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# Subirrigation for Gardens

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by M. R. Bentley, Agricultural Engineer

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The advantages of subirrigation over surface irrigation are: little labor is required to water the garden; less water is needed; and the soil does not crust so badly afterwards. Until recently, tile for subirrigation has been commonly made of cypress plaster lath, but at present home-made concrete tiles are almost always used because they cost little if any more and last longer.

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## Soil and Crops Adapted to Subirrigation

A loam soil that has a rather tight subsoil at a depth of 12 or 14 inches is best adapted to subirrigation. This form of irrigation may be used on many other soil types, however. In land that has a very porous subsoil, or in deep sand, the water from underground tile will tend to pass downward, instead of laterally, and be wasted. There is also likely to be an excessive waste of water in soils that crack deeply in dry weather, due to the water running down into the cracks.

While subirrigation is usually profitable in a home garden, it is questionable that it will pay on a commercial scale, or in a very large home garden. For example, it will not likely be profitable to subirrigate drouth resistant crops such as cowpeas, even in the home garden. It seems that the tomato is one of the crops best adapted to subirrigation.

In several instances subirrigation tile has been laid for the watering of shrubs and lawns. There is a possibility of the roots of perennial plants stopping up the tile. Usually it is not difficult to locate the stoppage and remove it.

## Amount of Water Required and Important Factors

In figuring on how much ground may be watered from a water supply, it is well to consider the minimum requirement as one inch depth of water. This will be about 125 gallons for one application to a plot of ground four feet wide and 50 feet long or one line of tile 50 feet long. For a plot 16 feet wide and 100 feet long, or four lines of tile 100 feet long, at least 1,000 gallons of water per application will be required.

It should not be necessary to apply water oftener than once a week, and usually once every two weeks will be often enough. It is usually considered that 400 feet of tile will meet the requirements for a garden for one family. In northwest Texas the wells with windmills will usually supply water for the subirrigation of a garden of ample size for one family.

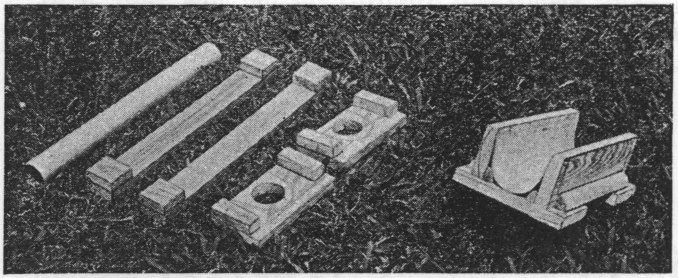
In using subirrigation tile it is important that all joints be made tight enough to keep the dirt out; that water free from sediment be used, that the feed pipe be kept covered when not in use; and that each tile line be laid level from end to end. In

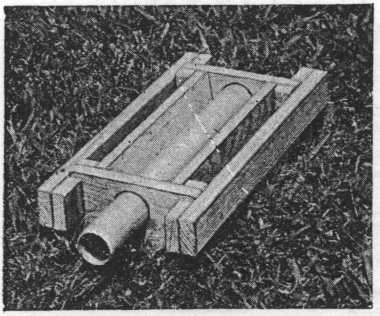
case the ground is sloping, run the tile line across the slope so that the tile will be about the same depth when laid in a trench the bottom of which is level.

The first two or three applications of water in tile after it is laid will not spread in the soil as uniformly as later applications when the soil in the trench has thoroughly settled.

## Making Forms for Subirrigation Tile

A plan for making a form for concrete tile is shown in the sketch. First the different parts of the form are shown separately, then the form is shown assembled ready for filling with concrete, and then the position of the form and pallet is shown as the form is lifted from the tile.





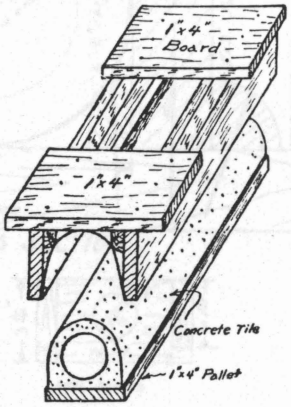



Fig. 1. Mold for making tile.

Make the round hole in the end of the form so that a one and one-half inch pipe will go through it. The hole will likely be a little less than two inches in diameter, to fit properly. The sheet iron should be rectangular in shape, 12 inches long and seven and three-fourth inches wide. It may be rolled in a tin shop to get a smoothly curved surface, or carefully bent over some cylindrical form. Sheet iron of 28 to 24 gauge may be used. Rough or rusty sheet iron will cause the tile to stick in the form.

