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We Need More Drainage

It Is One Way to Increase Our Acreage And Yield for Larger Total Production

By C. H. VAN VLACK

ANY THOUSANDS of acres of crops in Iowa were lost in 1943 because of inadequate drainage. And the situation was practically the same in 1942. What will be the report a year hence? The 1944 production goals call for over 14 1/2 million acres of intertilled crops. The large increase in cultivated crops confronts Iowa farmers with many critical production problems. Where will these extra acres be found?

Thousands of acres of the most fertile land in the world are in Iowa, and they could produce record yields if they were adequately drained. Many fertile acres could be brought into production in 1944 by the use of some simple drainage practices during the coming spring and summer. Much of some drained areas of the state is reverting to swamp land because of failure of existing drainage systems. Principal among the causes of drainage system failures are: (1) Physical structure of the soil, (2) improper design of ditches, (3) improper construction, (4) lack of inspection and maintenance.

We are going to discuss here construction and maintenance of drainage systems, with most consideration given to tile drainage. We need to keep in mind an important fundamental principle in soil management and cropping — satisfactory drainage can be obtained only when the physical properties of the soil are properly conditioned.

The shallow subsoil in some parts of Iowa is so heavy and tight that tile drainage won't do the job until deep penetrating roots have opened it. The growth of sweet clover before drainage will assist greatly in certain southern and northeastern Iowa areas. Proper cropping practices and good soil management are fundamental considerations in any drainage undertaking.

The Tile Outlet

The first problem in planning and installing a tile line is to locate a suitable outlet. Probably more failures with tile drainage have been caused by an inadequate outlet than by all other causes of unsatisfactory operation put together. Since a natural waterway, an open ditch, or another tile line may be used as an outlet, often the cooperation of a number of landholders is necessary to construct an open ditch or outlet channels before tile drain construction becomes feasible.

Protection should be provided the tile outlets against washing of the banks of the ditch into which they discharge. A substantial bulkhead of stone or concrete with an "apron" below the tile for the water to spill on is essential.

This washed out bulkhead caused loss of tile back 65 feet into the field. The loss is continuing and will until re-laid and a substantial bulkhead, such as shown in the design on the next page, is constructed. Adequate foundation, an "apron" for the water to spill on and properly placed wing walls are essential. The old material will be useless in reconstruction.
ing and thawing, it is desirable to substitute corrugated galvanized iron culvert pipe whenever possible for the first few feet of tile next to the bulkhead.

**Location of Tile Drains**

The location of tile lines is governed by that of the outlet, topography of the area and character of soil and subsoil. Through rough land and where the area does not involve more than one farm, the use of the "natural system" may be employed. As the name would imply, this means simply laying tile along the depressions where the soil is too wet for cultivation, with as much fall as possible toward the outlet. Some of these lines will empty into others. Thus a branching system may result with mains, sub-mains and laterals.

In rather flat areas which are uniformly too wet for cultivation, however, it is advisable to design a complete system of some rather regular layout, such as either the "gridiron system" or the "herringbone system" (see illustrations). The former, which is one of the most efficient systems possible for tiling wet areas, consists of a main ditch running across the lower end of the area with one set of parallel laterals entering it.

Less total length of tile is required for the gridiron than for the herringbone. The junction of the laterals with the main in either system should form an angle of between 30 and 60 degrees. The mains should follow the general direction of the natural water courses, while the laterals should be laid in the direction of the greatest slope.

Hillside wet spots (seepy areas) should be drained by laying a tile drain across the slope above where the ground shows most wet. That will intercept the water brought to the surface by an impervious layer of soil which prevents its downward flow.

**Depth and Spacing**

The important consideration in tile drainage is to remove rapidly the surplus water from the soil zone which is penetrated by a large portion of the crop roots. A common practice is to place tile 4 feet deep in light, open soils and 2 1/2 to 3 feet deep in tight soils.

Within limits, the greater the depth of the tile, the greater can be the spacing of the tile lines. The texture of the soil will determine the depth, and the amount of water to be drained will determine the spacing. In general, it will be best to place the tile at least as deep as the depth to which the water table penetrates, and at least as deep as the silence of the soil will tolerate, keeping in mind the fact that the tile should not be placed more than 6 feet deep in any case.
Selection of Tile

Since water enters the tile at the undersides of the joints like leaks in a boat, and not through the walls of the tile, porous tile are no more efficient than impervious tile. In general, soft tile which absorb large quantities of water are weaker than those which absorb small amounts. Good drain tile should be round with clean-cut ends so as to lay to grade in a well shaped ditch bottom. For the larger sizes (12 inches and larger) good qualities are assured by specifying that all tile used shall meet the standard specifications of the American Society of Testing Materials. These specifications are available from the Secretary of the Society at Philadelphia, Penn., and cover both clay and concrete tile.

