MaxiMarin' absorbents in gel form was 2.81 m^2, and tablet form-3.34 m^2, which is also quite significantly higher than the control variant.

Table 1. Effect of absorbents and water-soluble complex fertilizers with trace elements in the form of chelates on biometric parameters of Bastardo Magaratsky grape bushes.

Variants	The number of leaves, pieces.	Leaf blade diameter, cm	Leaf surface area of the bush,		The number of shoots, pieces.	Shoot length, cm	Shoot diameter, cm	The volume of one-year growth,	
			m^2	%				cm^3	%
Variant 1. Control	14.6	11.80	1.32	100	8.3	116.4	1.05	824.6	100
Variant 2. "MaxiMarin" gel	16.7	13.77	2.81	213	11.3	148.76	1.04	1546.2	187
Variant 3. "MaxiMarin" tablets	17.9	14.07	3.34	253	12.0	149.77	1.08	1633.0	198
Variant 4. "Biochelat" and	17.7	14.18	4.00	303	14.3	149.72	1.03	1788.7	217

"MaxiMarin" gel									
Variant 5. "Biochelat" and "MaxiMarin" tablets	17.0	14.24	4.33	328	16.0	148.07	1.00	1836.6	223
Variant 6. "Poly-Feed" and "MaxiMarin" gel	16.7	13.67	4.22	320	17.3	147.57	1.04	2153.0	261
Variant 7. "Poly-Feed" and "MaxiMarin" tablets	17.1	14.11	4.90	371	18.3	144.40	1.00	2094.4	254
Variant 8. "Poly-Feed"	16.3	12.88	1.87	142	8.8	135.89	1.08	1074.4	130
Variant 9. "Biochelat"	15.0	12.27	1.54	117	8.6	138.54	1.05	1033.1	125
SSD_{05}			0.19					146.20	

Note: * SSD-the lowest significant difference.

A significant mathematically proven excess in the leaf surface area of the bush was observed with the joint application of 'MaxiMarin' absorbents (various aggregate forms of production) with complex water-soluble fertilizers with trace elements in the form of chelates 'Biochelat' and 'Poly-Feed'-this excess over the control ranged from 2.68 m^2 in the fourth variant to 3.58 m^2 in the seventh variant. These increases are significant, which is confirmed by mathematical calculations and the SSD05 indicator (the lowest significant difference) -0.19 m^2.

When analyzing the indicators of one-year growth of shoot, the same shoots diameter is noted, but fluctuations in the average shoot length from 116.4 cm to 149.77 cm and their number per bush were recorded. When calculating the volume of growth over one year using the variants of the experiment, a similar pattern was observed for the leaf surface area of the bush. Therefore, the most significant volume of one-year growth was recorded in the variant with the joint application of absorbents 'MaxiMarin' in gel form with water-soluble complex fertilizers with trace elements in the form of 'Poly-Feed' chelates and was 2153.00 cm^3, which is 1328.40 cm^3 higher than the control.

The research program provided for the study of the development and formation of the grape root system. One of the numerous functions of the root system is to provide the ground part of the bush with water and minerals for the complete value crown formation and its ripening in the first periods, and yield formation when entering fruiting. Thus, when studying the development of the grape root system (Table 2), it was found that the bulk of the roots were formed in the soil layer, at a depth of 40-80 cm. The roots found were mainly represented by a fraction with a diameter of up to 1 mm and made up the bulk of the roots and a diameter of 1-3 mm. The presence of a small number of roots with a diameter of 3-5 mm or more was due to the young age of the vineyard.

The length and number of roots in all diameters differed by the experiment variants. However, they were the largest in the variants with the separate application of 'MaxiMarin' absorbents of various preparative forms of production and their joint application with water-soluble complex fertilizers 'Biochelat' or 'Poly-Feed'.

