IRRIGATION METHODS USED IN NEW JERSEY

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GENERAL

There are four general methods of irrigation – sprinkler, surface, trickle, and subsurface irrigation.

Most the present irrigation in New Jersey is the sprinkler type, where water is distributed under pressure through a system of pipes and sprinkled on the crop by rotating sprinkler heads. Sprinkler heads and nozzles, available in a wide variety of sizes, apply water at rates of less than 0.1 inch per hour to more than 2 inches per hour.

Surface irrigation involves the distribution of water over the soil surface either in a sheet or in furrows. Land leveling is generally required to obtain the proper soil slope for uniform water distribution.

Surface irrigation is practiced extensively in the New Jersey cranberry bogs, primarily for frost control and bog management. In recent years, surface irrigation is being supplemented by permanent sprinkler systems which use much less water and can start operation within a few minutes, whereas it takes several hours to flood a bog for frost protection. Flooding is still used for winter-flooding and for water-harvesting operations.

Trickle irrigation systems apply water through a low-pressure (15-to-20 psi) system of pipes and hoses, usually plastic, laid on the ground or buried at a shallow depth. There is an emitter close to the base of each plant. Water trickles, or drips, out the emitter and soaks into the ground. Several emitters may be placed around the base of the tree for orchard use. It is a highly efficient system, because water is applied right above the root zone. Trickle irrigation is starting to be used in New Jersey. It has the potential to replace some of the sprinkler irrigation systems with a savings in water and power usage while improving yields and quality of farm produce.

Subsurface irrigation systems distribute water below the ground surface through a system of ditches or tile drains rather than on top of the ground. To be successful, the topography must be nearly level and smooth. The upper soil layers must be permeable to permit free and rapid water movement laterally and vertically. The permeable soil must be underlain by relatively impervious soil on which an artificial water table can be built up or it must have a natural high water table.

SOILID SET SPRINKLER SYSTEMS

Solid set sprinkler systems consist of an above ground portable aluminum pipe system which is placed in the field or fields at the start of the irrigation season and left in place during the season. The main lines may be buried or above ground. Solid set sprinkler systems are adapted to irregular fields and rolling terrain. They have a low labor requirement. The surface lines and risers may interfere with field operations. Solid set systems have a higher initial cost than hand move lateral systems. The entire system can be operated at one time for frost control or crop cooling. The system can be moved to a different field at the end of the irrigation season.

PERMANENT SPRINKLER SYSTEMS

Permanent sprinkler systems consist of plastic pipe placed underground with only the sprinklers and a portion of the risers above ground. Permanent sprinkler systems are adapted to irregular fields and rolling terrain. They have a low labor requirement. The risers may interfere with field operations unless removed. Permanent systems have a higher cost than hand move lateral systems. The systems can be used for frost control or crop cooling.

HAND MOVE LATERAL SYSTEMS

Hand move lateral systems are the most common system in New Jersey for vegetable, orchard, and field crops. The aluminum laterals are moved by hand between irrigation settings. The mains may be portable above ground or permanent buried mains. Hand move lateral systems have the lowest initial cost and have the highest labor requirement. They are adapted to irregular fields and rolling terrain.

SIDE ROLL SYSTEMS

Side roll systems have wheels mounted on the lateral pipe, with the pipe serving as the axle of the wheels. Rigid couplers permit the entire lateral, up to ¼ mile long, to be rolled forward by applying power at the center or the end while the lateral pipe remains in a nearly straight line. Normally, the drive unit contains a gasoline engine and a transmission with a reverse gear. Side roll systems have a low labor requirement, but they have higher initial and maintenance costs than hand move lateral systems. They irrigate a rectangular area. They are not adapted to tall crops. Topography must be flat or gently rolling.

CENTER-PIVOT SYSTEMS

Center pivot systems consist of a single lateral with one end anchored to a fixed pivot structure and the other end continuously moving around the pivot while

applying water. The water is supplied from the source to the lateral through the pivot. The lateral pipe with sprinklers is supported on drive units. The drive units are normally powered by hydraulic water drives or electric motors. Center pivot systems have a low labor requirement and a high initial cost. They irrigate a circular area. With an end gun, part of the corners of the field can be irrigated. Topography should be uniform with slopes of not more than 10 percent.

TRAVELING GUN SPRINKLERS

A traveling gun system consists of a high capacity sprinkler mounted on a chassis to which a flexible hose, usually 3 to 5 inches in diameter and up to 1320 feet long, is connected. The traveler is pulled along selected travel lanes by a cable or the hose wrapping on a rotating reel. The reel can be powered by a water turbine, water piston, or engine drive. The cable reel pulls the traveler through the field in a straight line. Traveling gun sprinklers are adapted to irregularly shaped fields. The costs are moderate and require less labor than hand move laterals. Traveling gun sprinklers require high operating pressures and high power pumping units. Alleyways are required in the crop. Wind seriously affects the distribution pattern.

