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EFFECTS OF SHOOT TRIMMING AND ETHEPHON TREATMENTS ON VEGETATIVE CHARACTERISTICS OF 'USLU' GRAPEVINE

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ABSTRACT

Mediterranean, depending on the ecological conditions, is an important region in terms of earliness and grape cultivation in Turkey. Vegetative growth control is deemed to be necessary in grape cultivars that exhibit strong growth. This experiment was carried out for grapevines of Uslu grafted onto 1103 P rootstock at a spacing of 2 m × 3 m to analyze the influence of ethephon and shoot trimming on vine growth characteristics. Shoot trimming (control and 10 nodes) and ethephon (0, 500, 750 ppm) applications were carried out on vinestocks approximately one week before blooming. Summer shoot length (cm), node number of summer shoot (n), internode length of summer shoot (cm), axillary bud burst percentage (%), number of axillary shoot (n), mean length of axillary shoot (cm), total length of axillary shoot (cm), cane diameter (mm), pith diameter (mm), cane/pith, pruning wood weight (g) were determined. According to results, foliar treatments with ethephon applied in shoots growth period (before flowering) exhibited a strong inhibitory effect on shoot growth of cv. Uslu. Ethephon (500 ppm and 750 ppm) application reduced summer shoot length, node number and internode length. Increasing ethephon doses reduced active bud burst percentage, shoot length and pruning wood weight. The number of axillary shoots decreased by 49.4% in trimmed plants in comparison with the control. It was determined that mean length of axillary shoot was higher in trimmed plants, while total length of axillary shoot and pruning wood weights of grapevines were similar in both trimmed and control plants.

Key words: *Grapevine, summer shoot, axillary bud, ethephon, trimming, vegetative growth*

INTRODUCTION

Turkey is an important table grape producer. Table grapes are grown in 50.2% of the vineyards within the country. In terms of ecological conditions, table grapes ripen initially in Mediterranean region. The Mediterranean Region has an important role in grape production, producing 715.781 tons in 79.468 ha of vineyard (TUIK, 2017). In addition to ecological advantages of the region for earliness, selection of cultivars is also a very important factor in terms of ripeness time. Depending on these two factors, early harvested table grapes can be easily marketed at a high price. In this regard, the earliest grape cultivar in the region is 'Uslu'. This cultivar is bred in Turkey, seeded, dark red, and it has large berries (Celik, 2006). Its yield is average, and its grapevine are vegetatively strong (Tangolar et al., 1996). Shoot development of the cultivar is faster than other cultivars in both greenhouse and open cultivation (Kamiloglu et al., 2011). This cultivar has the tendency to produce numerous and strong axillary shoots (Turker and Dardeniz, 2014).

Intensive growth of vines in warm climates requires measures to control vigour in order to ensure fruit quality and vegetative balance of the plants (Di Lorenzo et al., 2011). In addition, in grapevines the amount of fruit is mainly governed by the number of shoots and not by their length (Lavee, 2000). The traditional method of containing excessive vegetative growth is to stop the vines by removing a length of the terminal part of the cane. But this practice suffer from several important disadvantages: its effect is limited in duration, axillary bud growth is promoted and the proportion all dry matter production allocated to such dispensible portions of growth as lateral shoot may even be increased (Nickel, 1983).

Certain growth regulators are used in keeping shoot development under control. Plant growth retardants used in viticulture for modification of fruit setting affect shoot development as well. The control of excessive vigor offers a number of advantages. Shading of the fruit is reduced, cultural practices are facilitated and the competitive sink strength of the developing shoot tips is reduced (Szyjewicz et al., 1984). Ethephon is an inhibitor effective in keeping vegetative development under control. When compared with the other growth regulators, ethephon is highly effective ethylene generator which most effectively controls excessive vigor on various cultivars (Szyjewicz et al., 1984). In a study conducted for this purpose, it was reported that 420-720 mg/L doses yielded the best result in terms of inhibiting shoot development, and ethephon also prevented growth comprising lateral buds (Shulman et al.,1980; Polat, 2002).

