MODULE - II WATER MANAGEMENT IN IRRIGATED AGRICULTURE

1. SCHEDULING IRRIGATION TO CROP

INTRODUCTION

If you pick up any newspaper today you will find mention of increase in population and Government is planning to increase food production through creation of irrigated facilities. In India irrigation potential created so far and to be created in future can irrigate hardly 50 per cent of the cultivated land in 2000 AD. You will also hear the news that the irrigation water created is not being utilised properly leading to more wastage than its use by crop. Therefore, it is necessary to utilise the irrigation water properly for crop production. For proper management of irrigation water in field one must know the time when the crop needs irrigation.

In this lesson, we are going to study the proper time of application of irrigation water to different field crops.

KEY CONCEPT

Proper time of scheduling irrigation on the basis of soil moisture status and critical stages of crop growth.

OBJECTIVES

After studying this lesson, you will be able to :

- *know about time of scheduling irrigation to crops*
- *understand the critical stages of crop growth requiring irrigation*
- *recognise the optimum ratio of cumulative pan evaporation and depth of irrigation for scheduling irrigation to crops.*
- *know the irrigation scheduling for transplanted rice.*

1.1 SCHEDULING

Before irrigation farmer visits his field and takes some soils from the rootzone of the crop and examines its moisture content or he may see the appearance of the crop of sometimes he may stick to certain time interval for irrigation. This indicates that soil or plant may be taken as the criteria for irriagtion. However, irrigation needs of crops depend upon evaporative demand of the atmosphere, soil-water regime in the root zone and plant foliage.

Therefore, attempts have been made to use soil, plant and atmospheric parameters as criteria for scheduling irrigation to crops.

(i) SOIL AS A CRITERION

Soil is the reservoir of water, which supplies water to plant. Evapotranspiration loss from soil decreases its moisture content. Decrease of soil moisture upto a certain level does not reduce the crop yield, beyond which the reduction in soil moisture decreases crop yield. This is generally considered as the lower limit of available moisture, when irrigation should be applied to replenish the soil moisture upto field capacity, which is the upper limit of available moisture. This lower limit of soil moisture depends on the crop grown.

Soil moisture levels are based either on available soil water depletion at certain depth or soil moisture tension of the same depth. The magnitude of available soil water depletion at which irrigation is to be scheduled may be 25, 50,75 per cent etc. depending on crops (Table 1), while in case of soil moisture tension, the values may be 0.3, 0.5, 0.7 bar . (Table 2). Soil moisture tension is the force with which water is held in soil and it can be measured by an instrument called Tensiometer.

Table 1
Soil water depletion in the zone of maximum root activity at which water should be applied

Crop	Available soil water depletion %	Crop	Available soil water depletion %
Wheat	50	Maize	50
Potato	25	Tobacco	25
Sugarcane	65	Sorghum	75
Soybean	60	Cotton	50
Sugerbeet	50	Peas	65

Table 2
Optimum soil moisture tension for irrigation to different crops

Crop	Soil moisture tension (bar)	Crop	Soil moisture tension (bar)
Rice (upland)	0.15	Maize	0.65
Wheat	0.50	Lentil	0.50
Potato	0.30	Sugarcane	0.70
Groundnut	0.60	Onion	0.65
Peas	0.45	Tomato	0.80
Soybean	0.50	Cauliflower	0.65
Beet root	0.50	Lady's finger	0.50
Berseem (fodder)	0.25	Radish	0.25
		Turnip	0.25

(ii) PLANT AS A CRITERION

Plant growth is directly dependent on water balance in its body. Water deficit affects all physiological processes and reduces growth and yield of crop plant. It is not easy to know when and to what extent water deficit has developed in the plant. Measurement of plant water status provides a fundamental approach for the problem but none of the teachnique developed so far is applicable to field conditions directly, Critical growth stage concept is found to be more practical than other methods. Certain physiological stage of crop plant are sensitive to water stress compared to other stages. Soil moisture stress at these sensitive stages reduces growth and yield of crop. These sensitive stages are known as critical stages for irrigation. Therefore, adequate moisture should be supplied to the soil during these critical stages. Critical growth stages for irrigation to different crops are given in table 3. These stages need irrigation if there is moisture deficit in the root zone depth of soil. However, the real number of irrigations will depend upon agro-climatic conditions of the region, rainfall during the crop growth season and soil types.