TRAVELING LATERAL SYSTEMS

Traveling lateral systems move continuously in a rectilinear fashion. The lateral is fed from a flexible drag hose or equipped with a traveling pumping plant to take water from a parallel ditch. The lateral pipe with sprinklers is supported on drive units. The drive units are normally powered by hydraulic water drives or electric motors. Traveling lateral systems require rectangular fields. They can irrigate the entire field. Traveling lateral systems have a higher labor requirement than a center pivot but less than a hand move system. They apply water very uniformly.

TRICKLE SYSTEMS

Trickle or drip irrigation systems slowly apply small amounts of water to part of the plant root zone. Water is applied on a frequent, usually daily, basis to prevent moisture stress in the plant by maintaining favorable soil moisture conditions. Higher yields and better quality produce is obtained than with other kinds of irrigation because of a continuous supply of adequate water.

Small water sources can be utilized. Trickle irrigation requires roughly 25 to 75 percent of the water needed by sprinklers or surface irrigation, depending on row spacing. Lower operating pressures and lower flow rates are required so pumping costs are less. The pump and pipe network to deliver the water can be smaller and less expensive. A high degree of water control is possible. Plants are supplied with the precise amount of water they need. Disease and insect damage is reduced because leaves are not wetted. Labor and operating costs are less. Extensive automation is possible. Field operations can continue during

irrigation because only a limited area around each plant is wetted. There is a reduction in weed problems and cultivation costs between rows. Water is not lost to weed growth. Fertilizers can be distributed by the system. Since water is delivered only near the plant, less fertilizer is needed. On hilly terrain, systems operate efficiently with no water runoff and without interference from the wind.

The small emission orifices are easily clogged by soil particles, algae, bacterial slime, or mineral precipitates. A good quality water supply or extensive filtering is required to minimize emitter clogging. Moisture distribution in the soil is limited. The wetted volume is a function of the emitter discharge, distance between emitters, and soil type. Distribution of moisture is a major design consideration. The system is not adaptable for frost protection. Rodents and insects may damage some components. Since there are emitters near every plant, field operations are restricted and emitters and lines are vulnerable to damage by cultivation equipment. Trickle systems are not suitable for closely planted crops such as cereal grains and alfalfa. A higher level of management than other irrigation systems is required. Initial investment and annual costs are higher than for some other irrigation methods.

SUBSURFACE SYSTEMS

Subsurface systems introduce irrigation water through open ditches or subsurface drains. The water table is maintained at some predetermined depth below the ground surface, usually 12 to 24 inches, depending on the rooting characteristics of the crop grown.

Open ditches are probably most widely used. Feeder ditches are excavated on the contour and spaced close enough to insure control of the water table. They are connected to a supply ditch that runs down the predominant field slope. The supply ditch has control structures as needed to maintain the desired water level in the feeder ditches.

A subsurface drainage system is generally used for high-value crops. Parallel tile lines are lad 24 to 40 inches deep at a nearly level grade that approximately parallels the ground surface. They are spaced close enough to insure almost complete control of the water table. In general, the upper ends of these feeder lines are connected to a supply line into which water is introduced. The lower ends are connected by an outlet tile that is used to carry excess irrigation water and storm water to a satisfactory outlet. Controls are placed in each feeder line to regulate the water-table level.

The surface systems are suited to soil having reasonable uniform texture and permeable enough for water to move rapidly both horizontally and vertically within and for some distance below the crop's root zone. The soil profile must also contain a barrier against excessive losses through deep percolation, either a nearly impermeable layer in the substratum or a naturally high water table on

which an artificial water table can be maintained throughout the growing season. Topography must be smooth and nearly level or the slopes very gentle and uniform. The subsurface systems are suited to irrigating vegetables, most field crops, small grains, pasture grasses, most forage crops, and flowers.

This method can be used for soils having a low water-holding capacity and high intake rate where the water level can be maintained at optimum depths for crop needs at different growth stages. Water loss by evaporation from the soil can be held to a minimum.

SURFACE SYSTEMS

Surface systems apply water rapidly to a level or nearly level area enclosed by dikes. Water is retained at a uniform depth until it has been taken into the soil or has served its purpose of preventing freezing or frost damage, or the water harvesting is complete.

Accurate land leveling makes this system much more efficient and effective. This system is used extensively in the cranberry bogs for frost control, freeze protection, bog management, and irrigation.