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THE EFFECTS OF DIFFERENT GROWING SYSTEMS ON THE YIELD AND QUALITY OF CURRANT CULTIVATION

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Abstract

In this study, two different currants varieties ('Rosenthal' and 'Red Lake') were investigated. The row spacing, number of branches and pruning practices has been evaluated in terms of their effects on yield and quality of the varieties. For this purpose, during three-year period (2014-2016) it were made three applications to black currant: the distance between rows and plants in the row 2.0 x 1.2 m, 2.0 x 1.5 m and 2.0 x 2.0 m, training bushes as 1, 3 and 5 branches per plants. In this application as well as other parts of plants, the pruning performed by keeping a part allowed pruning old shoots. Different biochemical, phenological and pomological properties have been evaluated too.

Key words**:** *currant, 'Rosenthal', 'Red Lake', fruit, yield, Uşak.*

INTRODUCTION

Many of the plant species used as berries are naturally grown in Turkey. These berries are rich in vitamins and minerals, also important for human health and their use in the food sector is increasing (Karaer and Adak, 2006). One of the well-known families with berries is Grossulariaceae.

The leaves of the currants are round, 3-5 slices, quite broad (about 12 cm) and have short shoots. The flowers are greenish, greenish-brown. The male organs are shorter than the bowl leaves all around. The bowl leaves are red-pointed and bowl shaped. Flowering in our country (Turkey) corresponds to April-May. The plant can reach up to 2 m in height (Islam, 2010).

The flower buds of the red currants are longer than the flower buds of the black currants. Bees or other insects are the main pollinators of currants. The pollen of most blackcurrants is spread from anthers between 2:00 and 6:00 am, so most pollination occurs during the day.

Currants are rich in organic matter, have a high water holding capacity, are well ventilated and grow well in soil with a pH ranging between 5.5 to 7.0 (Hummer and Dale, 2010). Choosing a place to grow a healthy plant is one of the most important factors. For good yield, plants should be planted in good sunlight areas. Cultivation techniques, such as fertilization and irrigation, must be performed in the canopy areas, on the northern slopes of the land, or in higher altitude areas (Barney and Hummer, 2005).

The natural value for the production of currant juice, fruit juice and other beverage products is considered high raw material. Fruits are preferred because of their sensory qualities such as color, taste and taste (Píry et al., 1995; Brennan et al., 2003).

The berry is also suitable for freezing and storage at the same time. In addition, it is made from fruit concentrates; jams, pastries and pies, ice cream, flavored mineral water and sugar for children. Cream, liqueur and white wine are made from the fruits in various countries (Brennan, 1996). In Sweden, 40% of the currant's production is used in the production of vodka and local alcoholic beverages, most of which is fresh on the market (Brennan, 2008).

The objective of this study is to establish a closed garden as an alternative fruit of nursery growing naturally in our country, to carry out different cultivation practices and to find the most suitable planting system.

MATERIALS AND METHODS

This study was carried out in a private enterprise farm in Sivaslı-Usak between 2014-2016. The altitude of the experimental area is

1044 m and the coordinates are 38° 29' 15.75' 'North and 29° 42' 16.53 " East. Soil samples were taken from 0-30 and 30-60 cm depths on 15.03.2014 for the physical and chemical analyzes of the test soil.

Soil analysis was carried out at the laboratory of Suleyman Demirel University, Faculty of Agriculture, Soil Department. The analysis results are given in Table 1.

In the study, one year old plants of 'Red Lake' (red currant variety) and 'Rosenthal' (black currant variety) were used. Currants were planted on April 15, 2014 in accordance with the design of the trial. Trial 3 was set up as a repeater.

In each experimental plot, 9 plants were evaluated and 3 plants were evaluated as 1 replicate.

Table 1. Physical and chemical soil properties of the trial area (2014)

Soil properties		Soil depth		Evaluation
		0-30 cm	30-60 cm	
Physical analysis	Sand (%)	67	72	Sandy loamy
	Plate (%)	19	12	
	Clay (%)	14	16	
	Salt (mmhos/cm)	140.8	129.8	Without salt
	pH	7.95	7.94	Light alkali
	Lime (%)	34.23	39.9	
Chemical analysis	Organic matter (%)	2.28	1.68	
	Nitrogen (ppm)	1142	839.68	
	Phosphorus (ppm)	8.97	0.79	
	Potassium (ppm)	128.4	82.2	
	Calcium (ppm)	4078.6	2453.4	
	Magnesium (ppm)	60.94	39.16	
	Iron (ppm)	2.74	2.77	
	Copper (ppm)	0.45	0.44	
	Mangan (ppm)	4.75	4.13	
	Zinc (ppm)	0.47	0.29	

