Table 1. Minimum treatments for 100% effect against Caribbean fruit fly larvae in naturally infested guavas, Orlando, Florida, 1975.*

<table>
<thead>
<tr>
<th>Compound</th>
<th>Exposure (hr)</th>
<th>Concentration (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Butyraldehyde</td>
<td>1.5</td>
<td>88</td>
</tr>
<tr>
<td>&quot;</td>
<td>24.0</td>
<td>62</td>
</tr>
<tr>
<td>&quot;</td>
<td>48.0</td>
<td>57</td>
</tr>
<tr>
<td>Valeraldehyde</td>
<td>24.0</td>
<td>17</td>
</tr>
<tr>
<td>Hexanal</td>
<td>7.0</td>
<td>18</td>
</tr>
<tr>
<td>Heptanal</td>
<td>24.0</td>
<td>9</td>
</tr>
<tr>
<td>Nonanal</td>
<td>48.0</td>
<td>1</td>
</tr>
<tr>
<td>Acetone</td>
<td>2.0</td>
<td>176</td>
</tr>
<tr>
<td>&quot;</td>
<td>7.0</td>
<td>176</td>
</tr>
<tr>
<td>Methyl ethyl ketone</td>
<td>2.0</td>
<td>286</td>
</tr>
<tr>
<td>&quot;</td>
<td>7.0</td>
<td>107</td>
</tr>
<tr>
<td>Ethyl acetate</td>
<td>7.0</td>
<td>179</td>
</tr>
<tr>
<td>Ethyl butyrate</td>
<td>24.0</td>
<td>55</td>
</tr>
<tr>
<td>Butyl acetate</td>
<td>1.0</td>
<td>38</td>
</tr>
</tbody>
</table>

*The number of pupae from untreated fruit ranged from 44 to 157 and averaged 63.

effectiveness after exposure for 48 hr at 1.6 ppm. The ketones were effective at high concns for as little as 2 hr. Examples of treatments nearly 100% effective are given in Table 2. Other less effective compounds were ethanol, amyl alcohol, and hexane.

De Greef and Van Sumere (5) who studied respiration of the fungus *Saccharomyces cerevisiae* Hansen, proposed that aldehydes may act as potent uncouplers of oxidative phosphorylation, and this action may also occur in higher organisms. Further work is necessary to establish whether naturally occurring compounds, such as the aldehydes, could be commercially useful to control pests, such as the Caribbean fruit fly. Our results suggest that further investigation is warranted.

**Literature Cited**


**BOD, COD AND TC MEASUREMENTS OF CITRUS PROCESSING WASTE WATER, A COMPARISON**

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**Abstract.** The Biological Oxygen Demand, Chemical Oxygen Demand, and the Total Carbon of the waste water effluent of a citrus processing plant were compared. Equivalent solutions of pectin, sucrose and orange juice were tested in like manner. One citrus processing season was considered. Some statistical evaluations are presented in comparing the three methods of analysis.

The consideration due a waste water treatment plant has risen to the level of an important coprocess for a processing and handling facility, both technically and economically. This has happened because new legal requirements have been established in the last four years and our awareness of the importance that ecology plays has resulted in a more conscientious approach. Accurate methodology to determine the waste loads is necessary to facilitate better control. An existing waste treatment facility now requires a close understanding of the processing and handling procedures to facilitate the best control. Three methods of waste effluent analysis are compared for this consideration.

**Materials and Methods**

The oxygen rate demand for an organic waste to completely support aerobic fermentation is measured by the Biological Oxygen Demand (BOD) (1). This is the official test method for the evaluation of a waste water effluent. It has been in use for over a hundred years and is notably
subject to variations up to 200% with waste load changes in concentrations, components, pH, etc. While this test method is aimed directly at the problems as presented by nature, it is hard to interpret the results for a varying waste profile. Five days are needed for the completion of the test.

The second method, and sometimes used as an alternate to the official method, is the Chemical Oxygen Demand (COD) (2). This test method is complete in its oxidation of waste materials and shows a good duplication of results. It is not sensitive to the same degree or substances as the BOD method, but it does show errors due to inorganic reactions. This method uses a boiling chromic acid solution as the oxidizing agent which entails a serious human hazard. A group of 6 samples may be run in 1 to 2 1/2 hours.

The third method considered here is the Total Carbon (TC). This is a very new procedure by which carbon containing compounds are oxidized in a stream of oxygen and the carbon dioxide resulting is determined by I. R. spectroscopy. It is being accepted officially in some areas. The method measures the total inorganic carbon (CO₂) directly. After complete oxidation it can determine the total carbon. The difference between the TIC and the TC is the total organic carbon (TOC). The method shows an excellent duplication of results (less than ± 3% variation). The time required to finish the determination is about 5 minutes.

**Results and Discussion**

Figures 1, 2 and 3 compare the results of analysis of three substances, a solution of pectin, sucrose and orange juice by the three methods. The COD and TC methods show fair to good agreement while the BOD method shows orange juice to stand uniquely alone.

