Thinning ‘Golden Delicious’ apple with the photosynthetic inhibitor metamitron – A different approach

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The problem

Small fruit size and alternate bearing are limiting factors in marketing apples.

To improve fruit size and reduce alternate bearing it is necessary to reduce crop load.

Since hand thinning is not practically and very costly a few alternatives of chemical thinning were developed. All of them are based on synthetic auxins (NAD, NAA) or Cks (BA).
The general mode of action of each group:

**Auxins**: Induce Ethylene $\rightarrow$ increase activity of hydrolitic enzymes $\rightarrow$ cell wall destruction in the AZ $\rightarrow$ abscission

In addition they have **direct** effect on the embryo abortion, and **indirect** effect by increasing respiration which reduces assimilates for developing fruitlets.
The general mode of action of each group:

**Cks**: Indirect effect by enhancing vegetative flush → temporary deficit of assimilates to the young fruitlets → abscission
The objective

Evaluate the photosynthesis inhibitor Brevis (contain 15% MM) as a thinner of apple fruitlets.
As a result of MM treatment (and photosynthesis decreasing) the assimilates are reduced exactly at the stage of great demand for them by the developing fruit → the abscission begins
The first to be damaged are the small and weak lateral (L) fruitlets according to the hierarchy of development.

Botton et al., 2011 (Plant Physiology)

Signaling Pathways Mediating the Induction of Apple Fruitlet Abscission

C= Central flower (King)
L= Lateral flower (1-3)
**Expt. 1 (2012)**

3 concentrations of Brevis (MM) were applied by hand-gun sprayer (1 L/tree) at:

- FB+7 (5-mm KFD = stage I)
- FB+14 (10-mm KFD = stage II)
- both stages (I+II)

**The concentrations were:**

1. 90 ppm MM = 0.06% Brevis
2. 120 ppm MM = 0.08% Brevis
3. 150 ppm MM = 0.1% Brevis
The highest concentration of 150 ppm MM (0.1% Brevis) at the early stage of FB+7 (5-mm KFD) was the optimal treatment. It reduced the fruit no./tree by ~ 40% (444 → 279) and caused significant shift to higher yield of large fruit.
The flowering intensity and yield at the following year (2013) was higher in the optimal treatment from 2012.
Expt. 2 (2013) –
Semi commercial study

On 2013 we conducted a semi-commercial trial with air-blower sprayer (1,300 l/ha)

We increased the concentration from 150 to 190 ppm MM (0.125% Brevis) and tested also double application (I+II)
Expt. 2 (2013)

Treatments:
1. 190 ppm MM (0.125% Brevis) at FB+7 (I)
2. 190 ppm MM (I) + 120 ppm MM (II)
3. Control
Fruit size distribution (Ortal 2013)
Expt. 3 (2014)

Objectives:

a). Semi-commercial experiment (in other orchard) with higher concentrations of MM.

1. 150 ppm MM (0.1% Brevis) at FB+7
2. 190 ppm MM (0.125% Brevis) at FB+7
3. 230 ppm MM (0.15% Brevis) at FB+7
Objectives:

b). Measuring the photosynthesis efficiency of leaves, using the Fv/Fm ratio

The measured florescence level is higher as the photosynthesis efficiency is reduced and the Fv/Fm ratio is lower.

The measurements were done every other day from 1 d before treatment (FB+6) until 10 d later at the end of the night (4:00-5:00 a.m.).
Expt. 3 (2014)

Objectives:

c). Find out the correlation between MM treatment and initial fruit-set percentage (3 weeks AFB), yield and fruit size distribution.
Results 2014
Fv/Fm ratio after treatment with MM 2014

![Graph showing Fv/Fm ratio over days after bloom with different treatments labeled. The graph compares control, MM 180, MM 225, and MM 270 treatments.](image-url)
The correlation between Fv/Fm ratio to fruit set percentage, 2014
## GD 2014

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Hand thinning (min/tree)</th>
<th>Yield (kg/tree)</th>
<th>Fruit (no./tree)</th>
<th>Fruit size distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Small (&lt;=65)</td>
</tr>
<tr>
<td>Control</td>
<td>24 a</td>
<td>119 a</td>
<td>932 a</td>
<td>63 a</td>
</tr>
<tr>
<td>Brevis 0.1%</td>
<td>22 ab</td>
<td>123 a</td>
<td>1010 a</td>
<td>74 a</td>
</tr>
<tr>
<td>Brevis 0.125%</td>
<td>17 ab</td>
<td>111 a</td>
<td>858 a</td>
<td>55 ab</td>
</tr>
<tr>
<td>Brevis 0.15%</td>
<td>13 b</td>
<td>90 a</td>
<td>665 a</td>
<td>34 b</td>
</tr>
</tbody>
</table>
Conclusion

1. Early and single application (FB+7 = 5 mm KFD) with 190-230 ppm MM (0.125-0.15% Brevis at 1,300 l/ha) reduces the photosynthesis efficiency and demonstrates good thinning effect: improves fruit size distribution and reduces alternate bearing.
Conclusion

2. The strong effect of MM in Israel, which might be related to the higher night temperatures (increase dark-respiration) and day temperatures (increase efficiency of MM) enable us to use lower dose of MM compare to the colder areas like Europe and USA.
Thank you