of the ethylene gas on the cytokinetic stage of endosperm development. Apparently, peach fruits in the stage of endospermic cytokinesis are more sensitive to ethylene than fruits in the pre- or post-cytokinesis stage (4, 10).

Other aspects of fruit development, such as increased maturity and fruit color, were also found to be affected by Ethrel and are attributed, as shown elsewhere, to be a response to ethylene stimulation (2, 8, 10).

Leuty and Bukovac (9) reported increased amounts of auxin present in peach seeds during the cytokinetic period and cites other work indicating that the endosperm tissue in the seed is the primary source of this auxin. Upon finding a high amount of auxin in the peach seeds at cytokinesis and finding a low concentration of auxin-destroying enzyme, IAA-oxidase, they proposed that any factor which might alter the auxin-enzyme balance could cause embryo abortion and abscission.

Ethrel has been found to release ethylene gas in the presence of plant tissue and promote the abscission of many different plant organs (1, 6, 12). Ethylene is a natural product of organs undergoing abscission (5) and is one of the more potent abscission accelerants (1, 5, 6). It has been suggested that the role of ethylene in senescence and abscission could be partially through an inhibition of auxin synthesis and stimulation of auxin destroying enzymes (5). However, a direct effect of ethylene on embryo abortion has not been ruled out since this is also a type of abscission.

LITERATURE CITED

PEACH FRUIT MATURITY AS INFLUENCED BY GROWTH REGULATORS
G. F. Martin2, D. W. Buchanan and R. H. Biggs
Department of Fruit Crops
University of Florida
Gainesville

ABSTRACT
Growth regulating chemicals were applied to 'Maygold' and 'Flordasun' peach trees to test their influence on fruit development and maturity. 2-Chloroethyl-phosphonic acid (Ethrel) treatment resulted in substantial acceleration of maturity and enhanced color without adversely affecting quality. Treatments of 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) increased yield at early harvest dates and increased red color, but the red coloration was splotchy. Fruit firmness and storage life were not changed by 2,4,5-T treatments. Neither N6-benzyladenine (BA) nor naphthaleneacetamide (NAD) caused any definite changes in the maturity indices measured. Gibberellic acid (GA) reduced yields and indicated trends of delaying maturity.

INTRODUCTION
Low chilling varieties of peaches adapted to Florida conditions produce small, poorly colored
Applications of chemical growth regulators have been shown to influence the fruit growth, maturity rate, color, size, soluble solids, firmness, and storage quality of peaches (5, 7, 10, 11, 12, 14) and other fruits (1, 2, 3, 4, 8). The Florida peach industry would benefit if these chemicals could be used dependably to induce early ripening and improve size, color, and quality of peach fruit. The purpose of these experiments was to investigate the influence of some growth regulating chemicals on maturity and color.

**Materials and Methods**

In April 1968, sprays of chemicals were applied to 5-year-old 'Maygold' peach trees on 'Elberta' seedling rootstock in a commercial orchard near Greenville, Florida. Some of the trees at the site of the experiment were in poor condition; only those that appeared healthy and vigorous were used.

The 1968 experiment consisted of 2 parts. The first, which included treatments 1 through 5 (Table 1), was designated Experiment 1. Treatments were randomly assigned to trees within the chosen area, and each chemical treatment was applied to 10 trees. An equivalent control (Check-1) was established. The second part, Experiment 2, included treatments 6 and 7 (Table 1) and a control (Check-2). Treatments were applied to 6 randomly assigned trees in rows adjacent to those of Experiment 1. Inadequate commercial thinning made it necessary to eliminate a number of poorly thinned trees from the experiment, resulting in varying numbers of trees per treatment (Table 1). Check-1 and Check-2 had 7 and 6 trees, respectively.

The fruit was harvested commercially on May 29 and 31. Pickers were instructed to select only fruit that were 2" in diameter or larger. Fruit from the first 2 harvest dates, May 29 and May 31, was used. Determinations were made as follows: fruit diameter; yield as weight and number of fruit; fruit firmness as pounds using a Magness-Taylor type pressure tester with a 5/16" plunger head; surface color as galvanometer deflection (d "a") from a red standard plate (d "a"=0) with a Hunter Color and Color Difference Meter; (9) storage life at 40°F.; and % total soluble solids using a Bausch and Lomb refractometer.

Experiments 1 and 2 were combined for analysis where homogeneity of variances was shown and controls were not statistically different as determined by Student's "t" test (13). This was the case for all variables except yield data (Figs. 1, 2). Tests for significance were analysis of variance and Duncan's multiple range comparison of unequal samples (13).

