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# EC746 Garden Irrigation

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Nebraska
COOPERATIVE EXTENSION WORK
IN AGRICULTURE AND HOME ECONOMICS
1935
U. of N. Agr. College & U. S. Dept. of Agr. Cooperating
W. H. Brokaw, Director, Lincoln

Extension
Circular
746

# GARDEN IRRIGATION

by
Aldert Molenaar

Unusually long dry periods, accompanied by burning hot winds, have made the raising of garden crops in Nebraska a rather unsuccessful venture, especially in recent years. Even in years of normal rainfall, there is a deficiency in the available moisture supply at the time when the growing vegetables are in greatest need of it. At this critical period in the development of the vegetables, supplementary irrigation, wherever irrigation is feasible, would well repay the operator for his efforts.

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The purpose of this circular is to familiarize the farmers and farm women of Nebraska with various methods of garden irrigation. Not all of the methods described will be adaptable to every community in the state. The type of soil, the regularity of the surface of the ground, and the available water supply will in every case be the factors that determine the method or methods best suited.

Several different methods of garden irrigation are practiced in the United States, but only the methods that best fit Nebraska conditions are mentioned in the circular. These are furrow irrigation, spray irrigation, and porous hose irrigation.

## FURROW IRRIGATION

In furrow irrigation, the water is supplied either from an elevated supply tank or directly from a well or stream. Except where the water can be taken from an already established irrigation system, a pump is a necessary part of the equipment to get the water onto the land.

The distribution system consists of a lateral ditch along the high side of the garden and usually at right angles to the direction of the plant rows. The water is pumped into this ditch and allowed to run into the furrows between the plant rows at the will of the irrigator.

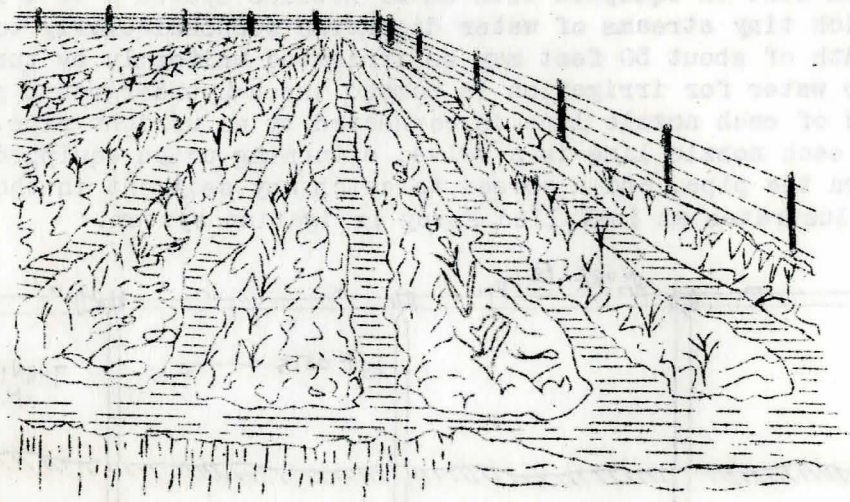

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Figure 1 - Furrow Irrigation

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Usually the water let into a furrow should be made to reach the lower end as quickly as possible; the quantity entering each furrow can then be decreased as necessary, although the regulation should be such that a sufficient supply will always reach the end of the furrow. It is best not to wet the surface of the ground in the row of plants, but to allow the water to seep into the soil from between the rows. This prevents the soil in the rows from baking and cracking.

After each irrigation, it is very necessary to cultivate the ground. This should be done as soon as the condition of the soil permits cultivation.

Very sandy soils are not adapted to furrow irrigation. A large quantity of water has to be supplied to the furrow in order to get it to run quickly to the lower end. Running the water through the furrow at too high a velocity causes the soil to wash. If run too slowly, much water is wasted due to deep seepage at the upper end, and not enough reaches the lower end of the furrow for satisfactory irrigation. A fall of ½-inch to 3/4-inch per rod length of furrow is in most cases sufficient to cause the water to run the full length of the furrow on sandy soils.

On heavy clay soils, the furrows should be deep and narrow and the water should be run on slowly and for a longer time. Heavy soils hold the water better and, therefore, need less of it for each irrigation. Unless the irrigator watches and carefully regulates the water flowing into each furrow, he will waste much of the water at the lower end. One-fourth inch to one-half inch fall to the rod is ample slope in the furrows for irrigating purposes on the heavier soils.

