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DEVELOPMENT OF THE VINEYARD CULTIVATION SCHEME FOR THE KAKHETI REGION USING MODERN TECHNOLOGIES.

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SUMMARY
Kakheti is mainly a viticulture-winemaking region, the vineyard areas are growing intensively here. A farmer builds a vineyard according to his opinion without any research, which caused
to a reduction of Harvest, All this was reflected in the quality of the grapes and the wine. The reduction in yield was followed by a change in agro-technological measures, deteriorating agro-technological measures led to a reduction in the quality of grapes and wine.
In the paper is discussed different schemes of vineyard cultivation, among them has been selected a completer and more cost-effective scheme. The vine feeding area is defined in each scheme, nutrient absorption intensity, is also were determined the chemical composition and growth intensity of the vine shoot in each variant. In the paper was investigated the chemical and mineralogical composition of the obtained grapes. Was made the Wine from grapes obtained from all variants and were determined its chemical composition and quality.
The better options for growing vines was allocated and after that was issued recommendations about the vine cultivation scheme.

Kakheti is the main region of classical viticulture and winemaking in Georgia, where are more than 65-70% of the country's vine eyards and 75-80% of the produced wine are concentrated there.
There is mainly represented the field of viticulture In Kakheti region, many of industrial or table grape varieties seedlings are mainly grown in this region and their is implemented modern agro-technological measures.
The based on market relations, to establish itself in the world market of competitive wine and spirits, new vineyards are being planted in Kakheti region at a fast pace,
The area of vineyards in Kakheti is 33,582 hectares
A farmer builds a vineyard according to his opinion without any research, which caused
to a reduction of Harvest, All this was reflected in the quality of the grapes and the wine.
The aim of our research was to develop a vineyard cultivation scheme based on scientific research.
The aim of our research was to develop a scheme for planting a vineyard based on scientific studies.
For this purpose, the following scheme was developed for planting one hectare vineyard on the research plot of land of TESAU: We selected the industrial varieties spread in Kakheti region such as Rkatsiteli, Kakhuri Mtsvane, Saperavi, Kisi, Khikhvi. For each variety we used the variants with a distance of 2,5 meters between the rows and 2 meters, 1.5 meters and 1,25 meters between the plants. For each variant we used 2 rows. The research was being carried out for 3 years. It started in spring 2019 and finished in autumn 2021.

Table N1

Vine variety	Number of rows	The distance between the rows is meters	The distance between the plants in the queue is meters	Number of plants in one row of pieces	Total number of plants in a row
Rkatsiteli	2	2.5	2.00	50	100
	2	2,5	1.50	66	132
	2	2,5	1.25	80	160
Saperavi	2	2.5	2.00	50	100
	2	2,5	1.50	66	132
	2	2,5	1.25	80	160
Kakhuri mcvane	2	2.5	2.00	50	100
	2	2,5	1.50	66	132
	2	2,5	1.25	80	160

Khikhvi	2	2.5	2.00	50	100
	2	2,5	1.50	66	132
	2	2,5	1.25	80	160
Qisi	2	2.5	2.00	50	100
	2	2,5	1.50	66	132
	2	2,5	1.25	80	160

We took soil samples from each variant in the planted vineyard and determined the phosphorus and potassium content in it, as well as the soil acidity in each row.
In September we took soil samples from each variant and conducted a chemical analysis to determine the amount of nutrients consumed by the grape vine varieties grown according to different schemes. We also determined the height and thickness of the sprout and the amount of the starch accumulated. According to this, we drew conclusions as to which variant is acceptable for growing the industrial vine from the given scheme

Table N2 shows the results of the chemical analysis of the samples taken from each variant.
Table N2

Vine variety	**Cultivation scheme**	Data before the onset of vine seedling vegetation			Data after completion of vine seedling vegetation			Starch content of vine horn in%
		P_2O_5	K_2O	PH	P_2O_5	K_2O	PH	
Rkatsiteli	2.0	2,5	35,0	7,3	2,0	9,0	7,3	22,0
	1.5	2,5	35,0	7,3	1,7	7,0	7,3	22,0
	1.25	2,5	35,0	7,3	0,5	4,0	7,3	16,0
Saperavi	2.0	3,0	28,0	7,3	2,5	8,0	7,3	19,0
	1.5	3,0	28,0	7,3	2,0	7,0	7,3	21,0
	1.25	2,8	28,0	7,3	1,8	5,0	7,3	19,0
Kakhuri mcvane	2.0	2,5	30,0	7,3	2,0	8,0	7,3	16,0
	1.5	2,5	30,0	7,3	1,4	6,0	7,3	19,0
	1.25	2,5	30,0	7,3	0,8	7,0	7,3	13,0
Khikhvi	2.0	1,8	27,0	7,3	1,5	9,0	7,3	19,5
	1.5	1,8	27,0	7,3	1,1	7,0	7,3	21,0
	1.25	1,5	27,0	7,3	0,7	5,0	7,3	13,6
Qisi	2.0	2,8	31,0	7,3	2,1	9,0	7,3	18,0
	1.5	2,8	31,0	7,3	1,7	8,0	7,3	19,5
	1.25	2,8	31,0	7,3	0,7	6,0	7,3	12,5

