

Course – Water Management in Horticultural crops, 2(1+1)
B.Sc. (Horticulture) Ist Year IInd Semester
College of Horticulture, Chhindwara
Course Teacher- Dr. Shikha Sharma

Topic- Critical stages of crop growth – for irrigation

- **Water molecules are integral part of living systems being the solvent for metabolites and structural component of proteins and nucleic acids.**
- **Transpiration lowers water potential at evaporative sites within leaves, and this effect is immediately translated to root system through creating tension in plants vascular system.**
- **This demand of water must be satisfied continuously to maintain leaf water potential.**
- **The internal water balance of plants depends on relative rates of water absorption and water loss.**
- **Despite stomatal resistance, the steep gradient in vapour pressure from leaf to air favours transpiration rate well in excess of CO₂ fixation.**
- **Transpiration rate normally ranges from 500 to 2500 mg H₂O/dm²-h, whereas CO₂ fixation rates range generally 5 to 25 mg CO₂/dm²-h.**
- **This physiological phenomenon amply justifies high water requirement to maintain high dry matter productivity.**
- **For this reason, actively growing plants as the case of all the vegetable crops need to maintain liquid phase continuity from soil water through its vascular system and all the way to evaporative sites in leaves.**
- **Vegetables contain large amount of water and the product qualities like tenderness, succulence, crispness and flavor are very much related to water supply at proper stages.**
- **In fact, texture of vegetables is determined by combination of tissue structure, cell wall properties and turgor pressure.**
- **The phenology of the growing plant can be characterized by vegetative, flowering, fruiting and other distinctive characteristics in vegetative stage like, curding in cauliflower, heading in cabbage and lettuce, bulbing in onion and garlic and tuberization in potato and sweet potato.**
- **During vegetative stage, consumptive use continues to increase till the end of this stage of growth and flowering occurs near and during the peak of consumptive use.**
- **The fruiting stage is accompanied by a decrease in consumptive use until the transpiration ceases during the later part of development of seeds inside the fruit.**
- **Stomata are the compulsory passage way for CO₂ and H₂O gas exchange between plant and atmosphere.**

- Therefore, to fix carbon, the plant loses water to the atmosphere, the ratio being variable depending on species and growing conditions. This ratio is called water use efficiency i.e. quantity water transpired/ unit of carbon fixed in dry matter.
- Water use efficiency increases as amount of water required /unit of dry matter production decreases.
- Transpiration ratio is used to express water use efficiency. Transpiration ratio refers to the quantity of water transpired by plant to accumulate 1 g of dry matter.
- This ratio ranges from 200 to 1000 (200:1 to 1000:1) depending on crop species, cultivation conditions and vegetation period.
- Vegetable crops can be categorized into four groups according to such index of water exchange.
- Leaf vegetables require more water to produce 1 g dry matter than pumpkin.
- Vegetable crops showing high transpiration ratio cannot endure water stress, and any shortage of water during the period of growth severely affects yield.
- On the other hand, vegetable crops characterized by very low transpiration ratio can somewhat endure water stress condition and can give satisfactory yield even in moisture deficit condition.

Critical stages of crop growth

- Optimal soil moisture for plant growth varies with the stage of crop growth.
- Certain periods during the crop growth and development are most sensitive to soil moisture stress compared with other.
- These periods are known as moisture sensitive periods.
- The term critical period is commonly used to define the stage of growth when plants are most sensitive to shortage of water.
- Inadequate water supply during moisture sensitive periods will irrevocably reduce the yield and provision of adequate water and other management practices at other growth stages will not help in recovering the yield lost.
- In case of vegetables, when they are young, though they transpire less water, need a stress free moisture condition because of the very weak root system which is sparsely distributed and located in the upper 15 to 20 cm layer of soil that gets quickly dried.
- Vegetable crops utilize and transpire more water in the later stages of growth during which moisture stress markedly reduces yield.
- All the stages of growth are equally sensitive to soil moisture stress for crops where vegetative parts are of economic importance.
- Total growth and yield of perennial plants are the summation of effects of stress at each growth stage.
- However, adequate water supply is essential at flower bud initiation, flowering and fruit set.

- Flower bud formation, however, increase due to restricted water supply prior to flower bud initiation in the case of citrus and mango.
- For realizing maximum benefit from the scarce irrigation water, irrigation is to be scheduled at moisture sensitive periods by withholding irrigations at other periods of lesser sensitivity.
- Such irrigation schedules along with improved practices increase the water-use efficiency in crop production.

➤ **Critical soil moisture periods of crops**

Crop	Available soil moisture (%)	Critical soil moisture stage of crops
Chillies	50	Tenth leaf to Flowering and fruit development and after periodical harvests
Potato	65	Stolon formation, Tuberization and tuber enlargement
Onion	60	Bulb formation and bulb enlargement
Tomato	60	Flowering and fruit development and each harvest
Peas	40	Flowering and pod development
Cabbage	60	Head formation and enlargement
Cauliflower	70	Curd formation and enlargement
Brinjal	50	Flowering and fruit development and after each harvest
Cucumber	50	Flowering and fruit development
Bhendi	45	Flowering and pod development
Leaf vegetables	70	Entire crop duration

Fruit crops : For fruit crops 50% Available soil moisture is taken as critical

Citrus	Flowering, fruit setting, fruit growth
Banana formation	Early vegetative period flowering and fruit
Mango	Start of fruiting to maturity

Pine apple	Vegetative growth
Grape	Vegetative growth. Frequent irrigation during vegetative stage may cause rotting of fruits
Guava	Period of fruit growth
Ber	A drought resistant plant ; irrigation is required during fruit growth

Peak Consumptive use and critical period

- These stages do not usually coincide with the periods of peak consumptive use by crops.
- It is not appropriate to consider the crops, at these critical stages, require more water as their water needs are at the higher.
- Critical stages of water requirement are usually the turning points in plant life cycle. This can be represented by a sigmoid or S shaped curve.
- The curve shows two most important points of change in the growth rate, viz., the point of inflection and the point of deflection.
- The point of inflection indicates a sudden spurt in vegetative growth and the point of deflection represents the slowing down of vegetative growth and initiation of the reproductive phase.
- Crops demand adequate water at these stages and can not afford to stand water stress without serious reduction in growth and yield.
- These two stages of crop life, therefore, considered as the most critical stages of water requirement.

Determination of critical periods of water need.

- For this purpose, a crop is subjected to pre-determined water stress at different stages of growth and then the corresponding yield reductions are considered.
- It is then related to the crop that has not been subjected to any water stress and irrigated according the normal schedule.
- To miss irrigation at different stages of the crop and then relating the corresponding the yield reductions with the yield from control plot which is irrigated normally.
- Periods at which yield reductions are significant are considered as the critical periods of water need in the life of the crop.