In this experiment, the effects of shoot trimming and different ethephon dose applications before blooming, intended for keeping vegetative development under control in Uslu grape cultivar, was researched.

MATERIAL AND METHODS

The experiment was carried out in Dörtyol city, in Eastern Mediterranean of Turkey. The experiment area of Agriculture Faculty of Hatay Mustafa Kemal University is located at 36°54′N and 36°13′E at 198 m.a.s.l. It has subtropical climate and the yearly average temperature is 19.0 °C, with 886 mm precipitation, which primarily falls during winter and spring. Eight-year-old *Vitis vinifera* L. cv. 'Uslu' (Hönüsü × Siyah Gemre), grafted onto '1103 P' (Berlandieri X Riparia) rootstock grapevines were used for this study. The vines are established at 3 × 2 m intervals and trained using bilateral cordon system. All practices were carried out

1st year and 2nd year on May 04 and May 05 respectively, approximately one week before blooming. Ethephon and trimming applications were experimented in the study. Shoot trimming was done by hand to maintain at 10 nodes per summer shoot. Grapevines with or without trimming were applied ethephon 0, 500, 750 ppm doses. Ethephon was sprayed to the upper part of primary shoots after clusters.

In order to determine their effects on vegetative developments of grapevine, certain measurements were made immediately after applications (at the beginning of the experiment) and 30 days later, and during dormant season. Four summer shoots were marked on each grapevine that was trained in bilateral cordon trellis. Eight summer shoots were used for each repetition. Immediately after treatment, shoot length in control (untrimmed) and trimmed vines were 119 and 76 cm, respectively. Likewise, total axillary shoot lengths were respectively 57 and 60 cm.

In the experiment; summer shoot length, summer shoot node number, summer shoot internode length, axillary bud burst percentage, number of axillary shoot, mean length of axillary shoot, total length of axillary shoot (cm) were determined. Pruning wood weights of the grapevines were weight in the dormant season. In the marked canes, two-way measurements were made from the midpoint between the internodes of the nodes 4-5. and 5-6. The cane and pith diameters were recorded in the measurements. The cane/pith ratio was calculated (Dardeniz and Şahin, 2005). Length measurements were made with measuring tape, diameter measurements were made with caliper, weight measurements were made with 1 g electronic precision scale, and counts were taken visually and by hand.

The experiment was arranged in a Randomized Complete Blocks with three replications. There were two vine per replication. Variance analysis was carried out through MSTAT statistical software and means were compared by Tukey Test (α=0.05; 0.01).

RESULTS AND DISCUSSION

The grapevine is generally considered a vigorous species developing long and rapidly growing canes (Patterson and Zoecklein, 1990). Significant increases can be seen in vine growth particularly due to ecological conditions and cultural treatments (watering, fertilization). It is attempted to keep vegetative development of vines under control by means of summer and winter pruning and, if deemed necessary, the use of certain plant growth retardants. In this study, effects of trimming and ethephon applications on vine development under subtropical climate conditions was researched.

During the study, the effect of applications on summer shoot length was found to be significant at a level of 1% in terms of the mean values of each year and both years. Similarly, 500 ppm and 750 ppm ethephon treatments statistically reduced shoot growth in comparison with the control. In addition, it was seen that trimming significantly limited shoot length. Upon examination of treatment x dose interaction, it was determined that ethephon doses did not affect shoot development in trimmed plants, while 500 ppm and 750 ppm doses reduced shoot development in plants that were not trimmed in comparison with the control (Table 1). According to the summer shoot measurements at the beginning of the experiment and repeated in 30th day, (Figure 1) level of development was proportionately 95.6% in comparison with the control (0 ppm), 25% at 500 ppm, and 21% at 750 ppm in plants that were not trimmed. This increase was maximum 2% in grapevines that were trimmed.

