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(a) IRRIGATING WITH LIMITED WATER SUPPLIES

Irrigation managers can do something other than purchase additional equipment or reduce irrigated acreage to accommodate limited water supplies. Well-timed irrigations may help some managers irrigate more acres without lowering crop yields. By making the best use of water, irrigation managers can free up both water and equipment for use on other crops or other land parcels. Seed- producing crops respond more to irrigations during one particular stage of development than during other stages. Some of those crops include corn, barley, sunflowers, wheat and beans. Yields of storage and forage crops--sugar beets, potatoes, alfalfa and grasses---are more directly related to climatic demand and cumulative water use during the season than to stress during any particular growth stage.

CORN

Corn is very sensitive to drought stress, especially during the flowering and reproductive stages. Stress during the early vegetative stage is not nearly as serious as stress during flowering, pollination and early seed filling. Grain corn is most sensitive to drought stress between the 12-leaf and blister kernel stages; this period includes flowering, pollination and initial seed filling. Stress during any part of the cropping season limits grain corn production. To maximize water use efficiency in grain corn, it is best to limit irrigations during the vegetative stage. The period from emergence to 12-leaf was lease sensitive to stress.

BARLEY

Barley responds to drought stress much like corn and other cereal crops. Yield is likely to be reduced very little when drought stress occurs during the vegetative period. However, a major disadvantage of early drought stress is the tendency for plants to tiller more than usual. Although the increased tillering is desirable, often the tillers never produce grain-yielding heads. Barley is most sensitive to stress during jointing, booting and heading. considering drought stress before, during and after heading, yield is reduced the most by drought before heading. flowering and pollination appear to be the most sensitive periods.

WHEAT

Several studies have been conducted with spring wheat and winter wheat to evaluate the effect of limited irrigations on crop quality and production. Stress was most critical during and after heading. this response is similar to that for barley. There is little or no measurable benefit from irrigating spring grains before the boot stage, unless moisture stress is evident. Stress is likely to occur when the plants appear wilted and the leaves curl. The period between grain filling and maturity is critical. Yield is reduced the most when stress starts during soft dough or during or following heading. Stress during the maturing process results in approximately a 10 percent lower yield. Moderate stress during the early vegetative period has essentially no effect on yield. Irrigation managers can use water most efficiently on spring-planted grains by reducing early-season irrigations and minimizing crop stress during flowering, pollination and seed filling. Drought stress on winter wheat production during early spring regrowth results in heading approximately 7 to 10 days prematurely. The consequence of early heading is early maturity and a shortened growth period; thus, yield is reduced. Early stress results in development of more heads than usual. However, many of the heads fail to produce grain. Winter wheat is most sensitive to drought stress during shooting and booting. It is essential to avoid even slight water stress at joining. Withholding water to increase tillering may lead to premature heading and grain maturity.

POTATOES

High-quality potato yields can be achieved only by maintaining a uniformly high level of available water throughout the crop season. Short 4 to 5 day stress periods do not lower yields significantly or deteriorate the quality of potatoes compared to unstressed crops. Potato production is directly related to crop water use between emergence and defoliation. Potatoes are not susceptible to severe yield reductions from short periods of moderate stress during any single period of production.

ALFALFA

Alfalfa forage yield is directly related to available water and actual plant water use. Alfalfa is not nearly as sensitive to plant water stress at different times of the season as are most of the grain-producing crops. Forage increases of one-sixth to one-fifth ton per acre per year for each inch of applied water have been obtained. Maximum water use by alfalfa is not likely to exceed 24 inches between late April and the later part of August. Most alfalfa varieties, when subjected to plant water stress, will go into dormancy, thus dramatically reducing both water use and production. When irrigation reduces stress, the crop resumes growth. Alfalfa is much less sensitive to plant water stress, regardless of when it occurs during the growing season.

SUMMARY

Essentially two types of response occur when irrigated crops are subjected to drought stress. Determinate crops, which are grown primarily for the harvest of mature seed and depend on day length and season length, are most sensitive to drought stress during the seed formation period. This period includes heading, flowering and pollination. Crops most affected by stress during this period include small grains, other cereal crops and oilseed crops. Drought stress that occurs between seed development and maturity also limits yield, but to a lesser degree. These same crops are relatively insensitive to drought stress during the early vegetative period.

Indeterminate crops, such as tuber and root crops that are grown primarily for the harvest of storage organisms, are relatively insensitive to moderate drought stress for short intervals throughout the entire crop growing season. Crops like potatoes, sugar beets, alfalfa and pasture, quickly recover from short stress periods and little reduction in yield occurs.

Irrigation managers confronted with limited irrigation water should consider making the most efficient use of water by their crops. For seed crops, this means cutting back on early- season irrigations and ensuring minimum stress conditions between seed development and maturity. For root, tuber and forage crops, irrigation managers should minimize the number of early-season irrigations and eliminate late-season irrigations.

For individuals wishing to read more about irrigated crops and irrigated crop management, some of the following references might be able to provide answers to your questions. Some useful references are found on the Internet at USU’s Cooperative Extension site http://extension.usu.edu/cooperative/

(b) Examples

Following are examples of how to select a Management Allowable Depletion (MAD) and use it to calculate Net irrigation requirement and irrigation frequency.

Given: The operator is growing Potatoes on a sandy loam soil. The crop ET rate is .26 in/day.

Find: Select an appropriate MAD value and determine the Net irrigation requirement and the irrigation frequency

Solution:

Step 1. Using procedures mentioned in Chapter 2, the available water capacity is estimated at 1.45 in/ft. Table 3-4 shows typical rooting depths. For the purpose of this example a rooting depth of 2 feet is selected. In an actual situation never assume a plant root zone for management purposes. Check actual root development pattern and depth. From Table 3-3 select a MAD of 35%. Net irrigation can be calculated the following way:

$$Net\ Irrigation = Available\ water\ capacity\ (AWC) \times Root\ Depth \times \frac{MAD\%}{100}$$

$$Net\ Irrigation = 1.45 \frac{in}{ft} \times 2\ ft \times \frac{35\%}{100} = 1.02\ inches$$ This can also be called MAD(inches)

Step 2. The Irrigation frequency can be calculated as follows:

$$Irrigation\ frequency = \frac{MAD}{Crop\ ET\ rate} = \frac{1.02\ inches}{0.26\ in/day} = 3.9\ days$$ Use 4 days