The first objective of the experiment is the evaluation of the effect on the yield and quality of the different spacing distance. For this purpose, the varieties were planted on 15.04.2014 as 2 m x 2 m, 1.5 m x 2 m and 1.2 m x 2 m modules. In the same day, the drip irrigation system was installed in the trial area. Another aspect of the experiment was directed to the effect on yield and quality of different number of branches per plant: 1, 3 and 5. The last approach of the experiment was the effect of pruning on the yield and quality of the currant fruits. In this regard, the old branches of the plants were pruned and the new branches bear fruits, while the young shoots of the other half were pruned and the fruits were picked from the old branches.

In terms of plant characteristics of the varieties of currants; Shoot diameter (mm) and shoot length (mm), in terms of pomological characteristics; Fruit weight (g), fruit width (mm), fruit length (mm) and yield per plant (g) and some biochemical properties; Soluble solid content (SSC) (%) (%), pH (%) and Titratable acidity (TA) (%) were examined.

RESULTS AND DISCUSSIONS

The diameter and length of the shoots for both varieties are presented in Table 2.

According to the measurements, the maximum shoot diameter in the 'Rosenthal' variety was found to be at 2.0×1.5 m in the planting interval and in the three branches without pruning system as 7.28 mm in average, and in the 'Red Lake' variety was found at 2.0×2.0 m planting interval area and in the three branches without pruning system as 7.40 mm in average.

The shoot length of 'Rosenthal' variety was found to be 2.0×1.5 m in the planting interval and in the single branches with pruning system as 63.02 mm in average, and in the 'Red Lake' variety was found at 2.0×1.5 m planting interval area and in the single branch without pruning system as 44.47 mm in average.

Table 2. Averages of shoot diameters and shoot lengths of varieties in the years 2015-2016

Pruning	Distance (m)	Number of branches	Shoot diameter (mm)		Shoot length (mm)	
			Rosenthal	Red Lake	Rosenthal	Red Lake
Applied	2x1.2	1	6.80±0.12	6.98±0.82	47.29±2.17	42.65±4.85
		3	6.62±0.26	5.87±0.15	49.27±2.13	46.56±6.14
		5	2.48±0.17	6.33±0.26	36.94±3.27	36.77±3.73
	2x1.5	1	6.47±0.63	6.74±0.73	63.02±5.82	41.85±4.15
		3	4.40±0.05	6.63±0.12	46.25±4.16	37.05±2.15
		5	5.76±0.27	6.59±0.48	40.98±6.02	33.59±6.41
	2x2.0	1	6.29±0.13	7.09±0.32	26.55±3.45	44.25±3.25
		3	5.83±0.18	6.56±0.39	32.82±4.88	34.72±7.08
		5	5.95±0.44	6.16±0.11	27.27±3.93	24.77±2.75
Non-Applied	2x1.2	1	6.69±0.31	7.08±0.22	40.47±2.73	38.74±3
		3	6.63±0.17	6.09±0.91	45.90±6.10	37.39±18
		5	6.01±0.19	5.66±0.02	34.60±4.18	28.41±2
	2x1.5	1	6.41±0.12	6.76±1.24	45.10±2.27	44.47±47
		3	7.28±0.83	7.07±0.33	47.33±5.13	43.48±3.46
		5	6.22±0.65	6.67±0.73	43.19±4.19	30.62±1.15
	2x2.0	1	5.98±0.43	6.67±0.26	44.95±7.15	32.68±4.21
		3	6.45±0.71	7.40±0.50	42.97±8.11	42.79±4.65
		5	5.29±0.09	6.47±0.83	24.96±4.93	20.11±2.17

Djordjević et al. (2014) reported an average shoot diameter of 6.5 to 15.1 mm in a study of currants in Belgrade. In another study conducted in Belgrade, it was reported that the average shoot diameters in currants are between 4.73 and 11.60 mm (Milivojević et al., 2010).

The number of bunch, fruit number in bunch and bunch length belonging to the applications in varieties are presented in Table 3.

According to the measurements, the maximum number of bunch in the 'Rosenthal' variety was found to be 2.0×1.2 m in the planting interval and in the five branches without pruning system as 18.84 in average, and maximum number of bunch in the 'Red Lake' variety was found at 2.0×1.5 m planting interval area and in the three branches with pruning system as 56.85 in average. The maximum fruit number of bunch in the 'Rosenthal' variety was found to be 2.0×2.0 m in the planting interval and in the three branches without pruning system as 12.5 in average, the maximum fruit number of bunch in the 'Red Lake' variety was found at 2.0×2.0 m planting interval area and in the three branches with pruning system as 30.6 in average. The maximum bunch length in the 'Rosenthal' variety was found to be 2.0×2.0 m in the planting interval and in the five branches with pruning system as 30.6 in average, the maximum bunch length in the 'Red Lake' variety was found at 2.0×2.0 m planting interval area and in the three branches without pruning system as 94.24 in average.

