Foliar applications of Zinc and Potassium to increase yield by reducing fruit drop in Hamlin oranges

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Fruit drop is a natural developmental process that may be influenced by other causes.
HLB is a major cause of increased preharvest fruit drop
Other possible causes?

- **Endogenous**
  - Loss of root density
  - Altered hormonal balance
  - Off blooms

- **Exogenous**
  - Other diseases
  - Warmer and drier than normal weather

These factors may interact. All related to HLB.
Fruit retention in healthy Hamlin and Valencia trees

<table>
<thead>
<tr>
<th>Days</th>
<th>FDF (Kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sept</td>
<td>0</td>
</tr>
<tr>
<td>Oct</td>
<td>2</td>
</tr>
<tr>
<td>Nov</td>
<td>4</td>
</tr>
<tr>
<td>Dec</td>
<td>6</td>
</tr>
<tr>
<td>Jan</td>
<td>8</td>
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<table>
<thead>
<tr>
<th>Days</th>
<th>FDF (Kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>10</td>
</tr>
<tr>
<td>Feb</td>
<td>12</td>
</tr>
<tr>
<td>Mar</td>
<td>14</td>
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</tbody>
</table>

High competence for resources

Auxins

Main bloom

Natural senescence starts

PLA2 activation

Fruit senescence and drop (the right signal at the right time)
A hormonal switch triggers lipid signaling and abscission via phospholipid degradation.

Fruit maturation and senescence

IAA/ABA * ratio decreases in mature fruit

ABA *

Abscission and fruit drop

*possible signals

A possible signal that might be involved in the process is the report by Alferez and Burns, 2012.
Pathogens
Osmotic stress
Water stress
Nutrient deprivation
Hormones

AT

PLA₂
PLA₁
PA
LysoPA
PLD

LPE

catabolism
signalling

Massive membrane degradation
Resistance

Loss of quality, senescence, abscission and fruit drop

Head group
P
sn-1
sn-3

glycerol

Fatty acid

PLD
PLC
PLA₁
PLA₂

Alferez et al., PBT 2008
The situation under HLB
Environmental stress

Spring flush

Summer flush

Fall flush

Off blooms

The wrong signal at the wrong time

Massive preharvest fruit drop

Fall-Winter harvest
Diversity of developmental stages affects hormonal interactions within the tree.

The wrong signal at the wrong time
But we can’t use AT or TIBA in our groves.

What can we do?

Auxins are the signal

Fruitlets are the sender

Interfering the message

AT, competitive inhibitor of PLA2
TIBA, Auxin transport inhibitor
Zn may modulate fruit physiology and retention. K increases fruit quality.
Our hypothesis: Auxin levels must be maintained high to avoid fruit abscission triggering and drop.

Auxin levels maintained $\rightarrow$ No abscission/no fruit drop

Fruit maturation

Auxin levels transiently increase to decrease thereafter $\rightarrow$ Abscission/fruit drop
Zn and K treatment in Hamlin on US942

- ZnSO4 (50 grams per tree, foliar spray)
- K2SO4 (60 grams per tree, foliar spray)
- ZN+K combined treatment

3 applications:
- After fruit set and physiological drop (early June)
- Fruit enlargement phase (July)
- Fruit color break (September)

50 grams (0.11 pounds) / 1 gallon of water
218 trees/acre planted at 25x8 ft
24 pounds per acre
Auxin levels are increased and maintained with treatments

Treatment (p = 0.0506)
Date (p < 0.0001)
Treatment x Date (p = 0.4099)
Fruit drop reduction after 2 years of treatments

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Fruit drop (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>50</td>
</tr>
<tr>
<td>Zn</td>
<td>40</td>
</tr>
<tr>
<td>Zn+K</td>
<td>30</td>
</tr>
<tr>
<td>K</td>
<td>20</td>
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</tbody>
</table>
## Yield

<table>
<thead>
<tr>
<th></th>
<th>Boxes/acre</th>
<th>% increase</th>
<th>2021</th>
<th>% increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>197</td>
<td></td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>Zn</td>
<td>216</td>
<td>10%</td>
<td>236</td>
<td>18%</td>
</tr>
<tr>
<td>Zn+K</td>
<td>240</td>
<td>22%</td>
<td>263</td>
<td>31%</td>
</tr>
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</table>
Conclusions and future work

• Zn and K combined increase yield in Hamlin by reducing fruit drop.
• These effects depend on the time of application.
• Independent treatments and harvests will help us to identify the best treatment dates and will likely increase yield beyond 31%