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EFFECT OF SOIL SURFACE MAINTENANCE METHODS ON THE YIELD AND QUALITY OF GRAPES OF THE VELIKA VARIETY

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Abstract

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During the period 2009-2012 was carried out research on the yield and quality of grapes of the Velika variety, depending on the method of maintaining the soil surface. Application of manure and mulching with straw for a few years leads to an increase in the productivity of grapevines, which is due to an intensified mineralization of the organic mass by microorganisms in the soil (ammonifying, nitrifying bacteria, etc.). In terms of yield, the plantation grown by organic farming is no worse than that grown by conventional technology. The factors which characterize the yield of grapes (number of bunches of grapes, weight of bunches and berries) in the case of grapevines grown in natural grass stand conditions are good. The percentage of developed buds, the weight of bunches and berries, the shape, the firmness of bunches and coloration of the skins of the berries are all better expressed in those originating from knots compared to those from fruiting canes. This is an indication that the percentage of Extra class grapes would be higher if loading is limited to two buds per knot at the time of pruning. The quality of grapes of the Velika variety is directly dependent on the loading of vines. On restricting the number of bunches to 8-10 per grapevine the yield obtained is 10990-12470 $kg.ha^{-1}$, containing 150-160 $g.kg^{-1}$ sugars and above 800 $g.kg^{-1}$ of it Extra class grapes. Increasing the load to 11-20 bunches per grapevine leads to an increase in the yield to reach 20 tons per hectare, but the quantity of "Extra" class grapes drops down to 12-14 $g.kg^{-1}$.

Key words: vine, cultivar, yield, mulching of soil surface

Introduction

It is quite difficult to determine the influence soil has on the yield and quality of grapes since it interlaces with the dependence on the variety, the rootstock and the complex impact of climate (Stoev, 1981). However, there is no doubt that the water and nutritional regime in rolling and plain localities has an effect on the quality of grapes (Stoev, 1960; Winkler, 1966; Branas, 1978; Babrikov et al., 2000; Reynier, 2000)

In biological agriculture a number of measures are applied, such as usage of green manure, compost of organic fertilizer, straw, peat, dust of rotten wood, household and plant scraps, turfs, garden soil, etc. in order to achieve and maintain soil fertility, as well as the required nutritional regime (Henatsch, 2000; Braikov et al., 2006).

Proper soil tillage creates favourable conditions for occurrence of appropriate biological processes and availability of nutrients in readily absorbable form, as well as for reduction of weeds and maintaining a sustainable fertility.

The aim of this study was to establish an appropriate and effective method of maintaining the soil surface in the process of organic table grapes production.

Material and Methods

Subject of the research was the variety Velika obtained through self-pollination (inbreeding) of hybrid 3/23. Hybrid 3/23 was created by Bolgar x Alfons Lavele varieties cross-breeding. In recent years, this variety gained popularity thanks to its large-sized berries and bunches, its transportability and storage durability. To achieve the research objective the flowing schemes of experimental work were established:

First experiment

Vo – Blank (conventional plant growing – application of mineral fertilizers [Basifertil - N:P:K 12:10:16 - 50 kg/da] and maintenance of weed-free soil surface)

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V_1 – Mulching of soil surface with straw – 20 t per ha.
V_2 – Grassy soil surface
V_3 – Application of manure – 60 t per ha.

Second experiment with restricting the number of bunches

The following scheme of loading with bunches of grapes was applied to the vines of the blank (V_0) and the vines fertilized with manure (V_3):

V_1 – 5 bunches, **V_2** – 8 ; V_3 – 11 bunches and **V_4** – 14 bunches.

The experiment consisted of three replicas, 10 vines each.

Protection of the plants from diseases and pests

No banned synthetic plant protection agents are to be used in case of plants grown by the organic farming system.

