



# AGRICULTURAL ENGINEERING NEWS LETTER

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## DRAINAGE REQUIREMENTS OF CROPS

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FIELD AND TRUCK CROPS

The ultimate purpose of farm drainage is to bring about a soil moisture condition that will be best adapted to plant growth, and a competent drainage engineer can scientifically design a drainage system that will remove excess water from the soil at a desired rate. Just what this rate of removal of excess water from the soil should be, however, to prevent injury to any one of the many different farm crops is not yet known. Studies are now being conducted at the Minnesota Agricultural Experiment Station to determine the best soil-moisture requirements of different crops and the slowest rate at which the water must be removed from the soil to prevent serious injury to the crop. Until these and other tests have been completed to determine the tolerance of the many different farm plants to waterlogged conditions, statements relative to the drainage requirements of specified crops must be general and based on personal observations and experience.

Since a close relationship exists between root development and crop production, proper precautions must be taken to insure a vigorous root system which cannot be grown where there is excess water in the soil.

A shallow water table limits the depth of rooting because roots of upland plants will not penetrate free water. Many marsh plants can thrive in wet soil, but even their root systems will not develop to any great extent below the surface of the ground water. This inability of plant roots, generally, to penetrate waterlogged soils is reflected in low quality and quantity yields.

A well-drained soil will make possible the deep and wide root penetration necessary for vigorous growth and heavy yields. A shallow rooted system may produce top growth of normal quality, but the ground water usually recedes much more rapidly than the roots can follow with the result that there is serious injury to the plants from lack of moisture because a high water table early in the season has forced root maturity before full development is attained. The rise of the water into the zone of the roots already matured will injure and often kill those roots exposed to stagnant saturation for any appreciable length of time. Some plants are killed by excessive ground water much more quickly than others. However, most plants will withstand a waterlogged condition of the soil for a longer time if the free water is not stagnant but is being drained off at an appreciable rate.

Table 1. Root Penetration for Crops  
(Average Loam Soil Conditions)

Species	Depth of dense root zone inches	Extreme depth of tap or main roots inches	Approximate average depth of tile for class of crop feet
<b>FIELD CROPS</b>			
Wheat	12	48-60	3½-4
Rye	20	60-90	
Oats	18-24	48-60	
Barley	24-30	54-78	3 -3½
Flax	12-18	30	
Sunflower	12	108	3½-5
Sugar beets		60-72	
Field corn	18-36	60-72	5
Alfalfa	36	72-108	
Clover	24-48	48-96	
Brome grass		66-78	2½-3½
Ky. bluegrass	18-20	60-84	
Red top	22	40	
Timothy	15	36	
<b>VEGETABLE CROPS</b>			
Beets	20	60-120	3½-5
Carrots	36	90	
Onions	24	60	
Cabbage	24	36-90	3½-4
Cauliflower	12-20	36-54	
Lettuce	8-12	90	3½-4
Chard	18	72	
Tomatoes	24	48	3½-4
Peppers	12-18	48	
Sweet corn	24	48	
Cucumbers	12	36-48	2½-3½
Muskmelons	8-12	36-48	
Beans	12	36	2½-3½
Peas	12	36	
Radishes	6	24	2½-3½
Spinach	10	42	
Potatoes	10-12	40	
<b>SMALL FRUITS</b>			
Strawberries	12-18	36	

Effective capillary rise in average loam soils is about 24 inches.

Recommended maximum penetration allowed for into the effective capillary zone is about 12 inches.

General averages seem to be from 3½ to 5 feet and in average mineral soils the deeper of these, or 5 feet, is in no danger of causing over-drainage. (A mineral soil cannot be over-drained.)

The Division of Agricultural Engineering has assembled the data for Table 1, giving the normal root penetration for many farm crops. This table does not show how rapidly the excess water must be removed from the soil to prevent plant injury, but it does give the best depths for laying drain tile for the crops listed.

On some farms the more common truck crops are grown as well as small grain, hay, corn, and potatoes. On this type of farm a depth of drainage must be selected so that the shallow rooting crops will not be so far above the tile that they cannot secure some moisture from the ground water supply, while at the same time the deeper rooting crops must have sufficient drainage so as not to retard normal root development. In most Minnesota areas where such a wide variety of crops are grown, good results are obtained by placing the tile laterals at depths of 3½ to 4 feet with proper spacing to fit local soil characteristics.

The drainage of a given tract of land that has been given over to a specified type of crop offers a different problem. Under such circumstances, it is wise to install a system that will have a depth best suited to the rooting habit of that particular type crop. Rarely will a drainage system installed to satisfy some specific crop prohibit the planting of a grain or a legume as a soil builder.

### ORCHARDS AND BUSH FRUITS

Orchard crops root as deep as 8 feet with most of the roots in the first 4 to 6 feet. The spacing of the rows of trees generally varies from 20 to 50 feet apart. If the spacing is 50 feet and the soil is heavy, the tile is frequently placed 4 to 6 feet deep and spaced between every other row of trees. If the rows are closer, the tile should be spaced between every 3 or 4 rows, depending on soil type.

Bush fruits vary greatly in their depth of rooting, only a few seeking depths of 4 feet, the bulk of their root system being in the upper 24 to 30 inches. It is customary with bush fruit crops to follow the same principles of drainage design for tile spacing and depth as would be used on land growing general farm crops.

Extension Bulletin No. 149, "Farm Drainage Practice," gives a complete discussion on laying out and constructing farm drainage systems. It may be obtained from the Bulletin Department, University Farm, St. Paul, Minnesota.