While the effect of ethephon doses on the number of summer shoot nodes vary according to years, the mean value of both years was found to be significant at 5%. In comparison with 0 ppm, other two doses reduced the number of nodes. In trimming application, reduction of nodes in comparison with the control was an expected result (Table 1). According to mean values of the 2nd year and the both years of the study, mean internode length of summer shoots was reduced in 500 ppm and 750 ppm doses, and this effect was found to be statistically significant. Internode length of summer shoots varied according to years in plants that were trimmed and not trimmed (Table 1). It was determined that the number of axillary shoots, formed on nodes of summer shoots, were lower in trimmed plants than the control and lower in 750 ppm ethephon dose than the other doses according to the mean values of two years. In treatment x dose interaction, while trimmed plants were statistically affected in a similar manner from ethephon doses, control treatment exhibited variance based on doses (Table 2).

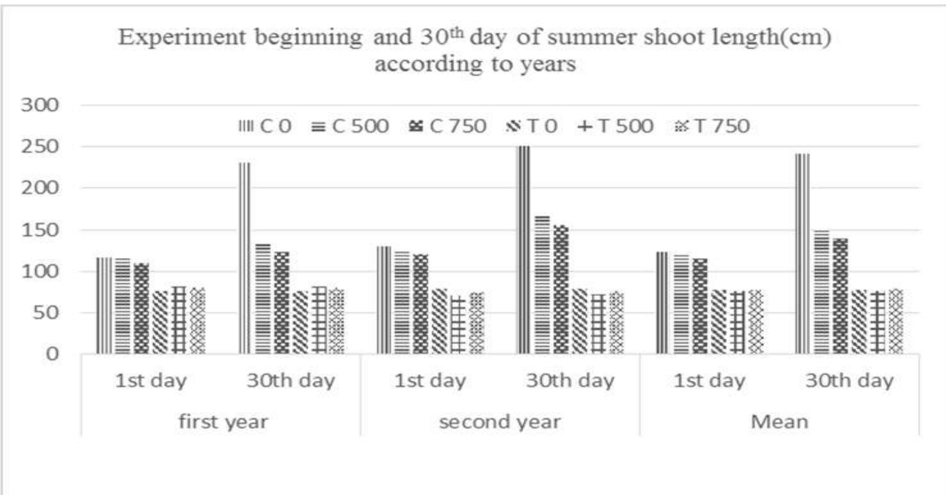

Figure 1. Experiment beginning and 30th day of summer shoot length (cm) according to years

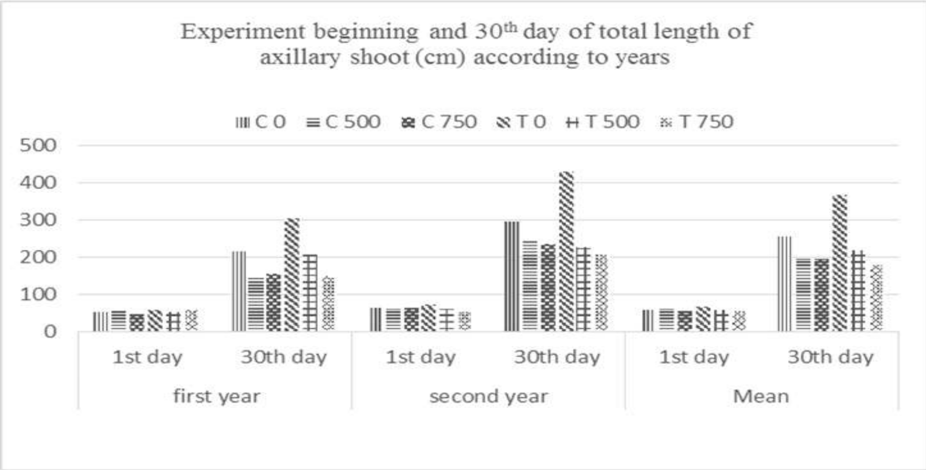

Figure 2. Experiment beginning and 30th day of total length of axillary shoot (cm) according to years