That is, in our case, thanks to the qualitative indicators of the 'MaxiMarin' preparations to preserve and regulate moisture, the main roots (heel) of the grape plant received water at the right time, which led to their more significant development in number, diameter, and length. In addition, not only moisture but also nutrients (in an easily digestible form) must be in the soil in the area of the absorbing roots, which leads to an increase in the volume of the root system, and this, in turn, contributes to better drought overcoming (Danilejchenko, 1965). Consequently, the most significant increase in the root system occurs with the joint application of absorbents and water-soluble complex fertilizers with trace elements in the form of chelates.(Fig. 1.).

Table 2. Influence of absorbents and water-soluble complex fertilizers with trace elements in the form of chelates on the development of the root system of Bastardo Magaratsky grape variety.

Variants	**Roots diameter, mm**	**Number of roots, pieces**	**Roots length, cm**
Variant 1. Control	up to 1 mm	3.2	5.6
	1-3 mm	7.7	9.0
	3-5 mm	0.7	3.0
Variant 2. "MaxiMarin" gel	up to 1 mm	10.2	13.3
	1-3 mm	7.4	4.8
	3-5 mm	1.6	3.9
Variant 3. "MaxiMarin" tablets	up to 1 mm	11.4	11.5
	1-3 mm	4.7	5.7
	3-5 mm	1.1	2.5

	up to 1 mm	16.5	10.5
Variant 4. "Biochelat" and "MaxiMarin" gel	1-3 mm	4.9	11.3
	3-5 mm	2.1	7.1
	up to 1 mm	13.1	14.0
Variant 5. "Biochelat" and "MaxiMarin" tablets	1-3 mm	11.0	10.2
	3-5 mm	2.4	11.8
	up to 1 mm	11.7	15.3
Variant 6. "Poly-Feed" and "MaxiMarin" gel	1-3 mm	11.3	6.9
	3-5 mm	1.1	3.0
	up to 1 mm	18.7	17.8
Variant 7. "Poly-Feed" and "MaxiMarin" tablets	1-3 mm	15.9	10.7
	3-5 mm	2.7	12.2
	up to 1 mm	10.7	8.3
Variant 8. "Poly-Feed"	1-3 mm	4.5	10.2
	3-5 mm	0.9	1.8
	up to 1 mm	6.7	7.7
Variant 9. "Biochelat"	1-3 mm	8.9	9.3
	3-5 mm	0.7	1.6

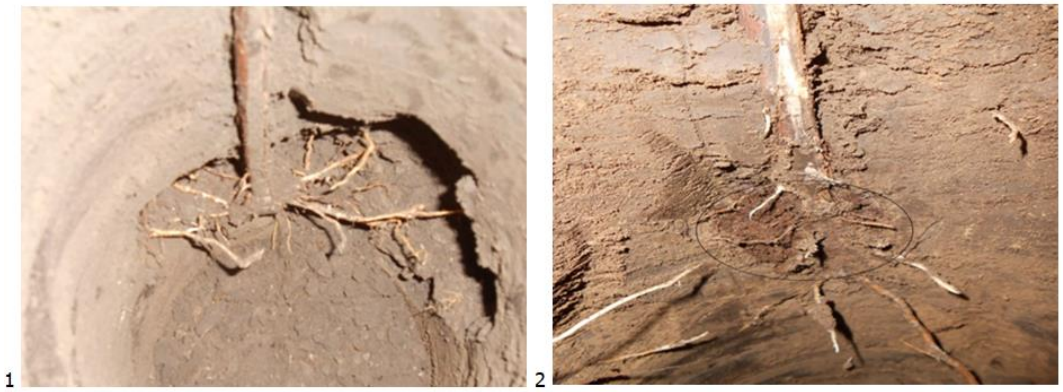

Fig. 1. Root system development of Bastardo Magaratsky grape variety: 1-application of "MaxiMarin" absorbent-gel; 2-application of "MaxiMarin" absorbent-tablets.

Obtaining the first yields and entering plantations in the fruiting period is a pretty stressful and responsible period since it is in parallel with this process that the selected type of bush formation is being bred, and the cropping capacity of the array will also depend on the speed of formation.