SPRAY IRRIGATION

In spray irrigation, the water is applied to the vegetables in a fine spray. The method is applicable to any type of soil and to any condition of ground slope. Considerably less water is needed and the distribution is much more uniform than with furrow irrigation. The water has to be supplied under pressure provided by an individual pumping plant or elevated supply tank.

The most common type of spray irrigation consists of parallel lines of pipe about 50 feet apart supported on posts about 6½ feet high. Each line is equipped with small nozzles spaced 3 to 4 feet apart from which tiny streams of water discharge perpendicularly to the pipe. A width of about 50 feet may be irrigated uniformly by turning the pipe. The water for irrigation is pumped through underground pipes, to which the end of each nozzle line is connected by an upright pipe. At the beginning of each nozzle line is a valve, a turning union equipped with a handle to turn the pipe, and a screen to catch any sediment in the water. Figure 2 illustrates an installed spray irrigation system.

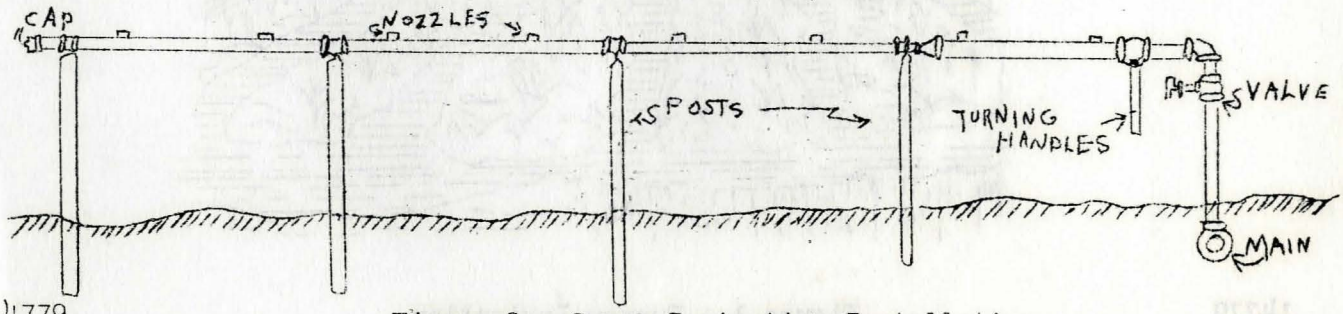


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Figure 2 - Spray Irrigation Installation.

In some localities, a portable system of spray irrigation is used. The nozzle lines are laid upon the ground or upon boxes or any other portable support, and can be carried from one part of the field to another as desired.

The portable system has the advantage of being cheaper than the permanent installations, although the cost of operation is considerably greater owing to the additional labor involved in moving the pipes and making the necessary connections and disconnections. Where the portable system is used, the ground can be cleared entirely when plowing or cultivating.

Spray irrigation is very advantageous to truck farmers. Land can be prepared at any time during the summer and no matter how dry the weather, the planted seed can be made to sprout by sprinkling.

The cost of a spray irrigation system is much greater than the cost of installing a system of furrow irrigation. The initial expenditure involved in installing the distribution system make the cost prohibitive for the ordinary small-sized home garden. In many cases, however, a home-made spray would suffice.

POROUS HOSE IRRIGATION

The porous hose method of irrigation has, heretofore, not been used in Nebraska. The method has been tried out with great success in the state of Michigan, where it was first introduced. The system consists of a pump to lift the water and force it into a length of canvas hose placed between the crop rows. Usually an iron pipe is used to connect the hose and the pump (Figure 3). One end of the hose is fastened to the supply line while the other end is closed.