Table 3. Effects of trimming and different ethephon doses on cane growth and pruning wood weight of 'Uslu' table grape

Treatment	Dose (ppm)	Cane diameter (mm)			Pith diameter (mm)			Cane/pith diameter			Pruning wood weight (g)		
		1st year	2nd year	Mean	1st year	2nd year	Mean	1st year	2nd year	Mean	1st year	2nd year	Mean
Control	0	8.93	8.97	8.95	3.67	4.09	3.88	2.55	2.28	2.41	2900.00	1528.00	2214.00
	500	7.65	8.91	8.28	3.21	4.23	3.72	2.48	2.20	2.34	1892.00	885.00	1388.50
	750	8.11	8.89	8.50	3.55	4.26	3.90	2.33	2.20	2.26	1824.50	1071.67	1448.08
Trimming	0	8.91	9.78	9.34	3.73	4.34	4.04	2.50	2.38	2.44	2322.17	1295.33	1808.75
	500	8.45	8.73	8.59	3.63	4.02	3.83	2.40	2.26	2.33	1795.83	777.50	1286.67
	750	7.77	8.69	8.23	3.65	4.31	3.98	2.23	2.11	2.17	1957.83	796.83	1377.33
Mean	Control	8.23	8.92	8.57	3.48	4.19	3.84	2.45	2.22	2.34	2205.50	1161.56 a	1683.53
	Trimming	8.38	9.06	8.72	3.67	4.23	3.95	2.38	2.25	2.31	2025.28	956.56 b	1490.92
Mean	0	8.92	9.37	9.14 a	3.70	4.22	3.96	2.53 a	2.33	2.43 a	2611.08 a	1411.67 A	2011.38 A
	500	8.05	8.82	8.44 b	3.42	4.13	3.77	2.44 ab	2.23	2.33 ab	1843.92 b	831.25 B	1337.58 B
	750	7.94	8.79	8.36 b	3.60	4.28	3.94	2.28 b	2.15	2.22 b	1891.17 b	934.25 B	1412.71 B
Dose		NS	NS	*	NS	NS	NS	*[1]	NS	*	*	**[1]	**
Treatment		NS	NS	NS	NS	NS	NS	NS[1]	NS	NS	NS	*	NS
Interaction		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

[1]NS, *, ** represent not significant and significant effect at the 0.05 (different lower case letter) and 0.01 (different capital letter) levels, respectively.

Table 1. Effects of trimming and different ethephon doses on summer shoot growth of 'Uslu' table grape

Treatment	Dose (ppm)	Summer shoot length (cm)			Node number of summer shoot (n)			Internode length of summer shoot (cm)		
		1st year	2nd year	Mean	1st year	2nd year	Mean	1st year	2nd year	Mean
Control	0	231.5 A	251.5 A	241.5 A	29.4 A	26.2	27.8 a	7.88 A	9.60 A	8.69 A
	500	133.5 B	168.0 B	150.8 B	21.3 B	22.4	21.9 b	6.27 AB	7.50 B	6.90 BC
	750	122.6 B	155.4 BC	139.0 B	20.5 B	21.3	20.9 b	5.97 B	7.30 B	6.65 C
Trimming	0	76.0 C	79.2 CD	77.6 C	10.0 C	10.0	10.0 c	7.60 AB	7.92 B	7.76 AB
	500	81.3 C	71.5 D	76.4 C	10.0 C	10.0	10.0 c	8.13 A	7.15 B	7.64 B
	750	80.5 C	76.5 CD	78.5 C	10.0 C	10.0	10.0 c	8.05 A	7.65 B	7.85 AB
Mean	Control	162.5 A	191.7 A	177.1 A	23.7 A	23.3 A	23.5 A	6.7 B	8.1 A	7.4 b
	Trimming	79.3 B	75.7 B	77.5 B	10.0 B	10.0 B	10.0 B	7.9 A	7.6 B	7.8 a
Mean	0	153.8 A	165.4 A	159.6 A	19.7 A	18.1	18.9 a	7.7	8.8 A	8.2 A
	500	107.4 B	119.8 AB	113.6 B	15.6 B	16.2	15.9 b	7.2	7.3 B	7.3 B
	750	101.6 B	116.0 B	108.8 B	15.3 B	15.6	15.5 b	7.0	7.5 B	7.2 B
Dose		**[1]	**	**	**	NS	*	NS[1]	**	**
Treatment		**	**	**	**	**	**	**[1]	**	*[1]
Interaction		**	**	**	**	NS	*	**	**	**