In a study conducted in Trabzon, it was examined the number of bunches in the currants and the most fruit bunches had 'Jonkheer van Tets' (78.10) and the least fruit bunches are 'Ojebyn' (27.20) and 'Detvan' (25.20) (Çelik, 2012). In an adaptation study conducted in Tokat ecology, it was reported that the number of bunch varieties varied between 1.78-2.47 in one branch (Gerçekçioğlu et al., 2009).

Fruit weight (g), fruit width (mm), fruit length (mm) and yield per plant (g) belonging to the measurements of varieties are presented in Table 4.

Table 3. Number of bunches, number of fruits and average length of bunches in the years 2015-2016 for experimented currant varieties

Pruning	Distance (m)	Number of branches	Number of bunch		Fruit number of bunch		Bunch lenght (mm)	
			Rosenthal	Red Lake	Rosenthal	Red Lake	Rosenthal	Red Lake
Applied	2x1.2	1	5.67±1.25	18.31±2.83	9.90±2.74	28.00±3.16	43.39±4.15	67.65±8.95
		3	10.34±2.48	13.50±1.95	10.00±2.00	18.65±2.74	43.26±5.18	49.85±6.16
		5	18.84±3.16	34.12±3.18	8.65±1.89	30.15±2.18	39.22±4.29	85.94±5.28
	2x1.5	1	5.34±2.18	14.34±1.83	10.10±2.74	26.80±4.86	48.87±3.95	51.30±5.12
		3	11.83±1.78	52.54±5.81	10.20±3.15	28.45±3.26	41.18±3.87	71.01±6.92
		5	17.18±1.45	50.32±4.72	9.35±2.73	28.85±3.16	36.94±5.91	92.67±8.16
	2x2.0	1	4.67±1.90	19.83±3.91	11.23±3.18	26.20±3.91	48.17±2.18	88.45±7.59
		3	10.15±1.25	53.65±4.17	12.15±4.90	27.90±2.85	58.35±4.19	94.24±9.28
		5	19.70±2.15	43.34±4.18	9.04±8.76	28.65±2.45	42.70±6.13	87.38±7.16
Non-Applied	2x1.2	1	5.00±1.00	17.67±3.50	10.40±2.60	29.65±2.67	43.22±5.80	68.79±7.23
		3	15.01±2.00	45.84±7.82	11.72±3.28	28.45±3.16	42.24±2.75	69.63±8.16
		5	18.5±3.48	34.15±9.18	11.30±2.17	29.45±3.71	56.52±7.19	91.57±9.11
	2x1.5	1	5.17±1.82	14.84±5.17	11.60±2.82	28.10±4.85	42.50±8.20	89.47±10.93
		3	12.23±1.39	56.85±12.23	12.30±2.91	30.05±3.76	43.00±4.75	68.67±2.90
		5	17.69±1.82	46.00±4.00	11.61±2.35	29.00±4.00	57.27±9.18	86.53±5.17
	2x2.0	1	8.00±1.50	26.17±8.12	11.20±2.41	29.35±1.91	62.40±6.21	87.56±4.18
		3	9.34±1.23	42.81±3.64	11.75±1.86	30.60±4.18	42.87±4.27	69.50±3.17
		5	15.00±2.08	49.17±5.82	11.05±1.18	27.10±3.19	58.64±6.13	50.69±5.16

Table 4. Average of fruit weight, fruit length and yield per plant for currant varieties (2015-2016)