Analysis of the data (Table 3) showed that naturally the highest quantitative indicators of the yield structure were variants with the application of "MaxiMarin" absorbents both in the form of a tablet and in the form of gel in combination with the application of chelated fertilizers "Biochelat" or "Poly-Feed" in pre-planting preparation, which provided a rapid active start to plants growth, and therefore indirectly, as an aftereffect, caused changes in the value of the first yields. The cropping capacity of a hectare of plantations of Bastardo Magaratsky grape variety, in these variants, exceeded the cropping capacity of the control variant by 38-54%.

Table 3. Yield and quality of berries of Bastardo Magaratsky grape variety.

Variants of the experiment	Number of bunches, pieces	Bunch mass, g.	Yield from the bush, kg	Cropping capacity from 1 hectare		Mass concentration	
				T	%	Sugars, g/dm³	Titrated acids, g/dm³
Variant 1. Control	16.6	103.6	1.720	5.73	100.00	177	5.66
Variant 2. "MaxiMarin" gel	17.4	126.5	2.201	7.33	127.92	183	4.84
Variant 3. "MaxiMarin" tablets	17.3	131.7	2.278	7.59	132.46	201	4.74
Variant 4. "Biochelat" and "MaxiMarin" gel	17.3	118.6	2.052	6.83	119.19	182	4.89

Variant 5. "Biochelat" and "MaxiMarin" tablets	18.1	146.5	2.651	8.83	154.10	201	4.80
Variant 6. "Poly-Feed" and "MaxiMarin" gel	18.1	136.5	2.470	8.23	143.63	208	4.82
Variant 7. "Poly-Feed" and "MaxiMarin" tablets	20.1	120.6	2.424	8.07	140.83	209	4.97
Variant 8. "Poly-Feed"	17.4	114.6	1.994	6.64	115.88	179	5.20
Variant 9. "Biochelat"	14.7	125.2	1.840	6.13	106.98	177	5.60
SSD_{05}		9.46	0.195			3.6	

Note: * SSD - the lowest significant difference.

So, the average number of bunches by the experiment variants ranged from 14.7 pieces in the variant where the fertilizer 'Biochelat' was applied and up to 20.1 pieces in the variant with the application of two tablets of absorbent 'MaxiMarin' in combination with 'Poly-Feed' fertilizer. All other variants did not significantly differ in the number of bunches and were almost the same, in the range of 17.3-18.1 pieces of bunches on a bush.

The average mass of the bunch by the variants of the experiment had significant fluctuations. Therefore, the average mass of the bunch in the control variant was 103.6 g. In contrast, in the variants using 'MaxiMarin' absorbents both separately and in combination with 'Biochelat' or 'Poly-Feed' fertilizers, this indicator significantly exceeded the indicators in control, which is confirmed by calculating the lowest significant difference, which is equal to 9.46 g.

Consequently, in terms of 1 hectare, the highest cropping capacity of the Bastardo Magaratsky grape variety was recorded in variants where absorbents 'MaxiMarin' were applied in both preparative forms of production, both separately and in combination with water-soluble complex fertilizers 'Biochelat' or 'Poly-Feed'. The highest indicator was recorded in the variant with the application of two 'MaxiMarin' tablets combined with 'Biochelat' fertilizer and amounted to 8.83 tons per hectare, significantly exceeding the control, the cropping capacity of which was 5.73 tons.

We want to note that with a reasonably high cropping capacity (for young plantations) of grapes, the berries' quality indicators (sugar content and acidity) were relatively high. However, due to the insignificant reserve of the leaf canopy area, the acidity was slightly reduced. Thus, the mass concentration of sugar in the juice of the fruits ranged from 177 g/dm^3 in the variant where the fertilizer «Biochelat" was applied and up to 209 g/dm^3 in the variant where the absorbents "MaxiMarin" with the fertilizer "Poly-Feed" were applied, with an acidity of 4.74 to 5.66 g/100 dm^3.

In general, we can say that 'MaxiMarin' absorbents in different aggregate forms of production: gel or tablet, when the joint use with water-soluble complex fertilizers with trace elements in the form of chelates 'Biochelat' and 'Poly-Feed', due to their action in the post-planting period, really affects the quantitative and qualitative indicators of grape yield.