Be sure that the ends of the form are cut square. Also put the cleats on the ends of the form so that the iron pipe core will be in the center of the inside form. Bevel the inside top edges of the side boards a little.

## Making the Tile

Use one part of Portland cement to four parts of clean, sharp sand. Coarse sand is best, but it should not have pebbles in it that will not go through one-fourth inch mesh screen. Very fine sand or sand containing vegetable matter or much

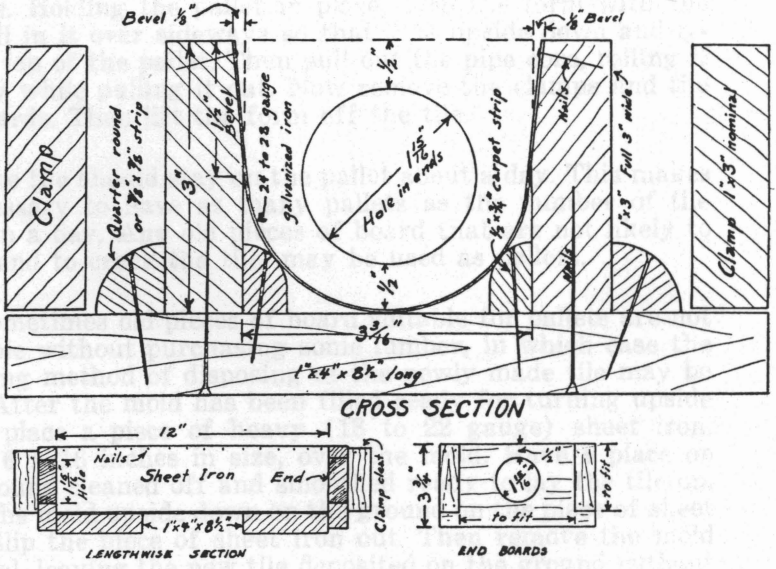



Fig. 2. Working drawing of mold.

clay is unsatisfactory for tile. A sack of cement with four cubic feet of sand will make about 110 of the concrete tiles, each one foot long.

Use only enough water to make a so-called dry mixture. A little too much water will make the tile stick in the form. Usually several trials are necessary to get the proper amount of water so that the tile will come out of the form immediately. Concrete made with fine sand will stick in the form. A paper lining is sometimes used in the form to prevent sticking, but this is not necessary if good sand and the proper amount of water are used in a well made form.

With the form assembled, fill with the concrete mixture. Then tamp with a thin board around the pipe core. Roll the pipe slightly while tamping around it. Keep filling and tamping until the form is packed full. A short piece of 1" x 4" is good to give the final packing to the concrete. Cut the surplus concrete from the top of the form with a little piece of board or a trowel. Do not cut off so much that it will not touch the pallet that is laid over the top of the form.

To remove the tile from the form, lay a pallet (piece of board, which may be a piece of 1" x 4" a foot long) on top of the tile. Holding the pallet in place, turn the form with the tile still in it over sideways so that it is upside down and lying on top of the pallet. Then pull out the pipe core, rolling it slightly while pulling it out. Now remove the clamps and the end boards. Then lift the form off the tile.

The tile should stay on the pallet about a day. This makes it necessary to have as many pallets as the number of tile made in a day. Any old pieces of board that are not likely to warp, and to crack the tile, may be used as pallets.

Sometimes old pieces of board suitable for pallets are not available without purchasing some lumber, in which case the following method of disposing of the newly made tile may be used. After the mold has been filled ready for turning upside down, place a piece of heavy (18 to 22 gauge) sheet iron, about 6 x 16 inches in size, over the mold. Have a place on the ground cleaned off and smoothed ready to lay the tile on. Turn the mold upside down on the ground on the piece of sheet iron. Slip the piece of sheet iron out. Then remove the mold as usual, leaving the new tile deposited on the ground without any pallet under it.

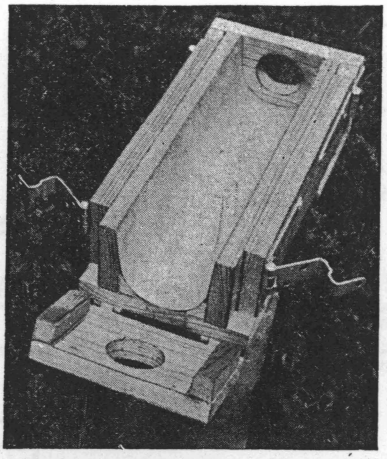


**Fig. 3. Tile mold.—One of the many that vary somewhat from the standard described.**

## Curing the Tile

The tile should be kept in the shade and out of the wind for several days. Sprinkle the tile with water about two hours after they are made. The tile should be kept moist for about two weeks after they are made. This may be done by covering with wet sacks, or wet hay or straw, and applying more water each day.