From the chemical analysis of the soil it is clear that at a distance of 1,50m between the young plants, the plant absorbs the maximum amount of nutrients, so that the soil is not left impoverished. At a distance of 2, 0 m, the nutrient area of each young plant is so large that the nutrients remain in the soil unabsorbed, which means that such nutrient area for the plant is not recommended because the plant is fed with extra consumption. As for the plant at a distance of 1.25 m, the nutrient area is small and the plant absorbs the maximum amount of nutrients at this time so that the soil is left very impoverished, which of course is an undesirable process for the soil. At a distance of 1.5 m the plant is sufficiently provided with the nutrients, moisture and soil air. We got a better result during the determination of the chemical composition of the vine itself in case of a distance by 1.5 m. The vine sprout contains more starch if the distance between the plants is 1.5 m.
Strong hail and wind occurred in August 2020 significantly damaged the young vineyard. Unfortunately the storm hindered the research because it destroyed the grown crop. We examined the bunch of grapes and its juice but we could not manage to produce proper wine materials because of the destruction of the crop. The research lasted for another two years, so we had a full harvest and then determined the chemical composition of the grape juice. We will also study the chemical composition of the wine produced from these varieties.
After harvesting we studied the bunch of grapes of each variety and the juice extracted from it. We also studied its mineralogical and vitamin composition.
The mechanical composition of the bunch of vine varieties is presented in the table N 3

Table N3

Vine variety	Cultivation scheme	Average size of the bunch (cm).	Average weight of the bunch (In gram)	Average yield per root (kg)	Juice and pulp %	Average yield per row (In kg)
Rkatsiteli	2.0	16x8	168	2.15	80,5	107.5
	1.5	16x8	168	2.15	80,5	141.9
	1.25	14x7	160	1.37	60,7	109.6
Saperavi	2.0	12x20	149	1.2	74,8	60.0
	1.5	12x20	149	1.2	74.8	79.2
	1.25	10x18	138	9.01	72.9	72.08
Kakhuri mcvane	2.0	14x10.5	158	0.9	76.6	45.0
	1.5	14x10	158	0.9	76.8	59.4
	1.25	12x9.6	150	0.67	73.8	53.6
Khikhvi	2.0	16,5x8	136	1.6	78.3	80.0
	1.5	16x8	136	1.54	78.4	101.64
	1.25	14,7x8	131	1.24	76.8	99.2
Qisi	2.0	1.75x1.54	158	1.85	80.02	92.5
	1.5	1.74x1.54	156	1.8	80	118.8
	1.25	1.68x1.47	143	1.46	76	116.8

Research showed that at distances of 2 meters and 1.5 meters the results are almost the same but we should take it into consideration that at a distance of 2 meters we get less harvest in each row, although the consumption is the same. In addition to the chemical analysis of the soil we determined the content of mineral substances in the bunch of grapes according to different varieties The mineralogical composition of different varieties of grapes is given in Table N4

TableN4

Vine variety	Cultivation scheme	K_2O g/l	CaO g/l	P_2O_5 g/l	MgO g/l
Rkatsiteli	2.0	1,570	0,20	1,22	0,10
	1.5	1,570	0,20	1,22	0,10
	1.25	1,343	0,20	1.02	0,10
Saperavi	2.0	1,630	0,10	1,31	0,07
	1.5	1,630	0,20	1,31	0,07
	1.25	1,465	0,20	1,11	0,07
Kakhuri mcvane	2.0	1,700	0,10	1,33	0,09
	1.5	1,700	0,20	1,33	0,09
	1.25	1,567	0,20	1,03	0,09
Khikhvi	2.0	1,670	0,20	1,36	0,11
	1.5	1,670	0,20	1,36	0,11
	1.25	1,514	0,20	1.00	0,11
Qisi	2.0	1,490	0,20	1,30	0,08
	1.5	1,490	0,20	1,30	0,08
	1.25	1,431	0,20	1,1	0,08

From the table it can be seen that during 1.5 variants more minerals were absorbed by the plant and it is guarantees the high quality of the wine.

The composition of organic acids (tartaric acid, malic acid) was determined in the grape juice wich we have picked.

