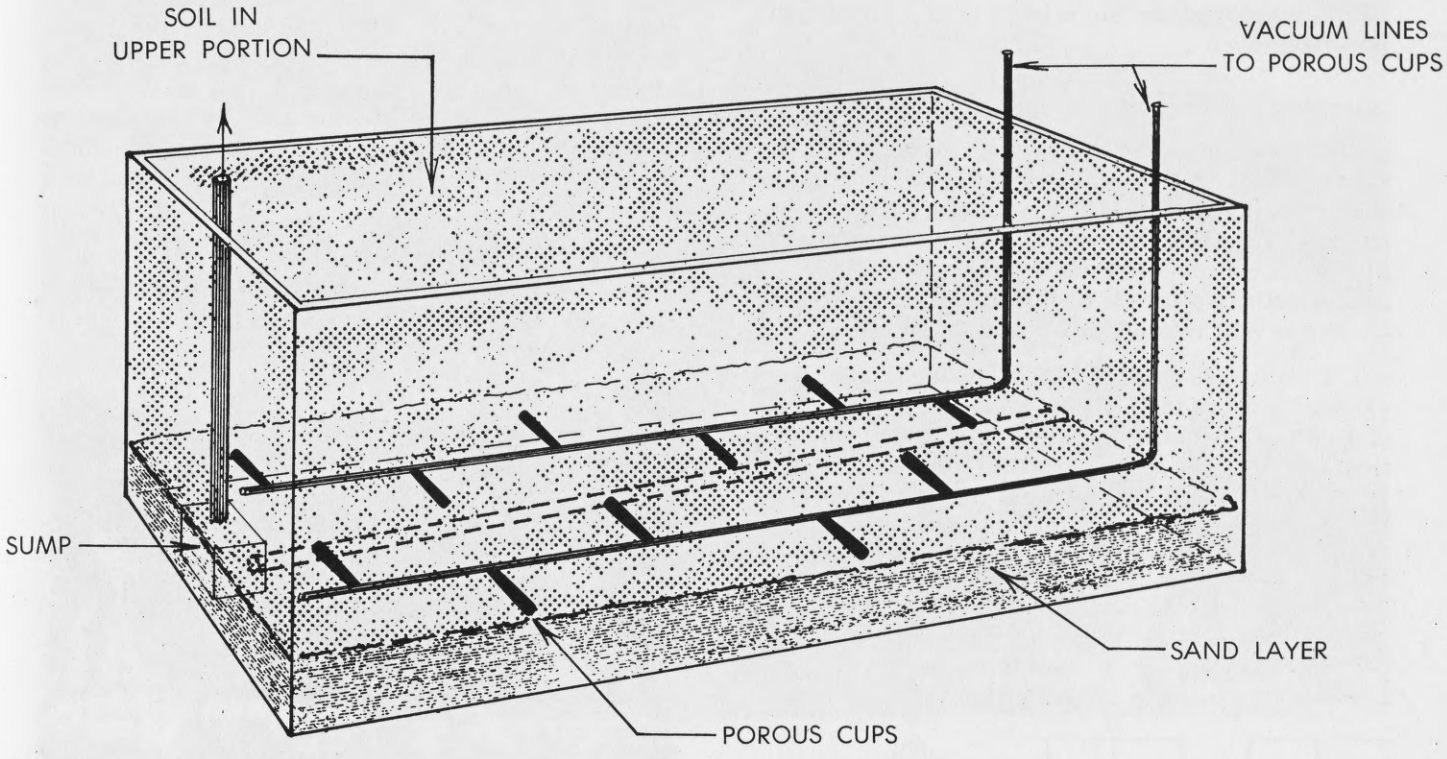

Figure 1. Schematic of a lysimeter.

LYSIMETERS AID SUGARBEET ROOT MAGGOT AND EUROPEAN CORN BORER RESEARCH

D. K. Cassel, R. D. Frye and F. W. Schroer

The sugarbeet root maggot is one insect pest which can greatly reduce sugarbeet yields; likewise, the European corn borer can reduce corn yields. Use of the lysimeters described in this article enable agricultural scientists to better understand the seasonal development of these pests and to study effective ways to control them.

The sugarbeet root maggot and the European corn borer are two insect pests found in North Dakota which cause crop losses amounting to many thousands of dollars annually. Studies which define the seasonal cycle and control of these insect pests are expensive, time-consuming and may require extensive travel to areas within the state where the pests are numerous.

To decrease expense and save time, a set of lysimeters was constructed on the Main Agricultural Experiment Station in Fargo. Lysimeters

Dr. Cassel and Schroer are associate professors, Department of Soils; Dr. Frye is associate professor, Department of Entomology.

are containers buried in the ground; soil is placed in the containers and crops grown. The sugarbeet root maggot, for example, can be introduced into the soil in the fall and the effects of different soil types on the overwintering maggots determined the following spring. This report describes the lysimeters and indicates how they are currently being employed in sugarbeet maggot and corn borer research.