For the plants grown by conventional methods, the following agents were used:

- Fungicides - Dimethomorph + Copper oxychloride – 2 g.kg^{-1}, Kresoxim-methyl – 0.5 g.kg^{-1}, Folpet + Triadimenol – 2 g.kg^{-1}, Simoksanil + Trifloxystrobin –1.2 g.kg^{-1}, Metiram + Pyraclostrobin – 1.5 g.kg^{-1}
- Insecticides – Bifenthrin – 0.3 g.kg^{-1}, Dimethoate – 1.5 g.kg^{-1}

For the plants grown by organic farming methods, the following measures were applied:

- Fungicides – Copper sulphate – 1 g.kg^{-1} + Sulfur – 3 g.kg^{-1}
- Pests control – pheromone traps and dispensers.

In 2009 there were 8 treatments, in 2010 - 13 and in 2011 - 6.

The obtained data is mathematically processed with SPSS program and for establishing the differences between the tested variants was used the Duncan test in the least significant difference (LSD) – 0.05 – 5%.

Results and Discussion

There were insignificant divergences in bud proliferation between the different soil surface maintenance methods (Table 1). This is explained by the fact that during the first year from starting the experiment the various factors have not exerted any influence yet. A faint tendency toward an increase in the fertility factors could be observed with the vines that had grassy inter-row space and were fertilized with manure - V_1 and V_3, where the largest number of shoots bearing two bunches of grapes was ascertained. The fertility coefficient of replacing buds was very low (Table 1).

The percentage of developed buds in all versions was high – ranging from 765.1 g.kg^{-1} in V_1 to 816.0 g.kg^{-1} in V_2. The differences among the individual versions were insignificant.

Table 1
Actual bud fertility

Variant	Year	Developed buds, g.kg^{-1}			Fruit shoots, g.kg^{-1}	Fertility Rate (FR)			FR of one leading shoot	FR of one Replacement shoot	FR of one fruit shoot	Fruit shoots with, g.kg^{-1}	
		Spurs	Fruit cane	Average		Spur	Fruit cane	Average				1	2
												Cluster	Clusters
V_0	2009	779	709	744.0	565.0	0.58	0.62	0.60	0.61	0.38	1.06	873.0	127.0
	2010	962	800	881.0	804.8	0.73	0.80	0.77	0.80	0.00	0.80	727.2	272.8
	2011	917	652	784.5	697.0	0.80	1.10	0.95	0.92	0.00	1.32	671.0	329.0
	Average	886	720.3	803.1	688.9	0.70	0.84	0.77	0.78	0.13	1.06	757.1	242.9
V_1	2009	836	589	712.5	586.0	0.62	0.77	0.68	0.50	0.00	1.14	847.0	153.0
	2010	896	750	823.0	658.5	0.63	0.83	0.73	1.00	0.00	1.16	585.8	201.5
	2011	930	590	760.0	717.0	1.02	0.92	0.97	0.99	0.00	1.19	618.0	312.0
	Average	887.3	643	765.1	653.8	0.75	0.84	0.79	0.83	0.00	1.16	683.6	222.1
V_2	2009	813	777	795.0	640.0	0.65	0.93	0.79	0.80	0.25	1.21	790.0	210.0
	2010	931	762	846.5	804.8	0.72	0.91	0.82	1.07	0.00	1.02	666.7	333.3
	2011	958	667	812.5	726.0	0.95	0.90	0.93	0.93	0.00	1.29	707.0	293.0
	Average	900.7	735.3	818.0	723.6	0.77	0.91	0.85	0.93	0.08	1.17	721.2	278.8
V_3	2009	764	698	731.0	726.0	0.84	0.89	0.87	0.87	0.00	1.16	820.0	180.0
	2010	893	800	846.5	878.0	0.70	0.93	0.82	1.00	0.00	1.13	694.4	305.6
	2011	901	780	840.5	850.0	0.76	0.91	0.84	0.96	0.00	1.27	673.0	327.0
	Average	852.7	759.3	806.0	818.0	0.77	0.91	0.84	0.94	0.00	1.18	729.1	270.9

