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Effect of Pruning on Morphological and Biochemical Characteristics of Grapes (*Vitis vinifera* L.)

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ABSTRACT

The objectives of this study were to determine whether bud pruning severity impacts some pomological traits of white and red varieties of table grapes. Vine canes were pruned to 3 or 6 buds in 12-year-old vines in conventional systems. Results revealed that number of bunches, bunch weight, bunch width, number of shot berries, and berries per bunch was significantly ($p<0.05$) affected by the bud pruning, whereas bud pruning had no significant effect on bunch length. In general, moderate bud pruning can enhance the nutritional quality of table grapes.

Keywords- Bud pruning, Bunch weight, Comparison, Nutritional quality.

I. INTRODUCTION

Grape *(Vitis vinifera L.)* is one of the oldest and most important fruit trees in the world, which has economic value and many beneficial effects on human health (Khadivi et al. 2019). Consumers' awareness of the close relationship between health and environmental concerns has increased the demand for providing high quality food (Mikulic-Petkovsek et al. 2012). In the world, after apples and citrus fruits, the largest area of orchards is related to grapes. According to the statistics of the FAO (2020), the production of grapes in the world is more than other fruit trees. The continents of Europe, Asia, America, and Africa are the most important continents for growing and producing grapes, respectively. The latest statistics obtained are related to 2020, according to which China ranks first in grape production in the world with the production of 14,769,088 million tons of grapes. After that, Italy, Spain and France are in the next place respectively. Iran ranks 11th in the world both in terms of cultivated area and production. Grapes, having rich sources of vitamins and organic and mineral compounds, are among the fruits that are beneficial for human health (Fia et al. 2022; Keskin et al. 2022; Mohamed et al. 2016). Grapes with high amounts of resveratrol compounds (derivatives of phenolic compounds) have anti-viral, anti-cancer, anti-inflammatory, anti-aging and longevity effects (Dennis et al. 2020).

Afghanistan is one of the centers of grape origin in the world, which has a lot of genetic diversity (Arab and Ahamed 2022; Yousufi 2016). With 78,405 hectares of vineyards, this country is considered one of the largest producers of grapes and raisins in the world (Mushair et al. 2020). Considering the great variety of grape cultivars in the world, which is the result of both rooting and vegetative propagation, the common methods for identifying grape cultivars are measuring quantitative and qualitative traits between cultivars.

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In addition to the variety and suitable environmental conditions, pruning is one of the important management priorities in the quantitative and qualitative production of grapes (Senthilkumar et al. 2015). Pruning is one of the most important operations in the management of sustainable grape production in the world (Bindon et al. 2008). Optimum pruning causes the balance of vegetative growth, fruit production and maximum yield without reducing the root of the vines (Senthilkumar et al. 2015).

Pruning is considered as the most important operation in grapes to increase the quantitative and qualitative yield of the product. However, different grape genotypes may have different reactions to winter pruning. Therefore, carrying out a study to optimize winter pruning in different grape cultivars has a great help in improving the quantitative and qualitative characteristics of the product. The grape tree is one of the most pruneable fruit trees, and in fact, the amount of grape fruit harvest has a direct relationship with pruning (Feitosa et al. 2018; Friend and Trought 2007). The present study was carried out with the aim of evaluating and comparing the appearance and biochemical characteristics of some cultivars of Dokshor grapes and optimizing the intensity of winter pruning in some cultivars of Afghan grapes.

II. MATERIAL AND METHODS

2.1. Description of site

The present research was conducted in 2018 at the Khajah Sabzeposh city (Faryab provincem, Afghanistan). Four varieties of local Afghan grapes (Lal, Taifi, Qhare Zagh, and Sahebi) were used for pruning. All the above-mentioned varieties were harvested at the commercial ripening stage according to regional customs and interviews with local gardeners.

2.2. Pruning

In this section, the effect of pruning on the morphological and physicochemical characteristics of four Afghan grape varieties (Qhare Zagh, Taifi, Lal, and Sahebi) of annual fruiting pruning method (short and long) was investigated in three replications. To prune the branches, four fruitful branches were selected and labeled on each plant in March. The branches were pruned by two methods of short pruning (three-bud pruning) and long pruning (six- bud pruning), and with the appearance of flower clusters, the fruitful and non-fruitful branches of the cultivars were recorded.