Lysimeter Construction

Lysimeters were built and installed in November, 1971. A schematic drawing of a lysimeter is shown in Figure 1. Each lysimeter box was constructed of ½-inch plywood, and had dimensions of 4 x 4 x 8 feet. The lysimeters were lined on the inside with two layers of 6 mil polyethylene plastic before soil was added.

Two holes, each 8½ x 25 x 4 feet deep, were excavated in a field adjacent to the agroclimatic station on the Main Agricultural Experiment Station at Fargo. Six lysimeters were installed in each hole, as indicated by the field diagram in Figure 2. An empty lysimeter being lowered into the hole is shown in Figure 3. Four men were required for this task.

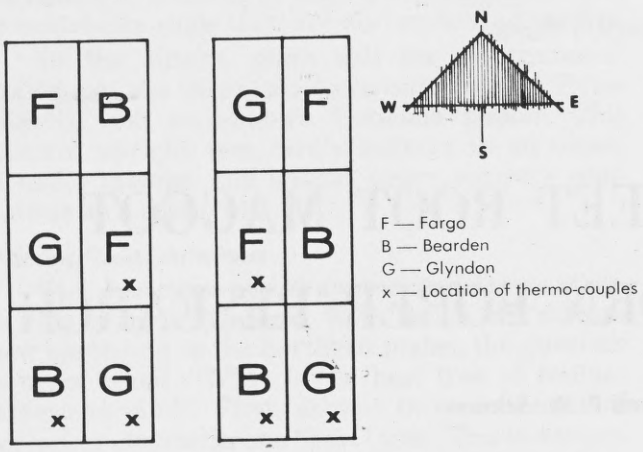

Figure 2. Field diagram of the lysimeter installation. The agroclimatic station is located immediately south of the lysimeters.

After the 12 lysimeters were lowered into place, each was partially instrumented. Six inches of medium textured sand was placed in the bottom of each lysimeter. A drainage system constructed of plastic pipe and a sump were installed in the sand layer (Figure 1). The drainage system is used to lower the water table when the soil becomes saturated due to abnormally heavy rainfall. An additional drainage system, one that can reduce the soil water content to levels well below saturation, was placed on top of the sand. The unsaturated drainage system shown in Figure 4 consists of porous cups connected to a vacuum line. Details are shown in Figure 1.

After the drainage systems were installed, soil was added to each lysimeter. North Dakota soils presently important in sugarbeet production were used: Glyndon silt loam, Bearden silty clay loam and Fargo silty clay. Each soil type was replicated four times (Figure 2). Soil in each lysimeter was constructed horizon by horizon to closely represent the soil as it occurs in the field. Figure 5 shows the process of filling and packing the lysimeters.

Soil in the lysimeters settled during the 1972 spring thaw. Because of this, soil from the A

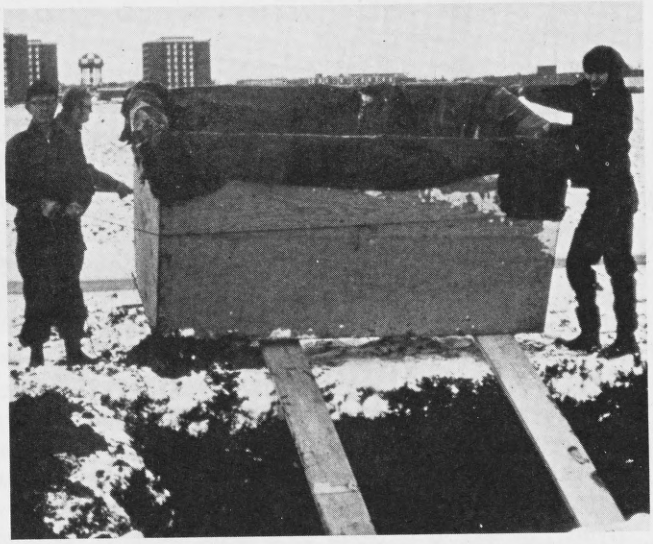

Figure 3. Lowering a lysimeter into the hole was a four-man operation. The lysimeter was lowered on the skids, which were then carefully removed.

Figure 4. A system to allow drainage of unsaturated soil was constructed of porous cups and installed in each lysimeter.

Figure 5. Filling and packing soil in the lysimeters after the drainage systems were installed.

horizon was added to make the level of the soil surface in each lysimeter identical to that of the surrounding soil. The finished lysimeters appear as shown in Figure 6.

