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PLANNING TO INSTALL A SPRINKLER SYSTEM?

J. J. COONY
Farm Advisor, San Diego County

Avocado growers who intend to install sprinkler systems should realize the importance of proper design. The job is essentially one of engineering. Most growers must seek helpful information and advice from various sources. But really the first thing to do is to appraise the situation critically to determine the need for or advisability of installing such a system.

In any system of irrigation, the problem is to convey the water from a source to where it is needed in the soil. The source may be a well, an irrigation canal, or a district pipeline. In orchard work, the idea is to get the water distributed to every tree—in the quickest, most efficient, and yet practicable way.

Where the soil is medium to heavy in texture, quite uniform, and the slope or grade of flow can be favorably arranged, the transportation of water over the land to where it is needed can often be by furrow. Many systems involving a combination of pipelines and furrows in use today are quite satisfactory—and a more costly system is not economically justified.

During the reign of the overhead sprinkler in the late twenties, it was generally felt that such a type of installation was justified only for "high return crops on land of high value." Now, with underhead sprinklers in rather general use, and avocado plantings even further extended to the hillsides, it became apparent that: 1) sprinkling was the only possible way to irrigate some of these lands; 2) on most hillsides irrigation could be more effectively done by sprinklers; 3) avocados seemed to benefit markedly from the flexibility offered by such a system; and 4) as water reached $25 to $35 an acre foot, interest was directed toward application with minimum waste of water.

Virtually every case of sprinkler installation presents a different problem in design and layout. By professional designers or irrigation engineers, only one rule is recognized: that there is no set of rules or specifications that apply to all situations.

Several governing factors must be considered and evaluated. The grower may have definite feeling that one type of installation or equipment is superior. Available capital may be a limiting factor. The labor input that is desired or available is another consideration. The time that must be or desired to be taken in covering the field for one irrigation is important. Even the tree spacing, planting system may be a deciding factor. Other factors are more fixed in nature, such as the source of water—head and pressure—that is available. The size of meter, supply line are often set. The lay of the land, the slope—or slopes—that are involved can present special problems.

Really, the job of designing the proper system for a particular piece of ground is one of

engineering. The principles governing the flow of water through pipes, connections, orifices and the like are involved. Most of us are not engineers, so we look elsewhere for help.

Certain necessary information—and often much additional help—is to be obtained from engineers with local irrigation organizations. Growers who have installed good systems may relate how their particular problem was attacked and solved. Considerable assistance can be obtained from commercial concerns that manufacture, sell, or install irrigation equipment. Some sprinkler companies provide an engineering service. In all but the very simple layouts, some professional help in planning is worth the cost.

The Agricultural Extension Service can point out the advantages and limitations of various types of equipment. They can furnish information relative to good irrigation practice, crop requirements, soil moisture relations, and other pertinent considerations. Write the Farm Advisor for bulletins on sprinkler irrigation.

In a sprinkler system, the distribution of water over the land is in closed conduits, or pipes. Ultimate application to the soil is through sprinklers. Exceptions are nozzle lines and perforated pipe lines. The sprinklers are often thought to be the key to success, and accent is placed on the type, spacing, and adjustment of sprinklers. Design of the system—size of pipes, number of sprinklers on a line, etc.—is equally important to proper functioning.

The main lines and main lateral lines must be chosen for: 1) adequate capacity, and 2) longevity. Standard iron, welded steel, or even galvanized pipe in smaller systems may be installed. Pipes of larger capacity than actually required offer no operational advantage, and are an economic waste. Lateral lines—the ones to which the sprinklers or risers are attached—vary with the type. The permanent system will usually have galvanized laterals. Size of pipe will decrease as fewer sprinklers remain to be served. The reason for this is essentially economic. Laterals in portable systems often are light-weight, large diameter, quick coupling pipe. Copper tubing, rejected boiling tubing, and hoses are sometimes used in connecting a series of sprinklers.

The choice of valves can be important from the standpoint of upkeep, repair and replacement. While gate valves result in small fractional or resistance losses, they often are costly in upkeep, replacement. Soft seated globe valves are more satisfactory. The reduction in head due to frictional losses in globe valves is higher, and the use of a larger size valve and bushing will often work out.

In the choice of sprinklers, growers have many from which to choose. The ideal would be one that would distribute the water uniformly at a rate which the soil could readily absorb. One would be desired that had a low spray path or trajectory, with the stream of water broken up into relatively small droplets.

There are three general types: the fixed head, slow-revolving and whirling sprinklers. The fixed heads, often referred to as lawn-type sprinklers, have had many improvements for orchard use. They generally can give a very satisfactory distribution pattern. They operate best at fairly high pressures, throw the spray quite high, and are on the high side for rate of discharge.

The slow revolving types may have spinning wheels or other driving mechanisms. Some

are pushed around by the effect of the stream of water on a balanced arm as the arm is continually brought back into the path of the stream by an oscillating spring. These types often have a high discharge rate per sprinkler, but cover a relatively large area. They can give uniform distribution, some types have been designed for low-trajectory. They cost more per sprinkler—yet fewer are required. Larger number of moving parts should mean more upkeep yet experience has often shown the opposite. Some can operate at quite low pressures—an advantage.

