

Side Hill Irrigation, Its Efficiency, Its Cost and Its Dangers

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Judge Halm: Our next topic is "Problems in Irrigation and Erosion." Now we have heard of irrigation in many forms. It is a great question in the arid section of the United States and it is one of the prime questions in California. When applied to avocados it has some peculiar problems. There is a man who has been connected with the Agricultural Extension Service of California for a number of years, who has given this subject much study. Of late years he has been giving considerable more attention than in former years to the irrigation of the avocado. It gives me pleasure to present to you Mr. J. B. Brown.

J. B. Brown; Ladies and Gentlemen of the Avocado Institute: I have appeared on this program a number of times and I always enjoy being with you. The subject which you have given me for this afternoon is "Problems in Irrigation and Erosion." We know that many of our avocados are grown on foothill, rolling, or steep lands, so we might call it "Side Hill Irrigation, Its Efficiency, Its Cost and Its Dangers." All side hill irrigation is difficult. Generally it is costly, either in preparation of the land or in mechanical installations, or it is costly in labor. These things enter into the problem of the avocado orchard or any other side hill farm. That does not mean we should not farm hillside lands if the economic returns justify the costs. One of the reasons why you go to the side hill for avocado and citrus farming is that it is generally freer from frost and you are desirous of protecting your crop from freezes. Consequently some of these hills represent ideal situations. But, if we are to farm them, we must consider the cost. We must be sure to get income enough to justify that cost and take certain precautions in our irrigation practices to get the proper distribution of water to properly protect those lands from erosion and destruction of soil. Let's consider the methods of side hill irrigation. We will start with furrow irrigation of some sort, and some people, believe it or not, irrigate straight down the hill! That is absolutely true. I know of sections in Placer County where they irrigate slopes as steep as 33%, straight down the hill. The stream of water isn't any bigger than a lead pencil. They start half a dozen furrows in the morning, go out and milk the cow, and the next morning set another half dozen furrows, and go out and milk the cow, and at the end of the month they get around and start all over again. In other words, it is very economical in labor. It is just one of the chores which they do every morning. But you don't see that in Southern California. So with your furrow irrigation you generally go across the slope on a very flat grade and get distribution of water that way. Or you go into contour irrigation. That is, plant the trees

on contour grades and use a number of furrows between the rows. Some contour systems remain as contour systems because of the system of cultivation which is adopted. If all cultivation is along the row, very shortly terraces are developed. If, however, cultivation is in two directions it is entirely possible to maintain, to a greater or lesser extent, the contours in their natural condition, and also maintain a fairly smooth field. Ordinarily, they soon develop into terraces.

Some years ago, I wrote a bulletin describing this method of planting in contour rows and in the investigations for that bulletin we visited many of the orchards in Southern California and Northern California planted on contours and we tried to establish certain rules for contour grades. We stated that for light soils we should have a foot fall to the hundred, and for the heavier soils we should use less than a foot per hundred. But there is this factor; as cross slope increases the grades should increase, and we had a table put into that bulletin which gave proper grades for different soil types and for different cross slopes.

In our later experiences with this system we found most people laying out contours on grades which exceeded the grades which we gave in that bulletin and for a very definite reason. When the tractor man is putting in furrows and has a very gentle cross slope and it doesn't matter much whether he is up the hill or down the hill from the true or rigid location of a grade contour, he still maintains a good grade in the furrow. But, if the cross slope becomes very steep, it becomes more difficult to properly locate furrows. By increasing the grade in the furrow, the tractor man has a little more leeway. Most of you are familiar with these terraces.

You have in La Habra section and other sections in Southern California certain methods of applying water along those terraces. I will state that in some cases irrigation is carried on by means of furrows and in other cases by modified basins—elongated basins in the tree rows. Then you have the young avocado trees, using basins, intending at a later period to develop some other system of irrigation besides the basin system. On some of the flat slopes people continue to irrigate in basins. There is another type of basin I would like to talk about. That is the pot hole basin. On many of our very shallow soils where bedrock is close to the surface, people are attempting to grow avocado trees and other types of fruit trees, and are attempting to make the soil better by using dynamite. It has never been done yet. You may fill that hole with good soil but you are not going to grow a big tree under such conditions because sooner or later the root system of that tree is going to occupy all of that good soil in that pot hole. It lacks drainage, and you are going to have a sick tree which will not produce a profitable orchard.

