J Krishi Vigyan 2024, 12(4) : 845-848
DOI : 10.5958/2349-4433.2024.00145.7
ISSN 2319-6432 (Print)
ISSN 2349-6433 (Online)

Evaluation of Thinning Practices for Crop Load Management in High-Density Gala Apple Orchards in Kashmir

Ishtiyaq A. Khan, Shabeer Ahmad Ganaie, Ishtiyak Ahmad Mir and Suheel Ahmad Ganai
Krishi Vigyan Kendra –Anantnag, SKUAST-Kashmir, Jammu and Kashmir, India

ABSTRACT

The adoption of high-density (HD) apple orchards in Kashmir, particularly for the cultivar Gala, provides a pathway for improving productivity and fruit quality. Effective crop load management, especially during the formative years, is essential to avoid biennial bearing and maintain yield consistency. This study, conducted as an On-Farm Trial (OFT) from 2022 to 2024 in the Anantnag district, assesses the impact of various thinning methods on fruit quality, yield, and economic returns in HD Gala orchards. Six thinning treatments, encompassing both chemical and manual methods, were evaluated against a control. The findings demonstrate that precision crop load management significantly enhanced fruit size, uniformity, and marketable yield, affirming the critical role of thinning in HD systems.

Key Words: Crop load management, Gala apple, High-density orchards, Kashmir, Thinning

INTRODUCTION

Apple (Malus × domestica Borkh.), often referred to as the "King of Temperate Fruits," holds global significance, covering approximately 4.7 million hectares with an annual production of around 79 million metric tons (FAOSTAT, 2019). In India, apple orchards span 309,000 ha., yielding 2.78 million metric tons, with Jammu and Kashmir contributing about 164,742 ha. and 1.88 million metric tons (Anonymous, 2020a; Anonymous, 2020b). The shift towards high-density (HD) orcharding is a key strategy to boost yield and fruit quality in Kashmir, particularly for Gala, a cultivar appreciated for its regular bearing and consumer preference.

During the last decades, the foliar application of mineral elements has become an established procedure in fruit plants to increase the production and improve the quality of produce (Khan *et al,* 2019). Without proper crop load management in the early growth phases, HD orchards risk biennial bearing, adversely impacting yield stability and fruit quality. Excessive crop loads often lead to reduced fruit size and color, limiting economic returns and potentially shortening orchard lifespan. Thinning—both chemical and manual—is a vital technique in crop load management to enhance fruit size, quality, and marketability. This study aims to evaluate the effectiveness of various thinning techniques for optimizing crop load, yield, and fruit quality in HD Gala apple orchards in Kashmir.

MATERIALS AND METHODS

Experimental Design

The study was conducted from 2022 to 2024 across three locations in Anantnag district, Kashmir. The experiment followed a Randomized Complete Block Design (RCBD) with each site comprising high-density Gala apple trees of similar age (3-4 years) under uniform management conditions. Six thinning treatments, plus a control (no thinning), were tested as under.

Treatments

T1: Control (No Thinning) - Farmer's Practice

T2: Chemical Thinning with Benzyladenine (BA) @ 150 ppm when fruit diameter was 10-12 mm.

Corresponding Author's Email - ishtiyaqkhan7@gmail.com

T3: Chemical Thinning with Naphthaleneacetic Acid (NAA) @ 15 ppm at 10-12 mm fruit diameter.

T4: Hand Thinning to retain 4 fruits per Trunk Cross-Sectional Area (TCSA).

T5: Hand Thinning to retain 6 fruits per TCSA.

T6: Hand Thinning to retain 8 fruits per TCSA.

T7: Chemical Thinning (BA or NAA) followed by Hand Thinning to 5-6 fruits per TCSA.

Plot Size and Replications

Each treatment was replicated three times at each location, with plots consisting of high-density Gala apple trees spaced at 3 m x 1 m. A randomized layout was used to avoid bias.

The Trunk Cross-Sectional Area (TCSA) was calculated using the formula as given by Westwood (1993).

Trunk cross section area (cm^2) = [Trunk girth of scion (cm)]^2/3.14

Observations recorded

Fruit Size and Quality: Average fruit weight, length, diameter, % A Grade Fruits (based on color uniformity and size) were recorded at harvest. A digital caliper and weighing scale were used for measurements.

Yield per Tree: Total yield was measured as the weight of harvested fruits per tree (kg/tree).