1 NS, *, ** represent not significant and significant effect at the 0.05 (different lower case letter) and 0.01 (different capital letter) levels, respectively.

Table 2. Effects of trimming and different ethephon doses on axillary shoot growth of ‘Uslu’ table grape

Treatment	Dose (ppm)	Axillary bud burst percentage			Number of axillary shoot			Mean length of axillary shoot			Total length of axillary shoot (cm)		
		1st year	2nd year	Mean	1st year	2nd year	Mean	1st year	2nd year	Mean	1st year	2nd year	Mean
Control	0	71.5 (57.7)	76.6 (61.1)	74.0 (59.4)	21.1A	20.0	20.6a	10.2b	14.6B	12.4B	216.3	295.5	255.9
	500	64.9 (53.7)	65.4 (54.0)	65.2 (53.9)	14.0B	15.0	14.5b	10.2b	15.5B	12.9B	148.6	242.9	195.8
	750	62.1 (52.0)	64.1 (53.3)	63.1 (52.7)	12.8BC	14.0	13.4b	11.9b	16.4B	14.2B	156.3	236.3	196.3
Trimming	0	84.2 (66.7)	81.3 (64.4)	82.7 (65.5)	8.4C	8.1	8.3c	36.4a	52.3A	44.3A	303.5	428.0	365.7
	500	85.8 (68.1)	80.8 (64.1)	83.3 (66.1)	8.6C	8.1	8.3c	24.5ab	28.1B	26.2AB	207.7	226.0	216.9
	750	82.5 (65.3)	77.1 (61.4)	79.8 (63.4)	8.3C	7.7	8.0c	18.4b	27.0B	22.6B	152.6	208.2	180.4
Mean	Control	66.2 (54.5)B	68.7 (56.1)B	67.4 (55.3)B	16.0A	16.4A	16.2A	10.8B	15.5B	13.2B	173.7 b[1]	258.2	216.0
	Trimming	84.2 (66.7)A	79.7 (63.3)A	81.9 (65.0)A	8.4B	8.0B	8.2B	26.4A	35.8A	31.0A	221.3 a	287.4	254.3
Mean	0	77.8 (62.2)	78.9 (62.7)a	78.4 (62.5)a	14.8A	14.1	14.4A	23.3	33.5a	28.3a	259.9 A	361.7a	310.8A
	500	75.4 (60.9)	73.1 (59.1)ab	74.3 (60.0)ab	11.3B	11.6	11.4 AB	17.3	21.8b	19.6b	178.2AB	234.5b	206.3B
	750	72.3 (58.6)	70.6 (57.4)b	71.4 (58.0)b	10.5B	10.9	10.7B	15.1	21.7b	18.4b	154.4 B	222.3b	188.3B
Dose		NS[1]	*[1]	*	*	NS	**	**	NS	*	**	*	**
Treatment		**[1]	**	**	**	**	**	**	**	**	*	NS	NS
Interaction		NS	NS	NS	**	NS	*	**	*	**	NS[1]	NS	NS

[1]NS, *, ** represent not significant and significant effect at the 0.05 (different lower case letter) and 0.01 (different capital letter) levels, respectively. Values in parenthesis is angle transformation.

