WASHING STUDIES WITH SWEET CORN

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Horticultural Mimeo Series No. 186 - 2/6/59

Since last year the washing studies have been expanded to include the use of irritants and detergents as well as time and temperature of the soak water. This report is a progress report of the work done in the past season.

Raw Materials:

Approximately two acres were planted to Golden Beauty and North Star varieties of sweet corn. An early and a late planting were made of each variety. No pesticides were applied.

The corn was harvested at different stages of maturity over a four week period. Three harvests were made of each planting of each variety for a total of twelve harvests. Approximately 4 ton of corn was picked at each harvest.

Additional corn was obtained from the Deep Gold variety sweet corn later in the season. However, only three small harvests (about 400 lbs. each) were utilized.

In the early part of the season, borer and worm contamination was very heavy. During mid-season, no infestation was noted. In the late season, borer damage was slight, but worm damage was excessive.

Processing Procedure:

The corn was brought to the Horticultural Products laboratory at the Ohio State University for processing. It was husked on an FMC husker and the ears were separated into two lots as follows: (1) ears without damage and (2) ears with worm and/or borer damage. The undamaged ears were few in most cases in the early harvests and were discarded. However, in mid-season, these ears were used for cream style corn. To these lots both whole worms and fragments were added prior to the filling operation. These samples were used for evaluation of methods of insect fragment recovery.

The washing studies included a series of screening tests on both detergents and irritants and the concentrations of both as well as pilot plant evaluation of soak time, soak temperature, concentration of detergent, concentration of irritant and spray pressures on the removal of borer and ear worms.

Screening Tests:

The screening tests were carried out in a three-gallon container filled with two gallons of solution. Temperature and soaking period were kept constant and the concentrations of pyrethrums and detergents were varied. The purposes of these tests were to evaluate (1) the wetting agents for foaming and cleansing characteristics and (2) the irritants for removal of worms and borers.

Several wetting agents and detergents were screened. These included nonylphenol ethylene oxide, alkyl ethylbenzyl dimethyl ammonium chloride, benzene alkyl dimethyl benzyl ammonium chloride, alkylaryl sulfonate (liquid and powder) and the fruit and vegetable washing compound. The fruit and vegetable washing compound appeared to be most nearly ideal for washing sweet corn.

Three irritants were also screened. These were Fairfield Chemical Company pyrethrums, McLaughlin Gormley King Company Insect Looseener and Malathion. Fairfield
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Chemical's pyrethrum contained 6 percent pyrethrins and the McLaughlin Gormley King insect loosener contained 9 percent pyrethrins. However, when the samples were diluted to equal proportion basis, approximately the same result was obtained. Each irritant was tested at five concentrations. These included 41.6, 50.0 55.5, 62.5 and 83.3 ppm. From five replications of the experiment, an average removal of 85 percent of the worms and borers was obtained at 83.3 ppm of pyrethrins. On the other hand, only 80 percent of the worms and borers were removed using 83.3 malathion. However, since malathion was less expensive than the pyrethrums, it was hoped that by increasing the amount of malathion a greater reduction of worms and borers could be obtained. When the concentration was increased, little increase in reduction was obtained and at 100 ppm, a slightly disagreeable odor was detected from the corn.

Pilot Plant Studies:

The pilot plant studies were carried out in the Horticultural Products laboratory at the Ohio State University. The ears were placed in an 83 gallon soak tank which was equipped with air and steam lines. The time of soak was varied from 1.5 to 6 minutes by 1.5 minute increments. The soak water was held at 100° F., and the ears were violently agitated during the soak period. 2500 ppm. of the fruit and vegetable washing compound was added to the soak water and either 55.5 or 62.5 or 83.3 ppm. of pyrethrums were added.

Following the soak, the ears passed under a high pressure spray on a roller conveyor. Each ear made approximately three revolutions while under the spray. The spray manifold consisted of four 18SQ nozzles and two U6520 nozzles (Spraying Systems Company Nozzles.)

The soaking experiment was repeated five times and the results of the soak time studies are shown in Table 1.

Table 1 - Average Percent Reduction of Corn Borers and Earworms Obtained at Different Soak Times in 100° F. Soak.

<table>
<thead>
<tr>
<th>Time</th>
<th>Average Number of Worms and Borers</th>
<th>Average Percent Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5 minutes</td>
<td>49</td>
<td>71.5</td>
</tr>
<tr>
<td>3.0 &quot;</td>
<td>28</td>
<td>82.0</td>
</tr>
<tr>
<td>4.5 &quot;</td>
<td>69</td>
<td>89.8</td>
</tr>
<tr>
<td>6.0 &quot;</td>
<td>46</td>
<td>93.5</td>
</tr>
</tbody>
</table>

From Table 1 it can be seen that the removal of borers and worms was more efficient as the soak period increased. However, a period of 4.5 minutes would seem to be more satisfactory than 6.0 minutes of soaking for two reasons. First, the increased holding period might be too costly for the small increase in the removal of the worms and borers. Secondly, the difference in percent reduction between the 4.5 and 6.0 minute soak periods was not significant.

The experiments with irritants were replicated four or five times depending upon the concentration and the material used. The results are shown in Table 2.

Table 2 - Average Percent Reduction of Corn Borers and Earworms Obtained at a Soak Time of 4.5 Minutes at 100° F. Using Detergent and Different Concentrations Of Irritants

<table>
<thead>
<tr>
<th>Irritant</th>
<th>Concentration</th>
<th>Ave. number of Borers and Worms</th>
<th>Ave. Percent Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pyrethrums</td>
<td>55.5 ppm.</td>
<td>66</td>
<td>92.5</td>
</tr>
<tr>
<td></td>
<td>62.5 ppm.</td>
<td>47</td>
<td>95.8</td>
</tr>
<tr>
<td></td>
<td>83.3 ppm.</td>
<td>61</td>
<td>98.4</td>
</tr>
<tr>
<td>Malathion</td>
<td>83.3 ppm.</td>
<td>57</td>
<td>93.0</td>
</tr>
</tbody>
</table>
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From Table 2, it can be seen that the different concentrations of the irritants produced a reduction in the number of worms and borers. The amount of reduction increased with an increase in the amount of irritant. It should be noted that the data include both earworms and borers and that the earworms could be easily removed. On the other hand, the borer larvae were more difficult to remove and sometimes were not removed at all. Thus, borers and earworms should be studied separately since each insect attacks and damages different portions of the corn ear.

The data indicate that there are three factors which should be considered further in the washing of sweet corn to remove insect pests and their residues. These are: (1) the insect and its susceptibility to the various irritants, (2) the types of damage and portion of the ear attacked, and (3) the metamorphic stage of the insect since different stages may react to the treatments differently. These are included in the plans for work next season because although 98% removal of worms and borers was obtained by use of irritant, detergent and warm water soak and a high pressure spray rinse, this would not prevent some contamination in the finished product.
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