Economic Analysis: Gross returns were based on market prices, with net profitability calculated as: Net Profit =Gross Returns − Cost of cultivation including Thinning Costs

Bloom Return: Number of flower clusters per tree was recorded in the subsequent spring to assess the impact of thinning on future productivity.

Statistical Analysis

The data were analyzed using ANOVA, with differences between treatments assessed using the Least Significant Difference (LSD) test at a 5% significance level.

RESULTS AND DISCUSSION

Effect on Fruit Size

As shown in Table 1, chemical and manual thinning significantly enhanced fruit size (fruit weight, length, and diameter) compared to the control. Treatment T7 (Chemical + hand thinning) achieved the highest average fruit weight (195 g) and diameter (76.05 mm), indicating the efficacy of combined methods in achieving optimal fruit quality. Increase in fruit size and weight by thinning can be attributed due to reduced number of fruits per tree, increased leaf to fruit ratio, increased availability of photosynthates and lesser nutritional competition among the developing fruits and more translocation of assimilates to the remaining developing fruits, resulted in increased fruit size and fruit weight. These results were in agreement with the findings of Khan *et al* (2023a), Link (2000) who also observed that average fruit diameter is negatively correlated with crop load. Maximum fruit weight was observed by thinning treatments over the control. Koike and Ono (1998) also reported that crop load management by thinning is the most important step to harvest large sized fruit. Serra (2016) reported that the highest crop load resulted in a dramatic reduction in fruit size and fruit weight. Henriod *et al* (2008) reported that mean individual fruit size was negatively related to the number of fruit per tree.

Yield, Quality and Economic Returns

Table 2 illustrates the impact of thinning on yield, percentage of A-grade fruits, and economic returns. Although T_1 (control) had the highest yield per tree (14.44 kg), it produced a lower proportion of A-grade fruits. Conversely, T_7 achieved the highest revenue with a benefit-cost ratio (BCR) of 3.81, demonstrating that precision thinning enhances marketable yield and profitability. These results were in alignment with the results of Khan *et al* (2023b) wherein the study underscores the critical importance of thinning Gala Redlum apple trees to ensure a high quality yield is achieved and thereby returns. Moreover, the study further revealed that maintaining an

Table 1. Effect of Crop load management on Fruit weight, length and diameter of Apple cv.Gala

Treatment	Fruit weight (g)	Fruit length (mm)	Fruit diameter (mm)
T1 (Control)	143	60.05	68.0
T2 (BA @ 150ppm)	185	65.55	73.70
T3 (NAA@ 15 ppm)	178	64.0	69.30
T4 (Hand Thinning 4 fruits/TCSA)	193	68.49	75.07
T5 (Hand Thinning 6 fruits/TCSA)	179	67.0	72.55
T6 (Hand Thinning 8 fruits/TCSA)	155	62.00	70.10
T7 (Chemical + Hand Thinning)	195	69.10	76.05
Mean	175.43	65.17	72.11
C.D ($p \leq 0.05$)	28.54	4.39	3.99

Table 2. Effect of Crop load Management on Yield (Kg/tree), % A Grade Fruits and Economics (B ratio) of Apple cv. Gala

Treatment	Yield (Kg/tree)	A Grade Fruits (%)	Revenue (₹)	Cost (₹)	BC Ratio
T1 (Control)	14.44	53.0	650.52	259.92	2.81
T2 (BA @ 150ppm)	10.61	79.50	716.97	190.98	3.75
T3 (NAA@ 15 ppm)	11.87	77.90	785.97	213.66	3.68
T4 (Hand Thinning 4 fruits/TCSA)	8.49	79.90	576.60	152.82	3.77
T5 (Hand Thinning 6 fruits/TCSA)	11.81	79.95	802.57	212.58	3.78
T6 (Hand Thinning 8 fruits/TCSA)	13.64	62.30	722.31	245.52	2.94
T7 (Chemical + Hand Thinning)	11.93	80.70	818.34	214.74	3.81
Mean	11.83	73.32			
C.D ($p \leq 0.05$)	2.44	14.57			

Table 3. Effect of crop load on return bloom (number of flower clusters per tree) in apple cv. Gala

