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Studies on Berry Thinning and Leaf Removal Practices in Grapes

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Berry thinning and leaf removal are important operations in viticulture to achieve quality crop harvest. Consequently, an experiment was conducted to investigate the effect of berry thinning and leaf removal practices in Thompson Seedless grapes at RHRTS Sharbo, Kinnaur in 2023. For the study, summer pruning including leaf removal and berry clipping practices were considered as main treatments at veraison stage. Among various treatments combination of removal of basal five leaves and berry clipping by keeping six shoulders (T_5) and clipping by keeping four shoulders (T_4) have improved berry weight (4.47 g and 4.29 g), berry size (12.96 mm and 12.52 mm), bunch weight (216.65 g and 218.25g) and TSS (17.33^{0}B and 15.50^{0}B) respectively, compared to control

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(2.81g, 8.43 mm, 181.45g and 13.81^{0}B respectively.). Hence, berry clipping and leaf removal practices is essential form of crop load management to get quality grapes.

Keywords: Grapes; Berry clipping; leaf removal; bunch weight; TSS.

1. INTRODUCTION

"The grape, one of the ancient fruit crops of India is cultivated in an area of 171 thousand hectares with the production of 3781 thousand MT" (NHB, 2023). "Thompson seedless grapevines (*Vitis vinifera* L.) are planted throughout the world and are used to produce dried fruits (raisins), grapes for the fresh market (table grapes) and juice for concentrate" [1]. "Natural berry size of this cultivar is not large enough for commercial as table grapes so cultural practices are used to increase its size several fold and up to 10 g berries have been found in some vineyards" [2]. "Berry size is the main quality factor in international markets. To produce quality berries, careful balance of source sink ratio i.e .vegetative growth and bunches to retain in vine is required" [3]. "Summer pruning can be used as a useful means for maintaining vine balance between vegetative growth and productivity. For low to high vigour vineyards, summer pruning on fruit zone and leaf removal may be sufficient to improve the microclimate of the vine" (Freese, 1988). Many authors mentioned that the yield and vegetative growth affect grape and wine quality and controlled by many agricultural practices including grape cluster and shoot thinning, berry thinning" [4], shoot topping and defoliation (Reynolds *et al.*, 2004; Suklje *et al.*, 2013) [5-7]. "Cluster thinning (CT) is undoubtedly one of the most commonly used vineyard practices for achieving the optimal ratio between yield and quality, balancing crop and improving grape and wine composition. Entire clusters or their parts are usually removed by hand at different phenological stages during grape ripening before harvest" [8,9,4]. "Though the cluster thinning is costly and labour-intensive procedure (time-consuming and requiring skills, experience and precision), the enhanced product quality makes it economically feasible" [10]. However, timing and intensity of this technique depend on the purpose and goal of the vine style. Prajitna *et al.* [8] confirmed that cluster removal at the pea-size stage significantly increased pH, total phenolic content and anthocyanins and decreased titratable acidity in grape. Berry thinning allowed the inner berries to get more sunlight and fresh air, which was beneficial to preventing a higher incidence of pests and diseases [8]. On the other hand, Bubola *et al.* [11] reported an increased size of the remaining berries after cluster thinning. Specifically, berries were 34 % bigger in the 60 % cluster thinning treatment compared to the control.

Leaf removal is also one of the excellent practices to increase fruit quality by improving flavor compounds, color, bud fertility, decreasing TA, pH, and potassium, and reducing some of the more vegetative aromas in some varieties. Additionally, more sun exposure, increased air flow, and better spray penetration can all help reduce disease pressure. According to Caspari, *et al*., [12] leaf removal an important tool for improving the microclimate inside the grapevine canopy especially in the fruiting zone and this should be performed near berry set. On the other hand, Feng et al. [13] summarized little influence of cluster-zone leaf removal on vine growth, crop load, or grape maturity in terms of total soluble solids (TSS), pH or titratable acidity (TA) at harvest. The clusters should be exposed to sunlight during ripening for obtaining the best colouration of berries.

In view of above discussion an experiment was conducted to study the effect of cluster clipping and leaf removal on berry characteristics of Thompson Seedless grapes.

2. MATERIALS AND METHODS

Leaf removal around clusters and cluster thinning are common viticulture techniques usually applied in cool-climate vineyards in order to achieve optimal grape maturity and quality. However, the impact of the timing of these two operations differs across varieties. Thus, the aim of the present work was to investigate the effects of cluster thinning and leaf removal practices on grape quality. Therefore, the study was carried out during 2023 at an experimental farm of Dr YSPUHF RHRTS Sharbo, Himachal Pradesh. The experiment was laid out in randomized block design with eight treatments of summer pruning including berry thing and leaf removal at veraison stage of Thompson seedless grapes. The treatments consisted of T_1: Removal of basal 5 leaves, T_2: Removal of basal 5 leaves +2 above leaves, T_3: Clipping by keeping 6 shoulders, T_4: Clipping by keeping 4 shoulders, T_5: Removal of

basal 5 leaves + Clipping by keeping 6 shoulders, T_6: Removal of basal 5 leaves + Clipping by keeping 4 shoulders, T_7: Random leaf removal, T_8: Control. Each treatment was replicated three times. In each replication, vines spaced at 3 X 3 m distance were tagged. All the vines received uniform cultural practices during the season.

Fruit samples collected during September were weighed, washed and kept for analysis. The diameter of the berry was measured with vernier caliper and the weight of the berry and bunch was recorded on a sensitive balance. The TSS content was directly read on Zeis's hand refractometer by putting a drop of fruit juice on prism and reading as Brixº at 20ºC (A.O.A.C., 1980). The obtained data were tabulated and analyzed under analysis of variance (ANOVA) procedure of statistical analysis system (SAS).