In March 1969, a similar experiment was conducted, using the chemicals that gave the most promising results for advancing and delaying fruit maturity. Alar (N-dimethylaminosuccinamic acid) was also used. Thirty and 50 ppm of Ethrel, 50 ppm of GA, and 2000 ppm of Alar were applied at the pit-hardening stage to 5 trees each of 'Flordasun' variety near Brooksville. This, with a 5 tree control (Check-3), was designated Experiment 3. Fruit from the first harvest were tested. The criterion for harvest was color. All measurements were as described for Experiment 1 and 2.

**Results and Discussion**

**Size of Harvested Fruit**

Mean diameter of all fruit harvested was 2.07". There was no significant difference in fruit size between treatments; however, this was expected, since the pickers were instructed to harvest only fruit of 2" or greater in diameter. Fruit size difference could then be inferred from yield data of fruit of acceptable size for harvest (Table 1) which indicated that 2,4,5-T and Ethrel induced earlier fruit sizing, and that GA delayed fruit sizing.

A significantly smaller number of fruit were harvested from trees treated with GA alone or in combinations with other chemicals than from the check in Experiment 1; however, this was not the case in Experiment 3, where no differences were found between GA and check. The latter was probably because of the later application, i.e., at pit hardening. The treatments with BA and NAD also yielded less fruit, but the results were not as striking (Fig. 1). In Experiment 2, the 2,4,5-T treatment yielded 150% more fruit than Check-2, and the Ethrel treatment produced 90% more fruit than the check, but only the former was statistically greater, due possibly to the large within-treatment variation (Fig. 1). In Experiment 3, the 50 ppm Ethrel treatment was the only one showing a significantly larger yield than Check-3 (Fig. 2). The increased yield from the Ethrel treatment was due to an earlier size increase associated with earlier maturity. This was in agreement with
Table 1. — Dates of spray applications

<table>
<thead>
<tr>
<th>Chemical and concentration (ppm)</th>
<th>Number of trees per treatment</th>
<th>1 April&lt;sup&gt;1&lt;/sup&gt;</th>
<th>13 April&lt;sup&gt;2&lt;/sup&gt;</th>
<th>25 April</th>
<th>30 April&lt;sup&gt;3&lt;/sup&gt;</th>
<th>14 May</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. GA (30)</td>
<td>6</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. BA (30)</td>
<td>8</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. GA (30) + BA (30)</td>
<td>6</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. GA (30) + NAD (25)</td>
<td>4</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. BA (30) + NAD (25)</td>
<td>6</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. 2,4,5-T (50)</td>
<td>6</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Ethrel (30)</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

<sup>1</sup>50% petal fall.  
<sup>2</sup>60% calyx split.  
<sup>3</sup>Early pit hardening stage for 50% of fruit.

Scott and Rom (79), who found that weight and length of peace fruit were increased with Ethrel application. A direct comparison between the yield data from Experiment 1 and Experiment 2 is not statistically valid because of the differences in the 2 variances.

It will be noted, however, that the yields of the Ethrel and 2,4,5-T treatments in Experiment 2 were much greater than those in any of the treatments in Experiment 1.

Response to Ethrel in 1968 experiments Fig. 3) and in 1969 (Fig. 4) corroborated the previous report (12) that this compound produced significantly softer fruit than other treatments. Fruit from the Alar treatment were firmer than the check fruit, and GA showed no influence. Reports of softer fruit resulting from 2,4,5-T (14) were not supported by these data.

Color measurements were not made in Experiment 1. Visual examination showed that none of these treatments compared favorably with fruit treated with Ethrel in Experiments 2 or 3. Both Ethrel and 2,4,5-T treated fruits in Experiment 2 were redder in surface color than the Check-2 fruit Fig. 5). Visual observation indicated that Ethrel-treated fruit was uniform in color development; whereas, 2,4,5-T-treated fruit was unevenly colored, sutures and tips being dark red, adjacent areas yellow and

![Fig. 1.—The effect of Ethrel, 2,4,5-T, GA, BA, and NAD on the number of fruit harvested at the first 2 harvest dates (May 29th and May 31st) in 1968. Means not having like letters differ statistically at the 5 percent level.](image-url)
much russetting all over. Perhaps this uneven color development was due to differential anthocyanin formation rather than a response to general fruit ripening stimulated by 2,4,5-T as previously proposed by Crane (4) for apricots. The 2,4,5-T-treated fruit were more intensely colored than the Check-2 fruit only at the first harvest, but coloration with Ethrel treatment was similar at both harvests. In 1969, Ethrel again caused a more intense red color, but only the 50 ppm treatment was significantly different from the control (Fig. 6).