Figures 4, 5 and 6 are respectively that of sucrose, pectin and orange juice for each of the three methods being compared. The BOD reading in each case shows the lowest correlation, that of the COD and TC are quite close together and show a very good correlation. The higher correlations (R) indicates less scatter of points about the regression line.

Figures 7 through 12 shows a series of 3 consecutive waste treatment stages and the correlation of COD/BOD and TC/BOD in that order. The three stages of waste water treatment are as follows:

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Fig. 5. Comparison of the BOD, TC and COD values for pectin.

Fig. 6. Comparison of the TC, BOD and COD values for orange juice.

Fig. 7. COD/BOD values for the waste plant influent.

Fig. 8. TC/BOD values for the waste plant influent.

Fig. 9. COD/BOD values for the final clarifier to the tertiary stabilization pond.

Fig. 10. TC/BOD values for the final clarifier to the tertiary stabilization pond.

Fig. 11. COD/BOD values for the tertiary stabilization pond to the holding pond.

Fig. 12. TC/BOD values for the tertiary stabilization pond to the holding pond.

Fig. 13. COD/TC values for the waste plant influent.

Fig. 14. COD/TC values for the first clarifier.

Fig. 15. COD/TC values for the final clarifier to the tertiary stabilization pond.

Fig. 16. COD/TC values for the tertiary stabilization pond to the final holding pond.

1) Primary waste plant influent.
2) Final clarifier to tertiary stabilization pond.
3) Tertiary stabilization pond to holding pond.

The nature of the waste load of each consecutive stage is different due to the general waste load reduction by biological oxidation, blending and breakdown products of the initial waste material. This is shown by the data presented in the figures and the varying correlations. The grouping of the data value points are expressed for each figure as that percentage of the points which fall within ± 20% of the mean along the “y” axis form the regression line. The correlations are good between the BOD and the COD and TC except for the initial waste plant influent.

Figures 13 through 16 show a series of graphed data from four consecutive stages of the waste treatment process. The COD to TC is compared. The correlations were very good and ranged from .8742 to .9642. The grouped data points at ± 20 percent of the mean “y” axis from the regression line is shown.

Conclusions
The two methods COD and TC show good correlations. The BOD method is shown to be more erratic in results. Considering the time (5 days) consumed for determinations and the less reliable results from the BOD method, it is a less likely method of choice for evaluating waste water effluents of a citrus processing plant. The COD method of waste analysis seems reliable, but moderately time consuming (1 up to 2½ hours) and hazardous. The TC method of analysis seems very reliable and the 5 minutes time consumed for a test is considered very short. The TC method may well be supported as the official method for waste water analysis.

Literature Cited

Materials and Methods
Studies were conducted for 2 seasons to investigate injury to mechanically harvested ‘Hamlin’, ‘Pineapple’, and ‘Valencia’ oranges and ‘Marsh’ grapefruit in comparison with hand harvesting. Fruit were harvested with 2 different limb shaker-catch frame machines and were evaluated for injury as related to suitability for the fresh market. In most cases, the machine harvested fruit sustained higher levels of injury than did the hand harvested fruit, although in some tests the difference was not very great. Holding studies on in-grade (non-eliminated) fruit showed consistently higher levels of decay for machine harvested fruit than for fruit that were harvested by hand. Treatment of fruit with Benlate (benomyl) fungicide reduced decay levels for both machine and hand harvested fruit. Results of this study indicate a good potential for mechanical harvesting of oranges and grapefruit for shipment on the fresh market, but fruit will require careful inspection and grading for injury.

Introduction
Citrus production in Florida totaled 10.4 million tons during the 1974-75 season, of which 1.76 million tons were shipped fresh with the remainder processed (3). The volume of fresh fruit shipments in Florida might be looked upon as a relatively small part (16.8%) of the total for the state, yet it represents a very significant quantity and is roughly equal to the volume of fresh citrus shipments from California which totaled 1.82 million tons during the 1974-75 season (3).

Much of the research emphasis and commercial interest related to mechanical harvesting of citrus in Florida in past years has been for fruit to be used for processed products. More recently, there has been some interest in the use of mechanical harvesters for fruit to be shipped on the fresh market.

Previous studies conducted by others (4, 6) showed the effects of mechanical harvesting on the quality of citrus fruit harvested with mechanical shakers, air shakers, a spindle picking head, and a vacuum tube picker’s aid. Although some fruit is damaged when harvested with a limb shaker-catch frame harvesting system, fruit harvested by this system has been found to incur lower levels of damage than with other mechanical harvesting systems. Results are reported here on studies, conducted over the past 2 seasons, for evaluating amounts and types of damage to relatively large volumes of fruit harvested with the latest designs of limb shaker-catch frame systems. This research was carried out in order to learn more about the feasibility of using such systems for the harvesting of fresh market fruit, and to provide background information for devising economical methods for sorting out damaged fruit.

Materials and Methods

Grapes and Fruit
Experiments were conducted with ‘Hamlin’, ‘Pineapple’,