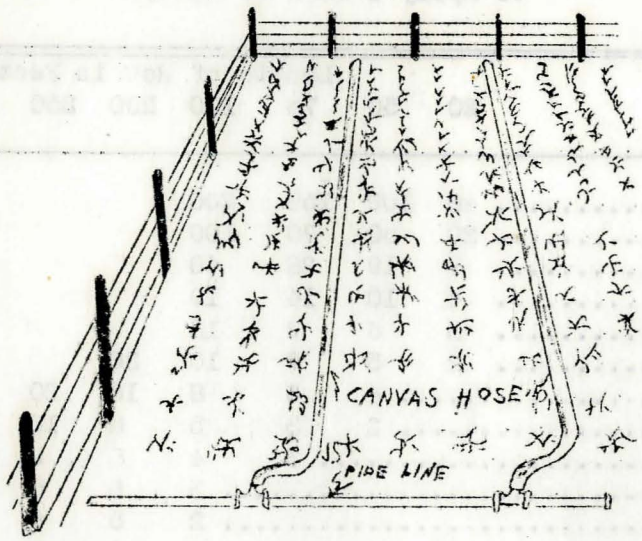


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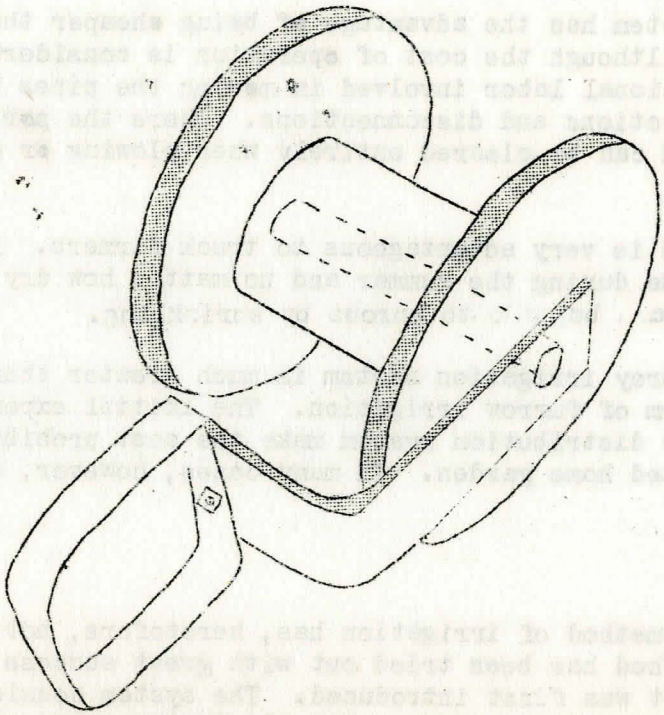
Figure 3 - Porous Hose Distribution System.

When the water is pumped into the hose, it seeps through the pores of the fabric and soaks into the ground for a foot or more on each side of the hose. The hose is left long enough to supply the needed water and is then moved to the next crop row with the aid of a convenient roller device. (Figure 4)



The length of time the hose should remain in a row to supply one inch of water depends upon the length of the row and the quantity of water pumped into the hose line per unit of time, and may be determined with the aid of Table 1.

Figure 4 - Roller Device for Moving Canvas Hose

TABLE 1 - Showing Number of Minutes Hose Should Remain in Different Length Rows to Apply 1-inch of Water.*

| Gallons Pumped per Minute | Length of Row in Feet 20 | 50 | 75 | 100 | 200 | 250 | 300 | 400 | 500 | 600 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 40 | 100 | 150 | 200 | | | | | | |
| 2 | 20 | 50 | 70 | 100 | | | | | | |
| 5 | 8 | 19 | 28 | 40 | | | | | | |
| 10 | 4 | 10 | 14 | 19 | | | | | | |
| 15 | 3 | 6 | 9 | 13 | | | | | | |
| 20 | 2 | 5 | 7 | 10 | 20 | | | | | |
| 25 | | 4 | 6 | 8 | 16 | 20 | | | | |
| 40 | | 2 | 3 | 5 | 8 | 10 | 15 | 20 | | |
| 50 | | | 3 | 4 | 8 | 9 | 11 | 15 | | |
| 60 | | | | 3 | 6 | 8 | 9 | 13 | 16 | 19 |
| 75 | | | | 2 | 5 | 6 | 7 | 10 | 12 | 15 |
| 100 | | | | 2 | 4 | 5 | 6 | 8 | 9 | 11 |
| 125 | | | | | 3 | 4 | 5 | 6 | 8 | 9 |
| 150 | | | | | | 3 | 4 | 5 | 6 | 7 |

* Table based on a 3 ft. row. Fractional parts of a minute have been omitted.

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The canvas hose can be made at home from 8, 10, or 12 ounce duck by sewing narrow strips of the material on the sewing machine. The French seam is most commonly used in making the home-made hose; factory hose is put together with a lap seam. Hose two and one-half inches in diameter is satisfactory for most purposes. The resistance to the flow of water in a smaller hose increases rapidly as the size of hose decreases and difficulty may thus be encountered in getting the water to flow the full length of the hose. For larger pump installations, it is well to have the hose as large as, or larger than, the discharge pipe of the pump.