The whirling types of sprinklers used in orchards are mostly of the reaction drive. The arm or arms are usually curved slightly near the end, and the centrifugal force action drives the sprinkler around. The result is a surprising constant rate of rotation. They cover one-third to one-half of the area covered by most slow revolvers, more are required per acre. Discharge and distribution are considerably affected by changes in pressure. At too high a pressure, fogging may occur, meaning unnecessary evaporational losses and the bulk of the water deposited near the sprinkler. When pressure is low, the bulk is applied in a doughnut circle some distance from the sprinkler.

There are two approaches in planning a sprinkling system for an orchard. The amount or flow of water available might be a limiting factor, requiring special consideration. But more often the supply is such that the usual approach is based on the period of time desired to be taken, or estimated should be taken, for one complete irrigation. For instance, if two sets or changes a day are desired, and from ten days or more to be used in covering the block or grove, a minimum investment in a portable system is indicated.

On the other hand, it may be that several changes can be made per day, and complete irrigation is desired in two or three days. Portable systems can still be used, getting more pieces of equipment, higher capacity pipes and sprinklers. Quick coverage of a block with minimum effort is accomplished by a permanent system.

Planning can often proceed on a three-day irrigation basis. In many districts, meter sizes allowed for various acreages are based on covering the ground with an irrigation in approximately three days continuous flow.

After making a choice of the type and make of sprinkler, and obtaining some data as to pressures and discharge, designing the system can begin. A sketch of the planting showing tree and sprinkler spacing is needed. By way of illustration, suppose that the sprinkler data shows that a normal irrigation can be applied in six hours. Four sets or changes could be made per day, or twelve in three days. Dividing the grove into twelve sections gives the number of trees to irrigate, number of sprinklers to operate at one time, and controlled by a single valve.

Continuing the illustration, the number of sprinklers in operation at one time determines the flow necessary to be carried through the main lines and the valve in each section. Sizes of pipe are chosen accordingly. In lateral lines with risers and sprinklers, the pipe size is reduced as soon as the flow required for the remaining sprinklers permit. This insures better distribution and is more economical.

In arriving at the ultimate design, adjustments will have to be made, considering the

many factors that can become involved. One important principle to keep in mind is that of convenience and simplicity in arrangement and location of valves.

Basic planning could just as well begin with the amount of water or flow available. The number of sprinklers of a given type that could be operated could be calculated, and design, size of pipes, etc. worked out.

One of the most convenient formulas for problems of sprinkler application is:

$$\frac{\text{Average sprinkler discharge (g.p.m.) x 96.3}}{\text{Sprinkler spacing (Ex: 20 ft. x 40 ft.)}} = \text{Precipitation or application in inches per hour.}$$

No matter how well designed the system may be, proper operation depends on a known and relatively constant operating pressure. Even where water is delivered under pressure, there are often daily and seasonal fluctuations. The effect of very high pressure can be offset by a pressure regulator located just inside the meter. Where delivery pressures are too low, the use of a horizontal centrifugal booster pump of the proper size should be considered.

Summarizing, from an operational standpoint, a desirable sprinkler system would give good distribution of water at the available pressure. The design must be right—sizes of pipe, number of sprinklers on a line. Many types of sprinklers can serve satisfactorily. Ideal or perfect distribution is not possible; nor is it necessary. At least eighty percent of the soil area should be wet. Sprinkler patterns are usually round, overlapping is necessary and desirable. Application should be at a rate which the soil will readily absorb without runoff. Some soils will take an inch an hour, some soils require three to four hours.

One of the objectives of sprinkler irrigation is flexibility. Systems should be designed, using extra valves where needed, and adjustable sprinklers to permit differential treatment of spotty soil conditions. Portable systems inherently have flexibility that is sacrificed in a permanent layout.

Most sprinklers have one or more possible adjustments. In many any change in adjustment alters the distribution pattern. Adjusting sprinklers properly can be a laborious though necessary task after installation, and periodically thereafter.

In planning a layout, thought should be given to the need of, and methods of straining foreign matter that may enter the system. Clogged or partially clogged sprinklers can be a consistent source of trouble

Convenience should be worked into a system in the planning stage. Have switches, valves logically and conveniently located.

In the process of installation, steps can be taken to obtain longer life, freedom from repair. For example, risers tend to rust and break at their connection to the pipeline. Protective coating of asphalt-type material is time well spent.

To plan an orchard sprinkling system, the following steps are in order:

1. Sketch of planting, type and spacing of sprinklers.

2. With an idea of common sprinkler discharge, and amount needed for one irrigation,

decide on a desirable time interval for one set. Divide the ground into approximately equal areas, corresponding to the number of sets and the time desired to cover the ground would allow. This determines the number of sprinklers controlled by one valve.

3. Check required flow with that at the meter or source.

4. Select sizes of pipes—considering resistance losses.

5. Install and adjust.

The maximum number of sprinklers on one line or lateral is limited by three factors: 1) pressure; 2) number and size of valves and fittings in the supply line; and 3) size and lengths of pipe used.

The job is essentially an engineering one. Other than commercial concerns, information sources are the Agricultural Extension Service, irrigation companies or district offices and experienced growers. A sprinkler system can result in most efficient irrigation practice. Improper layout may make even adequate irrigation unlikely.