Crop Nutrient Availability from Sugar Factory Spent Time: First Two Years after Field Application
Albert L. Sims, Carol E. Windels (Univ. of Minn.), and Carl A. Bradley (North Dakota State Univ.)

Introduction
Spent time is a by-product of the sugar producing industry. Raw juice extracted from sugar beet roots contains many impurities that interfere with sugar production. A clarification process wherein CaCl2 plus CO2 is added to the juice generates CaCO3, which precipitates and removes some of these impurities. The clarified juice is further processed to extract sugar. The precipitate left behind is called spent time, but can be referred to by other names. The seven sugar beet processing factories in North Dakota and Minnesota generate approximately 400,000 metric tons of spent time annually. Historically, this spent time has been stock piled near the factory site (fig. 1).

Spent time has been the acid-neutralizing capacity of large ponds in some places such as Great Britain. Spent time is also in demand material to control soil acidity in crops. In parts of the mid-west, spent time has been used to neutralize agricultural acidities. There are no data to support claims that the use of spent time is required to maintain soil pH. However, research conducted by Hess et al. (1990) indicated that spent time may decrease soil pH in certain agricultural situations. No research has been conducted to determine the long-term effects of spent time on soil quality and function. Spent time is not considered a hazardous waste, but there are regulatory issues that govern the use and management of the spent time in the sugar processing factories. No impurities are in the spent time if treated properly. However, spent time is used in the manufacture of some commercial fertilizers. Spent time is a source of many trace elements that are essential for plant growth. Spent time is also a source of nitrogen, as it is a by-product of sugar production. Spent time contains impurities removed from the raw juice. These impurities can include organic compounds and heavy metals. Spent time in some cases can be contaminated by the sugar beet harvest. The sugar beet harvest is a complex operation that involves the use of machinery and equipment. The machinery and equipment used in the sugar beet harvest can make the spent time contain impurities.

Currently, growers can obtain permits to land apply spent time up to 22 Mgha. However, verbal communication with many growers suggested most apply 11 Mgha or less. Propane gas is one of the impurities applied with the spent time. Propane gas application is implicated in surface water eutrophication. What is the impact of the P in the spent time to crop production and soil test P values? This pasture, soil test P values will be evaluated.

Objectives
1) Determine variation of P concentration in spent time land applied at seven sugar beet processing factories in North Dakota and Minnesota.
2) Evaluate the effects of field applied spent time on soil test P levels.

Objectives
1) Spent time samples were collected from seven sugar beet processing factories in North Dakota and Minnesota.
2) Samples collected Nov 15, Jan 19, and Mar 15 of the 2004-2005 production season.
   - 5 samples collected from each factory at each sampling date.
   - Samples collected as spent time was emptied from the factory and before it was transported to the area.
   - Spent time was dried, ground, and analyzed according to USDA procedure 2030 (0.02M). All values reported on dry weight.

Table 1: Phosphorus concentration of spent time collected from seven sugar beet processing factories in three periods during the sugar beet processing seasons of 2004-05.

<table>
<thead>
<tr>
<th>Factory</th>
<th>Nov 15</th>
<th>Jan 19</th>
<th>Mar 15</th>
</tr>
</thead>
<tbody>
<tr>
<td>....</td>
<td>....</td>
<td>....</td>
<td>....</td>
</tr>
</tbody>
</table>

Results:
- Spent time contains significant quantities of P.
- Proportionately varies among factories.
- In areas with large factories, the P content is significantly different.
- In areas with small factories, the P content is not significantly different.
- Proportionately varies with the spent time application rate of spent time.
- Proportionately varies with the spent time application rate of spent time.
- Proportionately varies with the spent time application rate of spent time.
- Proportionately varies with the spent time application rate of spent time.
- Proportionately varies with the spent time application rate of spent time.
- Proportionately varies with the spent time application rate of spent time.

Conclusions:
- Spent time contains significant quantities of P.
- Proportionately varies among factories.
- In areas with large factories, the P content is significantly different.
- In areas with small factories, the P content is not significantly different.
- Proportionately varies with the spent time application rate of spent time.
- Proportionately varies with the spent time application rate of spent time.
- Proportionately varies with the spent time application rate of spent time.
- Proportionately varies with the spent time application rate of spent time.
- Proportionately varies with the spent time application rate of spent time.
- Proportionately varies with the spent time application rate of spent time.