Table N5 shows the content of organic acids (tartaric acid, malic acid) in grape juice in g / kg:

Table N5

Vine variety	Cultivation scheme	The sum of organic acids	Tartaric acid	Malic acid	vitamin B_1	vitamin B_2	vitamin C	vitamin E	Carotene
Rkatsiteli	2.0	3,66	3,01	0,65	0,185	0,07	6,71	1,76	1,44
	1.5	3,66	3.01	0,65	0,185	0,07	6,71	1,76	1,44
	1.25	3,86	3,21	0,65	0,185	0,07	6,71	1,76	1,44
Saperavi	2.0	4,46	2,48	1,98	0,156	0,122	6,06	1,40	0,87
	1.5	4,46	2,48	1,98	0,156	0,122	6,06	1,40	0,87
	1.25	4,54	2,56	1,98	0,156	0,122	6,06	1,40	0,87
Kakhuri mcvane	2.0	3,17	2,68	0.49	0,126	0,142	6,28	1,161	1,68
	1.5	3,17	2,68	0.49	0,126	0,142	6,28	1,161	1,68
	1.25	3,45	2,96	0.49	0,126	0,142	6,28	1,161	1,68
Khikhvi	2.0	5,08	3,66	1,42	0,126	0,133	6,81	1,78	1,07
	1.5	5,08	3,66	1,42	0,126	0,133	6,81	1,78	1,07
	1.25	5,40	3,98	1,42	0,126	0,133	6,81	1,78	1,07
Qisi	2.0	2,81	2,07	0,74	0,144	0,110	6,01	1,09	1,03
	1.5	2,81	2,07	0,74	0,144	0,110	6,01	1,09	1,03
	1.25	2,92	2,18	0,74	0,144	0,110	6,01	1,09	1,03

The chemical and mineralogical composition of grape juice is the same in all variants because the agro-technological measures are the same for all variants. Obtained grapes are highly valued for their chemical and vitamin composition, characterized by the best flavor.

It is a well-known expression that the quality of wine is decided in the vineyard, which is mainly determined by the quality of the grapes obtained. The main indicators of grape quality are sugar content, acidity and their ratio (glucoacidimetric index); These are presented in Table N 6:

Table N6

Vine variety	Cultivation scheme	Sugar content G / l	Acidity G / l	Glucoacidimetric index
Rkatsiteli	2.0	24,2	7,1	3,5
	1.5	23,2	7,6	3,05
	1.25	21,2	7,9	2,7
Saperavi	2.0	23,8	6,4	3,7
	1.5	23,4	6,2	3,8
	1.25	20,8	5,8	3,6
Kakhuri mcvane	2.0	23,6	6,7	3,5
	1.5	23,5	6,4	3,6
	1.25	21,4	6,0	3,5
Khikhvi	2.0	20,6	7,8	2,6
	1.5	19,6	8,3	2,4
	1.25	17,4	8,9	2,0
Qisi	2.0	23,8	6,6	3,6
	1.5	23,5	6,3	3,7
	1.25	21,5	5,8	3,7

Due to the damage caused by the disaster, we only produced wine for the 2021 harvest. The chemical composition of the obtained wine is given in Table N 7

Table N7

The tape of wine	Cultivation scheme	Alcohol g / l	Sugar g / l	Titular Acidity G / l	Akroladi Acidity G / l	Common Sulfur Anhydride SO_2 Mg / l	Free Sulfur Anhydride SO_2 Mg / l	Iron mg / l	Extract g / l
Rkatsiteli	2.0	11,3	2,3	4,4	1,02	57,0	10,0	2,3	17,5
	1.5	11,8	1,9	5,4	1,00	57.0	10.1	2,2	17,5
	1.25	11,0	1,9	5,4	1,00	57.0	10,1	2,2	17,5
Saperavi Gvinis citeli	2.0	11,4	2,0	4,8	0,9	58.0	10.3	2,3	16,5
	1.5	11,4	2,1	4,8	0,9	58.0	10,3	2,3	16,5
	1.25	11,4	2,1	4,8	0,9	58.0	10,3	2,3	16,5
Kakhuri mcvane	2.0	10,9	2,4	4.0	0.87	56,0	10,0	3,8	16.3
	1.5	10,9	2,4	4,0	0,87	56,0	10,0	3,8	16,3
	1.25	10,9	2,4	4,0	0,87	56,0	10,0	3,7	16,3
KhiKhvi	2.0	11,5	2,2	4,6	0,92	56,0	10,0	3,3	16,9
	1.5	11,5	2,2	4,6	0,92	56,0	10.0	3,3	16,9
	1.25	11,5	2,2	4,6	0,92	56,0	10,0	3,3	16,9
Qisi	2.0	11,0	2,6	4.0	0.88	54,8	9,8	3,0	16,7
	1.5	11,0	2,6	4,0	0,88	54,8	9,8	3,0	16,7
	1.25	11,0	2,6	4,0	0,88	54,8	9,8	3,0	16,7

CONCLUSION:

The difference between the variants is not noticeable during the chemical research of the wine, but the quantity of the crop and the condition of the soil are important.

We summarized the three-year data and determined the three-year average.

A three-years research has shown that the best option for cultivating a vineyard is 2.5 meters between rows, 1.5 meters between plants.