In addition to the instrumentation for controlling soil water content, the lysimeters were equipped for measuring soil temperature and the amount of soil water in the soil profile. One steel access tube (indicated by the arrow in Figure 6) was installed per lysimeter to a depth of three feet. Soil water content was monitored periodically with a neutron scattering procedure. To facilitate measurement of soil temperature, copper constantan thermocouples were installed in six lysimeters. at depths of ½, 4, 12 and 24 inches (Figure 2). Soil temperatures can be monitored manually, or automatically with a data acquisition system available at the nearby climatic station.

Research in Progress

Sugarbeet root maggot and European corn borer studies are currently being conducted at this site under the direction of the Department of Entomology. Experimental procedures are designed to detect differences in development and survival of the sugarbeet root maggot in fine, moderately fine, and medium textured soils.

Maggot development is studied by placing larvae in cages in each lysimeter in the fall (Figure 7, center). These larvae burrow downward into the soil to overwinter. As the maggots develop the following spring, their movement upward in the soil is determined and related to soil and air temperatures. Subsequent maggot development will be related to accumulation of heat units (degree days). Maggot survival in the three soil types is being studied by determining differences in the number of adults that emerge in the spring from larvae placed at various depths in the soil in cages the previous fall (Figure 7, left). Differences in egg deposition in the various soil types also will be determined. If appearance of the various stages in the seasonal cycle of the maggot can be predicted well enough according to degree days, proper timing of control operations will be easier. Cages located on the right hand side of each plot in Figure 7 are used to study winter survival of the European corn borer in cornstalks buried at different depths in the various soils.

