Drip Pan for Field Plot Sprinkle Irrigation

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Highlight: *The construction and use of the drip pan are described. It was developed for irrigating small field plots in remote locations by simulated rainfall and has a combination of advantages not found in other plot irrigators. The drip pan is inexpensive to build, easily operated by one man, sturdy, portable, clog resistant, and adaptable to a wide variety of treatment requirements and site conditions. It applies water uniformly over the plot area and requires minimum or no border barriers.*

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The drip pan was developed as a simple, inexpensive, portable rainfall simulator to meet the need for irrigating small field plots in remote areas. Supplementing natural rainfall at needed amounts and frequencies, especially in arid regions, can shorten the time requirement for range studies and reduce labor and costs.

Previously developed rainfall simulators (Mutchler and Hermsmeier, 1965) did not meet our needs because they were fragile, bulky, complex, or expensive and often required skilled operators. Some were designed only for use in the laboratory or at fixed locations.

Flood irrigation, though simple and cheap, may not be desirable (Selby, 1970). It affects soil structure differently than rainfall and can trap air in the soil column (Johnson, 1963). Consequently, water infiltration and moisture retention may also differ. Border barriers required to control runoff from flood irrigation can be difficult to construct where the soil is rocky and may cause undesirable soil disturbance (Meeuwig, 1971). Flood irrigation is not suited to sloping or uneven ground surfaces because of difficulty in retaining water on the slopes and uneven infiltration.

The distinguishing feature of our drip pan is the hanging wick drop formers. Use of such wicks is not new. A rainfall simulator with drops formed on short lengths of woolen yarn, called a "Dripolator" or "Stalactometer," was developed in 1937 and later improved (Ellison and Pomerene, 1944). This simulator, however, was complex, bulky, and designed for laboratory use only.

Construction

The drip pan is an open-faced pan constructed from 18-gauge sheet metal (Fig. 1). The size can be varied but we found a convenient size to be 107 cm (42 inches) long by 91 cm (36 inches) wide by 10 cm (4 inches) deep. Two baffles the same depth as the pan and at right angles to each other dampen water movement and provide additional strength and rigidity. Each baffle has eight slots along the bottom edge to maintain an equal water level among the four pan compartments. All edges are hemmed and lipped. The hems eliminate sharpness and increase strength of the edges. The lips increase strength and rigidity and make for easier handling of the pan. Also, the lip around the outside edges supports the pan when it is mounted in a frame.

Drip-holes 2.4 mm (3/32 inch) in diameter are spaced 3.8 cm (1½ inches) apart in the pan bottom. These holes are made by driving a steel punch downward through the pan bottom causing them to be funnel shaped. This shape provides a large amount of bearing surface and enables the wicks to fit more snugly than in drilled holes.

Wicks are made from 16-ply cotton wrapping twine cut to 11.4 cm (4½ inches) lengths. Each length is knotted so as to secure it above the hole and allow 7.6 cm (3 inches) of wick to hang below the pan bottom.

