PRE-PLANT LAND PREPARATION AND IRRIGATION SYSTEM DEVELOPMENT

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Irrigation is recognized to be one of the most important cultural practices required for the production of alfalfa in California. Careful irrigation can often increase yields by 50 to 100% on fields which have previously been inadequately irrigated. Proper irrigation starts with the planning of the irrigation system before the seed is planted.

Where the strip check method of flood irrigation is used it is not possible to change the slope of the field, fill in low spots, vary the width of borders, or change the direction which the water flows across the field after the crop is in the ground. The only irrigation practices which can be changed by the farmer after the alfalfa has been established are the frequency of irrigations, the size of stream turned into each border check, and the length of time that water flows into each check during each irrigation.

Where the sprinkler irrigation method is used it is often difficult to change the precipitation rate, the depths of water applied, or the frequency of irrigations without changing the pump, the pipelines, and the sprinklers once the system has been installed.

In planning an irrigation system we should keep in mind what we want to accomplish. The objectives of primary importance are:

1. To maintain a continuous supply of readily available soil moisture for the use of the alfalfa roots so that maximum yields can be obtained.
2. To provide a healthy environment in the soil in which the roots can grow. The soil should not be allowed to become water-logged which would exclude the oxygen supply needed by the roots, or might induce root diseases.
3. To obtain efficient use of water, labor, power, and equipment so that the farmer can gain a profitable return from his investment in the irrigation system.

Land Preparation

Most of the alfalfa grown in California is irrigated by the border, or strip check, method. The essential requirement for this method is to provide a means of controlling the water so that it will move as a uniform sheet as it flows across the field between the levees. This can best be accomplished by having a uniform slope in the direction which the water flows, and little or no slope across the checks between the levees.

Fields on which alfalfa is to be planted should be graded to a uniform plane. This can only be done properly by having the field surveyed and the depths of cut or fill computed a coordinate points. The earth moving work can then be done accurately, at minimum cost, and with a balance of cuts with fills. It is sometimes desirable to rip the field with a sub-soiler to break up any compacted or dense layers in the soil before the earth grading work is started. Following the land grading work the field can be chiseled to loosen any soil compaction caused by the earth moving equipment.

The final smoothing of the field is done with an open-bottom scraper (land plane) to remove any minor irregularities in the soil surface. After the levees are constructed, the checks are generally floated with a drag scraper to prepare a smooth seed bed for planting.

In computing the cuts and fills needed for land grading work consideration should be given to the final slope that will be best for irrigating the field. It is generally less costly to select the slope which best fits the natural slope of the field. However, there are maximum and minimum slopes that can be used for each soil type and which will permit efficient control of the irrigation water. Maximum slopes

are those needed to prevent soil erosion. Most fields on which alfalfa is grown in California are not excessively steep. Sprinkler irrigation is generally recommended for fields which are so steep that the soils would erode if the border method of irrigation was used. The most serious irrigation problems occur on alfalfa fields without sufficient slope to provide surface drainage for removing excess water. On tight soils, standing water will often result in the death of the alfalfa plants, the invasion of water loving weeds, and will serve as a source of mosquitoes. Minimum slopes of 0.2 percent (0.2 foot fall per 100 feet) in the direction of water flows are generally needed to provide surface drainage on tight soils. Flatter slopes can be used on porous soils where no water will stand for periods longer than 8 hours following an irrigation.

Since little or no cross slope is desirable where strip check irrigation is used, the fields are generally layed out so that the water will flow down the borders in the direction of the steepest slope. Where open field ditches are used to convey the water to the head ends of the strip checks, a slight cross slope is desirable to cause the water flow down the ditch. Slopes of 0.02 to 0.05 percent are usually adequate for this purpose.

On fields where crop rotation is used, with row crops following the alfalfa, the fields can sometimes be graded with a 0.2 percent in one direction which is used for irrigating alfalfa in strip checks, and with a 0.05 percent slope in a cross direction which is used for irrigating row crops with furrows.

Soil settlement sometimes occurs, particularly where deep fills were made during land grading, which leaves depressed areas in fields. These often collect water which injures the crop. Where land settlement has occurred it is desirable to re-survey the field and re-grade the land surface to a uniform plane before replanting alfalfa.

Preparing the Levees

The levees used with border irrigation serve to guide the water as it moves down the slope. The top of the levees need to be only a few inches above the water surface in the strip checks while irrigation is taking place. The levees should have a wide base with moderate side slopes so that harvesting and other equipment can pass over them without difficulty.

Border disks and other types of equipment which leave a borrow ditch should not be used for constructing levees used for irrigating alfalfa. Since an alfalfa planting is grown for several years, great care should be taken in constructing the levees in order to maintain a level surface the full width between adjacent levees. Cross-checkers which strip soil from the full width of the check and dump it along the line of the levee, have been used with considerable success. After the soil has been deposited along the line for the levee, a shaper is used to form the levee with the desired uniform cross-section.

