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THINNING INTENSITY AFFECTS THE YIELD AND FRUIT QUALITY OF APRICOT cv. TREVETT

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Abstract

The effect of thinning on yield and fruit quality attributes of apricot cv. Trevett was investigated during 2007-08 at Khyber Pakhtunkhwa Agricultural University, Peshawar, Pakistan The experiment consisted of eight treatments i.e., 0 (Control), 10, 15, 20, 25, 30, 35, 40% thinning laid out in randomized complete block design with four replications. Thinning significantly affected both the yield and quality attributes of apricot fruit. Thinning decreased fruit drop from 21 to 0.51% while fruit weight increased from 15.93 to 26.61 g but yield per branch decreased from 0.794 to 0.408 kg with 0 and 40% thinning, respectively. The TSS increased from 11.79 to 16%, Ascorbic acid content increased from 0.55 to 0.97%, reducing sugars from 8.07 to 10.40, non-reducing sugars from 0.96 to 1.31% and sugars/acid ratio from 3.045 to 6.303 with 40% thinning. The acidity of fruit pulp decreased from 2.650 to 1.650% resulting in pH decrease from 3.71 to 3.44 in control and 40% thinning, respectively. The increase in sugars due to thinning decreased the sugar acid ratio from minimum (3.04) in control to maximum (6.303) with 40% thinning.

Introduction

Apricot (*Prunus armeniaca* L.) is a traditional crop of dry temperate regions. It is grown both at low and high altitude regions of Pakistan. The important commercial varieties of apricot in Pakistan are Red Flesh Early, Old Cap, Charmaghz, Moor-Park, Trevett, Nuri, and Shakarpara (Malik & Bashir, 1994). Apricot trees produce more flowers than can develop into fruit (Southwick & Golzer, 200). Under optimum weather conditions, majority of flowers on apricot tree will set fruits (Chunk *et al*., 2001). The excessive fruit setting result in intense competition for carbohydrates. The carbohydrate drain, or "sink activity of fruits" causes small size and poor quality fruits (Meland, 2009). Excessive fruit load weakens the tree and make more it susceptible to pests and sunburn damage (Wunche & Ferguson, 2005) and promote the tendency of alternate bearing (Peter & Abraham, 2007; Anwar *et al*., 2011), a cycle in which the tree bears excessively in one year and little next year. Thus, apricot trees require proper thinning, which refers to partial removal of flower buds and small fruits (Peter & Abraham, 2007) to improve fruit size, color, edible quality and market value as well as decrease the tendency of alternate bearing and ensure healthy plants (Diezma & Rosa, 2005; Carlos *et al*., 2006). Fruit thinning also reduces alternate bearing and decrease the chances of limb breakage (Peter *et al*., 2011). Thinning provides an optimum leaf-to-fruit ratio during early spring to ensure good growth of fruits to the maximum size (Meland, 2009). Fruit species vary in their response to the timing and intensity of thinning but the rule of thumb is to thin when fruit is 1/2 - 3/4 inch in diameter and to left a space between fruits that around the diameters of two mature fruits (Southwick & Glozer, 2000; Son, 2004). The optimum thinning procedure is complicated by considerable variations among cultivars, timing and intensity (Chira, 1999; Son, 2004; Rettke, 2005; Diezma & Rosa, 2005, Dahlenburg, 2008). Furthermore, thinning reduce yield (Rettke, 2005), though the increased size, enhanced color and fruit quality usually compensate the yield reduction (Mitchell & Mayer, 2001; Son, 2004; Meland, 2009). The present study was therefore, initiated to investigate the influence of thinning intensity on growth, yield and quality of apricot fruit.

Materials and Methods

The experiment on the effects of thinning on growth, yield and fruit quality of apricot cv. Trevett was conducted during 2007-08 at Khyber Pakhtunkhwa Agriculture University, Peshawar, Pakistan. The experiment was laid out in a randomized complete block (RCB) design with eight thinning intensity treatments ranging from 0-40% and three replications. For each treatment, four branches of nearly uniform size were selected in opposite directions. Data were recorded on different pre- and post-harvest parameters. Fruits drop on selected branches was calculated by first counting the fruit set after petal fall and then number of mature fruits. The data were converted to percent fruit drop using the following equation.

$$\text{Percent fruit drop} = \frac{\text{Number of fruit at petal fall} - \text{Number of mature fruits}}{\text{Number of fruit at petal fall}} \times 100$$

The yield was recorded by harvesting fruits from selected branches and weighing at each picking and make total at the end of harvesting season. The fruit size was assessed by weighing 10 randomly collected fruit and averaged to determine weight per fruit. For chemical analysis, 10 fruits were randomly collected for each treatment and their pulp was mixed and used. Total soluble solids were determined with hand refractometer.