Patterson and Zoecklein (1990) reported that 750 ppm ethephon treatment decreased the number of laterals in vines, on which it was applied twice. In our study, it was seen that 500 ppm and 750 ppm doses exhibited reduction in comparison with control (0 ppm). As this characteristic was examined proportionally, a contrary situation was seen in terms of applications, while trimming application yielded a higher value than the control, and it was found to be significant at a level of 1% in terms of the mean value of years. Increasing ethephon doses caused a decrease in axillary bud burst and the lowest value was obtained from 750 ppm (Table 2). Gonzalez et. al. (2011) reported that 400, 800 $mg.L^{-1}$ ethephon treatments after berry set period significantly reduced sprouting of lateral buds, as well as leaf area development, leaf chlorophyll content and net photosynthesis rate in comparison with the control according to the measurements carried out on Verdejo vines in veraison period.

The effect of trimming and ethephon application on mean axillary shoot length was found to be statistically significant. While higher values were obtained in trimmed plants, 500 ppm and 750 ppm doses of ethephon caused a reduction in mean axillary shoot length (Table 2).

Total length of axillary shoots, formed by active budding in summer shoots, was higher in trimmed plants than untrimmed ones for the first year. It was determined that this effect continued for second year and the mean of both years; however, it was not statistically significant. A further reduction was seen in development of these shoots based on the increase in ethephon doses. However, the effect of 500 ppm and 750 ppm doses were statistically found to be similar (Table 2). Total axillary shoot lengths in summer shoots were found to be between 55.4 and 65.6 cm depending on the application and doses at the beginning of the experiment (Figure 2). In comparison with the beginning, mean axillary shoot length at 30th day exhibited 102% to 134% proportional increase in plants that were not trimmed. The proportional increase in trimmed plants were 437% in control (0 ppm), 258% at 500 ppm, and 191% at 750 ppm.

The effect of trimming on cane diameter was not found to be significant in measurements made in the dormant season. Likewise, while ethephon did not exhibit an effect on diameter growth for each year, increasing ethephon dose reduced diameter growth according to the mean value for both years (Table 3). Pith layer, which is an indicator of lignification, was not affected by the application and ethephon doses in the experiment. Cane diameter/pith diameter exhibited a statistical change by years, while the dose of ethephon that increased in terms of the mean value of years partially reduced this value. In comparison with the control, trimming application did not exhibit any effect on pruning wood weight (except for the 2nd year). However, it was determined that ethephon doses were statistically significant at 5% and 1%, and that 500 ppm and 750 ppm doses reduced pruning wood (Table 3).

Patterson and Zoecklein, (1990) determined in their study that the application of 750 ppm ethephon dose once or twice to vines did not lead to a difference in pruning wood weight, but other applications reduced pruning wood weight in comparison with the control. Mannini et al. (1981) in their study found that the topping treatment (1000 ppm ethephon) reduced the pruning weights relative to the 300 ppm ethephon treatments. However, Gonzalez et. al. (2011) reported that the reduction in lateral shoot development in plants treated with ethephon was compensated with further development of main shoot and total pruning wood remained unchanged. Weaver and Pool (1971) reported that particularly high doses weakened plant development in 'Thompson Seedless' vines treated with ethephon. It was reported that plant growth retardants temporarily delayed shoot growth during rapid growth periods of plants. A temporary delay in shoot growth during this period showed a positive effect on the fruit set (Todıć et al., 2012).

CONCLUSION

In the study, ethephon applied in shoot growth period (before flowering) exhibited a strong inhibitory effect on shoot growth of cv. Uslu. Ethephon (500 ppm and 750 ppm) application reduced summer shoot length, number of nodes and internode length. Increase ethephon doses reduced axillary bud burst percentage and pruning wood weight. Trimming significantly limited summer shoot growth. The number of axillary shoots was found to be lower in trimmed plants than the control and in ethephon 750 ppm dose than the other doses. While mean axillary shoot length was higher in trimmed plants, this effect was not seen in total axillary shoot length and pruning wood weights of grapevines were found to be similar.

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