Measuring Water Needs Of 5 Irrigated Crops[1]

By H. Holmen[2]

A study of five irrigated crops at the Deep River Development Farm near Upham, N. Dak., is being conducted to determine the seasonal water use of these crops. The soil moisture used by the crop, the irrigation water used, and the rainfall and other climatic conditions are recorded throughout the season. Data obtained to date have been summarized to determine the seasonal and periodic rates of water use.

It is true, generally, that different crops grown under irrigation do not require equal quantities of water to produce a season's growth. Neither do the periods of peak water use by each crop occur at the same time during the growing season. Consequently, the time of year to apply the correct amount of water for best plant growth is of major importance to the irrigator who wishes to make the most efficient use of his water supply. Knowing the seasonal water requirements of a crop and the periods of peak water use by this crop, it is possible to estimate the time and amount by which rainfall should be supplemented by irrigation in order to obtain optimum of crop growth.

The total quantity of water used by a crop during part or all of its normal growing season, expressed as depth in inches or feet over the area on which the crop is grown, is called the consumptive use of the crop. It includes all precipitation lost due to interception by the foliage of the plants and evaporation from the immediate area around the plants as well as the water transpired by the crop. Many natural factors, difficult to control in the field, influence this consumptive use. These factors include such variables as wind velocity, relative humidity, temperature, cloudiness, and state of plant growth.

The quantity of water removed from the soil by a certain crop may be measured for a given period of time by determining the reduction in soil moisture content within the depth of the crop's root zone, making proper allowance for any precipitation falling during the period. Many methods for measuring soil moisture content are in use. The most reliable way is to take actual soil samples from the field and weigh them before and after the moisture in the sample has been evaporated in a heated oven. This method has been used during the past two years to determine consumptive use of several crops grown under irrigated conditions

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[1]Progress report on Bankhead-Jones Offset Project No. 92.

[2]Assistant Agricultural Engineer. (M. E. Jensen, formerly Assistant Agricultural Engineer, and Rome Mickelson, formerly Research Assistant, did the initial work on this project and obtained most of the data. The author also acknowledges the assistance of C. W. Carlson, Soil Scientist, Western Soil and Water Management Section, ARS USDA, Mandan, North Dakota and the cooperation of the Bureau of Reclamation.)

on the Deep River Development Farm. The Oakfield soil probe was used to gather the soil samples taken at one foot intervals to depths of four or five feet below the surface of the ground, depending upon the penetration of the roots of the crop under observation.

Two other methods of measuring soil moisture were used to a limited extent. One of these involved the use of nylon blocks buried at various depths in the soil. The resistance of the blocks to an electrical current was measured by a soil moisture bridge. Different electrical resistances indicated different soil moisture contents. The third method involved use of an instrument known commercially as the "Irrometer." This instrument has a ceramic tip at the end of a hollow tube and a gauge to indicate a vacuum in the tube. When the tube is filled with water and buried in the soil, the tension created on the water in the tube causes the gauge to indicate the moisture condition of the soil.

In addition to making regular soil moisture measurements, a daily record was kept of temperature, wind, and humidity conditions. Several evaporation pans were installed to study evaporation.

In Figures 1 and 2, the rate of water use as determined by soil sampling is shown for five irrigated crops. Each point on the respective graph represents the daily rate of water use for the semi-monthly period in which it is plotted. The data of all crops except bromegrass have been averaged for a two year period. An extensive project involving a study of water use and yield of bromegrass hay and pasture was started in 1954 and the first data were obtained the following year.

Peak water uses are important to determine when a crop makes its greatest demand on the water supply. In Figure 1, the highest rate of water use for corn and potatoes occurred in late July, while

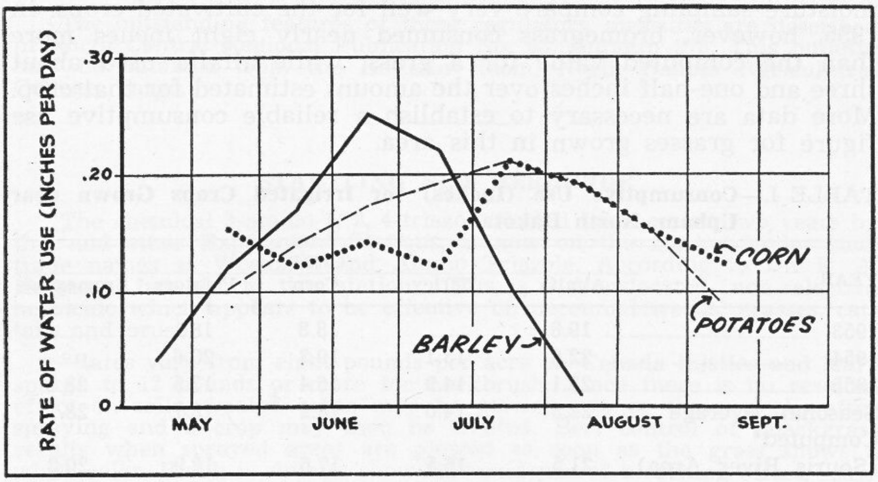

FIGURE 1.—*Average daily water use in semi-monthly periods for irrigated crops grown near Upham, N. Dak., during* 1954 *and* 1955.