Percent acidity of juice was calculated by extracting juice with a locally made juice extractor from 10 randomly taken fruits in each treatment/ replication, and that 10 ml juice was poured into volumetric flask and two drops of phenolphthalein was added before titration. It was titrated against 0.1 N NaOH solution till the appearance of pink color. Reducing sugar and non-reducing sugar were determined according to Anon., (1984). Sugar acid ratio was obtained by dividing percent reducing sugar with percent acidity of the juice.

Results and Discussion

Fruits drop, fruit weight and fruit yield per branch: Percent fruit drop decreased significantly with increased thinning percentage. Maximum fruit drop of 21% in control plants decreased to the minimum of 0.51% with 40% thinning (Table 1). Flowers and fruits act as powerful sinks for carbohydrates (Marcelis, 1996) and the fruit drop depends on nutrients availability to the fruits (Sanz *et al*., 2006). Since the fruit drop is primarily due to competition for food reserves (Chunk *et al*., 2001), increased thinning decreased the competition for photosynthates, which resulted 97.57% decrease in fruit drop with 40% thinning as compared to control (Tahir & Hamid, 2002).

Table 1. Number of leaves per branch, branch length and number of flowers per branch.

Thinning (%)	Fruit drop (%)	Fruit weight (g)	Yield branch^{-1} (kg)
0 (Control)	21.00 a	15.93 e	0.794 a
10	14.82 b	19.75 d	0.827 a
15	6.95 c	21.03 c	0.655 ab
20	5.51 cd	21.97 c	0.556 ab
25	5.01 cde	24.13 b	0.618 ab
30	1.5d e	25.04 b	0.445 b
35	0.63 de	26.16 a	0.373 b
40	0.51 e	26.61 a	0.408 b
$LSD_{(0.05)}$	4.69	1.077	0.291

The fruit weight continued to increase with increased thinning intensity, and the minimum fruit weight of 15.93 g in control increased to the maximum of 26.61 with 40% thinning followed by 26.16 g with 35% thinning (Table 1). However, the difference between fruit weight of 40 and 35% was nonsignificant. Overall, the increase in fruit weight with 40% thinning was 1.67 fold higher than control. The maximum fruit weight was due to greater growth and can be taken as an indicator of assimilate utilization, which is the result of its sink strength (Marcelis, 1996). The increase in fruit size/weight with increased thinning intensity indicates greater availability of nutrients for fruit growth and development (Tahir & Hamid, 2002; Southwick & Yeager, 2005; Peter & Abraham, 2007) and subsequent quality (Carlos *et al*., 2006).

The fruit yield per branch decreased with increasing intensity, and it was significantly less when thinning intensity was beyond 25%. The increased size due to thinning up to 25%, seems to be the right thinning intensity where increased size may compensate the yield of fruits removed by thinning (Naor *et al*. 1997, 1999). Heavy thinning beyond 25% decreased fruits number to such level where increased fruit size could not restore the yield losses (Rettke, 2005).

Total soluble solids (brix): The total soluble solid (TSS) content is an important constituent of fruit quality. The TSS continued to increase significantly with increased thinning intensity. Highest total soluble solid (16%) was recorded with 40% thinning followed by 35% thinning (14.13%), while the minimum TSS of 11.79% was recorded in control, and the same findings also mentioned by Tahir & Hamid, (2002). Thinning promotes greater supply of carbohydrates (Sucrose, Glucose, fructose and sucrose) to reaming fruits which eventually increase the total soluble solids contents (Link, 2000; Carlos *et al*., 2006).

Percent acidity, juice pH and ascorbic acid contents: The acidity was lowest (1.65%) with 40% thinning while maximum acidity (2.65%) was recorded in control followed by 10% thinning (2.35%). The juice pH followed a predictable trend to that of percent acidity, and was maximum (3.76) in 10% thinning followed by control (3.71). The juice pH decreased to minimum of 3.44 with 40% thinning (Fig. 1). The fruit acidity decreased with a concomitant decrease in pH as the fruit advances in maturity, thinning seems to delay maturation process by slowing down decrease in acidity of apricot fruits (Tahir & Hamid, 2002).

Thinning enhanced the ascorbic acid content of fruit and the minimum ascorbic acid (0.55%), recorded in control increased to maximum of 0.9710% with 40% thinning (Tahir & Hamid, 2002). Ascorbic acid is an important nutritional component of fruits that provides protection against various chronic diseases related to oxidative stress (Mark *et al*., 2002). The enhanced ascorbic acid contents with thinning may add further to quality of thinned fruits (Fig. 1).