Pruning	Distance (m)	Number of branches	Fruit weight (g)		Fruit width (mm)		Fruit length (mm)		Yield per plant (g)	
			Rosenthal	Red Lake	Rosenthal	Red Lake	Rosenthal	Red Lake	Rosenthal	Red Lake
Applied	2x1.2	1	0.59±0.02	0.37±0.05	9.91±0.76	8.27±0.22	9.79±0.62	7.77±0.82	32.23±4.16	191.27±15.18
		3	0.70±0.05	0.54±0.02	9.88±0.92	9.54±0.38	9.76±0.54	10.05±0.93	70.47±12.75	173.33±12.17
		5	0.92±0.03	0.46±0.04	9.56±0.62	9.35±0.17	10.16±0.76	8.50±0.54	95.19±14.83	475.13±11.18
	2x1.5	1	0.64±0.05	0.56±0.05	11.16±0.48	9.82±0.26	11.02±0.17	10.34±0.87	35.23±12.18	210.54±27.83
		3	0.54±0.05	0.38±0.02	9.66±0.27	8.74±0.31	9.38±0.98	7.85±0.81	65.34±11.00	571.58±47.20
		5	0.91±0.07	0.55±0.07	12.62±0.18	9.91±0.24	9.88±0.32	9.00±0.18	217.28±19.91	801.62±56.18
	2x2.0	1	0.85±0.05	0.47±0.08	11.31±0.82	9.63±0.92	11.49±1.32	8.75±0.21	40.47±12.83	249.84±14.84
		3	0.40±0.08	0.55±0.06	10.17±0.26	10.08±0.21	8.62±0.87	9.15±0.46	25.54±16.23	817.60±25.19
		5	0.65±0.04	0.47±0.05	9.98±0.46	9.47±0.85	9.63±0.46	8.64±0.89	119.51±13.07	572.83±38.69
Non-Applied	2x1.2	1	0.59±0.06	0.38±0.05	9.87±0.81	8.37±0.18	9.75±0.54	7.90±0.08	30.28±8.15	198.52±26.51
		3	1.23±0.07	0.38±0.04	12.72±0.73	8.51±1.23	12.59±0.39	8.00±0.20	198.92±15.82	483.63±22.94
		5	1.18±0.09	0.54±0.09	12.66±0.19	9.79±0.73	12.72±0.76	8.89±0.19	230.33±26.92	544.41±32.82
	2x1.5	1	0.56±0.08	0.43±0.01	9.70±0.28	8.88±0.86	9.62±0.65	8.28±0.58	34.70±7.16	179.48±18.94
		3	0.57±0.05	0.37±0.00	9.82±0.10	8.49±0.81	9.70±0.20	7.59±0.17	85.46±8.12	618.51±14.72
		5	1.05±0.01	0.41±0.12	12.36±0.93	8.63±0.37	11.52±0.03	8.01±0.20	185.11±22.85	554.39±16.90
	2x2.0	1	0.28±0.02	0.42±0.08	7.62±0.17	8.73±0.42	7.41±0.19	8.10±0.15	24.32±5.19	319.94±18.23
		3	0.57±0.03	0.37±0.04	9.88±0.26	8.60±0.29	9.76±0.05	7.69±0.09	62.82±16.12	474.99±10.82
		5	0.72±0.08	0.55±0.15	10.52±0.82	9.66±0.82	10.27±1.12	10.22±0.14	110.59±11.10	783.13±19.95

According to the measurements, the maximum fruit weight in the 'Rosenthal 'variety was found to be 2.0×1.2 m in the planting interval and in the three branches without pruning system as 1.23 g in average, and in the 'Red Lake' variety was found at 2.0×1.5 m planting interval area and in the single branches with pruning system as 50.56 g in average. The maximum fruit width in the 'Rosenthal' variety was found to be 2.0×1.2 m in the planting interval and in the three branches without pruning system as 12.72 mm in average, and in the 'Red Lake' variety was found at 2.0×1.2 m planting interval area and in the three branches with pruning system as 10.08 mm in average. The maximum fruit width in the 'Rosenthal' variety was found to be 2.0×1.2 m in

the planting interval and in the five branches without pruning system as 12.72 mm in average, and in the 'Red Lake' variety was found at 2.0×1.5 m planting interval area and in the single branch with pruning system as 10.34 mm in average. The maximum yield of per plant in the 'Rosenthal' variety was found to be 2.0×1.2 m in the planting interval and in the five branches without pruning system as 12.72 mm in average, and in the 'Red Lake' variety was found at 2.0×1.5 m planting interval area and in the single branch with pruning system as 10.34 mm in average. The maximum yield of per plant in the 'Rosenthal' variety was found to be 2.0×1.2 m in the planting interval and in the five branches without pruning system as 230.33 g in average, and in the 'Red Lake' variety was found at 2.0×1.5 m planting interval area and in the five branches with pruning system as 801.62 g in average.

In a study conducted by Nikolic et al. (2006), pomological characters of currant varieties to determine the fruit weight of varieties 0.90-2.36 g. In an adaptation study conducted in Samsun ecology, it was reported that the fruit width of currants varieties varied between 9.56-14.10 mm (Kaplan and Akbulut, 2006). Gerçekçioğlu et al. (2009), in their study of Tokat conditions, they determined that fruit length of currants varieties changed between 8.01 and 13.99 mm. Göktaş et al. (2006), in their study in Isparta Eğirdir region, the highest yield per plant in the varieties of currants Tokat 3 (4802,59 g), while the lowest yield was found in Tokat 2 (422.27 g).

