Thiabendazole Reduces Chilling Injury (Pitting) of Cyprus-grown Grapefruit

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Abstract. Thiabendazole (TBZ) incorporated in the wax coating at 2000 ppm, considerably reduced chilling injury of Cyprus-grown grapefruit during storage for 102 days at 8°C plus 34 days at 7°C.

Chilling injury (CI) is expressed as dark sunken surface lesions on the peel of grapefruit (pitting) stored at low temperatures for prolonged periods. CI has been associated with a breakdown of the ATP/ADP energy transfer system (4, 5) and reduced by high levels (10%) of CO₂ (4). It was prevented when grapefruit were covered with films of polyvinylchloride and cast vinyl for a month at 4.5°C (5). Shiffman-Nadel et al. (3) demonstrated that incorporation of TBZ in a wax coating significantly reduced the amount of low temperature pitting during prolonged storage at 8°C and 12°C. TBZ has also been found effective against postharvest citrus pathogens (1, 2).

The purpose of this study was to determine the effect of TBZ on CI of grapefruit grown under Cyprus conditions.

'Marsh Seedless' grapefruit were harvested at the Morphou Experimental Station of the Agricultural Research Institute when the Brix value by refractometer was 11.3° and citric acid 2.3%. The day after harvest, 800 fruit were randomly sorted into 40 telescope cartons. Fruit in 20 cartons were coated with "Sivadar" wax using a hand mist sprayer; those in the remainder were coated with "Sivadar" wax mixed with 2000 ppm TBZ. Cartons were subsequently paired and placed randomly by side in 4 stacks. Storage temp was 8°C for 102 days followed by 7°C for 34 days. Relative humidity of the room was 80 to 85% but in the cartons it was higher. The top 4 pairs of cartons were visually examined once a month for CI. All grapefruit were examined at 116 days and 136 days, then after 3 and 7 days at 27°C to 30°C. Fruit was considered

Table 1. Effect of TBZ on the percentage pitting and decay in 'Marsh Seedless' grapefruit.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>102 days at 8°C</th>
<th>102 days at 7°C</th>
<th>+ 3 days at 27°C</th>
<th>+ 7 days at 27°C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pitting (%)</td>
<td>Decay (%)</td>
<td>Pitting (%)</td>
<td>Decay (%)</td>
</tr>
<tr>
<td>Wax</td>
<td>7.75</td>
<td>4.25</td>
<td>29.00</td>
<td>7.5</td>
</tr>
<tr>
<td>TBZ in wax</td>
<td>0.50***</td>
<td>0.75</td>
<td>8.25***</td>
<td>0.75</td>
</tr>
</tbody>
</table>

*; **; ***Significant at 5% (*); 1% (**:); 0.1% (**).
as chilling injured when one pit of 5 mm² or larger was observed on the surface. The paired “+” test was used to analyze the data (Table 1).

TBZ incorporated in wax at 2000 ppm reduced CI and decay during and after cold storage. CI was generally light, less than 5 pits per fruit, upon removal of fruit from cold storage. The Brix value was 11.5⁰ and the citric acid 1.8%. The Brix/citric acid ratio was thus increased from 4.9 at harvest time to 6.4 after cold storage. Appearance of the fruit was very good after storage but the flavor was not as good, probably due to the loss of acidity. There was no difference in taste between TBZ-treated and wax-treated grapefruit.

### Literature Cited

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### Table 1. Effect of terbacil and fertilizer management on yield of lowbush blueberries.

<table>
<thead>
<tr>
<th>Treatment (kg/ha)</th>
<th>Blueberry yield (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>168 N(1-2-2)</td>
</tr>
<tr>
<td>2.24</td>
<td>168 N(1-2-2)</td>
</tr>
<tr>
<td>3.58</td>
<td>168 N(1-2-2)</td>
</tr>
<tr>
<td>7.17</td>
<td>168 N(1-2-2)</td>
</tr>
<tr>
<td>2.24</td>
<td>Unfertilized</td>
</tr>
<tr>
<td>3.58</td>
<td>56 N(1-2-2)</td>
</tr>
</tbody>
</table>

²Mean separation by Bayes LSD, ratio 100 (approx 5% level).

Fifty-six kg N/ha from 1-2-2 fertilizer in combination with terbacil at 3.58 kg/ha increased blueberry yield when compared to non-fertilized stands receiving 2.24 kg/ha terbacil treatment. This yield, however, did not differ from that obtained from blueberry stands receiving 168 kg N/ha from 1-2-2 fertilizer without terbacil treatment. Plots receiving fertilizer treatments without terbacil had excessive weed growth and were difficult to rake.

In native lowbush blueberry stands in which herbaceous flowering weeds were not abundant and perennial grasses and sedges were the principal herbaceous weeds, terbacil in combination with high fertility management doubled yields.

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**Terbacil and Fertility Effects on Yield of Lowbush Blueberry**

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Abstract. Terbacil (3-tert-butyl-5-chloro-6-methylpyridazin) at either 2.24, 3.58 or 7.17 kg/ha applied under high fertility level (168 kg N/ha from 1-2-2 formulation) significantly increased yield of lowbush blueberries (Vaccinium angustifolium Ait. and V. Myrtillodes Willd.). No yield differences were observed among terbacil rates. Rate of fertilizer application affected berry yield.

Blueberries are commercially harvested in Maine, the Maritime Provinces and the Province of Quebec from native lowbush blueberry stands. The presence of numerous native and introduced plant species, including grasses, sedges and herbaceous flowering weeds, constitutes a serious weed problem. To prevent excessive growth of weeds, growers have traditionally adopted low fertility management, thereby restricting yields of blueberry fruit (1, 3). The need for an herbicide that effectively controls grasses and sedges is a major concern of the lowbush blueberry industry.

In 1972 Trevett and Durgin (2) reported that, in native lowbush blueberry stands, terbacil controlled perennial grasses and sedges. In 1973, they reported that, for the year of application, terbacil gave control of the following flowering weeds in lowbush blueberry fields: yarrow (Achillea millefolium L.), hawkweed (Hieracium pratense Tausch.), rattle weed.

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1 Received for publication, April 15, 1974. This research was supported by a grant from Maine Blueberry Industry Board.
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