

IMPLEMENT TILLAGE FOR IRRIGATION

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The task of introducing implement tillage into a country where this method of cultivation has never been practiced, is one beset with many difficulties. In the first place, I don't believe there is a business under the sun, where inefficient work will show up to worse advantage than poor work in cultivation with implements. And the economical results of poor cultivation are equally disastrous.

Therefore, it is easy to comprehend what one has to contend with when you try to introduce this work into a country where there are no teamsters, and where none of the laborers have the slightest conception of the principle of the implement, and the *mayordomos* are very slow indeed in learning to use judgment in putting different instruments in the different fields as conditions change.

Another idea which we have not been able to impress on our *mayordomos*, is that implements should be confined to such territory as they can attend to properly, and leave the rest of the work to be attended to by hand.

Another condition that was met with here. These fields never have been cultivated by animal power, so were not layed out with the idea of accommodating this kind of work.

Also each country has its peculiar conditions that required certain implements. Some of them may be found on the market, and others have to be improvised. These are a few of the things that have to be contended with while introducing a proposition of this kind. However, they are minor details, all of which may be overcome in time.

The chief questions that have to be determined are whether or not you are able to cultivate a piece of land cheaper by this method, whether you can produce more tons per acre, and whether or not you are able to make as good use of a limited water supply for irrigation.

In discussing tillage with irrigation there are two distinct propositions to consider:

One, where you have an abundance of cheap water, where the only object in cultivation is to maintain a good soil condition for the cane, and the other, where you have a very limited supply of

expensive water and where the only object is to make a gallon of water reach over as much territory as possible, never pretending to give the plant all the water it wants, merely holding it up until it rains.

The former is quite simple, and there really is not much room for discussion. I have had occasion to introduce cultivation into a proposition of this kind and in many instances obtained an increase of 100 per cent in yield and a material reduction in cost.

However, with the latter, where we have a great scarcity of water and the water is very expensive, we meet with greater difficulty, and we have to proceed with more care and judgment than where water is plentiful and cheap.

As the condition of scarcity of water obtains more generally in the better cane districts in Porto Rico, I will discuss the subject under these conditions.

The primary principles of conservation of moisture in dry farming are well known to most every one, and these are the principles which have to be applied to cultivation with irrigation under these conditions, where conservation of moisture is of primary importance.

On undulating lands and in districts frequented by drought, there is no question but that the deep-furrow system is the most desirable. First, from the view point of controlling the irrigation water; second, from the fact that moisture is conserved longer in a deep furrow than in a shallow furrow, or on level land, providing proper mulch is maintained.

In carrying on intensive cultivation with implements, in connection with the deep-furrow system, the problem which presents itself is the one of conserving the banks for the purpose of controlling the irrigation and at the same time keeping soil in good condition without filling up the furrow too much.

In making a study of this phase of the problem, I have come to the conclusion, that in loose land where it may be desirable to work two animals abreast, the least practical width that banks can be made is 6 feet from centre of furrows. Anything narrower than this, where furrows are made with a large *bombo* (lister) with bulls or steam plows, lister or furrow machine, it is not practical to get onto the banks with an animal-drawn implement, as they are thrown up so high and steep that it is hard walking for the animals, and the implement will roll entirely too much dirt down into the furrow.

A 6 feet bank allows a furrow of sufficient depth and at the

same time a bank wide enough for animals to walk on without filling the furrow with dirt and clods. In this connection would state that where a good bank is made, as with a steam plow, it is not practical to go in with cultivators, until the banks have had time to settle, or have been worked down a little either with hoes or by rains. This lessens the danger of rolling clods down on the young shoots and at the same time gives the cane time to get up where it is not so easily disturbed by rolling dirt and clods.

There is no question, but what the continuous passing of implements works the banks down to a considerable extent, but this also takes place nearly to the same extent by the action of the rains and continuous passing of the hoe. And I find it is possible to lay the cane by with practically as good a bank by the use of animal cultivation as by use of hand implements, with the advantage that the cane is layed by with soil in a good state of tilth instead of in a hard baked conditions as when no implements are used.

In districts where (for lack of land) we are forced to put our fields back in cane as soon as the crop is cut, we have considerable difficulty getting rid of the old cane roots; while in the *gran cultura* planting the roots have pretty well disappeared through decay and repeated plowings.

In fields where we are obliged to chop up the stumps in search of the white grub and weevil root-borer, this trouble is done away with; and in fields not treated in this manner, where the old stumps are large and bothersome, we send men in with grub hoes and split up the larger stumps which interfere with the implements.

IMPLEMENTS

After having made a study of this subject for the past four years I have decided on the following implements, which we are now using under different conditions as requirements demand.