It is sometimes necessary to connect two or more lengths of the hose. The end of the next length of hose to be attached can be placed over the end of the hose already connected and the two will be held together by the outward pressure of the water flowing inside the hose. If such a connection does not prove satisfactory, a makeshift connection can be made from a piece of galvanized tubing about 8 inches long. One end of the tubing is inserted in the end of one hose while the end of the other hose is placed over it and the whole thing bound with flexible wire.

When long lines of canvas are used, it may be necessary to use different weights of canvas along the line. More even distribution of water will result if a heavy weight of canvas is used near the supply line, especially where the water has to be forced up-grade. When going down a rather steep grade, the order may have to be reversed and the heavier canvas put at the lower end.

The length of life of the hose depends upon the care it receives. If left lying on the ground between irrigations, the hose will not last more than one year; if taken up and properly dried, it should last from four to five years. Treatment with the following mixture has prolonged the life of hose considerably:

| | |
|---|---|
| Asphalt paint, | 1 gallon |
| Gasoline | 1 pint |
| Kerosene | 1 pint |

The mixture must be stirred thoroughly. The hose is soaked in the mixture and wrung out dry with an old clothes wringer or other suitable method.

The method of porous hose irrigation is especially suitable on slightly irregular land and where the soil is either too sandy or too heavy for satisfactory furrow irrigation.

Location of the Garden

Regardless of the method of irrigation planned, considerable thought should be given to the location of the garden. Nearness to the water supply is a very important item when irrigation is being considered. Conveying water through either a pipe or an open ditch greatly reduces the efficiency of the plant. The power required to force water through pipe increases rapidly as the length of pipe increases due to frictional resistance to flow. When using the open ditch system of conveyance, much of the water is lost by seepage.

Windbreaks to relieve the intensity of the hot burning winds become an important factor, especially in the central and western parts of the state. A permanent windbreak of trees and shrubs, buildings, or a hill is desirable, but temporary windbreaks can be made by planting a few rows of corn or other tall growing plants along the south side of the garden.

Regularity of the surface should be given due consideration. The more regular the surface of the ground to be irrigated, the simpler and more effective the work becomes, no matter which method of irrigation is applied.

Water Requirements

The quantity of water to be used in each irrigation will largely be determined by the amount of moisture in the soil and the kind of vegetables grown. An irrigation system should be capable of delivering at least a one inch depth of water per week over the area to be irrigated. 27,152 gallons of water are required to cover one acre of ground to a depth of one inch. Wherever the windmill pump is depended upon to supply the irrigation water, only a small part of an acre can be handled successfully. Assuming that the windmill will pump 120 gallons per hour (2 gallons per minute) and that the pump will be available for irrigation purposes 5 hours a day for 5 days a week, the maximum amount of water the irrigator can depend upon is 3,000 gallons a week or approximately enough water to cover one-ninth of one acre of ground to a depth of 1 inch once a week. One-ninth of one acre is equivalent to an area about 100 feet long and 48 feet wide.

(1) The success of irrigation invariably lies in applying the water as soon as the plants are in need of it, in applying ample quantities of water at each irrigation, and in running the water on as quickly as the soil will absorb it. Do not irrigate the same ground every day.

(2) Since the stream flowing from a windmill pump is very small, much of the water will sink down at the beginning of the furrow especially where the water is applied to the garden in open furrows. To overcome this difficulty, many farmers over the state have an ordinary galvanized stock tank built upon a scaffolding at the edge of the garden. The windmill pumps into this tank whenever it is not needed for other purposes. In the evening the water is allowed to run quickly out of the tank and onto the garden. In this manner, a large amount of water is saved from evaporation and the distribution is much more uniform.

In many parts of the state, the underground water supply is such that the wells will not stand up under the constant pumping during the critical period of the season. To make the irrigation load of the well as light as possible, it is advisable to do most of the irrigating of the garden during the fall and spring whenever the pump is available. Evaporation is at a minimum during these periods and most of the water supplied will be stored in the subsoil.

