WATER MANAGEMENT FOR IRRIGATION OF ALFALFA IN DESERT AREAS

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Not only are there different methods and schedules for irrigating alfalfa, but there are several reasons why and when we irrigate it.

Alfalfa generally may be considered as an uncooperative crop; that is, it is either too wet or too dry to harvest. There are probably fewer choices of times to schedule irrigations on alfalfa in the Southwestern United States than for most other crops. When alfalfa is to be cut on an average of once a month during 9 months of the year, the times when it can be irrigated are pretty well limited. There are several reasons for this. To attain maximum production, the plant needs over 10 inches of water for most of the periods between cuttings. When the time between cuttings is reduced by at least a week before harvest for soil drying, 5 days for the harvesting, and a few more days to prevent inundation which would occur if water were applied immediately after harvesting, it is obvious that there just isn't enough time between harvests to properly apply the 10+ inches of water. Mr. Al Halderman[1/], Extension Irrigation Engineer at the University of Arizona, has stated: "Irrigate according to crop needs," which I believe to be a very good rule. He has indicated what the plant needs in terms of water for maximum yield, and his findings could be expanded to include other aspects imposed by harvesting and price fluctuations.

Figure 1 represents the consumptive use for the season, semimonthly, by depth and peak use. "Consumptive use" is defined as the sum of the water transpired through the plant leaves, that which is evaporated from the soil surface near the plants, and that used in the plant's tissues. This curve represents a management practice in which the alfalfa is allowed to become partially dormant during part of the season, and the approximate increase that would take place if a full-season production practice were desired. We must keep in mind that these data represent consumptive use, the ideal, as far as meeting the plant needs. I[2/] developed this consumptive use curve some years ago and Al used it in his Agri-File Bulletin. Granted, the varieties at that time were not aphid resistant, and were probably more susceptible to scald but, nevertheless, it was possible to produce over 10 tons per acre, even with a partially dormant period in late July and August. I feel that, for all practical purposes, the consumptive use of water by the plant is about the same today.

In the Salt River Valley of Arizona, and in most desert areas of the Southwest, alfalfa is relatively dormant during December, January and part of February. With warm weather in late February and early March, the alfalfa begins to grow if it has moisture.

The amount and timing of the first spring irrigation depends on winter rains, stored moisture, and the availability of free winter irrigation water. The growth period for the first crop covers about 6 weeks, during which the plant uses nearly 8 inches of water Most of the silty clay soils in the Southwestern United States can store 8 inches of available water. In most cases, some winter-stored moisture exists and one irrigation may be adequate for this crop. If water infiltration rates are high, free water could be utilized in midwinter without harmful effects, thus supplementing the 8 inches needed for the first crop.

1/ Allan D. Halderman, "Alfalfa Water Use." Cooperative Extension Service Bulletin Q-203, University of Arizona, Tucson, Arizona, July 1973.

2/ L. J. Erie, O. F. French, and K. Harris, "Consumptive Use of Water by Crops in Arizona." Technical Bulletin 169, Agricultural Experiment Station, University of Arizona, Tucson, Arizona. 1965. Reprinted, 1968.

During the last 6 weeks of the growing season, the plant uses about 6 inches of water. Thus, one irrigation might suffice for the last cutting.

Let's now consider the main part of the production period, between the first and last cuttings. If a partially dormant period in August is not desired, the plants will probably use over 80 inches of water to achieve high production.

Soils cannot store enough water from one irrigation to last for the complete period between harvests; thus, at least two irrigations are needed to supply the 10+ inches. If 5 days are needed for harvest and at least 7 days are needed for drying of soil before harvest to allow machinery traffic, only 18 days at most are left for applying two irrigations. If the new crop is irrigated too soon and is inundated, stand may be reduced. Many times it takes more than 7 days to dry the soil before harvest and sometimes more than 5 days to cure and harvest the crop. Generally, the 18 days is reduced to less than 2 weeks. So you see, even though we wish to apply water when the plant needs it, according to the consumptive use curve, it just isn't always possible. It seems that if maximum production is to be achieved, we must accept some stand decline in order to squeeze the two irrigations into the program. If only one irrigation is given to maintain a better stand, yield will be decreased.

If a dormant-period program is practiced -- or perhaps I should say, if a worry-free fishing vacation is desired -- I guess all one has to do in late July is just forget about alfalfa, go fishing, return the last of August, clip whetever is there, irrigate, and prepare for a harvest in about 4 weeks. Note that we are still near the consumptive use rate of 10 inches per month. The dormant period has reduced the moisture to near the wilting point, thus a large irrigation is desirable at this time, and an improved intake rate resulting from the unusually dry soil might make this possible, even on heavy soils. A second irrigation before harvest will probably be necessary.

For many crops, including alfalfa, certain plant symptoms such as a dark gray color lack of new growth, early blossoming, or stunting, can be used as indicators of moisture stress. Usually there is an area of poor water penetration in some part of the field which can be used as the indicator site. Irrigating on this date may still be feasible from an economical water-use standpoint. This method is not well adapted for large operations and does not fit well into a program when harvesting is a critical variable. If water tables are high, one irrigation may be adequate, and the described indicators might be a clue to the validity of this practice.

It is obvious that we must live with the harvesting operations, and we must supply enough water to meet the plant needs, if we wish to achieve high production. We also know that sandy soils and tight clays or silts, which will also usually be salty, must be irrigated more frequently. How much more frequently will depend on water quality, salt content of the soil, and the amount of water stored with each irrigation, and will thus vary according to the management of each alfalfa-producing operator. The consumptive use for high production will change very little, regardless of soils; thus, water needs will have to be met by management. It is reasonable to assume that at least twice as many irrigations will have to be applied on sandy soils. During the hot period, on sandy soils in desert areas, the alfalfa plant cannot extract water from depths below 3 feet fast enough to make vigorous growth; thus, even more frequent, light irrigations are necessary.

