**Lecture 32 Furrow Irrigation System**

As discussed in the previous lecture on surface irrigation methods, furrow irrigation is a class of surface irrigation methods in which water is field is divided into ridge and furrows. The crop is grown on the ridge whereas irrigation water is applied to the furrow.

**32.1 General Adoptability**

The adaptability of furrow irrigation to a specific site depends on climate, soils, topography, crops to be grown, and water supply.

**32.1.1 Climatic Factors**

-         Precipitation and wind may affect suitability as well as the design criteria.

-         Risk of surface runoff and excessive soil erosion due to excessive precipitation, concentrated runoff in the channels resulting in crop damage from flooding; these conditions must be considered in determining which furrow method is suitable for a given area.

**32.1.2Soil**

-         Medium to moderately fine-textured soils of relatively high availablewaterholding capacity are desirable

-         Intakecharacteristics should facilitate both lateral and vertical water penetration (Fig. 32.1)

-         Furrow irrigation generally is not recommendedon soils containing high concentrations of salts.



Fig. 31.1. Lateral and vertical water movement during furrow irrigation. (Source: <http://www.fao.org/docrep/w3094e/w3094e03.htm>)

**32.1.3Topography**

-      The rows can be laid out on a continuous grade.

-      The topography must be such that levelling does not expose unproductive soil or that the cost oflevelling is not excessive.

-      The topography must not be so steep that it exceeds the allowable corrugation grade or prohibits installation of graded contour furrows that meet the design grade and cross-slope criteria.

**32.1.4Crops**

-         Adapted for nearly allirrigated crops except those grown in ponded water, such as rice.

-         Suitable for irrigating crops subject toinjury if water covers the crown or stems of the plants.

**32.1.5Water Supply**

The quantity and quality of the water supplydetermines its suitability for use in furrow irrigation.

**32.2 Furrow Irrigation Design Consideration**

Efficient irrigation by furrow method is obtained by selecting proper combination of spacing, length, slope of furrows, suitable size of the irrigation stream and duration of water application.

**32.2.1 Furrow Spacing**

Furrows should be spaced close enough to ensure that water spreads to the sides into the ridge and the root zone of the crop, to replenish the soil moisture uniformly.

Table 32.1.Recommended furrow spacing for different soil types, and depths of irrigation for complete wetting

|  |  |  |
| --- | --- | --- |
| Soil type | Depths of irrigation (m) | Furrow spacing (cm) |
| Sandy soil | 1 to 1.5 | 50 to 60 |
| Clay soil | 1 to 1.5 | 100 or more |

**32.2.2Furrow Length**

The optimum length of a furrow is usually the longest furrow that can be safely and efficiently irrigated. Proper furrow length depends largely on the hydraulic conductivity of soil. The length of furrow may be limited by the size and shape of the field.

Table32.2. Recommended furrow length for different soil types, furrow slopes and depths of irrigation

|  |  |
| --- | --- |
| Furrow slope(%) | Furrows length (m) |
| Slope type |
| Clay                                      loam                                sands |
| Net depth of water application |
| 7.5 cm | 15cm | 5 cm | 10 cm | 5 cm | 7.5 cm | 10 cm |
| 0.05 | 300 | 400 | 120 | 270 | 60 | 90 | 150 |
| 0.10 | 350 | 440 | 180 | 330 | 90 | 120 | 190 |
| 0.20 | 370 | 470 | 220 | 370 | 120 | 190 | 250 |
| 0.30 | 390 | 500 | 280 | 400 | 150 | 225 | 280 |
| 0.50 | 380 | 500 | 280 | 370 | 120 | 190 | 250 |
| 1.0 | 270 | 400 | 250 | 300 | 90 | 150 | 220 |

**32.2.3Furrow Slope**

Furrow slope controls the speed at which water flows down the furrow. A minimum slope of 0.05% is needed to ensure surface drainage. In general, the ranges in slope recommended for borders apply to furrows also.

**32.2.4 Furrow Stream**

The size of furrow stream usually varies from 0.5 to 2.5 litres per second.

The maximum size of irrigation stream that can be used at the start of the irrigation is limited by considerations of erosion in furrows, overtopping of furrows and prevention of runoff at the downstream end. The maximum non-erosive flow rate in furrows is estimated by the following empirical formula:

                                                                                           (32.1)

Where,

                     qm = maximum non-erosive stream, Lsec-1

*s*= slope of furrow expressed in percent

The average depth of water applied during irrigation can be calculated from the following relationship:

                                                                                       (32.2)

Where,

*d* = average depth of water applied,cm

*q*= stream size, Ls-1

*t*= duration of irrigation, h

*w* = furrow spacing, m

                      L= furrow length, m

**Problem 32.1:**

A non-erosive stream is applied for a period of 15 minutes in a furrow of 80 m long spaced 65 cm apart and having a slope of 0.15 %. Determine the average depth of water applied?

Answer:

In case of furrow irrigation non-erosive stream,

 

Where,

qm= maximum non-erosive stream, litres per second

*s*= slope of furrow expressed as a percent

So,

 

In a furrow 4lt/s water is applied.

Average depth of water applied, 

Where,

*d* = average depth of water applied, cm

*q*= stream size, Ls-1

*t*= duration of irrigation, h

*w* = furrow spacing, m

                       L= furrow length, m

                      Now, 