Another simple and effective way of increasing the subsoil moisture supply is to place a snow fence, or snow fences, across the garden in an east-west direction. In some seasons several drifts may be caught behind such a fence. Every foot of snow is equivalent to an inch of water on the area of the garden covered by the drift.

The root systems of most of the ordinary garden vegetables go down from three to four feet. If the subsoil is not supplied with moisture down to that depth, the roots of the plants will not develop normally. They will spread out in a lateral direction close to the surface of the ground. Plants that have their roots too close to the surface cannot live through a severe hot and dry period.

If the garden has been thoroughly soaked before the planting season so that the subsoil moisture is down far enough to give all plants an opportunity to develop their root systems normally, the next thing to strive for is to conserve as much of this moisture as is possible. Mulching the ground with straw, hay, or manure is a very effective means of keeping down evaporation, in addition to improving the quality and yield of vegetables. The benefits of mulching are greatest with long season crops such as potatoes and tomatoes. Because of the lowering of the temperature of the soil it is not deemed advisable to apply the straw until the plants are well established. A layer of straw from 2 to 4 inches thick (when settled) is adequate. At the end of the season, the straw should be removed. Dry organic matter plowed under in such large quantities would have a very unfavorable effect upon the soil. Straw mulching is not generally recommended for use in western Nebraska because of the lower temperatures.

Selection of Equipment

The selection of equipment for garden irrigation will depend largely upon the use to which it is to be put and the investment which it is desirable to make. In many cases, the irrigator will want to depend upon his windmill and pump to supply the water. In some parts of the state, the same well used for stock and household purposes will not supply enough water for irrigation of the garden. Other difficulties will arise because of the mill being occupied most of the time at furnishing water for stock and household use, especially during the dry and hot period when the water should be applied to the vegetables without delay and in ample quantities. A great deal more water is necessary for satisfactory irrigation than is usually thought of by the man or woman not familiar with irrigation.

Several types of pumps can be used for irrigation, although the initial cost of some types make their use for garden irrigation not practicable. The ordinary hand pump is a piston or plunger pump. Piston pumps are built for either deep or shallow wells. If the water level is more than 25 feet below the surface of the ground, a deep well pump is necessary. The piston pump is capable of pumping against high pressures. Unless some sort of relief valve is placed in the line, the pipe line should never be closed while the pump is operating.

Some small irrigation systems use the simplex double-acting piston pump. This pump has but one cylinder and discharges water at both the forward and backward strokes of the piston. The double-acting, as well as the ordinary piston pump, is self-priming. In case of too much drawing down of the water in the well, which may cause air to be let into the pipe, both pumps will again pick up the water as soon as it covers the opening of the pipe. The double-acting pump is not well adapted to deep well installations because of excessive cost.

The centrifugal pump is adapted to all three methods of garden irrigation described in this circular. One necessary requirement is a plentiful water supply at a shallow depth. The pump should be set as close to the water as possible and can even be placed below the water level by putting it in a pit, thus avoiding the trouble caused by the pump losing its priming.

Centrifugal pumps for delivering less than 50 gallons per minute cost about one-third as much as piston pumps. However, it is necessary to have either a foot valve on the end of the suction pipe or a check valve on the discharge pipe. The pump cannot be primed without at least one of these valves. Either an elevated tank or some other device is necessary for filling the casing when priming the pump.

This type of pump is designed for either high or low pressures. The low pressure pump is satisfactory for use in garden irrigation; the high pressure pump is more costly and would not be practicable unless it could be put to other uses than garden irrigation only. Centrifugal pumps are especially adapted to pumping dirty and gritty water from ponds and streams and can be run with the pipe line closed without injury to the equipment.

Resistance to Flow in Pipes

In many cases, it will be necessary to convey the water from the pump to the garden through a length of pipe line. When water flows through a pipe line, there is more or less frictional resistance. This resistance increases with the length of the line and the number of gallons flowing through it per minute, but decreases as the size of the pipe is increased. The loss due to friction is usually expressed in feet of "head". Table 3 shows the loss in feet of "head" for various lengths of pipe of different sizes with different rates of flow. The pump must not only lift the water from its level in the well or stream to the highest point on the land to be irrigated, but it must overcome the frictional resistance created in the pipe line and still supply enough water to irrigate the garden.

In cases where an elevated storage tank is used to supply the water for irrigation, pipe friction should receive the same attention. When the pipe line is of considerable length, most of the potential head incident to the elevated water supply may be lost unless a large enough size of pipe is being used.