2.3. Determination of morphological traits

The berry length, berry diameter, bunch length, leaf length, and leaf width were measured using a digital ruler and caliper. Bunch weight (five bunchs randomly), berry weight (20 of each bunch) and seed weight were measured by a digital scale with an accuracy of 0.001 grams. In order to count the seeds in a berry, the number of seeds of 20 berry of each variety was extracted and counted, and the average was taken.

2.4. Statistical analysis

Experiments were conducted in a completely randomized design with three replications and 16 treatments. In order to analyze the obtained information while respecting the necessary assumptions such as the normality of the data, analysis of variance was used by SAS 9.2 software.

III. RESULTS

The results of variance analysis showed that cultivar type and pruning had a significant effect on some morphological traits (number of bunches, bunch weight, bunch length, berry diameter, berry length, number of shot berries, and berries per bunch) (Table 1).

Table 1. Analysis of variance (mean square) effect of grape variety on morphological traits

Morphological traits	Source					
	Block	Cultivar	Pruning	Cultivar × Pruning	Error	C.V (%)
DF	2	3	1	3	14	-
Number of bunches	0.503 ^{ns}	8.58 **	6.25 *	2.50 ^{ns}	0.812	34.42
Bunch weight	9518.51 ^{ns}	5344.2 ^{ns}	163845.3 *	42616.9 ^{ns}	26927.4	22.21
Bunch length	3.1879 ^{ns}	35.55 **	18.2 ^{ns}	3.39 ^{ns}	4.99	9.79
Bunch width	0.923 ^{ns}	3.60 ^{ns}	23.6 **	7.30 *	1.46	6.83
Berry length	0.008 ^{ns}	0.36 **	0.08 *	0.0005 ^{ns}	0.017	6.41
Number of shot berries	13.17 ^{ns}	150.82 **	86.64 *	150.34 **	16.74	27.81
Berries per bunch	1700.93 ^{ns}	762.11 ^{ns}	17930 **	1866.8 ^{ns}	12.73	20.1

*** Significant at 1% level, * Significant at 5% level*

Figure 1, shows the interaction effect of cultivar and pruning on bunch width is presented. So that the application of different levels of pruning had a significant effect on bunch width at the 1% level, but the variety did not have a significant effect on bunch width. The removal of the branch from the sixth-bud has caused the maximum bunch width.

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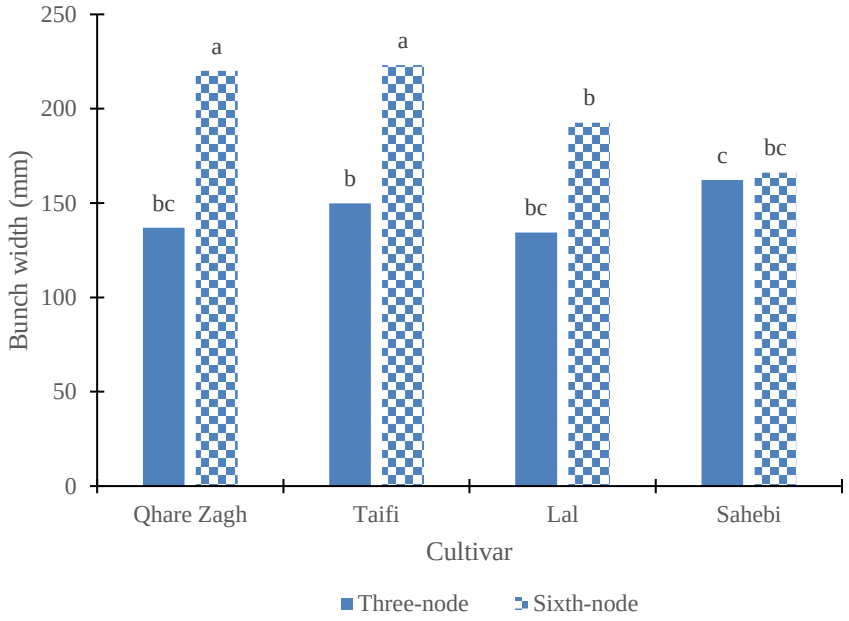

Figure 1: Interaction effect of cultivar and pruning on bunch width

Figure 2 shows the interaction effect of cultivar and pruning on the number of shot berries. Applying different levels of pruning and cultivar has had a significant effect at the 1% level on the number of shot berries. The response of different cultivars to three-bud and six-bud pruning has been different. So that in Qhare Zagh cultivar, six-bud pruning has caused the highest number of shot berries. The highest number of shot berries (30/63) corresponds to Qhare Zagh (six-bud pruning) and the lowest (8/86) corresponds to Sahebi (three-bud pruning).