The tile may be laid in the trench and covered with dirt ready for use about two and one-half or three days after they have been made. They should not break while laying them after about three days and if kept moist will cure in the trench as well as elsewhere. The main thing is to keep them moist for several days. Do not leave the tile exposed to freezing temperatures while they are curing.

## Vertical Feed Pipe

To construct the feed pipe, cut the ends of two tiles at an angle of 45 degrees as shown in sketch. This cutting is done more easily about two or three hours after the tile is made. It is best to use six or eight inches of tile for the upright piece that is cut at an angle, so that the upper joint of the upright tiling will be below the ground surface. These joints should be cemented, which may be done by pouring a little medium wet concrete around them. It is well to pour a ring around the upright tile at the ground surface to hold it in place and prevent it from getting brooken loose.

The feed pipe should extend eight or 10 inches above the ground. A cover for this pipe may be made from a piece of tin or sheet iron about three inches in diameter nailed to a stick six or 10 inches long and about an inch in diameter, such as a piece of broom handle. A big can may be put over the pipe for a cover. Do not put a wooden plug that fits tight in the tile or the wood may swell and burst the tile.

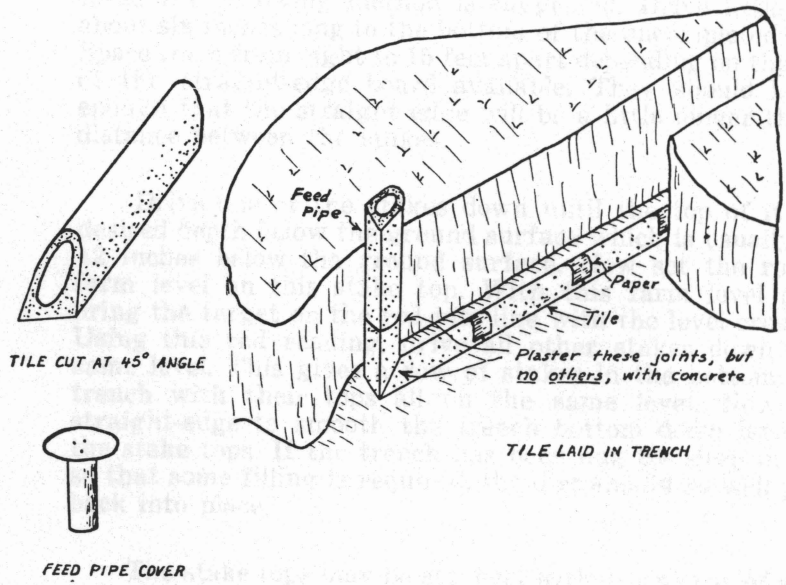



Fig. 4. Setting vertical feed pipe.

## Laying the Tile

The lines of tile are placed from three to five feet apart, usually about four feet. To determine the proper spacing of the tile lines for the soil type and depth used, lay a line of tile and run water into it for about 12 hours. Then examine the ground and see how wide a strip of ground is wet. The full width of the wet strip is the proper width for the spacing of the lines of tile. For garden crops the trench for the tile should be from 10 to 14 inches deep. It should be deep enough so that in plowing or spading the ground the tile will not be struck.

The bottom of the trench must be level and smooth, that is without humps or dips in it. If the ground has a slope, the lines may be run across the slope. To get the direction for the lines, lay off a level line on the ground surface with a farm level or carpenter's level on a board as if running a level terrace line. A trench following this line or approximately following it, may then be dug about the same depth from end to end.

However, be sure to level the trench bottom independently of the ground surface. To get the bottom of the trench

level, the following method is suggested. Drive little stakes about six inches long in the bottom of the uncompleted trench. Space them from eight to 15 feet apart depending on the length of the straight-edge board available. They should be close enough that the straight edge will be a little longer than the distance between the stakes.

Drive one of the stakes down until the top of it is the desired depth below the ground surface which is usually about 12 inches below the ground surface. Now set the rod of a farm level on this stake top. With this farm level set up, bring the target on the rod into line with the level cross hair. Using this rod reading, drive all other stakes down to the same level. This gives a row of stakes in the bottom of the trench with their tops all on the same level. Now use a straight-edge to smooth the trench bottom down level with the stake tops. If the trench has been dug too deep in places so that some filling is required, the dirt should be well packed back into place.