Power Requirements

The gasoline engine will be depended upon in many cases to furnish the power for operating the pump. A few farmers will have electricity available and use an electric motor for their power unit. To determine the horsepower necessary to operate an irrigation plant, assuming 50% pump efficiency, reference can be made to Table 4. Thus for a 50-gallon per minute delivery and a fifty foot head, determined as indicated in the previous two paragraphs, 1¼ horsepower would be required.

Cost of Irrigation

The most important item of expense for garden irrigation is the cost of the plant. This item will vary greatly in different localities and especially with the method of irrigation decided upon. The cost of pumping may be increased materially by having too large a power unit for the pump, by having worn out or poorly adjusted equipment, or by having a pump not suitable to the job.

A Practical Problem

The following examples will help the reader in becoming familiar with the use of the tables:

Problem - The garden to be irrigated has an area of 0.5 acres. A pump with a capacity of 50 gallons per minute has been installed. The source of water is a stream and the pump will be located 600 feet from the garden and on the bank 10 feet above the water level in the stream. The highest point in the garden is 20 feet above the pump.

Solution - Referring to Table 2, a pump with a capacity of 50 gallons per minute would require five hours to cover the one-half acre area to a depth of 1 inch.

The size of piping required, according to Table 3, for 50 gallons per minute and 600 feet in length is 2 inches and the friction loss is 34 feet. Therefore, the total head against which the pump must operate is: suction 10 feet, vertical lift 20 feet, friction loss 34 feet. In the case of spray and porous hose irrigation, an additional head of about 30 feet must be included for operating pressures in the hose or nozzle line. This makes a total head of 10 plus 20 plus 34 plus 30 equals 94 feet.

Power required according to Table 4 for 50 gallons per minute with 94 foot head is 2.35 H.P. or a two and one-half horsepower engine would be large enough to operate the system. The probable cost of pumping an acre-inch would be according to Table 5, $0.71, with gasoline at 16¢ per gallon. The one-half acre plot can therefore be irrigated to a depth of one inch at a cost of about 36 cents. This does not include depreciation and upkeep on the equipment, nor does it make any allowance for repairs and labor.

Definitions

An acre-inch of water is equal to 27,152 gallons and is the amount necessary to cover an acre of ground to a depth of 1-inch.

One acre is equal to 43,560 square feet. To cover one square foot of ground to a depth of one inch, five-eighths of a gallon of water is necessary.

TABLE 2 - Size of Pump Required for Applying one Inch of Irrigation Water on Various Areas.

| Size of Area in Acres | Rate of Application - Hours | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| | Gallons per Minute | | | | | | | | | |
| 0.1 | 50 | 25 | 16.6 | 12.5 | 10 | 8.3 | 7.1 | 6.2 | 5.5 | 5 |
| 0.2 | 100 | 50 | 33.3 | 25. | 20 | 16.6 | 14.2 | 12.5 | 11. | 10 |
| 0.3 | 150 | 75 | 50. | 37.5 | 30 | 25. | 21.4 | 18.7 | 16.6 | 15 |
| 0.4 | 200 | 100 | 66.6 | 50. | 40 | 33.3 | 28.5 | 25. | 22. | 20 |
| 0.5 | 250 | 125 | 83.3 | 62.5 | 50 | 41.6 | 35.7 | 31. | 27.7 | 25 |
| 0.6 | 300 | 150 | 100. | 75. | 60 | 50. | 42.8 | 37.5 | 33.3 | 30 |
| 0.7 | 350 | 175 | 116.6 | 87.5 | 70 | 58.3 | 50. | 43.7 | 38.8 | 35 |
| 0.8 | 400 | 200 | 133.3 | 100.0 | 80 | 66.6 | 57. | 50. | 44.4 | 40 |
| 0.9 | 450 | 225 | 150. | 112.5 | 90 | 75. | 64. | 56. | 50. | 45 |
| 1 | 500 | 250 | 166. | 125. | 100 | 83. | 71. | 62. | 55. | 50 |
| 2 | 1000 | 500 | 333. | 250. | 200 | 166. | 142. | 125. | 110. | 100 |
| 3 | 1500 | 750 | 500. | 375. | 300 | 250. | 214. | 187. | 166. | 150 |
| 4 | 2000 | 1000 | 666. | 500. | 400 | 333. | 285. | 250. | 220. | 200 |
| 5 | 2500 | 1250 | 833. | 625. | 500 | 416. | 357. | 310. | 277. | 250 |
| 6 | 3000 | 1500 | 1000. | 750. | 600 | 500. | 428. | 375. | 333. | 300 |
| 7 | 3500 | 1750 | 1166. | 875. | 700 | 583. | 500. | 437. | 388. | 350 |
| 8 | 4000 | 2000 | 1333. | 1000. | 800 | 666. | 570. | 500. | 444. | 400 |
| 9 | 4500 | 2250 | 1500. | 1125. | 900 | 750. | 640. | 560. | 500. | 450 |
| 10 | 5000 | 2500 | 1660. | 1250. | 1000 | 830. | 710. | 620. | 550. | 500 |

