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NF91-39 Precipitation and Sprinkler Irrigation Monitoring for Managing Irrigation Scheduling

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Precipitation and Sprinkler Irrigation Monitoring for Managing Irrigation Scheduling

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At its very root, the scheduling of irrigation is a water balance problem. Accurately assessing the amount of water in the soil root zone is essential when deciding the amount and timing of an irrigation application.

The water balance is often compared to a checkbook balance: there are deposits as well as withdrawals. In a soil water balance, precipitation and irrigation are similar to deposits, and runoff, drainage, and evapotranspiration (crop water use) are similar to withdrawals. Any error in the precipitation or irrigation measurement will affect the estimate of the amount of water in the soil and could lead to inappropriate decision making by the irrigator. Poorly made irrigation management decisions include: excessive irrigation applications — resulting in waterlogged soils, erosion, and leaching of chemicals; and insufficient irrigation applications — resulting in poor performance of chemicals, crop stress, and yield reduction. Therefore, careful monitoring of precipitation and irrigation amounts is integral to irrigation scheduling.

When an irrigator monitors precipitation and irrigation, it must be accurate and representative. Differences in the measuring ability of precipitation gauges and large geographic variations in precipitation, especially in summer, often lead to errors in an irrigator's estimate of actual soil water content.

Precipitation Gauges

Nearly all precipitation reported by the National Weather Service (NWS) is measured using a standard rain gauge with an eight-inch circular opening or orifice. This device has a precision of one-hundredth of an inch. However, it is just not practical (due to its size and cost) to use a NWS precipitation gauge on the farm. Still, precipitation measurements are essential, especially for the farmer who irrigates. Therefore, the catchment of three precipitation gauges commonly used on farms have been compared to the standard NWS gauge. A short description of the three gauges follows.

1. A plastic wedge-shaped gauge with a bracket for mounting on a post, an orifice of 2.5 inches by 2.3 inches, and a precision of one-hundredth of an inch to a depth of 0.2 inches, two-hundredths of an inch to a depth of one inch and five hundredths of an inch beyond a depth of one inch (thus providing excellent reading accuracy with light to moderate precipitation amounts).

2. A tubular gauge with an aluminum frame for mounting on a post, a 1.15 inch orifice, and a precision of one-tenth of an inch.

3. A tubular gauge (the familiar farm post type), frequently given away under advertising campaigns by seed and feed companies, with a frame for mounting on a fence post, with an orifice of 0.8 inches, and a precision of one-tenth of an inch.

Results showed that the wedge-shaped gauge compared best to the standard eight-inch orifice NWS gauge. In fact, this gauge caught, on average, the same amount of precipitation as the eight-inch orifice gauge.

The 1.15 inch and 0.8 inch orifice gauges tended to read higher than the NWS standard gauge. This was attributed to: the scale of the gauges (it was found to be very difficult to read amounts to the nearest one-hundredth of an inch on these two gauges), and a tendency for water to drain back from the sides after emptying. It was also noted that these two gauges tend to catch more precipitation than the standard NWS gauge under conditions of light rainfall (0.01"-0.49") and moderate wind speeds (11-20 mph).

Where to Locate Precipitation Gauges

In Nebraska, it is well-known that there is a great deal of geographic variability in precipitation from an individual storm, particularly the thunderstorm/thundershower type of precipitation that occurs during the summer. In fact, it is not at all uncommon for one area of a large field to receive rain while another area remains dry. This makes it more complicated to calculate a soil water balance and to plan irrigation applications. One way to handle geographic variability of precipitation, and avoid some of the soil water balance/irrigation application errors, is to install several rain gauges in the same field.

The reliability of a network of rain gauges for a particular rainfall event depends on the coverage area and the number of precipitation gauges. This simply translates to the number of rain gauges per unit area. The more rain gauges per unit area, the more reliable the estimate of precipitation or irrigation for the soil water balance, and thus the better the input for the decision regarding irrigation applications (and vice-versa).

The number of rain gauges per unit area and their placement is a practical matter related to accessibility and cost. While studies have shown that centrally located gauges provide, on the average, the best estimate of areal precipitation, gauges also need to be located on the periphery to provide the most accurate area-wide estimate of the soil water balance. Gauges placed along a center pivot access road can measure precipitation when it occurs but, the gauge could also measure irrigation applied by the irrigation system. Precipitation gauges in the field should be placed above the crop surface. Gauges measuring irrigation in the field must be placed below the point where spray is released. The recommended density of rain gauges is four to six gauges per 160 acres. It is also recommended that the average amount of water caught in the four to six gauges be used in the water budget. For furrow irrigation, it is also necessary to determine the amount of water applied but precipitation gauges would not be used.

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