Effect of Fruit Thinning on Fruit Growth and Profitability in ‘Irwin’ Mango Cultivation under Greenhouse

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Introduction

In Japan, mango fruit production has increased gradually. The cultivation area has, so far, been restricted to warm areas in the southwestern region, where ‘Irwin’ is exclusively grown. This cultivar exhibits high-yielding properties, but bears a large number of small seedless fruits. In mango, fruit size is considered to be one of the major factors that determine the income of the growers. The larger the fruit, the higher the financial return to the orchard grower. Development of practical techniques which enhance fruit growth should be promoted for increasing the profitability of mango growing.

Crop load regulation by thinning enables to increase the fruit size or to advance fruit ripening, as well as to control alternate bearing in fruit trees. Therefore, fruit thinning has long been practiced in temperate fruit trees such as apple, peach and grape to improve the yield, fruit quality and marketability. In mango, thinning is expected to increase the fruit size because a larger number of leaves per fruit resulted in the increase of the fruit weight. In practice, small seedless fruits are thinned in ‘Irwin’ mango-growing. However, the effect of fruit thinning on fruit growth has not been well known. In this study, the difference in the fruit weight, distribution of fruit weight, yield per tree and sugar content between thinned and non-thinned trees were compared to confirm the effectiveness of fruit thinning in ‘Irwin’ mango trees.

Materials and Methods

This experiment was conducted in 2000 on 4-year-old ‘Irwin’ mango trees grown in a greenhouse at the experimental farm of Kinki University, Yuasa, Wakayama Prefecture. Ten trees were selected randomly from 120 trees at the end of physiological fruit drop. The trees were thinned or not thinned (control), and 5 trees were used in each case. The number of fruits was different among trees used for this study just after the time of physiological fruit drop (Table 1). Thinning was conducted on July 2, 15 and August 3, and smaller fruits were picked off at first and two or three fruits were remained on a cluster. Finally the number of fruits was reduced by half on each thinned tree. Average number of fruits per tree was 24.4 and 43.2 in the thinning treatment and in the control, respectively, on August 12. A few fruits dropped until harvest in some treated and untreated trees.

Fruits whose skin turned red were harvested and weighted immediately. Then the fruits were stored at 25°C for 2 or 3 days to become fully ripened. The content of total soluble solids in the juice of the ripened fruits were determined with a refractometer. The fruits were classified
by their weight and the income earned by selling them was estimated in reference to the shipment price. The shipment price, which depends on the fruit weight, skin color and time of harvest, was 1,100–1,500 yen per kg for 200–399g fruits and 1,800–2,000 yen per kg for more than 400g fruits in this season.

**Results and Discussion**

There was no appreciable difference in the harvest time of fruits between the treated and untreated trees (Fig. 1), which indicates that the pattern of fruit growth was not affected by thinning. At the time of thinning, as the number of harvested fruits and yield fluctuated considerably among the trees, the results are shown for each tree (Table 1). As a whole the number of harvested fruits on the non-thinned trees was about twice as large as that on the thinned ones, and the total yield was higher in the non-thinned trees. In some cases, however, the fruit yield of the thinned trees No. 4 and No. 5 was nearly the same as that of the non-thinned trees No. 3 and No. 4, respectively, in spite of the lower number of harvested fruits, indicating that fruit growth was enhanced by thinning. The average fruit weight was 446g and 319g for the thinning treatment and the control, respectively. As a result, the total yield weight of the thinned trees was 78% of that of the non-thinned ones. In peach⁴) and kiwi fruit⁵), the fruit size increased with the decrease in the number of fruits on the tree. Our results showed that thinning of small fruits promoted the fruit growth of 'Irwin' mango. Increase in fruit size alleviated the reduction of yield caused by the decrease in the number of harvested fruits in the thinning treatment.

The number of fruits weighing 400–500g was highest among the harvested fruits in the treated and untreated trees, and a higher number of large-sized fruits, weighing more than 500g, was obtained by thinning (Fig. 2). On the thinned trees, larger fruits weighing more than 400g accounted for more than 80% of the yield, but the ratio of such larger fruits was about 45% of that in the non-thinned trees. Many small fruits, less than 200g, remained until harvest on the

<table>
<thead>
<tr>
<th>No. of fruits</th>
<th>Harvest date</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>0</td>
<td>10</td>
</tr>
</tbody>
</table>

Fig. 1 Cumulative number of fruits at harvest time on thinned and non-thinned trees

Fig. 2 Number of harvested fruits rated by their weight on thinned and non-thinned trees

<table>
<thead>
<tr>
<th>Tree no.</th>
<th>No. of set fruits</th>
<th>No. of dropped fruits</th>
<th>No. of harvested fruits</th>
<th>Total yield (kg)</th>
<th>Estimated income (¥)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>24</td>
<td>3</td>
<td>21</td>
<td>8.41</td>
<td>15,200</td>
</tr>
<tr>
<td>2</td>
<td>25</td>
<td>3</td>
<td>22</td>
<td>7.94</td>
<td>14,800</td>
</tr>
<tr>
<td>3</td>
<td>48</td>
<td>1</td>
<td>47</td>
<td>12.94</td>
<td>23,200</td>
</tr>
<tr>
<td>4</td>
<td>51</td>
<td>2</td>
<td>49</td>
<td>16.44</td>
<td>28,000</td>
</tr>
<tr>
<td>5</td>
<td>68</td>
<td>3</td>
<td>65</td>
<td>19.43</td>
<td>34,800</td>
</tr>
<tr>
<td>Total</td>
<td>216</td>
<td>12</td>
<td>204</td>
<td>65.16</td>
<td>116,000</td>
</tr>
<tr>
<td>Ave.</td>
<td>43.2</td>
<td>2.4</td>
<td>40.8</td>
<td>13.03</td>
<td>23,200</td>
</tr>
</tbody>
</table>

Table 1. Number of set, dropped and harvested fruits, total yield and estimated income for thinned and non-thinned trees.
non-thinned trees. On the other hand, only a few such small fruits were included in the harvested fruits on the thinned trees.

The difference in the shipment price of fruits between the treated and untreated trees in spite of the reduction of total yield on the thinned trees was not appreciable (Table 1). This was due to high ratio of large-sized fruits in the harvested fruits caused by thinning. On the thinned trees, most of the fruits exhibited an economic value while on thenon-thinned trees, about 20% of the harvested fruits were not marketable, indicating that the production of large-sized fruits by thinning is more beneficial for the mango growers.

The contents of total soluble solids of the fruits on the thinned trees were 15.7 and those on the non-thinned ones were 14.8, indicating that thinning increased the sugar content in ‘Irwin’ mango fruits. Weinberger and Cullin\(^8\) reported that heavy thinning improved the fruit quality of peach. In grape, the total fruit weight decreased by thinning while the total soluble solids contents of berry increased\(^5\). Increase in the total soluble solids contents in mango fruits might be due to considerable decrease in the fruit load on tree associated with thinning.

Lowering the fruit load strongly reduced the yield in cactus pear\(^3\). In this study, the decrease in the number of harvested fruits reduced the total yield, suggesting that thinning more than half of the number of fruits decreased the yield in ‘Irwin’ mango trees. However, since thinning increased the fruit size, comparable income could be obtained by selling fruits from thinned and non-thinned trees. Our results indicate that light fruit thinning which removes small fruits seems to be a suitable practice for enhancing the economic return of mango growers. Further studies should be conducted to determine the optimal thinning ratio for increasing both yield and income depending on the tree vigor, age, and size in ‘Irwin’ mango cultivation in the greenhouse.

**References**