TABLE 3 - Recommended Pipe Sizes for Ordinary Installations.

| Gals. per Minute | | Length of Pipe in Feet | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 100 | 200 | 300 | 400 | 500 | 600 | 700 | 800 | 900 | 1000 | 1200 | 1400 |
| 10 | Size of Pipe | 3/4" | 1" | 1" | 1" | 1¼" | 1¼" | 1¼" | 1¼" | 1¼" | 1¼" | 1¼" | 1¼" |
| | Loss in Feet | 30 | 21 | 31 | 41 | 12½ | 15 | 17 | 19 | 21½ | 24 | 29 | 33½ |
| 15 | Size of Pipe | 1" | 1" | 1" | 1¼" | 1¼" | 1¼" | 1¼" | 1¼" | 1½" | 1½" | 1½" | 1½" |
| | Loss in Feet | 16 | 32 | 48 | 22 | 27 | 33 | 38 | 44 | 20 | 22 | 27 | 31 |
| 20 | Size of Pipe | 1" | 1¼" | 1¼" | 1¼" | 1¼" | 1½" | 1½" | 1½" | 1½" | 1½" | 1½" | 2" |
| | Loss in Feet | 28 | 9 | 19 | 28 | 38 | 23 | 27 | 30½ | 34 | 38 | 42 | 14 |
| 25 | Size of Pipe | 1¼" | 1¼" | 1½" | 1½" | 1½" | 1½" | 1½" | 1½" | 2" | 2" | 2" | 2" |
| | Loss in Feet | 15 | 30 | 15 | 20 | 25 | 30 | 35 | 40 | 13 | 14 | 17 | 20 |
| 30 | Size of Pipe | 1¼" | 1¼" | 1½" | 1½" | 1½" | 2" | 2" | 2" | 2" | 2" | 2" | 2" |
| | Loss in Feet | 21 | 42 | 26 | 35 | 43 | 13 | 15 | 17 | 19 | 21 | 25 | 29 |
| 35 | Size of Pipe | 1¼" | 1½" | 1½" | 1½" | 2" | 2" | 2" | 2" | 2" | 2" | 2" | 2" |
| | Loss in Feet | 29 | 23 | 35 | 46 | 14 | 17 | 19 | 22 | 25 | 28 | 33 | 39 |
| 40 | Size of Pipe | 1¼" | 1½" | 1½" | 2" | 2" | 2" | 2" | 2" | 2" | 2" | 2" | 2" |
| | Loss in Feet | 37 | 30 | 45 | 15 | 18 | 22 | 26 | 30 | 33 | 37 | 44 | 51 |
| 45 | Size of Pipe | 1½" | 1½" | 2" | 2" | 2" | 2" | 2" | 2" | 2" | 2" | 2½" | 2½" |
| | Loss in Feet | 19 | 38 | 14 | 18 | 23 | 28 | 32 | 37 | 41 | 46 | 18 | 21 |
| 50 | Size of Pipe | 1½" | 1½" | 2" | 2" | 2" | 2" | 2" | 2" | 2" | 2½" | 2½" | 2½" |
| | Loss in Feet | 23 | 46 | 17 | 22 | 28 | 34 | 39 | 45 | 51 | 19 | 22 | 26 |

TABLE 4 - Horsepower Required for Pumping Water at 50% Pump Efficiency.