The stake tops may be set level without the use of a farm level, by using a carpenter's level on the straight-edge to level the stake tops from one to the other in turn.

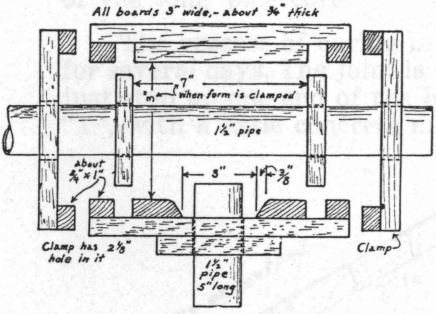
The tiles are laid end to end as close as possible so that dirt will not get into the joints. It is also advisable to lay a piece of heavy paper or old felt roofing over each joint before covering the tile with dirt, so as to be certain that no dirt gets into the tile.

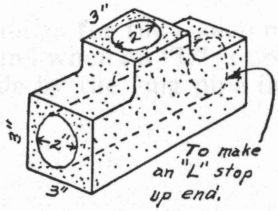
It is well to locate the feed pipes, which stick up out of the ground, near the garden fence so that they will not be disturbed when cultivating the garden. It is also advisable to locate the feed pipes in a straight row, so that a trough or pipe may be run along over them. Then with the hole in the trough or pipe over each feed pipe, water may be supplied to the tile lines. In this way water from a windmill or storage tank may be turned into one or more of the lines as desired. A hose may be used to supply each line if preferred.

The stream running into a tile line should be gauged so that the feed pipe will not overflow. The water should continue to run into a line until damp spots appear on the ground surface along the tile line.

## Concrete "T" Joint and "L" Joint

In some gardens it is practicable and may be desirable to connect two or three lines of tile to one feed pipe. This is not desirable on sloping ground, since all lines connected must be on the same level.




CONCRETE "T" JOINT

The joint shown here makes it easy to make any desired connection. The form and joint are not difficult to make. The concrete joint is three inches by three inches in cross section. The form is made from boards three inches wide and approximately three-fourths of an inch thick. The iron pipe core used in making tiles is used in making this joint. A pipe core five inches long is set at right angles to the long pipe.

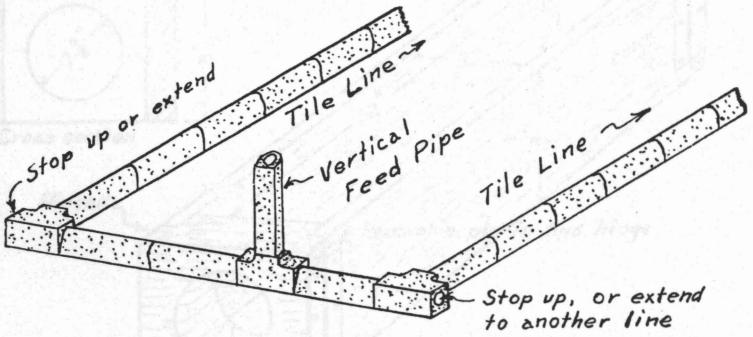
The pipe holes in the end boards and clamps should be centered in them. The holes in the clamp boards should be about two and one-eighth inches in diameter and in the end boards about one and fifteen-sixteenths inches in diameter. The little boards shown inside the side boards are nailed to them. The length of the end boards will depend on the thickness of the lumber nailed to the side boards but will be about four and one-half inches.

The form is put together on a pallet, such as a piece of 1" x 12" about a foot long. Concrete is packed around the pipe as in making tile. Roll each pipe while packing. After the form is packed full and smoothed off on top, put a pallet on top of it and turn it upside down. It is well to use a piece of greased paper between this pallet and the concrete since the board may get warped by the dampness and crack the concrete.

After the form has been turned upside down, add a little more concrete and pack again. Then pull out the pipes, remove the clamps and shuck off the side boards and end boards. This leaves the concrete joint completed on a pallet where it should remain as long as 12 hours.

In about two or three hours scratch out the rough places inside the concrete joint where the short pipe met the side of the long pipe core.

The process of curing is the same as for tile—keep moist for several days. The joint is a "T", and when an "L" is needed just stop up one end of the hole made by the long pipe in the "T", with a little concrete mortar.




TWO TILE LINES WITH ONE FEED PIPE, - USING "T" JOINTS

Fig. 7. One feed pipe for two lines of tile.

The joint may be used in either position desired, that is, lying on the side for turns in horizontal tile lines, or turned up to connect the vertical feed tile to the horizontal line or lines.

The "L" joint may be substituted for the connection heretofore described where two tiles are cut at 45 degree angles and plastered together.