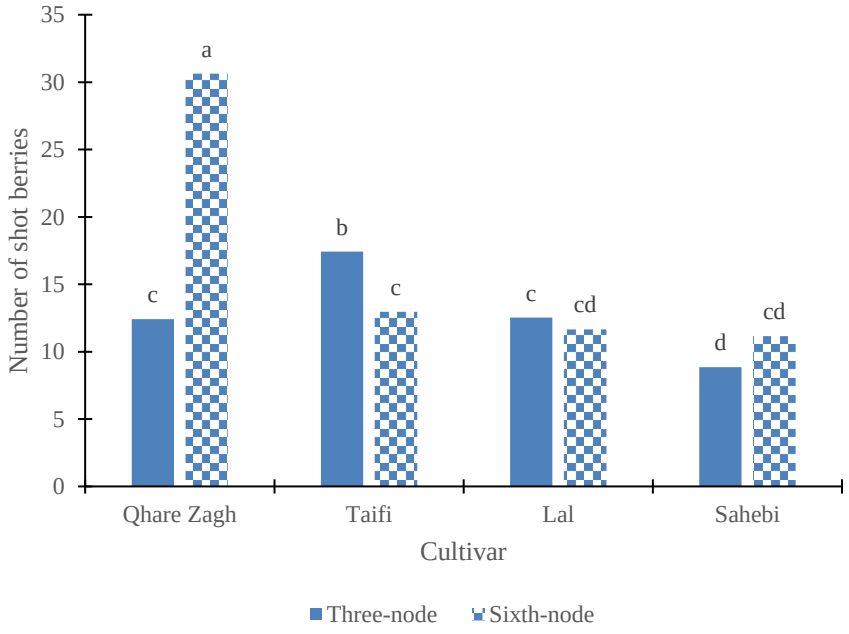

Figure 2: Interaction effect of cultivar and pruning on the number of shot berries

The results showed that there is no significant difference in grape cultivars of Afghanistan in terms of bunch weight and berry weight (Fig. 3).

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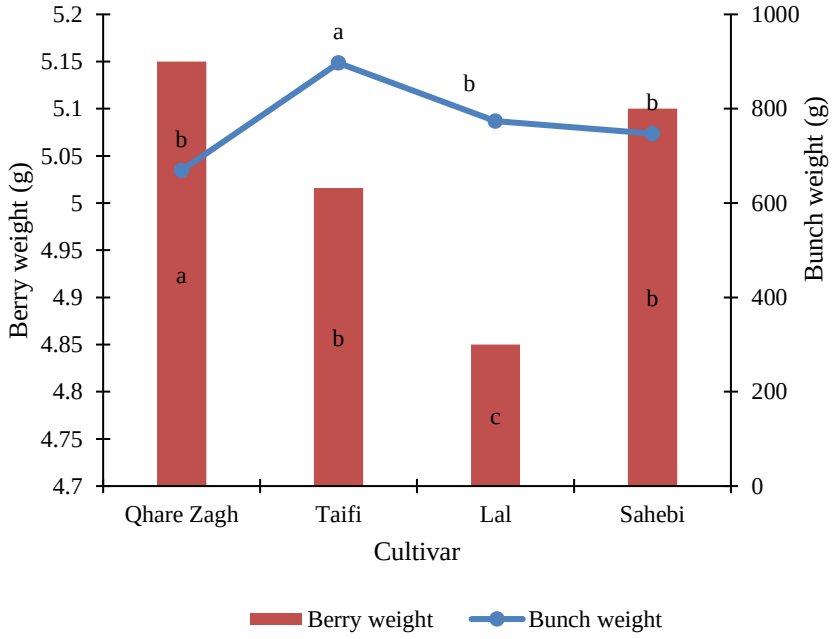

