MEchanical harvesting and trimming of sweet corn

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Abstract. Ears of sweet corn from the FMC1 fresh market sweet corn harvester were evaluated for mechanical injury and shank trimming. This harvester provides much needed shank removal in the field with knives that provide for adjustments in shank length. Kernel injury of grade defect severity ranged from 0 to 78% among 39 loads obtained from harvesters during commercial operation in the Homestead and Belle Glade areas. Since the injuries were oriented with the position of the stop bars on opposite sides at the base of the ear, and shank lengths averaged 1.7 inches on injured ears compared with 2.6 inches on non-injured ears, it was apparent that shank length was directly related to mechanical injury. If shanks were 2½ inches or more in length and the harvester was properly operated, kernel injury was nearly eliminated.

Locally constructed harvesters designed for fresh market sweet corn became available in 1967, and since that time a large portion of Florida's sweet corn crop has been harvested mechanically. Mechanical harvesting of sweet corn for processing has been a standard practice for many years, but kernel damage resulting from these harvesters make them unsuitable for fresh market sweet corn. Physical attributes of vegetables that are most apt to be changed as a result of machine harvesting are mechanical damage and the presence of undesirable plant material (trash). In changing from hand to machine harvesting the goals include the best yields and quality obtainable with the new system.

The sweet corn harvesters developed by Loren Meredith1 and Boots and Son Manufacturing Company1 detach the ears where the shanks join the stalks. Shanks on these ears vary in length from 2 to 10 inches, account for 3 to 12% of the total ear weight and require extra labor for hand trimming before packing for shipment (7, 8). After brussel sprout harvesting was mechanized, over 3 times as much labor was required to remove stems until a mechanical destemmer was developed (5). The sweet corn harvester recently developed by FMC Corporation grasps the ear on the stalk between moving stop bars which support the ear while knives cut the shank. Features of the three sweet corn harvesters have been described (1, 3, 4, 9). The FMC machine should reduce labor costs in addition to other trimming advantages previously reported (6).

Controversy has developed over what criteria should be used in judging harvester performance. At issue is the amount of shank and outer husk removed vs. damage to the kernels. Wholesale buyers want many green leaves as protection for the kernels, and when FMC harvesters were introduced, buyers objected because some outer leaves were removed (9). Florida sweet corn growers have tried to meet some of the highest U.S. grade requirements including the tight, undisturbed husk and freedom from mechanical injury. If more than 4 kernels are crushed or broken or if the husk is opened to examine all the kernels, the ear is no longer U.S. Fancy.

Little information is available on sweet corn mechanical injury resulting from fresh market harvesters. One report (2) on the Meredith harvester mentioned only light mechanical damage and buyers of Florida sweet corn have complained about bruising from the FMC machine. This study was made to evaluate kernel injury and shank trimming by the FMC fresh market sweet corn harvester.

Materials and Methods

Thirty-nine loads from FMC two row, self-propelled harvesters with shank trimmers were sampled and for comparison purposes, 9 samples were obtained from Boots and Meredith harvesters without shank trimmers. These samples of commercially grown sweet corn varying from 25 to 35 ears were obtained in fields and packing houses in the Homestead and Belle Glade areas during April and May of 1973 and 1974. Samples were obtained after packers had sorted out the ears which they considered unmarketable, and care was taken that no additional injury or trimming occurred between the actual harvesting and sampling. The husk was removed very carefully from the

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1Identification of sweet corn harvesters by their manufacturers does not imply endorsement.
sample ears, all injured kernels were counted and shank length was measured from point of attachment to the cob. The number of crushed kernels was separated into two classifications—over 4 per ear which is a grade defect and 1-4 kernels which is not scored.

The harvesters were operating under widely varying soil, field, plant and weather conditions when they were evaluated. No attempt was made to identify individual harvesters or operators when samples were taken from several machines operating on different farms.

