

SMALL PLOT IRRIGATION APPLICATOR*

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Purpose of the Investigation

The application of water by rotary sprinklers in irrigation research on small experimental plots has not proved to be satisfactory. It is not possible to achieve uniform coverage because the geometry of the plots does not provide the proper overlap, and wind is a variable factor affecting the water distribution. The large border areas necessary with rotary sprinklers make inefficient use of the available land. The use of small plots has an advantage for adequate replication, as soils may be more uniform over a smaller area. A small plot irrigation applicator was developed at the Ontario Agricultural College to meet these conditions as no other suitable equipment was available.

Review of Literature

Several attempts have been made to construct a satisfactory small plot irrigator for the precision application of water. The machines have generally been large and not readily maneuverable in the field (1). The rates of application of water were usually too high for medium to fine textured soils (2) and the coefficient of uniformity has varied considerably. Bean and Wells (1) designed an irrigator that operated on fixed rails with a movable boom. Myers (2) and Sparrow (3) designed a large machine having an overhead track with a single spray boom. The spray boom was operated by an outside power source such as a gasoline engine. Sparrow et al (4) developed a unit to irrigate tobacco plots 22.5 feet by 52 feet which was quite large and required two men to operate.

Design of the Equipment

For irrigation experiments in row ranges, staff agronomists stated the minimum size for a suitable individual plot should be 20 feet by 12 feet. This machine is designed for such a plot size. The primary design requirements for the machine were:

- (a) The application of water without the infiltration capacity of the soil.
- (b) A high coefficient of uniformity of application.
- (c) To not be adversely affected by wind.
- (d) To operate at a constant pressure.
- (e) To be highly maneuverable in

the field.

(f) To not have an adverse effect upon the crop or soil.

The small plot irrigation applicator as shown in Figure 1 consists of an inverted U-shaped member at each end which is held vertical by two parallel tracks twelve feet in length. By a

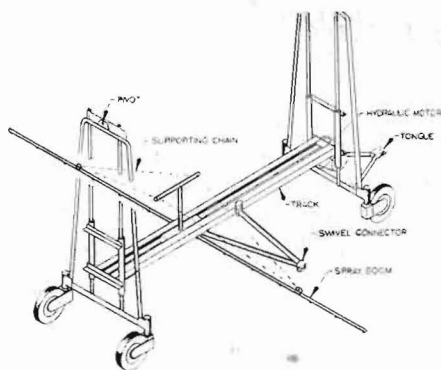


Fig. 1. Schematic view of Small Plot Irrigator.

unique design arrangement the spray booms are always the same distance over the crop on sloping ground, as the boom assembly is adjustable for height at each end and may also be moved to accommodate a five degree slope at right angles to the track assembly. This feature considers the stage of growth or height of the crop, as the boom may be positioned at the proper spray height. The main frame is mounted on four swivel-type rubber tired wheels. The rear pair has a lock to be used when the machine is being transported for some distance. This swivel feature makes the machine highly maneuverable in the field. A tongue is provided for transportation.

A two member 1½ inch diameter aluminum boom, each member 10 feet long, is suspended below and normal to the track assembly. Each boom may be folded back along the machine for transporting. There are 14 Spraying System ¼TT fan pattern even, nozzles spaced 20 inches apart on each boom from which the water sprays upon the plot.

Water is supplied to the machine from an irrigation main line through a length of ¾-inch hose. A Watts 135HW combination pressure regulator and strainer reduce the main line pressure and maintains a constant pressure at the machine. The water is fed to the moving booms through

swivel connectors. Rubber hose would probably serve as well and be more economical.

A Skinner System, Type C Oscillator was modified to supply the power required to move the boom. This is a positive power, water driven motor which was modified to operate at a forward speed twice as great as the original design and provided a forward motion of 0.8 feet per minute to the spray booms. This was accomplished by adding an additional dog to operate the segment on both strokes of the piston. The water motor had a volumetric efficiency of 53 per cent and the discharge water is removed from the plot area by a small rubber hose. The speed of operation is adjustable over a narrow range.

The water motor turns a gear and chain as shown in Figure 2. This in

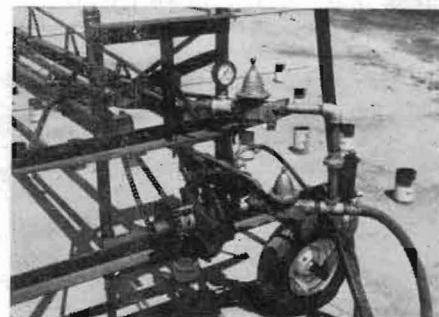


Fig. 2. Detail of the motor assembly.

turn moves a long roller link chain which moves in a groove on the main track. The carriage for the boom assembly is attached to a pin on the roller chain and is thereby moved back and forth along the track.

Test of Equipment

Laboratory tests of commercially available nozzle tips showed that there was a seven per cent variation from the mean discharge between individual nozzle tips. Many individual nozzle tips were then tested and 14 were selected having a variation within one per cent.

The selected nozzles were attached to the spray boom which was then tested in the laboratory for uniformity of overlap and discharge. This was tested by catching the runoff in a series of small cans from a corrugated metal sheet upon which the spray from the boom was falling. The coefficient of uniformity was determined from the relationship.