3. RESULTS AND DISCUSSION

Grapevine canopy management is a vital practice for improving quality of vine, berry and subsequent wine, and it has provoked many studies around the world. However, inconsistent results might be due to the different management practices, local weather conditions, cultivars and even rootstocks [13]. Hence, searching for an optimum management mode is still very important for grape production.

The data pertaining to berry characteristics i.e. berry weight, berry diameter, berry number, bunch weight, TSS influenced by various treatments of summer pruning is presented in Table 1. The observations indicated that the effect of different leaf removal and cluster thinning treatments varied significantly. Among the various treatments berry weight and berry diameter was recorded maximum in T_5 (4.47 g and 12.96 mm) and was statistically at par with T_4 and T_6. Minimum berry weight and berry diameter was recorded in T8 control (2.81g and 8.43mm).

In present study, leaf removal and cluster thinning treatments improved berry weight over control. These observations were also in accordance with the findings of Karoglan et al. [14] who reported increased in berry weights of Merlot and Cabernet Sauvignon grapes by the berry-thinning treatment, which was consistent with the result found in Crimson Seedless grape berries [15]. Jia Nan et al. [16] concluded that "heavier berry thinning tended to gain better fruit quality and berry weight, TSS, fructose, glucose, ratio of TSS to TA, ACs, berry firmness, and the mineral contents (Ca, Fe, Na, Mg) were increased by berry thinning". This might be attributed to optimum air movement and reduces disease incidence by ameliorating fruit exposure to sunlight by leaf removal in the fruiting zone. Gli Munoz *et al.* [4] also observed that cluster thinning tends to increase berry weight of Tempranillo and Syrah.

The data on berry number per bunch varied from 40.55 to 69.19 as presented in Table 1. The berry clipping practices by default had less number of berries and had larger berry size which leads to increase in berry and bunch weight i.e. T_4 (218.25g) and T_5 (216.25 g). The perusal of data on TSS depicted that, TSS significantly differed among the leaf removal and berry thinning practices. The maximum TSS was obtained in combination of leaf removal and berry clipping i.e. T_5 (17.33^0B) and was statistically similar to T_4, T_6, T_7 when compared to control (T_8, 13.81^0B). Soluble solids content represents the main and basic parameters determining the optimal harvest time, which can be affected by climatic conditions in the growing season. As the berry thinning technique tended to obtain higher total soluble solids and a similar result was verified by Han et al. 2019 in 'Cabernet Sauvignon' grapes. "Several studies demonstrated that crop removal significantly increases soluble solids and berry colour" [17]. "Fruits well exposed to sunlight generally exhibit higher concentrations of sugars and lower acidity in grape juice compared to those ripened in dense canopy shade" [18]. "The removal of basal leaves around the clusters is widely adopted to improve grape quality and to reduce the incidence of fungal infection" [19,12]. Moreover, the increase in soluble solids concentration in clipping treatments may have been due to the removal of less ripe fruit from shaded shoots in the lower third of the canopy. This would increase the average soluble solids concentration independently of crop size. However, similar results to the current trial were shown in a parallel study [20] where Shiraz bunches were hand thinned evenly from throughout the canopy. According to Greer and Weston, [21] high temperatures have been shown to contribute to lower TSS.

"Titratable acidity found statistically significant among various treatments. In present investigation, the berry clipping treatments and leaf removal practices had reduced titratable acidity compared to control. The lowest value was noted in T_5 i.e. combination of basal 5 leave removal and clipping at 6 shoulders followed by

Table 1. Effect of berry clipping and Leaf removal practices in grapes cv. Thompson seedless

Treatments	Berry Weight (g)	Berry Diameter (mm)	Berry Number	Bunch Weight (g)	TSS (^{0}B)	Titratable acidity (gL^{-1})
T_1	3.15	10.01	69.19	185.01	14.31	4.12
T_2	3.05	9.31	67.92	186.43	13.22	4.16
T_3	2.96	9.52	65.63	192.22	14.92	4.08
T_4	4.29	12.52	57.33	218.25	15.50	3.85
T_5	4.47	12.96	40.55	216.65	17.33	3.01
T_6	3.73	11.49	55.06	206.76	15.52	3.87
T_7	3.35	11.34	37.83	200.54	16.21	3.19
T_8	2.81	8.43	68.66	181.45	13.81	4.22
$CD_{0.05}$	0.76	1.77	4.64	11.46	2.28	0.11

T_4 and T_6. The effects of leaf removal applied around veraison (onset of ripening) on grape quality were possibly due to the competition in the accumulation of photoassimilates between fruits and roots, which starts around veraison" [22]. The reduction in TA after leaf removal practices was also observed by Bledsoe *et al.*, 1988 and Petrie and Clingeleffer, [23]. Profio *et al.* [24] and Rescic *et al.* [25] also observed less acidic berries on cluster thinning. According to Brandt *et al.*, [26] high temperatures during berry development was responsible to lower Titratable acidity [27-30].

4. CONCLUSION

Bunch compactness is an important trait that affects the sanitary status and quality of grapes. Many studies have demonstrated that canopy managements, such as leaf removal, shoot trimming, and postponed first shoot topping, can effectively reduce compactness. In Present observations, berry clipping and leaf removal did affects the physical and chemical characteristics of grapes. Thus, it can be concluded from the study that there is a potential benefit from berry clipping and leaf removal practices in grapevine in the commercial production of Thompson seedless grapes for its effective influence on quality harvest.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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