Conclusions

Therefore, the data analysis of the obtained data shows that the application of absorbents 'MaxiMarin' in the preparative form of gel or tablet, both independently and in conjunction with complex water-soluble fertilizers in the form of chelates, is practical and deserves attention when applied during the planting of industrial vineyards. The application of the studied substances really affects the value of the biometric indicators of the bush, which was manifested in an increase in the volume of one-year growth, which ensured faster breeding of the selected formation and entry into fruiting. It contributed to developing a more powerful root system of a grape bush, which in turn contributed to better drought overcoming. Their positive aftereffect on the increase in quantitative and qualitative indicators of the yield of Bastardo Magaratsky grape variety was revealed under industrial conditions of the south of Ukraine. Based on the above, we state that applying absorbents and chelated fertilizers helps increase the adaptability of grape bushes to environmental conditions.

References

Bejbulatov, M.R. (2009). Ispolzovanie vodonakaplivayushej kapsuly na plodonosyashih vinogradnikah Kryma. Magarach. Vinogradarstvo i Vinodelie, 1:14-16 (in Russian).

Bejbulatov, M.R. (2010). Primenenie guminovyh preparatov i kompleksnyh mikroudobrenij–zalog kachestva posadochnogo materiala i urozhaya vinograda. Magarach. Vinogradarstvo i Vinodelie. 2:8-11 (in Russian).

Veliksar, S.G., Kucevickaya, I.S. (1982). Vliyanie makroudobrenij na soderzhanie mikroelementov v organah vinogradnogo rasteniya. V kn. Optimizaciya Pitaniya i Produktivnost Selskohozyajstvennyh Rastenij, pp:58-65 (in Russian).

Vlasova, V.V. (2009). Vinogradarstvo severnogo prichernomorya: (monografiya). Arciz, FOP Petrov O.S. (in Russian).

Danilejchenko, A.V. (1965). Vliyanie udobrenij na rost i razvitie kornevoj sistemy vinograda. V kn. Tezisy dokladov konferencii molodyh uchenyh Kryma. Simferopol, pp:13-15 (in Russian).

Ishenko, I.O., Savchuk, Yu.O., Hrenovskov, E.I. (2018). Osoblivosti zakladannya vinogradnih nasadzhen iz zastosuvannyam sorbcijnih materialiv pri osvoyenni shiliv. Agrarnij visnik Prichornomor'ya: zb. nauk. pr. ODAU. Vip, 88:145-150 (in Russian).

Kuzmenko, A.S., Ivanova, R.B. (2009). Znachenie udobreniya dlya vinogradnogo kusta i normy udobrenij dlya vinogradnikov v razlichnyh prirodnyh zonah Ukrainy. Odessa, 1:33-36 (in Russian).

Litvinov, P.I., Polyakov, V.I. (1975). Vliyanie orosheniya na razvitie kornevoj sistemy i nadzemnoj chasti vinogradnyh kustov. Vinogradarstvo i Vinodelie, 18:124-130 (in Russian).

Metodicheskie rekomendacii po agrotehnicheskim issledovaniyam v vinogradarstve Ukrainy (2004). Yalta, Institut vinograda i vina Magarach (in Russian).

Sherer, V.A., Zelenyanskaya, N.N. (2011). Osobennosti vinogradnogo rasteniya i metody ocenki pokazatelej organov i tkanej. Odessa, NNC IViV im.V.E.Tairova (in Russian).

Yaroshuk, I.E., Yaroshuk, T.A., Bejbulatov, M.R. (2012). Innovacionnye tehnologii racionalnogo ispolzovaniya vlagi. Kirovograd, KOD (in Russian).

Schreiner, R.P. (2016). Nutrient uptake and distribution in young Pinot noir grapevines over two seasons. American Journal of Enology and Viticulture, 67:436-448.

Wallace, A. (1983). A one decade uptake on chelated metals for supplying micronutrients to groups. Journal of Plant Nutrition, 6:429-438.

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