Treatment	Return Bloom (No. of flower Clusters per tree)
T1 (Control)	17.44
T2 (BA @ 150ppm)	111.60
T3 (NAA@ 15 ppm)	107.80
T4 (Hand Thinning 4 fruits/TCSA)	137.00
T5 (Hand Thinning 6 fruits/TCSA)	109.10
T6 (Hand Thinning 8 fruits/TCSA)	47.64
T7 (Chemical + Hand Thinning)	131.93
Mean	94.36
C.D ($p \leq 0.05$)	58.55

optimal fruit quality and consistent bloom is achievable at a crop load threshold of around 6 fruits per cm^2 of TCSA. The thinning treatments tended to reduce the yield efficiency in comparison to control. But average fruit weight was significantly increased. This can be attributed to the fact that the percentage of fruits retained at the time of maturity was low compared to control and therefore, there was no appreciable increase in fruit yield. These findings were in accordance with those of Marini (2004). Our results were also in agreement with the findings of Fruk *et al* (2017)

who reported that the untreated trees yielded highest total number of fruits with maximum total yield efficiency.

Return Bloom

Table 3 highlights the influence of thinning treatments on the number of flower clusters in the subsequent season. Manual thinning (T4) to 4 fruits per TCSA recorded the highest return bloom (137 clusters), indicating improved future flowering potential, reducing biennial bearing risks. The results highlighted the significant roles of both crop load and trunk cross-sectional area in shaping return bloom in the studied apple cultivar. The intricate relationship between crop load and trunk cross-sectional area emphasizes the need for a holistic understanding of orchard management practices to optimize flowering and, consequently, fruit production. These findings are consistent with those of Khan *et al* (2023b).

CONCLUSION

Precision crop load management in HD Gala apple orchards during the formative years is essential for sustainable productivity. Combined chemical and manual thinning methods significantly improved fruit quality, economic returns, and return bloom, highlighting thinning's role in preventing biennial bearing. Future research should focus on environmentally friendly thinning alternatives and adaptive methods to align with evolving orchard management practices in Kashmir.

REFERENCES

Anonymous (2020a). Area and production of horticultural crops 2019-20. Ministry of Agriculture and Farmers welfare. (Government of India).

Anonymous (2020b). District wise area and production of major horticultural crops in Jammu and Kashmir state for the year 2018-19. Department of Horticulture, Jammu and Kashmir.

FAOSTAT (2019). Agricultural Statistical database, available online at http: /faostat. fao. Org.

Fruk M, Vukovic M, Jatoi M A, Fruk G, Josip B and Jemric T (2017). Timing and rates of NAA as blossom and fruitlet chemical thinner of apple cv. Braeburn. *Emirates J Food and Agri* **29** (2): 156-162.

Henriod R E, Tustin D S, Breen K C, Oliver M, Dayatilake G A, Palmer J W, Seymour S, Diack R and Johnston J (2008). Thinning effects on "Scifresh" apple fruit quality at harvest and after storage. In IX International Symposium on Integrating Canopy, Rootstock and Environmental Physiology in Orchard Systems 903: 783-788.

Khan I A, Rafiq A and Ganie S A (2019). Effect of different sources and concentrations of pre-harvest calcium and boron sprays on the quality and yield of apple (Malus x domestica Borkh). *J Krishi Vigyan* **7** (2): 78-82

Khan I A, Hassan S, Mir M A, Khalil A, Nazir N, Nisar S, Ganie S A and Amin Z (2023a). Effect of crop load on yield and quality parameters in apple cv. Gala Redlum. *Int J Environ and Climate Change* **13** (12): 317-325

Khan I A, Hassan S, Mir M A, Nisar S, Khalil A and Amin Z (2023b). Impact of crop load on growth, flowering and fruiting in apple cv. Gala Redlum. *Int J Environ and Climate Change* **13** (11): 4388-4395

Koike H and Ono T (1998). Optimum crop load for Fuji apples in Japan. *Compact Fruit Tree* **31** (1): 1-9

Link H (2000). Significance of flower and fruit thinning on fruit quality. *Pl Growth Regulators* **31** (1): 17-26

Marini R P (2004). Combinations of ethephon and accel for thinning 'Delicious' apple trees. *J American Soc Hort Sci* **120**: 802-807

Serra S (2016). Crop load influences fruit quality, nutritional balance, and return bloom in 'Honeycrisp' apple. Hort Sci **51** (3): 236-244

Westwood M N (1993). *Temperate Zone Pomology*. Timber Press, Portland, Oregon. Revised Edition pp. 223.

Received on 29/10/2024 Accepted on 20/11/2024