Storage Life

Samples of fruit from each treatment were placed in cold storage at 40°F after each harvest in 1968. Fruit was inspected on June 5 and 12. Data show that treatment with Ethrel resulted in significantly lower percentages of sound fruit after 7, 12, and 14 days in storage. Other treatments were similar to Check-1 and Check-2. Greater deterioration in storage of fruit treated with Ethrel was expected since this fruit was significantly less firm hence more mature at time of harvest (Fig. 3).

Percent Total Soluble Solids

Total soluble solids were measured for 2,4,5-T, Ethrel, and Check-2 fruits on both harvest dates of the 1968 experiment. Average total
soluble solids was 10.71%. The greatest difference between treatments, 0.8%, was not significant. This was not in agreement with reported changes in sugar content resulting from applications of 2,4,5-T and Ethrel (6, 12) and may have been due to varietal response, sampling procedure or some other undetermined factor.

Figure 5.—Effect of Ethrel and 2,4,5-T on red-surface color of fruit harvested May 29th, May 31st, and the average of the 2. Means not having like letters differ statistically at the 5 percent level.

**Fruit Maturity**

Yield data indicated that 2,4,5-T caused the fruit to achieve maximum size earlier but none of the other data gave evidence of an acceleration in ripening. Hardening of ripening is, however, regarded as one of the responses to Ethrel treatment and all of the maturity indices measured here indicate that Ethrel-treated fruit did mature earlier than any other treatment. Storage life data showed no effect of GA, but a trend toward delayed fruit development was indicated by yield and fruit firmness data. There was no evidence of the influence of GA or NAD on fruit maturity.

**Summary and Conclusions**

Spray application of 2,4,5-T advanced the date that acceptable fruit size was attained but a general fruit ripening response was not indicated. Ethrel-treated fruit ripened earlier, indicating a possible commercial potential for this chemical. An indication of delayed maturity due to GA applications was shown but results were not conclusive. The possibility exists that GA may be effective in extending the length of the harvest season when applied at early stages of fruit development.

**LITERATURE CITED**

TREE HEET FOR FROST PROTECTION OF PEACHES

J. F. GERBER, D. W. BUCHANAN AND G. R. DAVIS

Department of Fruit Crops
University of Florida
Gainesville

ABSTRACT

A test was made using Tree Heet for frost protection in a young orchard of ‘Early Amber’ peaches on February 19, 1969. The peach orchard was divided into 2 identical 2¼ acre plots. The southern plot was heated while the plot adjoining it to the north was the unheated control. One package of Tree Heet per tree was lit in the test block at 8:45 p.m. and this produced an immediate temperature rise in this plot. A second package of Tree Heet was lit at 10:45 p.m. which produced a second, smaller rise in temperature. An average temperature differential of 2 degrees was maintained between the 2 plots throughout the test period. The value of this protection was proven by the fact that the test plot bore peaches while the fruit was killed in the unheated plot.

INTRODUCTION

To grow peaches successfully in Florida “enough but not too much” cold weather is required. Horticulturists have found that peach varieties require a varying amount of chilling (temperatures at and below 45°) in order to obtain a good break of dormancy and fruit set (2). The average number of chilling hours in Florida ranges from less than 100 in the extreme southern portion to more than 600 in the panhandle. These amounts may vary greatly from year to year (1). The required chilling should be satisfied by the end of January in central Florida and by February 10th in the north portion (8). Peach flower buds will withstand temperatures as low as 20°F at the time they begin to swell while open blossoms are damaged at about 26°-28°. After petal fall temperatures of 28° will usually kill the young fruit. There is no area in Florida with less than a 25% probability that frost or freezing temperatures will occur during the time peaches are vulnerable to frost damage (7). The risk can be greatly reduced, however, by the selection of a warm site. A hilltop location or a slope would be a preferred site temperature-wise for a peach orchard and low pockets should be avoided. Since the risk of frost cannot be entirely eliminated the peach grower should be prepared to employ measures to protect his crop.

A fuel that shows some promise for frost protection of peaches is manufactured by the Mobile Oil Company and marketed under the trade name of Tree Heet. The fuel is sold in 4 pound packages. Each package contains 2 petroleum coke based bricks about the size of ordinary building bricks. They are capped with a special igniter pad, wrapped in waxed paper and sealed in a polyethylene bag.

METHODS OF PROCEDURE

A 4¼ acre orchard of one-year-old ‘Early Amber’ peaches at the University of Florida horticultural unit northwest of Gainesville was divided into 2 identical 2¼ acre plots. The south plot was heated while the one adjoining it to the north was the unheated control. The orchard terrain was nearly smooth but with a gentle