in the rear which results in far greater stability. The front wheels are driven independently by hydraulic motors making it possible to spin the machine in its tracks. The rear caster wheel is locked in place during operation and released when turning the machine.

Since Vogel threshers are standard equipment almost everywhere, it should be possible to adapt them to combine harvesting rather readily.

The costs were as follows:

<table>
<thead>
<tr>
<th></th>
<th>One-wheel Drive</th>
<th>Two-wheel Drive</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-hp gasoline motor</td>
<td>$500.00</td>
<td>$500.00</td>
</tr>
<tr>
<td>Hydraulic system</td>
<td>300.00</td>
<td>500.00</td>
</tr>
<tr>
<td>Pressure fan</td>
<td>200.00</td>
<td>200.00</td>
</tr>
<tr>
<td>Cutter bar</td>
<td>50.00</td>
<td>50.00</td>
</tr>
<tr>
<td>Miscellaneous (belts, pulleys etc.)</td>
<td>150.00</td>
<td>150.00</td>
</tr>
</tbody>
</table>

The cost can be reduced considerably by adapting used automotive equipment. In fact, many different models and improvements are possible. The basic ideas presented here are the coupling of a known threshing mechanism to a self-cleaning lift and a fluid drive.

Trouble can be expected at first, and time should be allowed for adjustments. It took the authors one full season to get the performance required. The increase in speed, efficiency, and ease of harvest are well worth the costs in money, time, and temper.

A mimeographed list of model numbers and costs is available.

**SHORT CUTS IN PLANT BREEDING**

John E. Grauus

The renowned plant scientist C. H. Goulden is credited with the suggestion that the growth chamber could be used for rapid turnover of small grain populations. His suggestion was to plant an F$_2$ and then harvest one seed from each plant for the F$_3$ generation and so on until the F$_5$ or F$_6$. In this way an F$_2$ genetic spectrum in homozygous form could be obtained in a very short time. Field and laboratory selection could then be made on head rows obtained by planting the heads of the last cycle from the growth chamber.

A new twist has been added at Michigan State University to Goulden’s scheme. While in Europe I observed two things which appeared to dovetail into a rapid turnover procedure. The first was the genetic work with the miniature mustard, Arabidopsis; and the second was a discovery by J. Bingham of Cambridge that he could grow barley plants to maturity without any nutrients in the media. True, the plants were small and had only a few seeds. But this was exactly what was needed. Why not make an Arabidopsis out of barley and oats?

The first attempt worked beautifully. Segregating populations of barley were planted in sand in the greenhouse. The rows were 2 inches apart with the seeds 3/4 inch apart in the row. A complete nutrient solution was applied only twice, once after the plants emerged and again at the third leaf stage. Tap water was applied as needed. The mature plants were small, but did not lodge and had from 0 to 4 seeds. Only a small percentage was in the sterile class. Had a full nutrient treatment been used with dense seeding a great deal of sterility would have resulted.

To date the nutrient treatment is more of an art than a science. The number of waterings with nutrients varies with depth of sand and temperature, but at present 2 and occasionally 3 applications are used at normal temperatures. One failure occurred under high temperatures in the fall. After observing the high sterility, the nutrient level was increased to stimulate tiller production and in this way seed was recovered from most of the plants.

It is possible to grow 8,000 plants in a bench 3.5 feet X 26 feet. When one realizes that this could be considered the equivalent of 8,000 plant rows, the potential savings in project money is obvious. This is, however, not a fair comparison since the material can be handled in bulk in the field at even less cost in money but a huge cost in time.

Seed may be harvested 2 weeks after the average date of anthesis. The seed must be dried before planting.

The rapid cycling of breeding material is an important tool in the effort to produce better varieties. The method has become a part of this small grain program and has been used successfully on winter barley, winter wheat, and the spring grains.

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1 Contributions from the Michigan Agricultural Experiment Station as Journal Article No. 3582. Received Feb. 17, 1965.

2 Professor of Crop Science.