In 2010, the grapevines had a somewhat higher fertility in all trial versions. The fertility factor slightly increased with vines grown in plots with grassed inter-row space (V_2) and those manured (V_3). No significant differences were observed in terms of the average number of bunches of grapes per 1 leading, 1 replacing and 1 fruit-bearing spring which could be attributable to the method of keeping the soil surface and the plant protection measures applied. The yield of grapes from the alternative versions was within the range from 6,50 kg to 7,61 kg per vine (Table 2). The highest yield of grapes was

Table 2
Quantitative changes in the yield of grapes

V-t	Year	Average yield per vine, kg				Average yield, kg.ha^{-1}	Average cluster weight, g				Average weight of 100 berries, G
		Spur	Fruit cane	Total	Lsd		Spur	Fruit cane	Average	Lsd	
V_0	2009	4.2	2.80	7.00 *	0.44	19390	404	359	381*	0.03	1155
	2010	4.32	3.38	7.70 **	0.38	21320	445	396	420**	0.05	1434
	2011	4.17	3.93	8.10 **	0.75	22430	449	427	438***	0.44	1040
	Average	4.23	3.37	7.33		21040	432	394	413		1209
V_1	2009	3.90	2.00	5.90 *	0.44	16340	444	300	368*	0.03	1068
	2010	4.00	2.60	6.60 *	0.38	18280	356	350	353*	0.05	1036
	2011	4.30	2.70	7.00 *	0.75	19390	384	359	371*	0.44	1020
	Average	4.06	2.43	6.50		18000	395	336	364		1041
V_2	2009	3.70	2.30	6.00 *	0.44	16620	415	361	388*	0.03	0.968
	2010	4.00	2.98	6.80 *	0.38	18830	430	380	405**	0.05	1281
	2011	4.15	2.75	6.90 *	0.75	19110	397	363	380*	0.44	0.990
	Average	3.95	2.68	6.66		18180	414	368	391		1.079
V_3	2009	4.15	3.00	7.15 **	0.44	19800	448	340	394**	0.03	1163
	2010	4.40	3.10	7.50 **	0.38	20770	425	395	410**	0.05	1400
	2011	4.35	3.85	8.20 **	0.75	22710	440	390	415**	0.44	1027
	Average	4.30	3.31	7.61		21090	438	406	412		1197

Table 3
Mechanical and chemical analyses of grapes, Velika cultivar

		Cluster								Berries	
Variant	Year	Rachis, g.kg^{-1}	Berries, g.kg^{-1}	Rotten, g.kg^{-1}	Shot berries, g.kg^{-1}	Raisined berries. g.kg^{-1}	Skins, g.kg^{-1}	Seeds, g.kg^{-1}	Flesh, g.kg^{-1}	Number of seeds in 100 berries	Average weight of 100 berries
V_0	2009	18.0	982.0	1.0	17.2	-	31.0	26.0	943.0	73	8.20
	2010	13.0	987.0	-	8.1	3.7	16.3	58.5	925.2	280	23.30
	2011	14.5	985.5	-	4.5	0.2	22.0	21.5	956.5	120	14.80
	Average	15.2	984.8	0.3	9.9	1.3	23.1	35.3	941.6	158	15.43
V_1	2009	9.0	991.0	-	25.0	2.6	45.0	14.0	941.0	100	8.00
	2010	15.0	985.0	-	1.3	2.7	24.9	78.5	896.6	340	27.10
	2011	12.9	987.1	-	10.5	-	37.0	17.2	945.8	90	8.40
	Average	12.3	987.7	-	12.2	01.8	35.6	3.7	927.8	177	14.5
V_2	2009	14.0	986.0	-	31.0	26.0	40.0	29.0	931.0	120	11.00
	2010	12.0	988.0	-	19.2	16.8	24.0	47.3	928.7	260	20.2
	2011	12.6	987.4	-	9.6	-	39.0	20.0	941.0	170	15.3
	Average	12.9	987.1	-	19.9	14.3	34.3	32.1	933.6	183	15.5
V_3	2009	11.0	989.0	-	15.0	14.9	49.0	24.0	927.0	130	13.00
	2010	11.0	989.0	-	15.6	7.5	19.5	49.7	930.8	250	23.4
	2011	10.9	989.1	-	14.8	6.5	21.5	37.0	941.5	235	19.8
	Average	11.0	989.0	-	15.1	9.6	30	36.9	933.1	205	18.7

achieved with V_3. The differences between versions V_1 and V_2 proved to be in favour of the blank. In all of them most of the yield came from the knots. The average weight of the bunches ranged in the same order of succession. The grape clusters of highest mass were these of V_0, while the smallest clusters were those of V_1. The average mass of grapes from knots in all trial versions was higher than that from fruiting canes. The bunches of grapes from fruiting canes were looser and had unequally sized berries, particularly in their upper part.