Now let's go to another type—that is, irrigation by sprinkling. Overhead irrigation is only one branch of sprinkling irrigation. Overhead is that type of sprinkling where the sprinklers are sufficiently high to irrigate a large circle. Sometimes the diameter of the circle is a hundred feet or more. Others have a diameter of thirty or forty feet. These are good methods but expensive in first cost. We have gone largely in the last few years to types of underhead systems of sprinkling, where the pipes are laid down each row and little sprinklers set in between the trees. An excellent system if you can stand the original cost, because it gets the water down on the ground and usually takes the sprinkler away from the tree itself where damage from leakage may occur. Avocado trees are sensitive to excess water as are citrus trees and you may have difficulties from

such causes. Underhead sprinklers, I think, are fairly good, and of course they can be arranged in several different ways. Portable sprinklers on a hose, similar to lawn sprinklers are sometimes used. I have seen in La Habra a type of lawn sprinkler that throws the water in a half circle for use on terraces and hillsides.

Recently there has been developed a portable system of sprinklers and by that I mean not a portable system of sprinklers where you would have a lateral down each row, but a line of portable pipes made up in twenty-foot sections with a quick attaching joint which is operated for a certain length of time and then moved to another row. It is possible to develop a system of sprinkling by means of these portable pipes, a system which would be either an overhead system by putting the sprinklers up on a rack and setting them in the row and then attaching to the portable lateral line by hose, or a number of underhead sprinklers could be used. Irrigation practices could be worked out in that manner.

Pressure and cost of water, as Mr. Wahlberg showed here a minute ago, due to extra power to lift water are items to consider in these portable systems. It takes about 45 pounds of pressure to operate portable systems. This means that all water is lifted an additional 103 feet. When the water in a well drops forty feet, we complain that conditions are bad, but many of you lift water an extra hundred feet in sprinkling systems and think nothing of it. It costs money to apply water in that way. There are limitations to the rate of applying water by any of these sprinkler systems. Soils do not absorb water at a very high rate. If an acre inch per hour is absorbed, you have a mighty porous soil. In sprinkling, if more than an acre inch at one application is applied, you have gotten more water on the soil than it will take up and you begin to get run-off water after about an hour. In the portable systems, that is about what they put on—one acre inch an hour. If water *is* not readily absorbed, the resulting mud makes it very difficult to move pipes and sprinklers.

There is another type of irrigation that is now in vogue—seepage pipes made of porous concrete. They operate like deep furrows but are rather expensive and not particularly good because pipes must be placed below depth of tillage, with consequent poorer irrigation of the surface soil. I have often said that all of the different types of irrigation used anywhere else are used in California. There is one I have been reading about which may be used in California but I haven't seen it. Instead of running water in furrows, some man in Michigan has developed a canvas hose 200 feet long, and 4 inches in diameter, which he lays on the ground and the water seeps out, similar to furrows but without any washing of the soil. I haven't seen that in California. For side hill irrigation such a system might be used.

With all of our irrigation, we must take certain precautions. You know what happens in a contour irrigated orchard when the top furrow breaks. All the rest of them break and the water comes down the side of the hill and we have the start of a gully, which is a very serious thing, and we begin to lose our soil. Likewise at the ends of runs in contour furrows, it is exceedingly difficult to adjust our water so there will be no run-off. Many times during the process of adjusting, we have difficulty. We have some run-off. Consequently, in all of this side hill irrigation we should make provisions to take care of the water at the lower ends of runs by leading them to natural down drains which should be left for that purpose. It is also important what we do in the winter to protect our soils

from erosion. It is well to leave furrows on terraces during the winter. Likewise in contour irrigated orchards, it is well to leave furrows and channels for the removal of winter water.

Professor T. C. Chamberlain of the University of Chicago, Geologist, speaking to a soil convention some years ago made this remark about the length of time that it took to accumulate the soils on our hills, and I am going to read it. "Without any pretensions to a close estimate, I should be unwilling to name a mean rate of soil formation greater than one foot in ten thousand years on the basis of observation since the glacial period." Soil forming processes in Illinois and the middle-West are faster than in California. "I suspect if we could positively state the time of formation of four feet of soil next to our rock, where such depth obtains, it would be found above rather than below forty thousand years. Under such an estimate of the rate of formation of soils, surface waste should not exceed one inch in a thousand years."

