

IRRIGATION WATER MANAGEMENT

FOR ALFALFA SEED PRODUCTION

It is now believed that a major reason for frequently observed decline in alfalfa seed yields after the first or second year has been the lack of sufficient subsoil moisture. In deep alluvial soils (for the first crop or two) the subsoil moisture present is generally a carryover from previous crops—if they were shallow rooted, or were irrigated late in the season. These test results show that 48 inches of irrigation water, applied to a dry soil, is sufficient moisture to insure production of a good alfalfa seed crop.

TO PRODUCE A MAXIMUM CROP of alfalfa seed, a plant must be produced large enough to fill the seed, after which further vegetative growth must be retarded to promote flowering and seed set. Before these experiments it was generally believed that 30 to 36 inches of water was adequate to produce acceptable yields of alfalfa seed. However, as yields continued to decline, it was thought that the absence of deep subsoil moisture might be at least partly responsible. Maximum seed yields can be achieved by proper water management more easily in the deep alluvial soils of the San Joaquin Valley (where most of California's alfalfa seed is produced) than on shallow soils. If the water in the upper soil has been depleted during the latter part of the season, the subsoil then supplies enough water for seed filling, but not enough for rapid vegetative growth.

Such a broad picture does not provide the details needed to make correct water management decisions. Should most of the seasonal water required be supplied by preseason irrigation, maximizing the amount of water supplied by the subsoil? Or is the desired growth balance and maximum yield achieved by a combination of preseason and crop season irriga-

tions. If there is not sufficient subsoil moisture, does relatively frequent rewetting of the upper soil seriously reduce yields?

To answer these questions, an experiment was conducted at the University of California's West Side Field Station near Five Points. The deep panoche clay loam soil found there is typical of those on which most of the alfalfa seed is grown.

The soil was dried to a depth of 10 ft by cropping to safflower in 1964. In the spring of 1965, six irrigation treatments were initiated by pre-irrigating with 6, 12, 18, 24, 30, and 36 inches of water to wet the soil to depths of 3, 5, 7, 9, 11, and 12 ft. Treatments were designed to control rooting depth, since alfalfa roots do not penetrate dry soil. The irrigation treatments were designated 1 to 6 in order of increasing rooting depth.

In the spring of 1965, Moapa variety of alfalfa was planted in rows on 40-inch beds, and all plots were treated uniformly for the rest of the season. All received 13 inches of water by seven sprinkler irrigations.

Preseason irrigation

In 1966, preseason irrigation was regulated to provide the same wetted soil depth as in 1965. Sufficient additional water was added during the crop season to supply a total of 30 inches for treatments 1, 2, and 3, and 36 inches for 4, 5, and 6. Soil moisture measurements verified that water did not penetrate below the planned depth in the soil during 1965 and 1966. Excavations at the end of the 1966 season showed the roots were limited to the wetted depth, or to 11 ft where the soil was wetted to more than that depth. Measurements of the amount of water in the soil at the end of each season were taken by soil sampling to one foot below the wetted depth or to 12 ft in treatments 5 and 6.

Results of the soil moisture samples collected after the first and second year of growth are shown in the graph. Each treatment was sampled to at least 1 ft below the depth of wetting, with the exception of treatment 6, which was sampled to 12 ft. Following the safflower harvest, the soil moisture values for 1964 are indicated by solid black bars (on the left by depth). The dark hatched bars indicate moisture content of the sample collected after the 1965 season, and the light cross-hatched bars are the same treatment and locations taken after the 1966 harvest. The 1966 sample was less for each depth increment, indicating that residual moisture had been utilized for the 1966 alfalfa seed production. The graph also shows that alfalfa (after the second year of growth) will extract more deep moisture than safflower—which may be expected since alfalfa is a perennial plant, while safflower is an annual.

The 1966 treatment summary, total water use by plants, and seed yields are given in table 1. These data show that if alfalfa is adequately supplied with water, the crop's seasonal water use is more nearly 44 to 48 inches than the 30 to 36 inches previously recommended. The additional 12 inches of water were extracted mainly from the deep subsoil in treatments 4, 5, and 6, as shown in the graph. In treatments 5 and 6, for example, about 3½ inches were depleted from the 10 to 12 ft depth.

Because the original plan did not provide adequate seasonal supply of water for any treatment (table 1), the treatments were changed for the 1967 and 1968 seasons by increasing the water application to 48 inches for treatments 2, 4, 6 (table 2). Wetted depths remained the same, and there was no change in treatments 1, 3, and 5.

