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Sprinkler Irrigation

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SUMMARY

In sprinkler irrigation, water is sprayed into the air and allowed to fall on the ground surface somewhat resembling rainfall. The spray is developed by the flow of water under pressure through small orifices or nozzles. The pressure is usually obtained by pumping. With careful selection of nozzle sizes, operating pressure and sprinkler spacing the amount of irrigation water required to refill the crop root zone can be applied nearly uniform at the rate to suit the infiltration rate of soil.

INTRODUCTION

Sprinkler irrigation is a method of applying irrigation water which is similar to natural rainfall. Water is conveyed under desired pressure (2 to 5 kg/cm^2) developed by a pump through a network of pipes, called mainlines and sub mains to one or more laterals and is sprayed in to the air through sprinkler nozzles or perforations so that it breaks up in to small water drops (0.5 to 4mm in size) which fall over the land or crop surface in an uniform pattern at a rate (0.06-5000 LPH) less than the infiltrability of soil. The pump supply system, sprinklers and operating conditions must be designed to enable a uniform application of water. Sprinkler irrigation systems may be classified as portable, semi portable, semi-permanent or permanent. They are also classified as set-move (hand-move, tow-move, side-roll and gun-type systems), solid-set or continuous move sprinkler (centre-pivot, traveler and linear-move) systems.

Advantages

- Elimination of field channels and their maintenance, which increase the production area.
- Harmful ditch weeds, which have allelopethic effects, do not appear with sprinkler irrigation.
- No water losses in conveyance, which amounts to 35% in surface irrigation methods.
- Close control over water application i.e., no runoff losses because water is applied below or equal to infiltration rate.
- Convenient for giving light and frequent irrigations.
- Higher application efficiency over surface methods of irrigation.
- Sprinklers give a gentle rain that does not clog or compact the soil ensuring better and quicker germination of seeds resulting in more plants per unit area.
- Suitable in undulated lands, soils with shallow depth and areas located at higher elevation than the water source.
- Feasibility of frequent, short water applications for germination, cooling & frost protection to plants, etc.
- Higher yield and water saving over surface irrigation methods.

Limitations

- Uneven distribution of water due to high wind velocities particularly during summer season.
- Higher evaporation losses when operating under high temperatures.
- Mechanical difficulties such as sprinklers fail to rotate, nozzles may clog, couplers may leak or engine may require repair.
- Initial investment and recurrent operating costs are much higher than in surface irrigation methods.
- Moving the portable lines, when the soil is wet results in the destruction of soil structure.
- Use of saline water for irrigation is not possible since it will be harmful to crops.
- Higher water pressure required hence extra energy cost.

General classification of different types of sprinkler systems

Sprinkler systems are classified into the following two major types on the basis of the arrangement for spraying irrigation water.

1) Rotating head: Small size nozzles are placed on riser pipes fixed at uniform intervals along the length of the lateral pipe and the lateral pipes are usually laid on the ground surface. They may also be mounted on posts above the crop height and rotated through 90 0, to irrigate a rectangular strip. In rotating type sprinklers, the most common device to rotate the sprinkler heads is with a small hammer activated by the thrust of water striking against a vane connected to it.

2) Perforated pipe system: This method consists of drilled holes or nozzles along their length through which water is sprayed under pressure. This system is usually designed for relatively low pressure (1 kg/cm2). The application rate ranges from 1.25 to 5 cm per hour for various pressure and spacing.

Based on the portability, sprinkler systems are classified into the following types:

1. **Portable system**: A portable system has portable main lines, laterals and pumping plant.
2. **Semi portable system**: A semi portable system is similar to a portable system except that the location of water source and pumping plant is fixed.
3. **Semi permanent system**: A semi permanent system has portable lateral lines, permanent main lines and sub mains and a stationery water source and pumping plant.
4. **Solid set system**: A solid set system has enough laterals to eliminate their movement. The laterals are positions in the field early in the crop season and remain for the season.
5. **Permanent system**: A fully permanent system consists of permanently laid mains, sub mains and laterals and a stationery water source and pumping plant.

Components of sprinkler irrigation:

A sprinkler system usually consists of the following components.

