EXPERIMENT 7 IRRIGATION SCHEDULING

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7.0 OBJECTIVE

After completing this practical exercise, you should be able to:
• schedule irrigation for the given crops.

7.1 INTRODUCTION

Irrigation scheduling leads to determination of the exact amount of water to be applied to the field and the exact timing for application. It helps in maximizing irrigation efficiency by applying the exact amount of water needed to replenish the soil moisture to the desired level. Irrigation schedules are either planned to either fully or partially provide the estimated requirement of the crop.

Irrigation criteria are the indicators used to determine the need for irrigation. The most common irrigation criteria are soil moisture content and soil moisture tension. The final decision depends on the irrigation criterion, strategy and goal. Irrigators need to define a goal and establish an irrigation criterion and strategy.

Amount of water required \( I \) can be computed by knowing soil moisture content at field capacity \( (f_c) \) and prior to irrigation \( (f_m) \), root zone depth \( (D_r) \) and irrigation efficiency \( (E) \).

\[
I = \frac{D_r (f_c - f_m)}{E} \quad (7.1)
\]

Depending on the water availability, either full or deficit irrigation can be resorted to. Full irrigation (moisture content at field capacity) aims at achieving maximum production but covers less area if the water is limiting. Deficit irrigation may not replenish soil moisture to field capacity resulting in some reduction in yield. However, it may cover more area with the limited water.

Irrigations for a crop can be scheduled based on maximum available deficiency \( (MAD) \) of readily available soil moisture which can be expressed as the ratio of readily available water \( (RAW) \) and available water \( (AW) \).

\[
MAD = \frac{RAW}{AW} \quad (7.2)
\]

Where,
\[
MAD = 0.50–0.65 \text{ for grain, fruit and vegetable crops.}
\]
RAW refers to difference in FC and critical moisture content beyond which ET sharply decreases impacting productivity of crops whereas AW is the difference of FC and wilting point. In order to ensure favourable growth and optimum productivity of crops, irrigation should be scheduled on the basis of above MAD criteria. It means that irrigation should be applied when 50-60% of AW is depleted. The depth of irrigation should be sufficient to replenish the soil moisture and is computed by equation 7.1 by using the difference between moisture at field capacity and moisture content prior to irrigation or critical moisture content and effective root zone depth. The root zone depth of a crop depends on the type of soil, physiological characteristics and growth stage of crop. Maximum root zone depth for different crops is given below.

<table>
<thead>
<tr>
<th>Crops</th>
<th>Root Zone Depth, cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetable crops such as onion, potatoes, radish</td>
<td>60</td>
</tr>
<tr>
<td>Wheat, beans, sorghum</td>
<td>90</td>
</tr>
<tr>
<td>Fruit crops such as apples, pears, plums and oil seed crops-safflower and sunflower</td>
<td>120</td>
</tr>
</tbody>
</table>

### 7.2 EXPERIMENT

#### 7.2.1 Requirements
- Auger for soil sampling;
- Weighing balance; and
- Oven.

#### 7.2.2 Procedure
- determine soil moisture content on dry weight basis (dwt) at field capacity and permanent wilting point following the procedure outlined in Exercise 7.1;
- compute soil moisture content on volume basis by multiplying soil moisture content with bulk density of given soil;
- compute AW as follows;
\[
AW = \frac{(FC(\%vol) - PWP(\%vol)) \times Max \ rootzone \ depth \ (cm)}{100}
\]  
(7.3)
- compute RAW using equation 7.2; and
- compute critical moisture content (CMC) by subtracting RAW from FC
\[
CMC = FC - RAW
\]

### 7.3 OBSERVATIONS AND CALCULATIONS

#### Example 7.1

**Wheat crop**

1) Soil moisture content at FC, % by weight = 20
2) Soil moisture content at PWP, % by weight = 7
3) BD, gm/cm² = 1.5
Calculation

1) Soil moisture content at FC, % by weight = 20
2) Soil moisture content at PWP, % by weight = 7
3) AW, % by weight = (20–7)
   = 13
4) BD, gm/cm³ = 1.5
5) AW, % by volume = 13 × 1.5
   = 19.5
6) Max root zone depth, cm = 90
7) AW, cm (Eq. 7.3), cm = 17.6
8) MAD = 0.5
9) RAW (Eq. 7.2), cm = 17.6 × 0.5
   = 8.8
10) FC, cm = (20 × 1.5) × 0.9/100
    = 27
11) CMC, cm = (27–8.8)
    = 18.2
   CMC, % by volume = 20.2%
12) Irrigation efficiency, % = 70
13) Depth of irrigation, cm = 8.8/0.7
    = 12.6

Thus irrigation should be applied when 50% of AW has been depleted reducing CMC to 18.2 cm or 20.2% by volume. Depending on climate and crop, as soon as moisture content declines to the above value, depth of irrigation equal to RAW (8.8 cm) should be scheduled. Assuming irrigation efficiency as 70%, the depth of irrigation will be 12.6 cm. For different crops, the CMC has been transformed into number of days at which irrigation should be scheduled after sowing.

Exercise 7.1

Bean crop

1) Soil moisture content at FC, % by weight =
2) Soil moisture content at PWP, % by weight =
3) AW, % by weight =
4) BD, gm/cm³ =
5) AW, % by volume =
6) Max root zone depth, cm = 
7) AW, cm (Eq. 7.3), cm = 
8) MAD = 
9) RAW (Eq. 7.2), cm = 

10) FC, cm 

11) CMC, cm 

CMC, % by volume = 
12) Irrigation efficiency, % = 
13) Depth of irrigation, cm = 

7.4 RESULTS 

1) AW, % by weight = 
2) AW, % by volume = 
3) AW, cm (Eq. 7.3), cm = 
4) RAW (Eq. 7.2), cm = 
5) FC, cm = 
6) CMC, cm = 
7) CMC, % by volume = 
8) Irrigation efficiency, % = 
9) Depth of irrigation, cm =