**Lecture 16 Multipurpose and Special Applications**

Sprinkler irrigation system is adaptable to a variety of special uses in addition to ordinary irrigation to control soil moisture. Chemigation involves injecting a water soluble-fertilizer, herbicide, insecticide, fungicide or namaticide into the irrigation system. When fertilizer is injected is called fertigation, which is an important multipurpose function of all types of sprinkle system. Germination, frost protection, bloom delay, micro climate control and disposing of waste water the most important special use functions of sprinkler systems. Some additional special uses of sprinkler equipment are: providing farm fire protection, providing cooling and dust control for feed lots and poultry building, providing moisture for earth fill construction and curing log piles.

**16.1 Germination**

Application of sprinkler irrigation has been found very effective in seed germination. Particularly when salts contained in irrigation water accumulate on the surface of the furrow irrigated beds, sprinkler irrigation is applied during seed germination to provide a low salinity seed bed (*Robinson, 1968*). This allows seedling roots to penetrate below the zone of salt accumulated on the surface of furrow irrigated beds. Sprinkling water enhances initial radical development.

**16.2 Environmental Control**

**i) Preventing frost damage**

Portable and fixed lateral sprinkler irrigation systems can be used to protect crops from frost. The equipment must be specially set up for frost control. There are two approaches to protecting against frost. One is to protect the leaves, flowers or fruit from freezing when temperatures fall. The other is to use evaporative cooling to delay early bud formation on fruit trees until after the last expected frost. The first is called frost protection and the later bloom delay.

Overhead systems are the most versatile and can protect some crops down to temperature as low 70C. The liquids in the plant parts being protected have higher freezing point than water due to salts and sugars in them. Buds, blossoms, leaves or young fruit for the crops of greatest interest for frost protection can survive wet bulb temperatures ranging from roughly -1 to -30C. The actual lethal temperature depends on the crops and stage development. The protective effect of overhead sprinkling is mainly from the release of 80 kcal/L of latent heat as water freezes. The freezing water encases the plant parts being protected in ice this keeps their temperature at 00C, the freezing point of water, which is higher than the lethal temperature. The plant parts being protected will remain at the freezing point of water as long as ice continues to form around them. The main design consideration for overhead frost protection by sprinkling is the recommended application rate for different environmental situations, crops and crop growth stages. The required rate can be easily converted to system capacity, because the area being protected by overhead sprinkling must be watered continuously.

In the fall, deciduous tree, vines and bushes lose their leaves and enter a condition known as winter rest. Plants are normally incapable of growth during this period and fruit buds do not develop until the rest period has been completed. After rest is completed, changes occur in the buds that will eventually cause blossoming and leafing of the trees. The rate of bud development depends upon the air temperature around the buds after the completion of rest. Bud development accelerates and the trees blossom early if the early spring temperatures are above normal. If early bud development is followed by a sudden cold spell, the potential for frost damage becomes serious. Overhead sprinkling can be used to cool the buds before they develop and keep them dormant until after the major danger of frost damage is past. The cooling is caused by evaporation. Therefore, overhead sprinkling for bud delay is not effective during periods of high humidity.

Evaporative cooling with sprinklers during early spring months, when frost danger is still prevalent, seems to be an effective way to delay bud development. Automated sprinkler system has been used to actuate and deactivate irrigation system to delay bud development.

**ii) Foliar spraying for micro climate control**

Research studies in California, Lousiana and Georgia on some of the crops cooled by sprinkler irrigation are almonds, apples, beans, cherries, carton, cucumbers, grapes, strawberries. At intermittent sprinkling rate of 2 mm h-1 with a 15 min on- 15 min off period gave good temperature reduction and improves crop quality. The color of the red delicious apples was found to be enhanced by reducing fruit temperature by over-head sprinkling.

Foliar cooling requires two to six short applications of water every hour, which is practical only with automated fixed sprinkler systems. The small amounts water intermittently applied cool the air and plant, raise humidity and to improve the produce quality and yield. When water is applied on the plant surfaces, the plant is cooled and the excessive transpiration demand reduced. Each crop has an upper demand above which it can no longer function efficiently. Fixed sprinkler systems used for foliar cooling require high quality water and up to double the capacity of ordinary high-frequency system. Foliar cooling systems must have sufficient capacity to satisfy the excess transpiration demand on a minute-by-minute basis through out the peak water use rate days. To accomplish this, the system capacity must be 1.5 to 2.5 times greater than for a conventional periodic move system in similar environment.

 **iii) Frost and freeze protection**

Frost control is another special use for irrigation by coating plants with water, the heat of fusion is released as the water freezes, maintaining plant temperatures that would otherwise drop well below freezing. The ice coating on the plant must be continually in contact with unfrozen water until the ice melts. Sprinkler has been successfully used for frost protection in small fruits, potatoes and grapes (Addink et al., 1980).