| Gals. per Minute | Total Head in Feet | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 | 20 | 30 | 40 | 50 | 60 | 75 | 100 | 125 | 150 |
| 10 | .05 | .10 | .15 | .20 | .25 | .30 | .37 | .50 | .62 | .75 |
| 15 | .08 | .15 | .22 | .30 | .37 | .44 | .56 | .75 | .94 | 1.12 |
| 20 | .10 | .20 | .30 | .40 | .50 | .60 | .75 | 1.00 | 1.25 | 1.50 |
| 25 | .13 | .25 | .37 | .50 | .62 | .74 | .94 | 1.25 | 1.56 | 1.87 |
| 30 | .15 | .30 | .45 | .60 | .75 | .90 | 1.12 | 1.50 | 1.87 | 2.25 |
| 35 | .18 | .35 | .52 | .70 | .87 | 1.04 | 1.31 | 1.75 | 2.19 | 2.62 |
| 40 | .20 | .40 | .60 | .80 | 1.00 | 1.20 | 1.50 | 2.00 | 2.50 | 3.00 |
| 45 | .23 | .45 | .67 | .90 | 1.12 | 1.34 | 1.69 | 2.25 | 2.81 | 3.37 |
| 50 | .25 | .50 | .75 | 1.00 | 1.25 | 1.50 | 1.87 | 2.50 | 3.12 | 3.75 |
| 60 | .30 | .60 | .90 | 1.20 | 1.50 | 1.80 | 2.25 | 3.00 | 3.75 | 4.50 |
| 75 | .38 | .75 | 1.12 | 1.50 | 1.87 | 2.24 | 2.81 | 3.75 | 4.69 | 5.62 |
| 90 | .45 | .90 | 1.35 | 1.80 | 2.25 | 2.70 | 3.37 | 4.50 | 5.62 | 6.75 |
| 100 | .50 | 1.00 | 1.50 | 2.00 | 2.50 | 3.00 | 3.75 | 5.00 | 6.25 | 7.50 |
| 125 | .63 | 1.25 | 1.87 | 2.50 | 3.12 | 3.74 | 4.69 | 6.25 | 7.81 | 9.37 |
| 150 | .75 | 1.50 | 2.25 | 3.00 | 3.75 | 4.50 | 5.62 | 7.50 | 9.37 | 11.25 |
| 175 | .88 | 1.75 | 2.62 | 3.50 | 4.37 | 5.24 | 6.56 | 8.75 | 10.94 | 13.12 |
| 200 | 1.00 | 2.00 | 3.00 | 4.00 | 5.00 | 6.00 | 7.50 | 10.00 | 12.50 | 15.00 |
| 250 | 1.25 | 2.50 | 3.75 | 5.00 | 6.25 | 7.50 | 9.37 | 12.50 | 15.72 | 18.75 |

TABLE 5 - Cost of Pumping an Acre Inch of Water Against Various Heads with a Gasoline Engine or Electric Motor.

| Head in Feet | Gas Engine | | | | Electric Motor | | |
|---|---|---|---|---|---|---|---|
| | Gasoline Price per Gallon Cents | | | | Electricity Price per K. W. H. Cents | | |
| | 10 | 12 | 14 | 16 | 2 | 3 | 5 |
| 20 | $0.09 | $0.10 | $0.12 | $0.14 | $0.09 | $0.14 | $0.23 |
| 30 | .13 | .15 | .19 | .21 | .12 | .17 | .29 |
| 40 | .19 | .22 | .25 | .30 | .18 | .27 | .45 |
| 50 | .23 | .26 | .30 | .34 | .23 | .34 | .57 |
| 60 | .27 | .32 | .36 | .42 | .27 | .40 | .65 |
| 70 | .31 | .38 | .43 | .50 | .32 | .48 | .79 |
| 80 | .35 | .42 | .48 | .56 | .36 | .54 | .91 |
| 90 | .39 | .48 | .54 | .63 | .41 | .61 | 1.02 |
| 100 | .45 | .54 | .63 | .71 | .45 | .68 | 1.13 |
| 125 | .54 | .65 | .76 | .88 | .57 | .85 | 1.42 |
| 150 | .66 | .79 | .93 | 1.08 | .68 | 1.02 | 1.69 |
| 175 | .77 | .92 | 1.09 | 1.24 | .80 | 1.20 | 2.00 |
| 200 | .88 | 1.08 | 1.22 | 1.42 | .90 | 1.35 | 2.26 |

The tables apply only to small installations. Tables, as well as other information, applying to larger installations can be obtained through the County Agricultural Agent or the Agricultural Extension Service, College of Agriculture, Lincoln, Nebr.

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