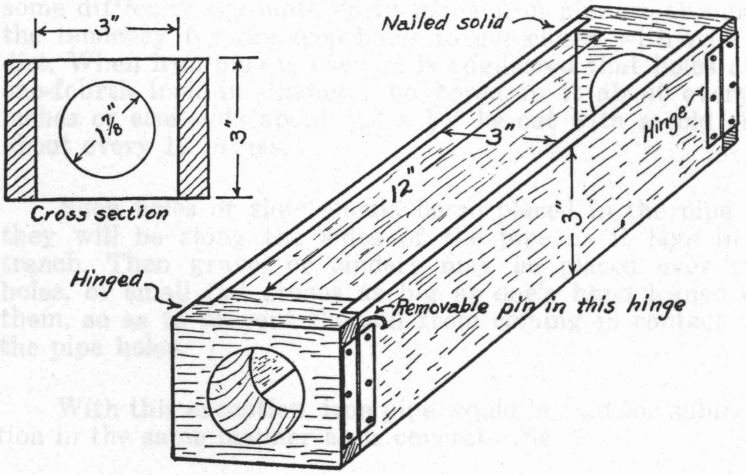
## Square Cross Section Tile Mold

The principal advantage of the square cross section tile mold is that it is easier to make the mold. It takes slightly more concrete to make the square tile. The concrete required for making 100 tiles that have only one flat side, will make about 95 square tiles.

The ends of the square tile mold are cut from 2" lumber, such as pieces of 2" x 4". Two corners of each end block are cut out about half its thickness to fit the ends of the side boards.

The usual one and one-half inch pipe core is used in this form.

Three corners of the form are hinged, but the corner diagonally from the hinge having a removable pin, is nailed solidly.




To make tile with this form, put the pipe core in it and lay it on a pallet (1" x 4" or 1" x 5" board about 14" long) with one of the open sides next to the pallet. Be sure that the reovable pin in the hinge is placed with the head down.

Next fill and tamp the form full of concrete, rolling the pipe core while filling. Then smooth off the concrete on the top side of the form. Next lay a pallet on top of the filled form and turn the form up side down, holding the two pallets in place while turning the form over. Remove the pallet that was formerly underneath and add concrete and tamp into the form. Again smooth off the concrete. Then pull out the pipe core, remove the hinge pin, and carefully shuck off the form from the tile. This leaves the completed tile on the second pallet that was brought into use in making this tile.

## Joints, "T" and "L", for Square Tile

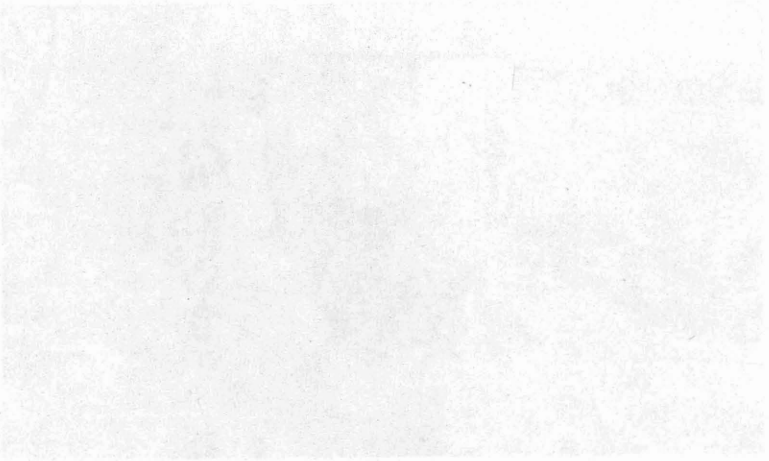
It is only necessary to make a 2″ hole in one side of a square tile to form a "T" or "L" joint. Such a hole is easily made a few hours after a square tile has been taken from the mold.

## Iron Pipe for Subirrigation

Iron pipe must be obtained at a very low cost to justify its use instead of concrete tile for subirrigation. There is some difficulty encountered in using iron pipe on account of the tendency for the seep holes to get closed with rust and dirt. When iron pipe is used, it is suggested that holes about one-fourth inch in diameter be bored in it about every 12 inches or else slots about ⅛″ x ½″ be cut with a cold chisel about every 12 inches.

Such holes or slots should be so placed in the pipe that they will be along the sides of the pipe as it lays in the trench. Then gravel or cinders may be placed over these holes, or small flat stones as big as one's hand leaned over them, so as to prevent the soil from coming in contact with the pipe holes.

With this exception, iron pipe would be laid for subirrigation in the same manner as is concrete tile.



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