Water Table Management Systems

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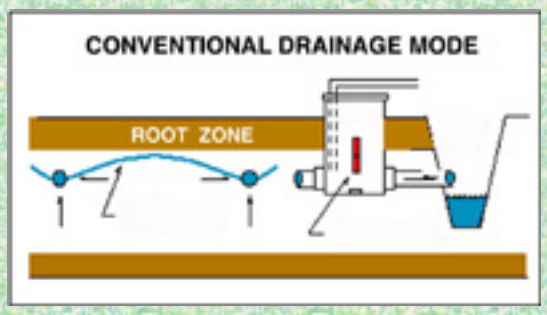
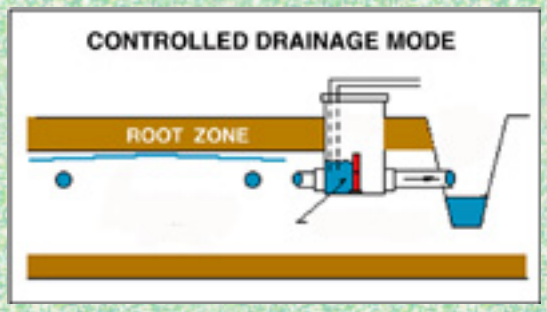
Water table management is the regulation of soil-water excess and availability by structures specifically designed for given farm site conditions. Practices include subsurface drainage, controlled drainage, and subirrigation.



SUBSURFACE DRAINAGE

Farm lands susceptible to seasonal or intermittent high water tables usually require subsurface drains, which serve to lower the water table to a level equal to the drain depth. Subsurface drainage is common throughout the flat and gently rolling areas of the Midwest, as well as in other parts of the country. Subsurface irrigation improves trafficability, and allows earlier planting. Subsurface drainage decreases crop damage from standing water.

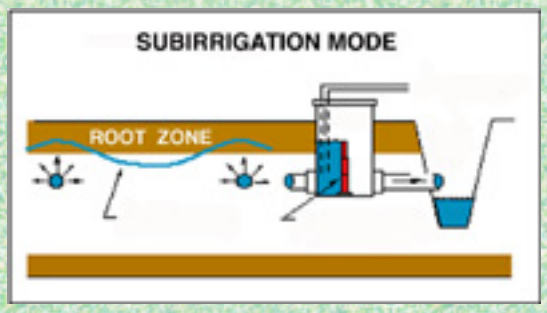
CONTROLLED DRAINAGE



The addition of control structures to a subsurface drainage system allows the drainage outlet to be set at any level between the ground surface and the drains. Raising the outlet after planting helps keep water available for plant use longer than does "free," uncontrolled subsurface drainage. This practice can also be used for recharge of the water table between growing seasons.

SUBIRRIGATION

One system provides the drainage and irrigation requirements of the crop. Water is supplied through the subsurface drainage systems using control structures to regulate the water table level. Irrigation water is applied below the ground surface, thus raising the water table to the crop root zone. Subirrigation practices can be used to create a constant water table depth or a fluctuating water table.



Some existing drainage systems may be retrofitted for subirrigation. Subirrigation systems require a high level of management to avoid excess soil wetness following rainfall.

BENEFITS OF SUBIRRIGATION

One system can be used to completely meet all water table management requirements. The drainage and irrigation components of a subirrigation system are one and the same. Installing a subirrigation system costs less than installing subsurface drainage and surface irrigation together. For certain soils, subirrigation is very efficient. Deep seepage is negligible, and no runoff of irrigation water occurs. The water is always applied where the crops require it. Most importantly, crops respond well to subirrigation when other production management factors are not limiting. In ten years of study, bean yields have been consistently over 75 bushels per acre under subirrigation and a high yield management system.

REQUIREMENTS FOR SUBIRRIGATION

Soil. Subirrigation is usually effective in soils that have a soil layer of low permeability located below the subsurface drains. This layer helps reduce deep seepage losses. The permeability of the restrictive layer should be less than one-tenth that of the crop root zone.

Both vertical and horizontal hydraulic conductivities should be measured in the field before designing the system. High horizontal hydraulic conductivity creates the potential for lateral seepage. This allows for a wider drain spacing. However, losses from the edge of the field may be excessive under these conditions, especially if the adjoining field is drained.

Topography. Subirrigation is best suited for flat or gently sloping lands (less than 1% slope) because uniform depth to the water table is much easier to maintain. A field with considerable surface undulation could result in excessive variation of depth to the water table. For this case, water table management may require multiple control structures.

Management. Management is very important and time requirements may be high. Until the farmer is

well acquainted with the system, monitoring the water table both over and between the drains may be necessary. Automated water level controllers reduce time inputs but are much more costly. Raising the water table four feet in a sandy loam soil with drains 60 feet apart could take 3 to 5 days. Times would be longer for clay soils.

Drainage Drainage system improvements may be necessary to adequately distribute the irrigation water. Drain spacing may need to be closer than required for drainage alone for certain soils. Surface improvements, such as land grading or field ditches, may be useful.

Ability to drain rapidly when rainfall occurs during subirrigation periods is critical.

Water Supply. Water is needed most during the driest parts of the growing season. Streams are often unreliable, because flow rates decrease when water demand is highest. Wells, ponds, and reservoirs are used frequently for irrigation water supply. Net irrigation water requirements in the Midwest depend on crop, location, and weather. Irrigation to meet evapotranspiration demand may typically require 5 gallons per acre per minute.

Materials. Materials include the subsurface drainage system with its control structures, a properly sized pump, and perhaps monitoring wells (piezometers) at several locations. The designer must determine the layout of the system and the depth and spacing of the drains. The slope, hydraulic gradeline, and the size of lines must be determined for both drainage and irrigation. Control structures are needed, at least in the main line, to maintain a uniform water table depth. Provisions for adjusting the weir setting (water level) must be included and should be easy to implement.

Converting from Drainage to Subirrigation. Subsurface drain spacings for subirrigation usually are 30% closer than those for drainage only. Retrofitting an existing subsurface drainage system for subirrigation may be possible in some cases by installing additional drains between existing lateral drains.

POTENTIAL PROBLEMS OF SUBIRRIGATION

Sudden heavy rains during the irrigation mode may flood the root zone, especially if the weir setting (water table) is high. This problem may be solved by careful on-site management. If possible, the farmer should allow time for the soil to drain before a rain occurs. A major problem may be creating and maintaining a level water table. This is especially true in soils with low lateral hydraulic conductivity, such as clays. Problems also exist in soils that lack an adequate restrictive layer below the drain depth.

INFORMATION

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