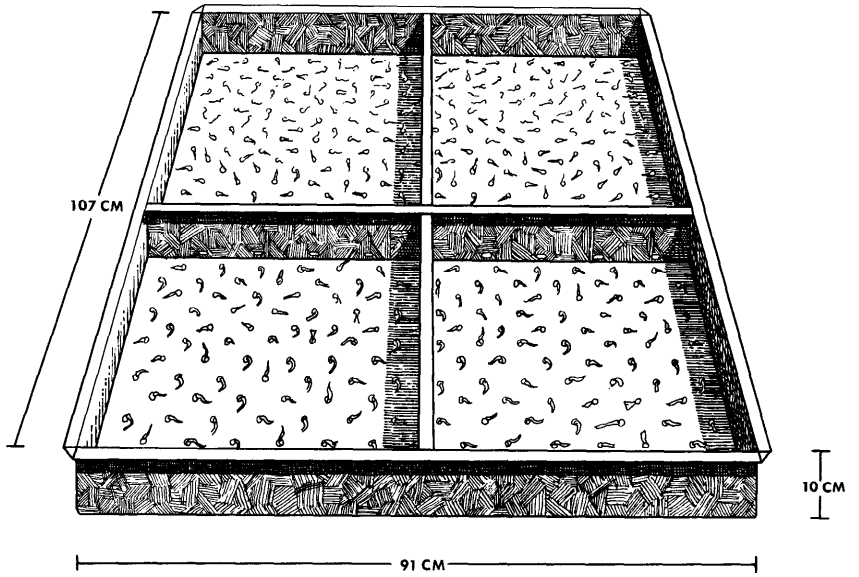

Fig. 1. *Top view of drip pan showing cross baffles, equalizing slots, drip holes, wicks, lip placement, and general construction.*

The drip pan is suspended on a frame above the treatment plot. Several pans can be mounted on one frame to match various size plots. When necessary, light, inexpensive, plastic film can be wrapped around the frame as a shield against the wind.

Use and Discussion

The drip pan used over two field seasons with frequent movement among different planting locations performed well. It was easy for one man to set up, use, take down, and transport. No breakage or maintenance problems were experienced even though we transported the pans over rough roadless areas in an open pickup with no special handling care.

Water in the drip pan occasionally had dirt and debris contamination. No hole clogging or decreased wick water transmission efficiency was observed.

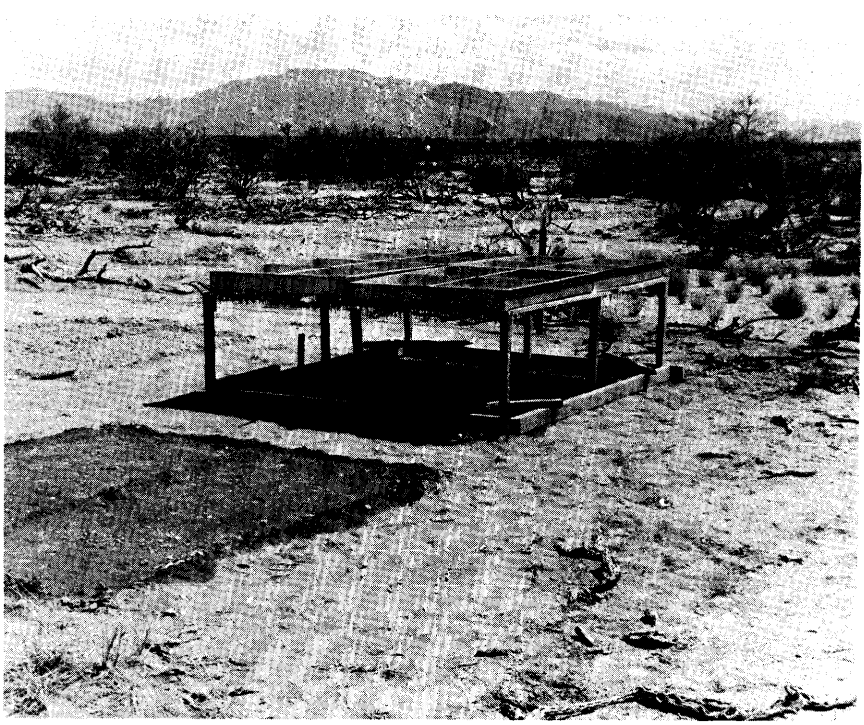

Fig. 2. *A combination of four drip pans mounted on a wooden frame in use on a range seeding research plot at a remote field location.*

This indicates that water cleanliness may not be a critical factor for satisfactory operation.

The drip pan proved suitable for irrigating a variety of ground surfaces ranging from smooth and level to rough, uneven, sloping and rocky; and from bare soil to high density grass, half shrub and forb cover. It was not tested on steep slopes or tall brush but appears to have a potential for use on these sites although steep slopes might induce difficulties because of rapid runoff.

