USING SENSORS TO SCHEDULE IRRIGATION

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ABSTRACT-

Water is an essential element for plant growth. The demand and crisis of available fresh water is increasing in recent times due to factors like climate change, natural calamities, irrational use of water and pollution, making it gradually expensive. In India 69% of water is used for agricultural purposes (FAO) so for conservation of this precious resource, it needs to be judiciously used in the fields itself. Irrigation scheduling is an important element in improving water use efficiency as it is the process of determining when, how and how much to irrigate to achieve full crop production potential. Since long back in developed countries, sensor based irrigation scheduling tools are in practice, which helps in conservation of huge volumes of water and increasing productivity. Although there are a few challenges in adopting these but can be overcome.

INTRODUCTION

Irrigation scheduling was defined by Jensen (1981) as a "Planning and decision- making activity that the farm manager or operator of an irrigated farm is involved in before and during most of the growing season for each of the crop that is grown". Thus, it emphasis on when, how and how much to irrigate. Irrigation schedule is of paramount importance for conservation of water in this dire situation of climate change and population explosion, as the water use efficiency in India is only 38 % while in developed countries it is 50- 60 % (Ministry of Water resources). Thus there is an urgent need to shift our focus from conventional irrigation scheduling to advanced or smart/sensor based irrigation scheduling.

ADVANCED IRRIGATION SCHEDULING

Advanced irrigation scheduling involves the use of modern technologies and tools like sensors, satellites, decision support system and apps to replenish the soil moisture for efficient crop growth and increase water productivity. Out of these, sensors are most important in all the advanced tools, for quick and site specific action. They are mostly plant based sensors, soil based sensors, and ET- based sensors.

DIFFERENT TYPES OF SOIL BASED SENSORS-

1. **Plant based sensors-**
   a. **Measuring crop canopy temperature-** Measuring crop canopy temperature with the help of infrared thermometer. It is based on the principle that when there is high stress of water or when the plant is moisture deficient then stomata closes to prevent water loss through transpiration and hence the temperature rises.
   b. **Sap flow sensors-** It measures the amount of heat carried by the sap flowing through the stem. The sensor calculates the amount of sap flow and indirectly measures the water content and hence can predict amount of water required for maintaining and enhancing crop growth.

2. **Soil based sensors-**
   a. **Time Domain Reflectometry (TDR)-** TDR utilizes a high-frequency electromagnetic signal and a probe to measure soil water content indirectly. The time required by the signal gives a measure of dielectric constant of the soil and it in turn measures the water content in soil.
   b. **Frequency Domain Reflectometry**

(FDR)- It is based on the principle that circuit frequency changes with changes in dielectric constant of the soil. It sends electromagnetic signal with the help of an oscillator through a wave guide or metal tine. Example- EC-5 and 10-H. In most cases it gives continuous changes in moisture level thus helpful to schedule irrigation as and when required.

3. **ET-based sensors-**
   - **a.** LOCOMOS (IoT- based Low-Cost Sensor Monitoring System) was developed by Michigan State University. It measures soil and environmental conditions in irrigated fields. The collected data were then sent to the IoT cloud web server, and it provides the recommendations of irrigation, like timing and amount of irrigation to be provided. It is generally powered by a 12 V 7A battery, a 12 V solar panel IoT website was set up to sent email and text message for alerting.
   - **b.** WISE (Water irrigation scheduling for efficient application) was developed by Colarado State University. It is based on evapotranspiration and soil water balance model.
   - **c.** Cotton App developed by the University of Georgia and the University of Florida, is an ET-based irrigation scheduling tool, which operating system is available on both iOS and android. It uses soil parameters, meteorological data, crop growth stage, crop coefficients, quantity of rainfall and irrigation applications to estimate root zone soil water deficits in terms of inches of water and percent of total.

LIMITATIONS-

a. Initial cost is high to ensemble the components
b. Data accuracy is needed. The technologies should be well validated
c. Skill is required.
d. Lack of awareness

CONCLUSION-

Modern tools of irrigation scheduling with the help of sensors are very efficient and along with being responsive to plant demands and environment woes also sustain the future needs , thus it is the technology that needs to be imbibed. It is the time to bring science from lab to lands as rightly said by honorable PM Narendra Modi. Although there are some limitations of it but they can be overcome through awareness, guidance and Government support such as subsidy.