The average weight of a bunch of grapes and of 100 berries from the vines fertilized with manure was inferior to that in the blank version since the number of bunches of grapes was greater by 4 (Table 2).

The percentage of berries was very high in all trial versions, ranging from 98,48 to 98,90% (Table 3). Rotten berries accounted for 0.3-1.0 g.kg-1 in V_0, shot berries (Millerandage) were 9.9 $g.kg^{-1}$ – 19.9 $g.kg^{-1}$, while dried berries accounted for 1.3 $g.kg^{-1}$ - 14.3 $g.kg^{-1}$. Fruit flesh ranged from 927.8 $g.kg^{-1}$ in

Table 4
Grape quality (Standard B-19)

Variant / Year	Extra quality, $g.kg^{-1}$		First quality, $g.kg^{-1}$		Second quality, $g.kg^{-1}$	
	2010	2011	2010	2011	2010	2011
V0	290	250	520	540	190	210
V1	190	140	450	460	360	400
V2	130	120	390	430	480	4500
V3	350	280	490	480	160	240

Table 5
Quantitative changes in the yield of grapes

Clusters per vine	Variant	Average yield per vine, kg		Average yield, $kg.ha^{-1}$	Average cluster weight, g		Average weight per 100 berries, g
5	V_0	3.02	0.799 4.005	8370	605 NS	0.159 0.800	890
	V_3	2.85	40.05	7895	570 NS	8.000	802
8	V_0	4.43	1.050 5.250	12270	554 NS	0.131 0.656	1200
	V_3	3.97	52.59	10990	496 NS	6.567	1050
11	V_0	4.60	0.686 3.428	12740	418 NS	5.984 0.299	870
	V_3	4.40	34.38	12180	400 NS	2.997	845
14	V_0	5.52	2.283 11.43 114.3	15290	395 NS	0.164 0.824 8.245	940

Statistical reliability of the differences * P<0.05, **P<0.01, ***P<0.001, NS- Unproven differences

Table 6
Grapes quality from the variant with different bud loading (Standard B-19)

Clusters per vine	V-t	Extra quality, $g.kg^{-1}$	First quality, $g.kg^{-1}$	Second quality, $g.kg^{-1}$
5	V_0	880	90	30
	V_3	860	120	20
8	V_0	840	70	90
	V_3	810	150	40
11	V_0	680	210	110
	V_3	630	200	170
14	V_0	430	380	190
	V_3	390	460	150

V_1 to 941.6 g.kg^{-1} in V_0, fruit skin – 23.1 g.kg^{-1} and 35.6 g.kg^{-1} for V_0 and V_1 respectively. Mechanical analysis showed that berries had fleshy consistency and thick but tender fruit skin. The grapes of first class prevailed in quantity (Table 4).

The portion of Extra class superior quality grapes was comparatively small, ranging within 120 g.kg^{-1}-130 g.kg^{-1} for V_2, 140 g.kg^{-1}-190 g.kg^{-1} for V_1, 250 g.kg^{-1}-290 g.kg^{-1} for V_0 and the highest 280 g.kg^{-1}-350 g.kg^{-1} for V_3. The main reason for the relatively small percentage of Extra class grapes was that the grapevines were overloaded. This variety is very susceptible to overloading, which has a negative impact on both the mass of berries and of grape clusters, as well as on the general appearance of the produce and its presentation in package. This necessitated starting a detached experiment applying differentiated restriction on the number of bunches.