Results and Discussion

The amount of kernel injury varied so widely among the 39 FMC harvester loads that the data were divided into 6 ranges according to percent grade injury (over 4 crushed kernels). This included a minimum of 0 injury in one load and a maximum of 78% injury in another load (Table 1). There were 10 loads with grade injury from 0 to 3%. Only 2% of the 300 ears examined in this group had more than 4 crushed kernels per ear and 13% of the ears had 1 to 4 crushed kernels. In the less severe classification of 1 to 4 kernels per ear, the percent of injured ears exceeded those with grade injury in all but 2 of the 6 load groups. In the two loads with the highest injury only 10% of the ears were unjured. The FMC harvester injury was located in small areas on opposite sides at the extreme base of the ear. The broken kernels were aligned on two sides of the ear above the corresponding areas on the shank that were contacted by the knives. Since the stop bars were directly above the knives, it was obvious that injury occurred where the bars contacted the ear.

Short shanks cut with wedge shaped ends distinguished the ears from an FMC harvester. Shanks on ears from Boots and Meredith harvesters were longer with broken ends. Very little mechanical injury was apparent on the husks from either of the three harvesters but this did not indicate the absence of damage to the kernels as shown by examination after husking. Sometimes the location of severe kernel injury was indicated on the outer husk by slight water soaking. Grade injuries ranged from 2 to 9% among the 5 Boots and 4 Meredith harvester samples. The crushed kernels resulting from harvesting with these two machines were not localized on any particular portion of the ear. The random location of the injuries and the absence of similar shaped, bruised

<table>
<thead>
<tr>
<th>Grade injury</th>
<th>Total ears examined</th>
<th>Percent of ears examined</th>
<th>Shank length</th>
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</thead>
<tbody>
<tr>
<td>Range</td>
<td>Loads</td>
<td>No.</td>
<td>No.</td>
</tr>
<tr>
<td>%</td>
<td>No.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-3</td>
<td>10</td>
<td>300</td>
<td></td>
</tr>
<tr>
<td>4-7</td>
<td>9</td>
<td>256</td>
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</tr>
<tr>
<td>10-12</td>
<td>6</td>
<td>169</td>
<td></td>
</tr>
<tr>
<td>14-16</td>
<td>8</td>
<td>227</td>
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</tr>
<tr>
<td>25-34</td>
<td>4</td>
<td>109</td>
<td></td>
</tr>
<tr>
<td>70-78</td>
<td>2</td>
<td>68</td>
<td></td>
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</tbody>
</table>

*More than 4 crushed kernels per ear is a grade defect.

*Averages include only ears with number of crushed kernels indicated in column headings.*
areas on the ears provided little assistance in determining where and how the injuries occurred.

Much different evidence is provided by the shank length data and location of the injuries on FMC harvested ears. Ears without injury had shanks averaging 2.3 to 2.9 inches compared with shanks of 1.4 to 1.9 inches on grade injured ears. The shank length data in Table 1 are not averages of loads with varying percentages of injured ears, but averages of the non-injured, slightly injured and grade injured ears compiled from each load sampled. Since the ears with over 4 injured kernels had shanks averaging 1.7 inches long, the shanks on non-injured ears were almost 1 inch longer, and the slightly injured ears had an intermediate length shank, these data indicate that kernel injury by the FMC harvester can be greatly reduced by trimming the shanks no shorter than 2.5 inches.

Unfortunately, shanks shorter than 2.5 inches are needed to reduce the trash from the harvesting operation, provide longer shelf-life (6) and greater efficiencies in usage of containers and shipping space. When the knives which cut the shanks on the FMC harvester are adjusted upward and the stop bars are sufficiently separated, the shank can be shortened until lower portions of the cob and kernels are cut away. The stop bars are curved inward at the lower end to prevent the ears from dropping too close to the knives. The harvester manufacturer has recently provided rubber shields for the lower end of these bars, but when the base of the ear gets squeezed between them, some kernels are still broken. When the knives are lowered and the shanks lengthened, an increasing number of stalk sections and leaves remain attached to the ear and must be removed by hand in the sorting and packing operation.

Shank trimming equipment on the FMC harvester provides much needed mechanization in preparing sweet corn for market, but the quality is often lowered by mechanical injury. The tremendous range in amount of injury among different harvester operators and locations indicates that much improvement is possible. Since hidden injury is difficult to detect at harvest and machine operators may not be aware of the quality losses from crushed kernels, more training would be very advantageous.

**Literature Cited**