Tile size depends upon the area to be drained, porosity of the soil, topography and the grade or fall which can be obtained. Tile smaller than 5-inch should not be used except for a short steep grade. The carrying capacity of a 5-inch tile is twice that of a 4-inch tile. While this rate of increase in capacity does not continue for each increase in tile size, the capacity of a larger tile is much greater than is indicated directly by comparison of diameters.

To secure the proper and most economical balance in tile sizes for an extensive drainage system of mains and laterals, a competent drainage engineer should be employed. He will take into account the run-off to be taken care of, the most suitable depth and spacing of laterals, the available grade and the arrangement of the drains into systems that will best suit the land and most economically provide thorough drainage.

Laying the Tile

Digging for tile should begin at the outlet and proceed upstream. Great care should be taken not to excavate below grade. A high spot in the ditch has the effect of reducing grade which results in the tile gradually filling with silt at that point, since the reduced velocity causes the heavier particles of soil being carried by the water to be deposited as pointed out above under the cautions in reducing grade. For extensive systems and especially when labor is scarce, it is advisable to use a tile-trenching machine.

Tile laying should follow the trench digging as closely as possible. The ends of the tile should be made to fit together tightly by turning as needed. Any irregular fitting should be adjusted so that the top side fits closely with the more open portion of the joint on the
Seepy ground on hillside should be drained by intercepting the water some distance above the "spouty" area, since wet spots along hillside usually are caused by an impervious layer of soil which stops downward water flow.

Underside. Oftentimes pieces of broken tile can be used to cover small openings on the tops or sides to prevent soil from getting into the tile.

The importance of laying the tile and covering with a few inches of earth (blinding) as soon as the trench is completed to grade cannot be overstressed. Caving of the banks is always likely.

Maintenance of the System

Open ditches should be kept free from tree and weed growth which slow down the velocity of the stream and result in excessive silting. Logs, brush, old fencing and other debris should be kept cleared from the channel. Controlled pasturing of the berm and spoil-sides will help prevent tree and weed growth and will cause no serious difficulty if hogs are not used in the pasture.

Unless obstructions are kept out of the channel, silting will not only diminish the capacity of the ditch, but will submerge tile outlets emptying into the ditch.

Tile drains to be effective must be kept open. It seems to be the common impression of landowners and others that once tile are installed they should continue to function indefinitely without any attention. The chief difficulty is that of keeping the outlets in good condition. Root growth may cause tile stoppage. Any hole or "cave-in" over the tile line indicates that a tile is out of position or has broken. This damage should be corrected at once or else the line above will become filled with silt.

FINER, BETTER LIME, PLEASE!

During the past 4 years, Iowa farmers have used over 5 million tons of ground limestone, approximately four times as much as in any similar period prior to the AAA Conservation Materials Program. This limestone is helping materially in producing record crops on several million acres of good crop land. But many million acres still need to be mobilized for maximum production by liming.

Now more than ever before, we need to get the quickest results and the greatest efficiency possible from the limestone we use. This means, first of all, using limestone that is finely ground — limestone that contains a large percentage of "dust." Unfortunately, much of our ground limestone is too coarse for maximum war-time value, as our study here shows.

Fineness Speeds Benefits

Many ground limestones contain particles that vary from dust in size to particles that are the size of gravel. When limestone is applied to the soil, the fine particles dissolve readily and combine with the soil acids to neutralize them and to furnish calcium to the

Plants. The coarse particles, however, dissolve very slowly and many of them will not be of any value in the soil for a number of years after application.

It is very important, therefore, to determine the fineness of any ground limestone if we are to know its value. Fortunately, this is easily done by passing a small sample of the ground limestone over a set of small screens or sieves. Usually three different sized sieves are used in our screen analysis. The coarsest of these sieves has eight openings per linear inch and is known as an 8-mesh sieve; the finest sieve has 60 openings per inch, and is referred to as a 60-mesh sieve.

The actual size of the particles obtained from passing a ground limestone sample over these sieves is shown in the small circles in the accompanying illustration. By knowing what percentage of a sample of limestone is made up of particles of these different sizes the value of the limestone during the first few years after it is applied to the soil can be easily calculated.

Particles held on an 8-mesh sieve have relatively little value in correcting soil acidity during the first few years after application, whereas the particles that pass a 60-mesh sieve are practically all available during the first few months after application. It is for this reason that the fineness specification usually recommended, and that used in the AAA program, requires that at least 90 percent of the limestone particles should pass through an 8-mesh sieve.

Fine Lime Boosts Alfalfa

The benefits that are obtained by using limestone that is finely ground are...