I have devised a banking machine, and a disc cultivator with eight discs. In addition to these I use a diverse or spring-tooth cultivator, an ordinary double-shovel cultivator, and small plows.

For conservation of moisture and destruction of small weeds just as they are germinating, I use the spring-tooth cultivator, with levers set so that teeth slant back toward the center of the bank; this has a tendency to draw the mould away from the cane, together with any loose trash and deposite it in the centre of the bank. This is drawn by one animal, and two passes are made; one down the

right side of the bank and back on the left side. We are doing this work now at an expense of 15 cents per acre.

For the destruction of small weeds and building up the bank which may have become flattened out from any cause or other we use the banking machine which is composed of two pieces of sheet iron five feet long set on a slant, with the front ends set apart, the width of the bank and the rear end set just far enough apart to allow the mould to roll out onto the centre of the bank. This is drawn by two good mules, and as this requires only one pass, we pay 8 cents an acre for this work. We find that by passing this implement after cultivation with other implements, we are always able to keep the banks in a satisfactory condition and never lose control of our irrigation water.

After the banker we quite often run the disc cultivator, which leaves a mulch on the sides of the bank next to the cane. When the bank becomes slightly packed as a result of passing these implements, we go in after irrigation with a double-shovel cultivator and make three or four passes as the case may require, and if the bank has become very hard we go in with a small plow and break it up thoroughly, then follow up again with the banker and other implements as the case may require.

It is always desirable, after passing either the small plows or double-shovel cultivator, to pass the diverse or spring-tooth cultivator at once. By this I mean the spring tooth should be in the field at the same time as, and only two or three furrows behind, the small plow or double shovel. This will assist materially in conservation of moisture as well as improving condition of soil.

In addition to this system of cultivation, we have introduced in the Guánica district, for the conservation of moisture, and to prevent germination of weeds, the practice, after each of the first three or four irrigations of mulching, or pulverizing the irrigated surface in the bottom of the furrow, both before and after germination, with a tool known in the United States as a potatoe hook—which is a heavy rake of four or five prongs. This operation to be of any material benefit must be done soon after irrigation.

In my opinion, by this treatment of the soil we get considerably more benefit out of our irrigation water, which in the Guánica group constitutes our chief expense.

The foregoing is with reference to our district where (1) we rely principally on our pumps for moisture, (2) where soil is prin-

ipally loose loam and readily adapted to cultivation and very productive with sufficient moisture, (3) where due to pests we do not make a practice of ratooning.

In our other districts where we depend almost entirely on rain, conditions are quite different. The soil for the most part is of a stiff clayey nature, becomes exceedingly hard immediately after rain or irrigation if not properly worked, and has always been considered rather poor in regard to productiveness. And I believe it is on these poor soils where we are deriving greatest benefits from cultivation. A large portion of these lands are farmed in *grand banks*, or in *tableta* of from three to four rows in a *tableta*. Here a greater portion of the year, conservation of moisture is *not* the chief object; but the desired result is to maintain a good soil condition and keep down the weeds, thereby reducing the expense.

However, in accomplishing this we find that where we are able to obtain a good soil condition or mulch before drought, that the cane on these fields comes through the dry weather in good shape and makes some growth instead of drying up and dying back, as in fields not cultivated.

In these fields, where we have to pay more attention to drainage than to irrigation, we make no effort to maintain the bank between the row, and sometimes even bank the dirt on the cane row.

Here also we are never bothered with old cane roots, as land always lies idle a few months giving roots time to rot.

In these districts we ratoon a great deal and start these off by lining trash on every other bank and plow the clean bann with as large a plow as is practical, then transfer the trash to the plowed bank and plow the other one. In some cases where, due to floods, we are obliged to burn the trash to prevent same being piled on young cane, we go in with a 9-inch plow and three yoke of bulls or three teams of mules and offbar as deeply as possible up close to the cane row. Then we apply fertilizer and either plow this dirt back or work it back with the cultivator.

I am very much in favor of offbarring and believe it should be practiced wherever possible.

In some of these poorer districts we have, through eradication of diseases, introduction of new varieties and cultivation, been able to raise our average yield in tons per acre in the past four years, from 11 and a fraction tons up to an average of 24.6 tons for the crop just finished. Just how much of this increase is to be credited

to cultivation cannot be stated, but there is no question but that cultivation is entitled to a part of it.

Conditions with reference to drought, disease and pests have been so unusual during the past four years, that it has not been possible to compile any positive data regarding the actual advantage to be derived from implement cultivation; and as conditions on different parts of the Island vary so much, any one introducing cultivation with implements has to figure out methods which will apply to his particular conditions.

And while in many instances it may not be practical to introduce a system of intensive cultivation with implements, I am firmly of the belief that in nearly every instance, some implement can be profitably introduced.