Reducing sugar, non-reducing sugar and sugar acid ratio: Maximum reducing sugar (1.31%) was recorded in 40% thinning, followed by 35% thinning (1.28%), while the minimum reducing sugars (0.96%) was obtained in control fruits. The non-reducing sugars were also significantly affected by thinning (Table 2) and maximum non-reducing sugar (10.40%) was found in 40% thinning, followed by 35% thinning (10.16%), while minimum (8.07) was found in control (Table 2). Thinning process decreased the number of fruits which act as active sinks for carbohydrates (Meland, 2009), thus, ensure ample nutrient supply to remaining fruit. Thinning, therefore, results in not only rapid growth and increased fruit size and weight, but also encourage total soluble solid, reducing and non-reducing sugar (Tahir & Hamid, 2002). The increased sugar contents resulted in increased sugars acid ratio with increased thinning intensity, and the minimum sugar acid ratio in control fruits (3.045) increased to the maximum of 6.303 with 40% thinning (Link, 2000). Fruits with high sugar/acid ratio tend to be sweet in taste which confirms that thinning may also contribute to taste of apricot fruit.

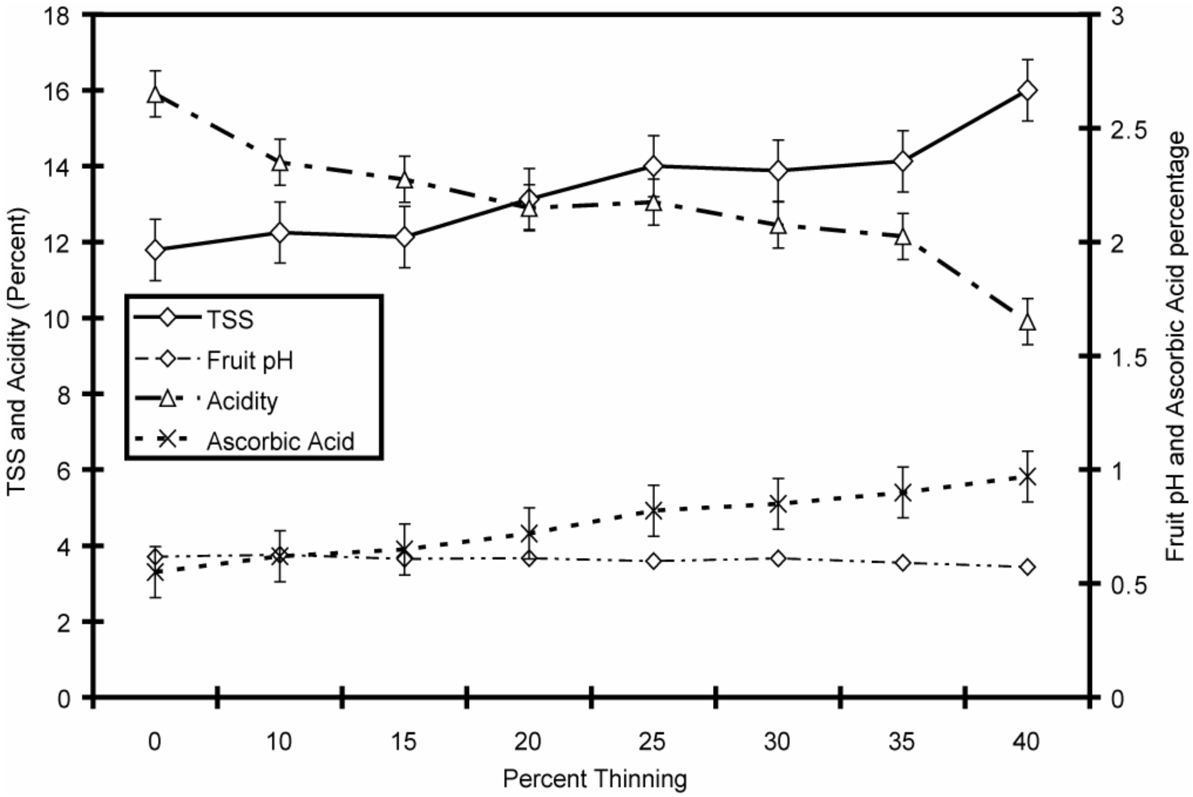

Fig. 1. Influence of thinning intensity on TSS, acidity, juice pH and ascorbic acid content of apricot fruit.

Table 2. Effect of fruit thinning on reducing, non reducing sugar and acid sugar ratio of apricot cv. Trevett.

Thinning (%)	Reducing sugar	Non-reducing sugars	Sugar acid ratio (%)
0 (Control)	8.07 e	0.96 e	3.045 c
10	9.63 d	0.99 de	4.098 bc
15	9.35 cd	1.10 cd	4.110 bc
20	9.04 d	1.14 bc	4.205 bc
25	9.73 bc	1.10 cd	4.474 b
30	9.85 abc	1.17 bc	4.747 b
35	10.16 ab	1.28 ab	5.017 ab
40	10.40 a	1.31 a	6.303 a
$LSD_{(0.05)}$	0.615	0.139	1.337

Conclusion

Results revealed that mild thinning (25%) caused nonsignificant decrease in yield but increasing thinning intensity beyond 25% caused significant reduction. The decrease in yield with modest thinning may be compensated by larger fruit size and superior quality due to higher TSS, sugars and ascorbic acid contents. Thinning might also delays fruit maturity by retaining acidic pH resulting in superior sugar acid ratio.

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