On tight soils where infiltration rate is low, scalding will occur if too much water is applied. Light, frequent applications are the only temporary answer, unless the intake can be improved. Disease and stand reduction are prevalent on these soils. Some relief is possible by the use of minimum tillage before planting, and in some cases, chiseling before planting and at later dates. 3/

3/ Karl Harris, L. J. Erie, and W. H. Fuller. "Minimum Tillage in the Southwest." Bulletin A-39, Agricultural Experiment Station and Cooperative Extension Service, University of Arizona, Tucson, Arizona. 1965. Reprinted 1969.

SUMMARY

We can expect that the alfalfa plant will use at least 80 inches of water, if a full maximum yearly production is planned. Keep in mind that this is what the plant uses, and not what you must pump or what you must purchase to make it available to the plant within its root zone.

If soils are relatively well-aerated, 60 percent of the consumptive use water will be drawn from the top 3 ft of soil. This does not mean that we should not maintain water at lower depths as a "spare tire" to take care of emergencies. Of course, we are all perfect, and get the water on exactly when needed -- but there is some satisfaction in knowing we have a spare tire.

In order to attain maximum yield on the generally silty-clay desert soils, we will probably have to irrigate at least twice between harvests. This is quite difficult to do because of the short intervals between harvests, the need for dry soil for machinery operation during harvesting, and the inadvisability of inundating new growth. The pressure for high production will probably result in quicker decline in alfalfa stands and reduced soil intake rates.

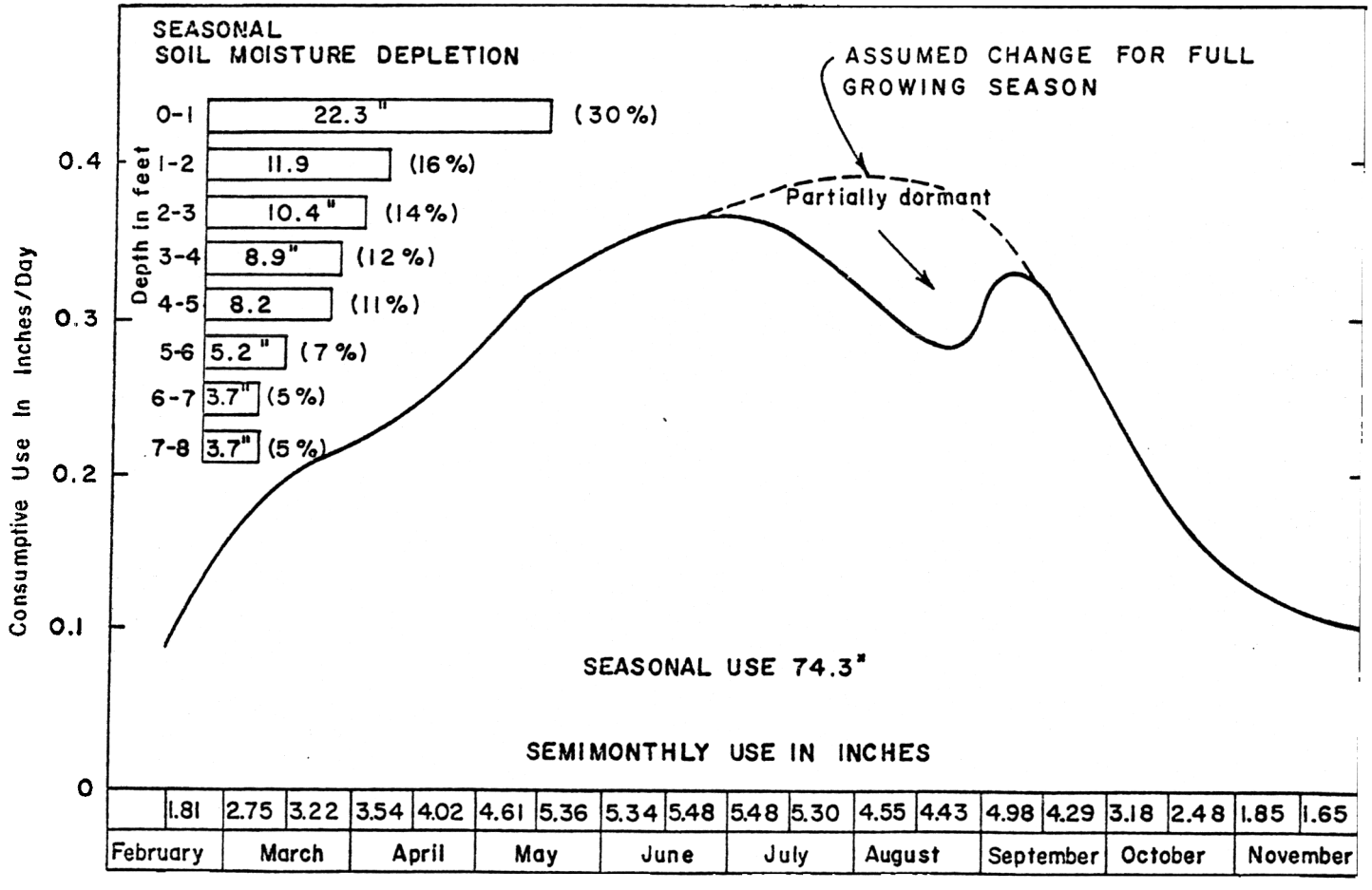

FIGURE MEAN CONSUMPTIVE USE FOR ALFALFA AT MESA AND TEMPE, ARIZONA
1946-1950-1962-1963