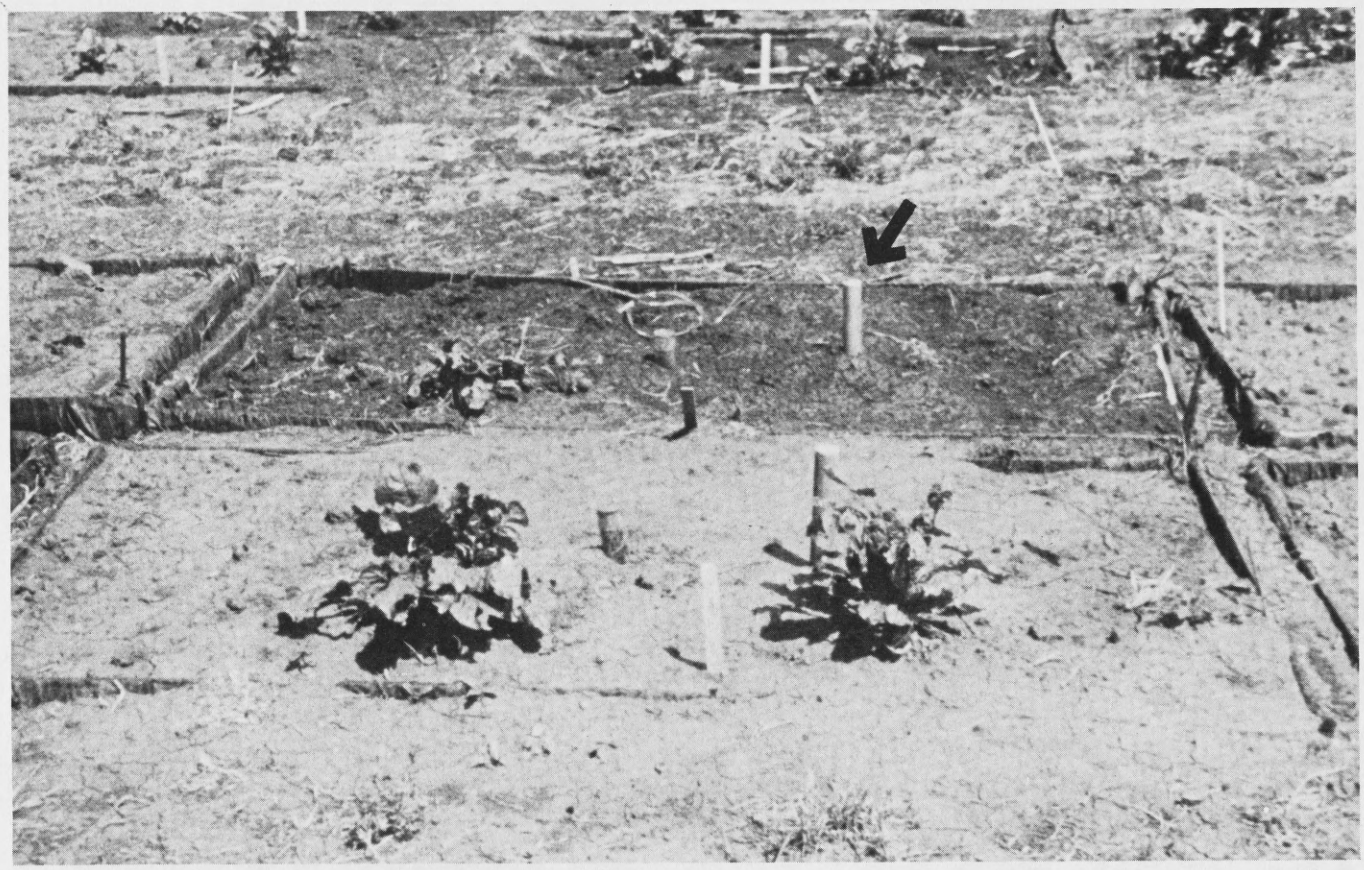

Figure 6. Lysimeters with growing sugarbeets. The arrow indicates the steel access tube for soil water monitoring equipment.

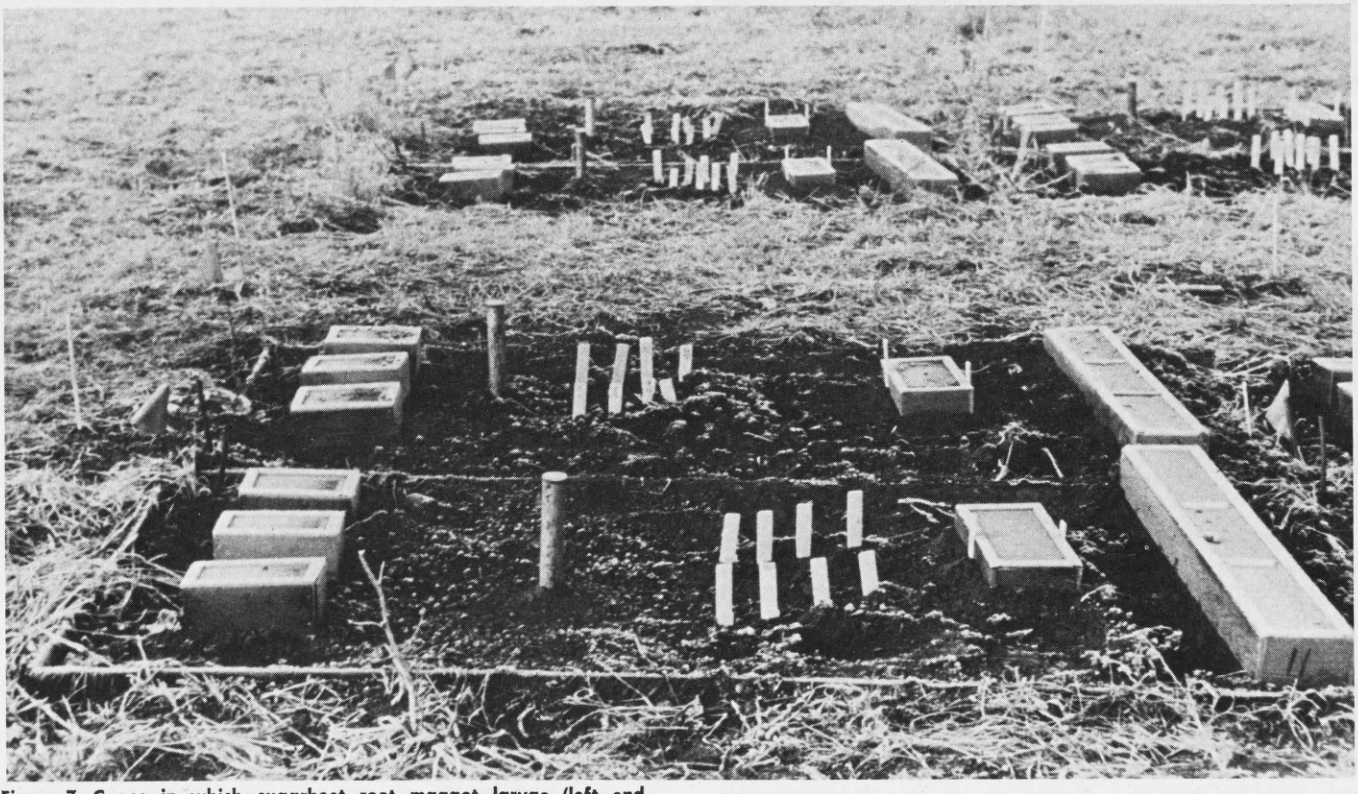

Figure 7. Cages in which sugarbeet root maggot larvae (left end and center of the lysimeter) and European corn borer larvae (right end of the lysimeter) are placed.