We found drip pan irrigation usually required smaller, less elaborate border barriers than flood irrigation. On level, permeable ground and where lateral water movement from the plot is not critical border barriers might be entirely eliminated.

Weak air eddies were found to be desirable because they deflected drops falling from the drip pan to produce an essentially random impact pattern at the ground surface. We had no occasion to operate the drip pan in strong winds, but a plastic film wind shield around the pan frame should prevent adverse wind effects.

The drip pan was used as a high-intensity, low-velocity, low-impact sprinkler. As checked by five separate measurements with six individual catchment containers, it dripped 5.1 cm of water (±5%) per hour with uniform coverage. Any uneven dripping could be observed and corrected by adjusting the wick lengths. Drip pans were easy to level by blocking the corners of the frame base. We used a combination of four drip pans suspended over the treatment plot at a 9.1- dm (3-ft) height on a wooden frame (Fig. 2).

The drip pan can be adapted for many uses because water drop frequency, size, and impact force may all be varied to meet special requirements. Drop frequency can be varied by changing the size and spacing of the drip holes, the material, diameter and length of the wicks, and the height of the pressure head. Ellison and Pomerene (1944) with their wool wick rainfall applicator were able to apply water at rates ranging from 12.2 to 37.6 cm (±3%) per hour by changing the pressure head and drip-hole sizes. They also concluded that a still wider gradation was possible. We poured water directly into the drip pans with a calibrated bucket which caused the pressure head to vary. A constant pressure head could be achieved by using some type of constant head tank (Zwolinski, 1969; Meeuwig, 1971).

Waterdrop impact force can be varied by changing pan height and drop size because the kinetic energy of a falling body is equal to one-half the mass times the square of the velocity. The terminal velocity and impact force of different size drops falling from various heights can be determined from the curves developed by Laws (1940). Methods for measuring drop size are described by Pearson and Martin (1957).

Rainfall contains a wide variety of drops ranging from approximately 0.25 to 7.00 mm in size (Laws and Parsons, 1943). A disadvantage of previous drip-type rainfall simulators is the limited range of drop sizes produced with the smaller sizes not represented (Mutchler and Hermsmeier, 1965). The drip pan because of its wicks and their location directly in the pan bottom has the potential for producing a wide range of drop sizes. Regulation of size will depend upon using the proper combination of drip-hole size, wick material, diameter and length, and head pressure. The smallest part of the natural raindrop size spectrum may not be obtainable but this should not be important for most studies in which the drip pan would be used.

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Winter Injury to Fourwing Saltbush

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Highlight: *Winter hardiness of fourwing saltbush (*Atriplex canescens*) varies with its point of origin. Data indicate that factors other than temperature and origin affect the hardiness of these plants, since variations in winter hardiness occur between individual plants from the same source. The sex of a plant has no effect on hardiness. Generally, seed for reseeding should be obtained from the immediate vicinity of, or from an area colder than, the anticipated planting site.*

Fourwing saltbush (*Atriplex canescens*) occurs widely in the western states. In addition, it is one of the most rapid in vegetative growth and produces an abundance of forage savored by game and livestock. Cold tolerance is only one characteristic used to measure the performance of this plant in evaluation and selection, but it is one of the more important traits when selecting for future plantings in the colder areas. The unusually severe winter of 1972-73 was ideal for checking the hardiness of plants in Utah. During this period, many ornamental shrubs and trees around homes and buildings, as well as some indigenous shrubs, suffered winter injury.

Fourwing saltbush plants from several sources were planted during 1970 and 1971 at two locations to check their performance as transplants in terms of such characteristics as palatability, vegetative growth, seed production, and winter hardiness. The plantings were at either Snow Field Station in Ephraim, Utah, or Nephi Field Station, south of Nephi, Utah.

The Snow Field Station is in a relatively high and dry mountain valley at an elevation of 5600 ft. Some winters are quite mild, with few nights dropping below zero degrees Fahrenheit. Others may be extremely cold, with many below-zero nights. Wind chill is not a problem in this area.

The winter of 1972-73 was characterized by early winter storms

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