The width between the levees should be based upon the type of soil, the slope, the length of the strip checks, and the flow of water available for irrigating the alfalfa field. Table I shows some general relationships between the above factors. The unit flow is the amount of water turned into each strip check. For example, alfalfa planted on a sandy loam soil with a slope of 0.2 percent with checks 40 feet wide would require a unit flow of about 30 gallons per minute per foot of width, or 1200 gpm (2.67 cubic feet per second) turned into each check.

TABLE I. TENTATIVE STANDARDS FOR BORDER WIDTHS, LENGTHS, AND UNIT FLOWS FOR VARIOUS SOIL TYPES AND SLOPES.

Soil Type	Slope	Strip Width	Check Length	Unit Flow per foot width of strip check	
	%	feet	feet	gpm	c.f.s.
Sand	.2-.4	20-60	220-440	50-70	.11-.16
	.4-.6	20-40	220-330	45-50	.10-.11
	.6-1.0	20	220-330	25-40	.06-.09
Loam	.2-.4	30-80	660-1320	25-35	.06-.08
	.4-.6	30-40	660-1320	20-30	.04-.07
	.6-1.0	30	660-1320	10-20	.02-.04
Clay Loam	.2-.4	40-100	660-1320	15-20	.03-.04
	.4-.6	30-60	660-1320	10-15	.02-.03
	.6-1.0	30	660-1320	5-10	.01-.02
	2-.3	40-100	320	10-20	.02-.04

Another factor in determining width of strip checks is the amount of side fall. The difference in elevation across each check should not exceed 0.1 foot. If the field has a cross-slope of 0.3%, the width of the checks should be limited to 33 feet. Even with this amount of fall across a strip check, an attempt should be made to level the soil surface between adjacent levees. A road grader or some other type of angle blade can be used for this purpose.

Consideration might also be given to the width of harvesting equipment to be used when determining the width of checks. For example, if the mower and rake to be used have a seven foot width, it might be desirable to have the checks 35, 42 or 49 feet wide.

Head Ditches and Pipelines

The means used for delivering the irrigation water to the head end of each strip check can play an important part in bringing about efficient irrigation practices. The objective is to maintain control of the water at all times. The delivery system, whether it be an open ditch or pipeline, should be installed so that a minimum of water losses will occur. The gates, checks, turnouts, and valves used should be easy to operate and be capable of delivering the required amount of water into each strip check.

Surface Drainage

The importance of preventing water from standing for prolonged periods on alfalfa fields has been mentioned. If the field has been graded to the proper slope any excess water will move to the lower ends of the checks. Water which does not infiltrate into the soil within a few hours should be removed from the field by means of a drainage ditch installed across the lower end of the field. The drainage ditch can deliver this water into a master drain or into a sump where it can be re-used. Return-flow systems have proven to be an effective means of utilizing waste water. The water is either pumped back into the head ditch or pipeline where it can be used for irrigating the same field or the water can be delivered to other fields nearby where it can be used

for rrigation.

Sprinkler Irrigation

A number of alfalfa fields in California are now irrigated by means of sprinkler systems. These include portable aluminum pipe systems which are hand moved, and those with side-roll systems which permit mechanical moving of the pipe.

The proper design of the sprinkler system is an important factor in obtaining high yields. The criteria of a good system includes:

1. The water is distributed uniformly to all parts of the field.
2. The precipitation rate of the sprinklers is less than the infiltration rate of water into the soil.
3. The system is adequate to deliver the depths of water at the frequencies needed to satisfy the peak water requirements of the alfalfa plants.
4. The investment and operation costs of the system can be economically justified.

Highest efficiency in use of sprinkler irrigation equipment can be obtained if the systems are designed for nearly continuous operation during the period of peak water use by the alfalfa. This period normally occurs from June 15 to September 15.

The use of 24-hour sets for sprinkler systems used for irrigating alfalfa has a number of advantages. Moving the systems only once each day facilitates the efficient use of irrigation labor. Greater uniformity of water distribution is obtained where each set is exposed to the same diurnal variations in wind, sunlight, etc. The long sets allow using lower precipitation rates than are required for shorter sets, which often are necessary for adequate infiltration of the water into the soil.

Most California soils are characterized by slow infiltration rates. Most soils have intake rates less than 1/3 inch per hour over an extended period of time, and some soils have intake rates less than 1/10 inch per hour. In order to obtain high uniformity of water distribution with these low intake rates requires that the sprinklers be placed relatively close together. For soils that take water at a rate of 0.3 inch per hour, or less, the spacings of the sprinklers should not be more than 30' X 50'. For soils which will take water at a rate of 0.35 inch per hour or more, spacings of 40' X 60' feet might be used for the larger sprinklers.

Continously moving sprinkler systems, such as the pivot systems or the big-gun traveling systems, have precipitation rates of from 0.5 to 1.5 inches per hour. These systems can only be used on very porous soils with high infiltration rates.