**16.3 Fertilizer and Chemical Applications**

Sprinkler systems are also used to apply fertilizer, herbicides, and pesticides. Both liquid forms that dissolve and dry powder in water suspension can be injected through sprinkler irrigation systems. The main consideration in the design of sprinkler systems for chemical application is the method of injection. The methods to inject chemicals and fertilizers are:

(a) delivering the liquid to the suction side of a centrifugal pump from a supply tank, (b) injecting the chemical into the main lines using a pressure pump, (c) pressurizing the chemical supply tank from the main sprinkler lines and injecting the liquid at the low pressure area of a pitot tube, and (d) pressurizing a supply tank with a pitot tube facing in the upstream direction of flow and then injecting the liquid into the system with a second pitot tube facing downstream.

The most important consideration in designing the injection system is preventing contamination of the water supply. It is also important to provide check and vacuum relief valves (anti-siphon devices) for preventing the chemical from draining or siphoning back into the irrigation well or other water supply. The vacuum and check valves must be located between the pump and the point of chemical injection. If water is bled from the main irrigation supply into the chemical supply tank, the connecting line too must be equipped with a check valve to prevent the supply tank from overflowing and contaminating the adjacent area with chemical solution. In some countries codes are developed for proper plumbing of chemical injection systems into irrigation systems.

The coefficient uniformity of (CU) should be between 80 to 90% for uniform application of the chemicals to the area that is being fertilized or treated with herbicides or pesticides. Non uniform systems would results in poor placement of the chemicals and therefore, poor control.

The sizing of the pump or rate of injection into the sprinkler system should be checked closely so that sufficient quantities of the chemicals can be injected to obtain the desired application rate of the chemical. The rate of injection depends also on whether a continuous injection is made or whether the entire volume of chemical is injected in the beginning or at the end of the irrigation set. Intermittent injection allows the system to be flushed and chemicals to be either flushed from or left on the crop canopy.

**16.4 Irrigation for Turf**

Turf grasses are used in urban areas to provide multiple benefits to society and the environment. They cover millions of acres of home lawns, commercial properties, roadsides, parks, etc. A turf grass can be watered with a moveable sprinkler or an underground irrigation system. In either case, they require spray overlap for even coverage. Typical lawn sprinklers are inexpensive and must be moved throughout the lawn. A pop-up spray head system allows for greater flexibility in timing cycles and proper application rates. Pop-up lawn spray heads are those which raise

The nozzle above the surrounding grass during operation then drop down to the level of the ground when not in use. The pop-up feature minimizes the need for trimming the grass around the heads and at the same time improves water distribution since the head is high above the grass when in operation. Pop-up spray heads are usually spring-operated and require a certain pressure level to operate the pop-up mechanism. Operation of the pop-up mechanism may be a problem where the water contains large amounts of sulfur, iron or alkalines. Average precipitation of spray nozzles is relatively high, approximately 25 mm h-1. These nozzles are used for rapid watering of lawns. However, use on steep slopes and heavy (clayey) soils may result in runoff. Therefore all irrigated areas of the system should be examined for proper selection and location of nozzles to avoid runoff.

**16.5 Effluent Irrigation**

Land application of waste waters by sprinkler irrigation can be a cost-effective alternative to conventional waste water treatment. Waste waters are divided into municipal, industrial and agricultural categories. Municipal sewage requires extensive treatment before it can be safely discharged into the natural drainage system. Industrial waste waters may also require extensive treatment. It can range from simple screening to primary and secondary treatment for removing oils, greases, metals, harmful chemicals and pH adjustment and chlorination. The design of a system for land application of waste water is similar to the design of an ordinary sprinkle irrigation system. The rules of good design must be followed, keeping in mind that the effluent is not plain water, but a mixture of water and both dissolved and suspended wastes. Furthermore, waste waters that contain abrasive or corrosive materials will shorten the life of the system. Deep sandy or loamy soils are most suitable for land application of waste water. The soils must be well-drained; therefore, some sites may require subsurface drainage. For best results the application rate should be less than 75% of the infiltration rate of the soil. Either portable aluminum or buried plastic or corrosion resistant pipe may be used for main and lateral lines of periodic-move or fixed sprinkler systems. Single nozzle sprinklers should be used to reduce nozzle clogging.

**16.6 Erosion control**

Keeping the soil surface continually moist by using sprinkler can control soil erosion by wind. In areas with high winds and sandy soils, it may be necessary to irrigate daily or even more frequently to keep the surface wet for satisfactory erosion control. Solids set systems are found most suitable for wind erosion control. It has been estimated that sprinkling rate of 2.5 mm h-1is adequate for erosion control.