Figure 3: Effect of cultivar on bunch weight and berry weight

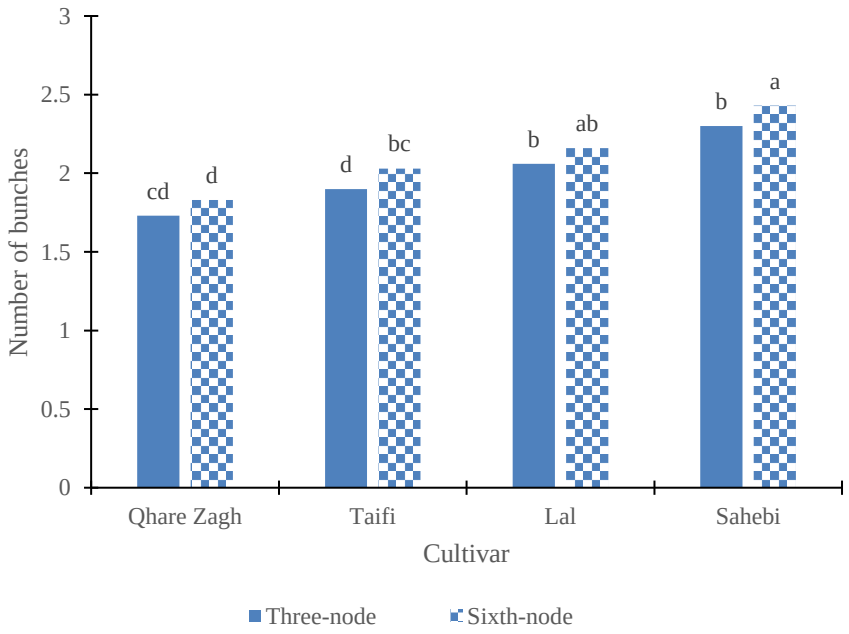

Figure 4: Interaction effect of cultivar and pruning on the number of bunches

Table 1: Comparison of morphological and physical characteristics of grape cultivars under the effect of three and six-bud pruning

Characteristics	Three-bud pruning	Six-bud pruning
Bunch length	21.95	23.7
Berry length	2.0	2.11
Berries per bunch	145.8	200.53

IV. DISCUSSION

The results of this study showed that the effect of pruning was positive in the studied traits (with the exception of shot berry). Increasing the number of shot berries has a negative effect on customer satisfaction and the market. The negative effect of severe pruning in grape cultivars on the above-mentioned traits may be due to the reduction of the vegetative level of grape bushes. Also, there are hidden and misplaced buds on the vine's

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trunk and arms, which severe pruning stimulates their growth. These buds become lateral branches. These branches create buds and secondary side branches on themselves, which act similar to the main branches and bear fruit in the same year and reach the fruiting stage a little later than the first crop of the same year. The vector arrives. But the fruits created on the secondary branches cannot reach their harvest.

In the bushes that were pruned in the form of three-bud, bunchs formed on the secondary branches, these bunchs remained immature until the end of the growing season. Also, increasing the ratio of flowers to leaf surfaces, weak and ineffective pollination, lack of inoculation of flowers due to inappropriate weather and climatic conditions, lack of carbohydrates in the pre-flowering stage, etc., are factors affecting the formation of small grains.

Ezzahouani and Williams (2003) reported that the average weight of berry in leaf removal and fruit thinning treatments was about 6% higher than the control treatment. Khadivi et al. (2019) reported that Budburst and endogenous cytokinins were increased by pruning and rest-breaking treatments. It is necessary to prune 'Sultanina' and 'Sunred Seedless' (both parthenocarpic) long for acceptable grape sets and yields. Rahmani et al. (2015) reported that the bud pruning had a significant effect on soluble solid content (24.2 degrees Brix), but not on titratable acidity. Comparing trellis training to conventional training, fruits from the trellis training system had higher phenolic, flavonoid and flavonoid compound contents.

V. CONCLUSIONS

There was a great variation in the quantitative traits of commercial grape cultivars of Afghanistan. Pruning has a significant effect on some quantitative and qualitative traits of Afghan grape varieties. Compared to other treatments, the six-bud treatment improved yield, cluster weight, kernel weight, length and width of cluster and kernel, etc.

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