Soluble solid content (%), pH and Titratable acidity (%) values are presented in Table 5.

Table 5. Average of SSC, pH and TA values of currant varieties (2015-2016)

Pruning	Distance (m)	Number of branches	Soluble solid content (%)		pH		Titratable acidity (%)	
			Rosenthal	Red Lake	Rosenthal	Red Lake	Rosenthal	Red Lake
Applied	2x1.2	1	14.64±0.66	12.25±1.63	2.69±0.36	2.77±0.03	4.02±0.24	2.85±0.62
		3	14.19±0.54	12.40±0.87	2.55±0.24	3.08±0.41	3.53±0.01	2.87±0.21
		5	14.19±0.11	12.07±0.82	2.66±0.47	2.61±0.08	3.52±0.05	2.97±0.06
	2x1.5	1	14.72±0.36	11.82±0.45	2.71±0.84	2.62±0.02	3.30±0.19	3.28±0.79
		3	13.52±0.87	11.68±0.58	2.60±0.22	2.84±0.05	3.99±0.12	2.87±0.47
		5	15.58±0.79	11.27±0.29	2.64±0.17	2.84±0.01	3.62±0.06	2.95±0.18
	2x2.0	1	15.30±0.18	13.00±0.37	2.76±0.35	2.92±0.04	3.31±0.05	2.70±0.00
		3	13.44±0.12	12.64±0.18	2.36±0.20	2.64±0.00	3.33±0.62	2.90±0.05
		5	14.20±0.36	11.57±0.99	2.61±0.12	2.83±0.17	3.83±0.21	2.78±0.05
Non-Applied	2x1.2	1	15.44±0.44	12.55±0.25	2.68±0.18	3.04±0.13	3.31±0.00	3.34±0.06
		3	14.42±0.28	11.65±1.13	2.55±0.17	2.86±0.06	4.09±0.14	2.72±0.17
		5	14.02±0.91	12.07±0.72	2.72±0.36	2.83±0.22	3.56±0.27	2.90±0.08
	2x1.5	1	15.47±0.53	12.05±0.14	2.64±0.74	2.73±0.17	3.56±0.32	2.90±0.15
		3	14.13±0.12	12.07±0.38	2.43±0.49	2.73±0.16	3.49±0.33	2.70±0.01
		5	14.87±0.23	11.63±0.12	2.62±0.57	2.98±0.62	3.55±0.17	2.84±0.11
	2x2.0	1	15.37±0.57	11.50±0.63	2.68±0.15	2.97±0.18	3.48±0.12	2.69±0.04
		3	15.80±0.11	11.69±0.14	2.55±0.22	2.95±0.24	3.40±0.05	3.26±0.17
		5	14.57±0.26	12.27±0.13	2.95±0.46	2.79±0.26	3.65±0.15	3.13±0.22

According to the measurements, the maximum SSC in the 'Rosenthal' variety was found to be 2.0×2.0 m in the planting interval and in the three branches without pruning system as 15.80 % in average, and in the 'Red Lake' variety was found at 2.0×2.0 m planting interval area and in the single branches with pruning system as 13.00 % in average. The maximum pH in the 'Rosenthal' variety was found to be 2.0×2.0 m in the planting interval and in the five branches without pruning system as 2.95 % in average, and in the 'Red Lake' variety was found at 2.0×1.2 m planting interval area and in the three branches with pruning system as 3.08 % in average.

The highest TA of 'Rosenthal' was found to be 2.0×1.2 m in the planting interval and in the singel branch with pruning system as 4.02 % in average, and in the 'Red Lake' variety was found

at 2.0×1.2 m planting interval area and in the single branch without pruning system as 3.34 % in average.

Kaplan and Akbulut (2006), in their study of Samsun Çarşamba Region, they determined that SSC of black currants varieties changed between 14.83-15.53 % and red currants varieties changed 9.26-10.43 %.

Zatylny et al. (2004), their study of Saskatchewan province in Canadian, the chemical of the fruits of currants varieties. According to the obtained results, PH value 2.85-3.04; Titration acidity values of 3.04-4.03% and briks Values are in the range of 15.1-16.6 %. The findings of our findings are similar to those of other investigators.

CONCLUSIONS

In terms of production, 'Rosenthal' variety performed better at 2.0×1.2 m distance, 5 branches with pruning system (average yield of 96 kg per/decar), and for the 'Red Lake' variety 2.0×2.0 m planting distance 3 branches and without pruning system (average yield of 205 kg per/decar).

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