

Water use Efficiency

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Introduction

The water utilisation by the crop is generally described in terms of water use efficiency. An efficient irrigation system implies effective transfer of water from the source to the field with minimum possible loss. The objective of the efficiency concept is to identify the nature of water loss and to decide the type of improvements in the system. Evaluation of performance in terms of efficiency is prerequisite for proper use of irrigation water.

Water use Efficiency: -

Water use efficiency is the yield of marketable crop produced per unit water used in evapo-transpiration (ET). It is expressed in kg/ha-mm.

Water use efficiency is of two types:

1. Crop water use efficiency and
2. Field water use efficiency

a) Crop water use efficiency: -

It is the ratio of yield of crop (Y) to the amount of water depleted by crop in the process of evapo-transpiration (ET).

It is expressed in kg/ha/mm or kg/ha/cm.

Formula

$$CWUE = \frac{Y}{ET}$$

Where, CWUE = Crop water use efficiency

Y = Crop yield

ET = Evapo-transpiration

b) Field water use efficiency: -

It is the ratio of yield of crop (Y) to the total amount of water used in the field (WR).

Formula

$$FWUE = \frac{Y}{WR}$$

Where, FWUE = Field water use efficiency

WR = Water requirement

Factors influencing water use efficiency: -

- A) Climatic factors: -**
1. Temperature
 2. Precipitation
 3. Sunlight
 4. Wind velocity
 5. Relative humidity
- B) Genetic factors: -**
1. Crop species
 2. Crop varieties
- C) Agronomic factors: -**
1. Time of sowing
 2. Depth of sowing
 3. Plant population
 4. Direction of sowing
 5. Fertilizer
 6. Irrigation method
 7. Pests and diseases
 8. Evapotranspiration control measures

Water use efficiency is influenced by crop and soil management practices. These are as follows: -

A) Climatic condition: -

- Low relative humidity increases evapotranspiration without a corresponding increase in crop yield.
- Sunlight and temperature that normally affect both evapotranspiration of the crop and the rate of a photosynthesis will either increase or decrease water use efficiency.

B) Crop species: -

- One of the primary ways of increasing crop yield and water use efficiency in a particular environment is to select a plant species adopted to the total amount and distribution of water.

- Plant species vary greatly in water requirement.
- Maize, Sorghum, Bajra, Ragi and Sugarcane, have high water use efficiency.
- Wheat, Barley, Oat have medium water use efficiency.
- Mung, Tur, Soybean and Pea have poor water use efficiency.

Measures or ways to improve water use efficiency: -

A. Climatic factor: -

- Plant transpiration and soil evaporation are dependent upon the temperature, wind velocity, relative humidity, sunshine hours and rainfall of a particular area.
- Evapotranspiration is directly correlated with temperature and wind velocity thereby reducing water use efficiency.
- Similarly, evaporation is inversely proportional to humidity of climate which results in reduced consumption of water thereby increasing water use efficiency.
- Increased availability of light to plants increases photosynthesis resulting in greater production which consequently increases water use efficiency of crops.

B. Nature of crops: -

- Crops with higher canopies have greater growth and consequently higher photosynthesis which results in greater yield and concomitant higher water use efficiency.
- Plants with shallow and less developed roots are able to absorb less water and fertilizers resulting in their lesser growth and production.
- Consequently, their water use efficiency is reduced.

C. Cultural practices: -

Cultural practices which directly affect water use efficiency are as under: -

- ✚ **Sowing time:** - The crops sown at proper time have greater production and hence higher water use efficiency. The crops sown later have lesser growth and development produce low yield and hence lesser water use efficiency.
- ✚ **Methods of sowing:** - Compared to broadcasting method of sowing of crops, line sowing of crops has greater utilization and absorption of nutrients, water and light resulting in higher production which results in higher water use efficiency. Grain yield of wheat, oat and pearl millet were also increased when crops were sown in the North- South direction.

- ✚ **Depth of sowing:** - Crops whose seeds are sown at optimum depth have greater growth since germination and hence higher production resulting in greater water use efficiency.
- ✚ **Use of antitranspirants :-** Antitranspirants are those materials whose spray upon plants reduced transpiration. Kaolin, phenyl mercuric acetate and abscisic acid are a few well known antitranspirants. The spraying of antitranspirants upon plants results in their reduced transpiration which lessens their consumptive use thereby increasing water use efficiency.
- ✚ **Use of growth retardants:** - Experiments have proved that there exist certain chemical substances like cycocel (CCC), phosphon, etc., whose spraying upon plants gives good production despite lack of water. Hence, it generates high water use efficiency.
- ✚ **Use of mulches:** - Mulches refer to the artificial or natural materials covered on the surface of soil with the object to reduce evaporation and destruction of weeds resulting in greater use of light, fertilizers, air and water by crops which results in higher production consequently higher water use efficiency.
- ✚ **Methods of irrigation:** - Compared to flooding method of irrigation, sprinkling and drip methods of irrigation results in lesser loss of water through evaporation and infiltration etc. which results in greater production using less water thereby increasing their water use efficiency.
- ✚ **Fertilizer application:** - The optimum application of fertilizers at proper time increases the growth and development of crops thereby increasing their water use efficiency.
- ✚ **Weed control:** - Weeds always compete with crops for the use of water, nutrients, air and light. Hence, destruction of weeds through proper methods is essential for the proper growth of crops and their consequent higher water use efficiency.
- ✚ **Insect-pest and disease control:** - The insect-pest and disease management at proper time is imperative for production of a good crop. If crops are not saved from insect-pest and other diseases, their growth and development is lessened resulting in reduced water use efficiency.

- ✚ **Use of shelter belts:** - There is greater irrigation water loss in areas having hot and high wind velocity through evaporation. In such area, use of shelter belts helps to reduce evaporation loss of water and ultimately increases water use efficiency.

Besides all above factors, certain factors like crop rotation, soil testing, seed treatment, soil and water management practices, addition of organic matter in the soil and type of soil etc., which also affects the water use efficiency of crops.