In the light of some of the things which have happened in Southern California in the last two months, we have exceeded that rate of erosion, and it behooves us to protect in any way we can our soil, which is our capital, and to keep it in good shape.

There are two seasons when we should be looking to the protection of our soil. They are the rainy season and the irrigating season. I have a little slogan for erosion protection against natural causes in California. That slogan is: "Adequate protection for hill side farms which are clean cultivated during the rainy season." If any piece of ground is clean cultivated in the winter time, it is going to lose soil some time or other. Most of you people grow cover crops—a very important thing, but sometimes you are in such a position where you have a limited water supply and you must get rid of that cover crop early in the spring. Your orchard is then in a condition to be damaged by any torrential storm which might come in late March or early April and that is the time when you should adopt some engineering means of protection or structures of various sorts. Primarily the best protection we have is the vegetative cover, but we sometimes have to put in engineering structures. Contour furrows leading to some natural drainway, hold and retain water and do not let gulleys get started.

In the irrigating season, take care of run-off or tail water at the end of furrows. Avoid, in overhead irrigating, saturating the soil right down to bedrock. Not only from the standpoint of tree health but also when some of these soils are saturated with water, we destroy the natural angle of repose. Down goes your orchard into the ravine—a landslide, in other words. Another thing we need to do. I don't know whether it applies here or not—something that is important in erosion protection. Look out for burrowing animals. I was in Santa Barbara County recently and we were going along the new highway and the Commissioner pointed out a gully that had been started by a squirrel hole up at the top. The water had run down and cut out and destroyed a good share of that very fine piece of engineering work.

You may be interested in some of the literature on side hill irrigation, and I give you these:

University of California

#4—"Irrigation by Overhead Sprinkling." This circular is now out of print but it may be had from public libraries.

#16—"Irrigation of Orchards by Contour Furrows."

Bulletin #538—"Soil Erosion in California, Its Prevention and Control."

Extension Circular #16 and Bulletin #538 may be had from the County Farm Advisor's Office or will be sent on request from Berkeley.

U. S. Department of Agriculture

Circular #33—"Soil Erosion, A National Menace."—Price 25c.

Farmers Bulletin #1234—"Gullies—How To Control and Reclaim Them."— Price 10c.

Above on sale by Superintendent of Documents, Government Printing Office, Washington, D. C.

Judge Halm: I am sure you have all been interested in Prof. Brown's discussion. We have a few minutes before the next paper. Are there any questions?

Question: Do you know anything about the question of irrigating avocados at this time of year, when the bloom is setting?

J. B. Brown: I'd rather have your Farm Advisor answer that question because it involves physiological problems.

Mr. Wahlberg: If there is ample moisture in the root zone at this time, it would not be advisable to put any on. If the trees are suffering from lack of moisture, it would be advisable regardless of the blooming condition.

Question: From your experience, what do you believe is the best system—furrow irrigation compared against the basin irrigation, on land at 10% slope?

J. B. Brown: It would depend on your soil condition. Supposing you had shallow soil, you could probably exercise a better control of water by basin irrigation because of the quantity you could apply. Discrepancies in depth of penetration in furrow irrigation between top and bottom of run are hard to control. There is greater penetration at the top of the run. The question of diseases is one that I cannot answer so well. Do you, as a grower, feel that the putting of water in basins and getting it up against the trunk of the tree does harm to your tree? Many believe that water against the trunk of the tree is harmful. Others believe riot. Lots of people do not think it is advisable under any circumstances to get water against the trunk of the citrus tree. In Imperial Valley I had a call to lay out contour basins, and I saw immediately that they were going to get water against the trunks of the trees and asked if that was all right. It seems that all citrus growers use the basin irrigation, so there was no objection to the large contour basins. I would say that there is better distribution of water by some method of flood irrigation.

Question: What do you think of overhead where you have calcium in the water?

Answer: Well you may be up many nights in the year working with a lot of old sprinklers caked up with lime.

Question: I meant the lime on the leaves.

J. B. Brown: I can't answer that question. What is the effect of calcium or lime deposited on the leaves?

Prof. Hodgson: I don't think there would be any effect unless there is a lot of lime, enough to clog up the sprinklers.