Table 3
Critical growth stages for water supplys to crops

Crop	Critical growth stages
Wheat	Crown root initiation, tillering, flowering and grain development
Rice (upland)	Boot, flowering and milk
Rice (wet)	Tillering, panicle initiation, flowering and milk
Maize	Tasselling and cob development
Sorghum	Flowering and grain filling
Pearl millet	Flowering and grain filling
Gram	Pre-flowering and pod development
Greengram	Flowering and pod development
Lentil	Pre-flowering and pod development
Blackgram	Flowering and pod development
Pea	Pre-flowering and pod development
Horse gram	Flowering and pod development
Groundnut	Flowering and pod development
Linseed	Flowering and pod development
Safflower	Rosette formation and flowering
Soybean	Flowering and seed filling
Sugarcane	Sprouting and tillering
Potato	Tuberisation and tuber elongation
Tomato	Flowering and fruit development
Cauliflower	Early seedling and curd development
Onion	Bulbing
Tobacco	Suckering and leaf maturity

iii) METEOROLOGICAL INDICATORS

When water supply is adequate, E_T loss from a cropped field is primarily controlled by the evaporative demand of the atmosphere. Meteorological approach on the basis of the depth of irrigation water (IW) to cumulative pan evaporation (CPE) ratio has been tested on different crops to find out the optimum IW/CPE ratio for scheduling irrigation to crops. The optimum IW/CPE ratio for irrigating different crops is given in table 4.

Table 4
Optimum IW/CPE ratio for irrigation to crops

Crop	Optimum IW/ CPE ratio	Crop	Optimum IW/CPE ratio
Wheat	0.90-1.05	Maize	
Gram	0.75 - 0.80	Kharif	0.75-0.90
Lentil	0.50	Rabi	0.80-1.05
		Fodder	0.90
Groundnut		Sorghum	
Kharif	0.40-0.60	Kharif	0.40-0.60
Rabi	0.60 - 1.20	Rabi	0.60-0.90
Summer	0.90-1.25	Fodder	0.90
Rapeseed			
and mustard	0.30 - 0.80	Bajra	
Barley	0.80 - 1.05	Kharif	0.60
Potato	2.00	Rabi	0.80
Barseem	0.90	Cotton	0.60 - 0.90
		Sugarcane	0.60-1.00

1.2 SCHEDULING IRRIGATION TO TRANSPLANTED RICE

Rice is mainly grown during **Kharif** in most parts and also during **Rabi** (winter) in southern and eastern states. In some areas it is planted during the pre-monsoon (summer) period. Transplanted rice requires standing water. Shallow submergence of 5-7 cm gives higher yield of rice. After soaking of standing water into soil the irrigation is to be applied to allow 5-7 cm standing water. However, during kharif, the irrigation may be delayed by 1 to 4 days after soaking of standing water into soil, depending upon the agro-climatic condition of the region.

1.1 INTEXT QUESTIONS

1. (a) Define soil moisture tension

   (b) Give the optimum soil moisture tension for irrigation to maize, sugarcane and cauliflower.

2. Write the available soil water depletion percentage for potato, wheat and tobacco.
3. (a) What do you mean by the critical stages of growth for irrigation?
   (b) Indicate the critical stages of wheat, rice (upland) and safflower.
4. (a) What is IW/CPE ratio?
   (b) Write the optimum IW/CPE ratio for irrigation to summer groundnut, rabi sorghum and cotton.

WHAT YOU HAVE LEARNT

- Soil is the reservoir of water which supplies water to plant.
- The degree of soil moisture depletion and optimum soil moisture tension suitable for scheduling irrigation to different crops.
- Certain physiological stages of crop growth are sensitive to soil moisture deficit and lack of adequate soil moisture at these stages reduces the growth and yield of crop.
- Climatic parameters controll evapotranspiration loss from crop field.
- Optimum IW/CPE ratio necessary for irrigating different crops
- Scheduling irrigation to transplanted rice.

TERMINAL QUESTIONS

1. Discuss the methods of scheduling irrigation based on soil.
2. Describe the method of scheduling irrigation to crops on the basis of critical stages of plant growth.
3. Write short notes on
   (a) Scheduling irrigation to transplanted rice.
   b) Optimum IW/CPE ratio for irrigation to potato, Barseem, lentil, gram, rapeseed mustard and sugarcane.

1.1 ANSWERS TO INTEXT QUESTIONS

1. a. Soil moisture tension is the force with which water is held in soil.
   b. Maize - 0.65
   Sugarcane - 0.70
   Cauliflower - 0.65

2. Potato - 25%

   Wheat - 50%

   Tobacco - 25%

3. (a) The stages of crop growth at which soil moisture stress reduces growth & yield of crop are known as critical stages of growth for irrigation.

   (b)

Wheat	-	Crown root initiation
		Tillering
		Flowering
		Grain development
Rice (upland)	-	Boot
		Flowering
		Milk
Safflower	-	Rosette formation
		Flowering