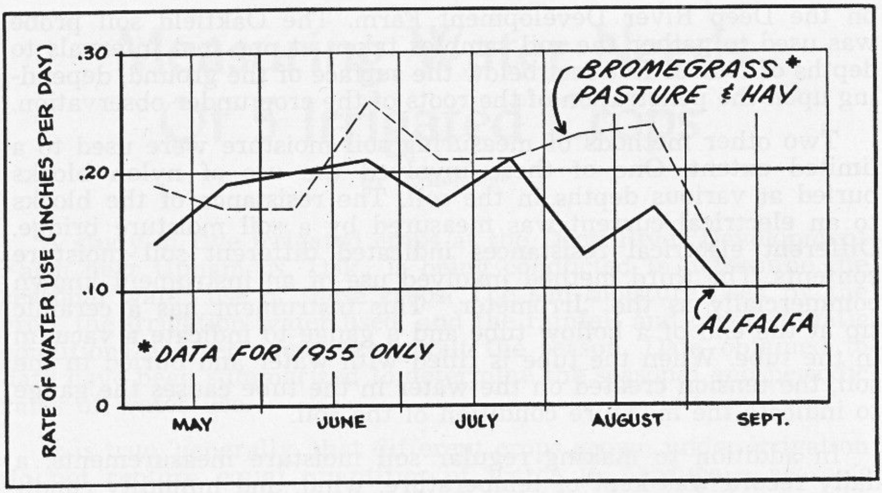

FIGURE 2.—*Average daily water use in semi-monthly periods for irrigated alfalfa and bromegrass grown near Upham, N. Dak., during* 1954 *and* 1955.

for barley it occurred in late June. Alfalfa and bromegrass used water at a rather high rate throughout June, July, and August without reaching a well-defined peak at any particular time of the season.

The seasonal consumptive use was obtained in 1953 for alfalfa, corn, and potatoes and is included in Table I with the data for 1954 and 1955 for the five irrigated crops. The computed consumptive use by the method described in the North Dakota Experiment Station Bulletin No. 377 and the actual values obtained by soil moisture sampling compare very well for the cultivated crops. In 1955, however, bromegrass consumed nearly eight inches more than the computed value for a grass, while alfalfa used about three and one-half inches over the amount estimated for that crop. More data are necessary to establish a reliable consumptive use figure for grasses grown in this area.

TABLE I.—**Consumptive Use (Inches) for Irrigated Crops Grown near Upham, North Dakota.**

YEAR	CROP				
	Alfalfa	Barley	Corn	Potatoes	Bromegrass
1953	19.8	-----	18.8	18.1	-----
1954	22.6	13.1	19.3	20.6	-----
1955	25.1	14.9	16.4	17.5	28.1
Seasonal Average	22.5	14.0	18.2	18.7	28.1
Computed* (Souris River Area)	21.5	16.5	17.6	18.9	20.2

*Estimates of Irrigation Water Requirements for Crops in North Dakota. N. Dak. Agr. Exp. Sta. Bul. 377. 1952. p. 16.

Summary

In the Souris River area, hay and pasture crops of bromegrass and alfalfa used water from the soil at a rather steady rate throughout the growing season. However, the grain and row crops had a period of peak consumption sometime during their growth.

From 1953 through 1955 the average consumptive use was 22.5, 18.2, and 18.7 inches for alfalfa, corn, and potatoes, respectively. Barley had an average consumptive use of 14.0 inches for 1954 and 1955, while bromegrass used 28.1 inches in 1955.

STUDY OF GRAIN STORING REGULATIONS AVAILABLE

The North Central Grain Marketing Technical Committee, representing all important grain producing states, has completed a study of state grain warehousing regulations. It is believed that important changes in grain storage conditions, not reflected in warehouse regulations, had occurred since the war. A series of large grain crops resulted in considerable quantities of grain put in storage. Prevailing high prices meant that the dollar value of the huge quantities of stored grain assumed a much greater economic importance than in pre-war years.

Demand for space brought into use new and sometimes untried types of storage facilities and conditioning equipment. The large scale federal price support program introduced new elements, such as lengthier storage periods, that were not present when state regulatory procedures were initiated. The question of the adequacy of present day state regulations in the light of these conditions prompted this inquiry.

This survey of present-day grain storage regulations in the North Central States indicated that, except in Ohio and Indiana where no regulation is attempted, control is accomplished by licensing systems, augmented by fidelity bonds, warehouse receipt control, periodic inventory reports and, less commonly, inspection of physical facilities and measurement of stocks.

The outstanding features of these regulatory measures are described in North Central Regional Publication No. 68, Bulletin 375. This bulletin may be obtained from the Bulletin Room, North Dakota Agricultural College, Fargo.

STARTLING NEW HERBICIDE

The chemical 3-amino-1, 2, 4-triazole, tested for the past two years by this and other Experiment Stations, is now on the market under such trade names as Weedazol and Amino Triazole. According to Dr. E. A. Helgeson, botanist at this station, "This is a translocated, non-selective herbicide which appears to be effective on perennial weeds, grasses, cattails and brush.

"Rates vary from eight pounds per acre on Canada thistles and leafy spurge to 12 pounds or more for buckbrush. Since there is no residual effect on soils, treated areas may be plowed two or three weeks after spraying and a crop may then be treated. Best control of quackgrass results when sprayed areas are plowed as soon as the grass shows a white color. Brush is slow to show this evidence of bleaching effect," says the botanist.

He warns that these new herbicides should not be used on food crops, nor on areas grazed by livestock.