1. Pumping Unit: Sprinkler irrigation systems distribute water by spraying it over the fields. The water is pumped under pressure to the fields. The pressure forces the water through sprinklers or through perforations or nozzles in pipelines and then forms a spray. A high speed centrifugal or turbine pump can be used for operating sprinkler irrigation for individual fields. Centrifugal pump is used when the distance from the pump inlet to the water surface is less than eight meters. For pumping water from deep wells or more than eight meters, a turbine pump is suggested. The driving unit may be either an electric motor or an internal combustion engine.

2. Tubings: Mains/submains and laterals: The tubings consist of mainline, submanins and laterals. Main line conveys water from the source and distributes it to the submains. The submains convey water to the laterals which in turn supply water to the sprinklers. Aluminium or PVC pipes are generally used for portable systems, while steel pipes are usually used for center-pivot laterals. Asbestos, cement, PVC and wrapped steel are usually used for buried laterals and main lines.

3. Couplers: Couplers are used for connecting two pipes and uncoupling quickly and easily. Essentially a coupler should provide

(a) A reuse and flexible connection
(b) Not leak at the joint
(c) Be simple and easy to couple and uncouple
(d) Be light, non-corrosive, durable.

4. Sprinkler Head: Sprinkler head distribute water uniformly over the field without runoff or excessive loss due to deep percolation. Different types of sprinklers are available. They are either rotating or fixed type. The rotating type can be adapted for a wide range of application rates and spacing. They are effective with pressure of about 10 to 70 m head at the sprinkler. Pressures ranging from 16 to 40 m head are considered the most practical for most farmers. Fixed head sprinklers are commonly used to irrigate small lawns and gardens. Perforated lateral lines are sometimes used as sprinklers. They require less pressure than rotating sprinklers. They release more water per unit area than rotating sprinklers. Hence fixed head sprinklers are adaptable for soils with high intake rate.

5. Fittings and accessories: The following are some of the important fittings and accessories used in sprinkler system.
(a)Water meters: It is used to measure the volume of water delivered. This is necessary to operate the system to give the required quantity of water.
(b)Flange, couplings and nipple used for proper connection to the pump, suction and delivery.
(c)Pressure gauge: It is necessary to know whether the sprinkler system is working with desired pressure to ensure application uniformity.
(d)Bend, tees, reducers, elbows, hydrants, butterfly valve and plugs.
(e)Fertilizer applicator: Soluble chemical fertilizers can be injected into the sprinkler system and applied to the crop. The equipment for fertiliser application is relatively cheap and simple and can be fabricated locally. The fertilizer applicator consists of a sealed fertilizer tank with necessary tubings and connections. A venturi injector can be arranged in the main line, which creates the differential pressure suction and allows the fertilizer solution to flow in the main water line

General Rules for Sprinkler System Design

- Main should be laid up and down hill.
- Lateral should be laid across the slope or nearly on the contour.
- For multiple lateral operations, lateral pipe sizes should not be more than two diameters.
- Water supply source should be nearest to the center of the area.
- Layout should facilitate and minimize lateral movement during the season.
- Booster pump should be considered where small portion of field would require high pressure at the pump.
- Layout should be modified to apply different rates and amounts of water where soils are greatly different in the design area.

Selecting the most Appropriate Sprinkler Systems

While selecting a sprinkler system, the most important physical parameters to be considered are:
The crop or crops to be cultivated. The shape and size (acres) of the field. The topography of the field and the amount of time and labour required to operate the system etc.

Suitable Crops

Sprinkler irrigation is suited for most field crops viz., wheat, lucerne, groundnut, Bengal gram, green gram, black gram, potato, leafy vegetables, sunflower, barley, Bajara, maize, wheat etc. wherein water can be sprayed over the crop canopy. However, large sprinklers are not recommended for irrigation of delicate crops such as lettuce because the large water drops produced by the sprinklers may damage the crop. Water containing specific ions such as sodium and chlorides in concentration of more than 3 meq/litre are not suitable for irrigation by overhead sprinklers.

CONCLUSION

From above information it is concluded that, in sprinkler irrigation system savings of water (30-35%) over flow irrigation, effective use of fertilizers and less labour. Water is conveyed under desired pressure (2 to 5 kg/cm2) in this system.

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