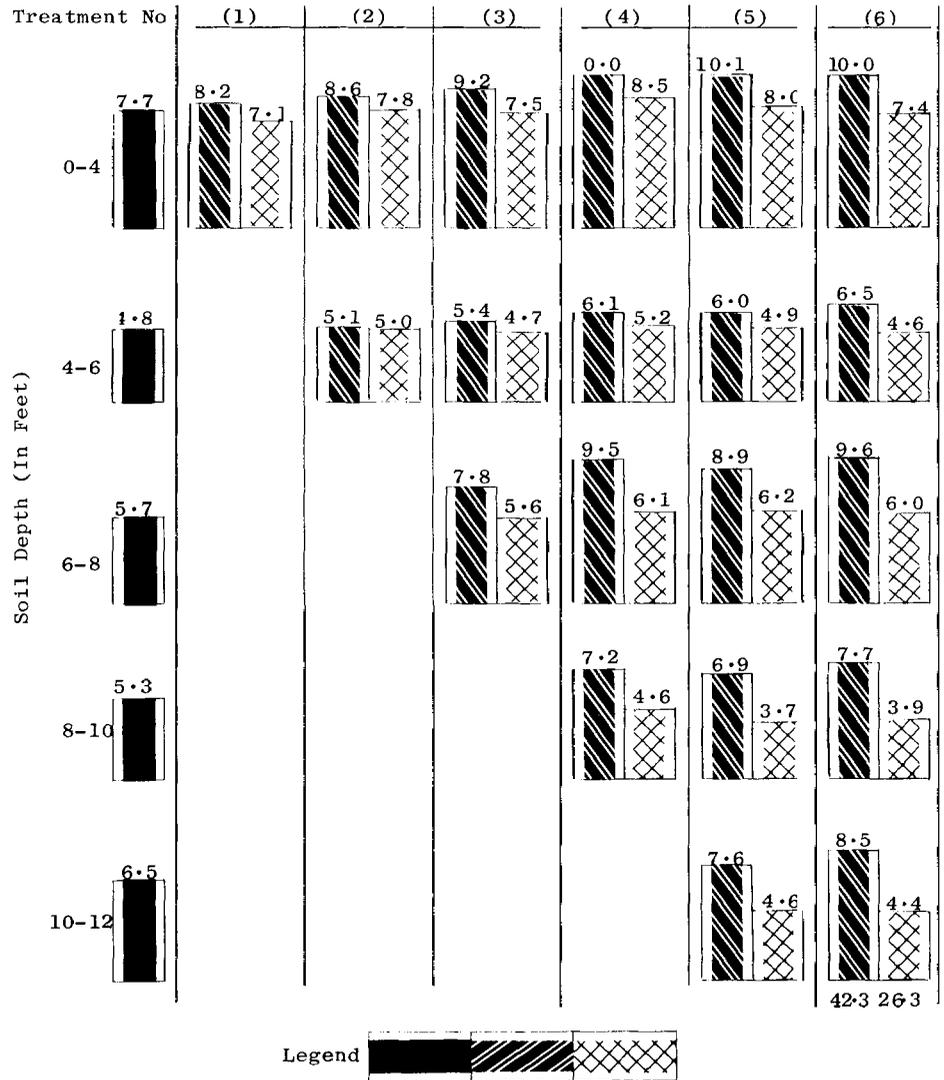
Two-seasons

Table 2 summarizes treatments, water use, and yield averages for the two seasons. The percentage of water supplied by irrigation during the cropping season is of secondary importance. This suggests that since yields of treatments 4 and 6 are highest, a balance of about half the seasonal supply of water applied as pre-irrigation, and the remainder applied during the growing season, may be the best method.

Twenty or more inches of water is a large amount to apply as a pre-season irrigation—even if partially supplied by effective rainfall—and considerable time and effort is required to apply it. However, a large reserve of subsoil moisture is good insurance against the onset of hot, dry weather, especially when water is required concurrently by other crops, and if water entry into the soil is slow. If the alfalfa growing season begins without a substantial reserve of subsoil water, the seed grower should apply enough water to bring the seasonal supply to a minimum of about 40 inches. If most of the irrigation water is applied before or during the desired vegetative growth period, the risk of promoting excess growth is minimized, and the risk of crop injury by frequent or prolonged irrigation is reduced.

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TOTAL MOISTURE IN INCHES BY DEPTH REMAINING IN SOIL AFTER HARVEST IN 1964, 1965, AND 1966 TESTS FOR ALFALFA SEED PRODUCTION



Total irrigation, inches	30	30	30	36	36	36
Soil water depletion, inches	1	1	5	8	12	16
*Seasonal water use, inches	31	31	35	44	48	52
Yield, lb/acre	1080	1260	1360	1440	1440	1360
**DMR 5%	a	b	bc	c	c	bc

the soil.
**Duncan Multiple Range Test. Yield values accompanied by same letter are not significantly different at the 5% level.

Preseason irrigation, inches	6	8	15	20	24	30
Crop irrigation, inches	24	40	15	28	6	18
Total irrigation, inches	30	48	30	48	30	48
*Seasonal water use, inches	30	45	26	44	26	39
Yield, lb/acre	1003	1192	1133	1320	928	1266
**DMR 5%	ab	cd	bc	d	a	cd

* Total irrigation depths corrected for changes in water stored in the soil.
** Duncan Multiple Range Test. Yield values accompanied by the same letter are not significantly different at the 5% level.