The scheme applied for differentiated loading of the vines with 5, 8, 11 and 14 bunches proved to be efficient. The results obtained (Table 5) show that with increase of the load on vines the yield of grapes increased from 3,02 – 2,85 kg per grapevine for V_0 and V_3 to 5,52 kg -5,30 kg for V_0 and V_3 respectively.

The increase in yield was not an aliquot of the increase in the number of bunches. With all trial versions the yield mass in the blank version was slightly higher compared to that from the grapevines fertilized with manure. Apparently, the grapevines fertilized with synthetic compounds enjoyed a better nutritional regime. The weight and size of bunches of grapes and of 100 berries normally decreased with the increase of load in both plantations (Table 5).

From 810 to 880 g.kg^{-1} of the grapes in the versions loaded with 4 and 8 bunches belonged to the Extra quality class (Table 6). It was also ascertained that the percentage of berries was very high for a table grape variety, there were no rotten berries, millerandage was in the range of 5.1 – 31.6 g.kg^{-1}, dried berries 0.2 – 2.2 g.kg^{-1}. Fruit skins and seeds accounted for less than 15 g.kg^{-1}, which meant that fruit flesh was over 980 g.kg^{-1}. In all versions, grapes were picked in compliance with the requirements of B-19 standard.

The results obtained from the conducted study showed that the optimum loading for the Velika variety of grapes grown under the conditions prevailing near the village of Nayden Gerovo was 8-10 grape clusters per vine thus achieving a yield of 10990-12270 kg of grapes per hectare. The quality of the grapes in the versions with 11 and 14 bunches of grapes per vine dropped drastically.

Conclusions

Application of manure and mulching with straw for a few years leads to an increase in the productivity of grapevines, which is due to an intensified mineralization of the organic mass by microorganisms in the soil (ammonifying, nitrifying bacteria, etc.).

In terms of yield, the plantation grown by organic farming is no worse than that grown by conventional technology. The factors which characterize the yield of grapes (number of bunches of grapes, weight of bunches and berries) in the case of grapevines grown in natural grass stand conditions are good. The percentage of developed buds, the weight of bunches and berries, the shape, the firmness of bunches and coloration of the skins of the berries are all better expressed in those originating from knots compared to those from fruiting canes. This is an indication that the percentage of Extra class grapes would be higher if loading is limited to two buds per knot at the time of pruning.

The quality of grapes of the Velika variety is directly dependent on the loading of vines. On restricting the number of bunches to 8-10 per grapevine the yield obtained is 10990-12470 kg.ha^{-1}, containing 150-160 g.kg^{-1} sugars and above 800 g.kg^{-1} of it Extra class grapes. Increasing the load to 11-20 bunches per grapevine leads to an increase in the yield to reach 20 tons per hectare, but the quantity of "Extra" class grapes drops down to 12-14 g.kg^{-1}.

References

Babrikov, D., D. Braykov and Sl. Pandeliev, 2000. Viticulture and Ampelography. *Videnov & Son Publishing House*, Sofia (Bg).

Braikov, D., S. Karov, A. Trifonov, I. Manolov, R. Andreev and S. Karov (son), 2006. Organic Production of Grapes. Ecofarm Plovdiv (Bg).

Stoev, K., 1960**.** Regionalization of Viticulture in Bulgaria. Scientific works of the Institute of Viticulture & Enology – Pleven, vol. III, Sofia (Bg).

Stoev, K., 1981**.** Grape Physiology and the Production Principles. vol. 1, Sofia, Bulgaria. (Bg).

Winkler, A. J., 1966**.** Grape Production. Moscow (Ru).

Branas, J., 1978. Les relations entre la vigne et la système climat sol /I Symposium international sur L'écologie de la vigne/, Constanta (Fr).

Henatsch, Ch., 2000. "Organic farming needs biological cultivation" – a network for independent seed production. IFOAM 2000- The World Grows Organic. Proceedings 13th IFOAM Conference, 28 to 31 August 2000 Convention Center Basel, pp. 542-545 (Ch).

Reynier, A., 2000. Manuel de viticulture. Edutions TEC & DOC. Paris. (Fr)

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