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Irrigation Management: A Water-Saving Strategy for Sustainable Agriculture

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One scarce resource is water. The most important component for global agricultural development that is sustainable is water. Water is becoming more and more in need every day. Crop cultivation in the agriculture sector requires more than 70% of the water that is available. Pollution and unsustainable water extraction are endangering ecosystems and livelihoods. It is not good to over irrigate or under irrigate. It is currently necessary to concentrate on considerable irrigation. Since independence, the area under irrigation has increased from 22.6 m. ha to 70 m. ha. Rising global temperatures, variations in rainfall that lead to increased floods, droughts, or heavy rains, and heat waves that cause uncertainty in crop and cropping systems on farms are all signs of changing weather and climate. Farmers must therefore implement appropriate management techniques in light of the shifting climate. One such management strategy that doesn't significantly lower yield is deficit irrigation.

Management of irrigation under water scarcity

Traditional methods of water provision are not the same as deficit irrigation. The manager must be aware of the minimum amount of transpiration that can occur without causing a major drop in crop output. Deficit irrigation's primary goal is to raise a crop's WUE by removing irrigations that don't significantly affect yield. The benefits of using the conserved water to irrigate other crops for which standard irrigation methods would typically not provide enough water may outweigh the yield reduction that results. Understanding how crop yields respond to water stress, either during certain growth phases or throughout the entire season, is essential when putting a deficit irrigation program into place. Agronomic practices may need to be modified under deficit irrigation practices, such as: reducing/optimal plant population

- ✓ splitting fertiliser application
- ✓ choosing shorter-season varieties
- ✓ adopting flexible planting dates
- ✓ choosing drought-resistant varieties
- ✓ reducing deep percolation and runoff with furrow irrigation
- ✓ conserving tillage
- ✓ mulching
- ✓ greening manuring, etc.

The methods of irrigation

Irrigation with regulated deficit (RDI): DI is a method of irrigation used when the amount of water applied is less than what the crop needs at a certain stage of growth and development.

Partial root-zone drying (PRD): It is an irrigation technique in which one side of the plant's roots is irrigated while the other side is subjected to drought. The wet/dry sides are switched to prevent the roots from drying out. According to PRD's theoretical underpinnings, drought

in one area of the roots causes the production of chemical signals (mostly hormones) in the roots, while irrigation in another area of the root system maintains the upper portion of crops in ideal water conditions. A number of variables, particularly soil properties, the extent and duration of the applied water deficit, crop species, and their phenological stages, influence the outcome of successfully implementing both deficit irrigation techniques (RDI or PRD) and comparing their effects in terms of increased WUE and sustained/improved yield.

Principles of the Alternate Wetting and Drying rice irrigation system

A few days after the ponded water has subsided, irrigation water is added.

Benefits

- Up to 30% less water is used.
- It can help farmers save money on pumping and irrigation
- Without lowering yield, AWD cuts methane emissions by 48%.
- Emissions can be further decreased by applying organic inputs to dry soil and using nitrogen efficiently.
- Farmers who pay for pump irrigation have greater incentives to implement AWD.

The critical stage method

Every crop goes through several stages in its life cycle. There are specific growth stages in every crop where a lack of water results in irreversible production losses; these times are referred to as critical stages. This method works better when there is a shortage of irrigation water. Water is only applied at the moisture-sensitive phases and skipped at the non-sensitive stages when there is a limited supply of water.

Crops	Critical Stages
Rice	Initial tillering, flowering
Wheat	Most critical stage: Crown root initiation, tillering, jointing,. booting, flowering, milk and dough stages
Wheat	Boot stage; dough stage
Pulses	Flowering and podding.
Peas	Pre bloom stage.
Berseem	After each cutting.
Gram	Pre flowering and flowering.
Pigeonpea	Flower initiation, pod filling.
Sorghum	Initial seedling, pre flowering, flowering, grain formation.
Barley	Boot stage, dough stage
Maize	Early vegetative, taselling and silking stage.

Conclusion

Studies have shown that the RDI method can save water by 43% to 65% while producing higher-quality produce at a slight yield drop. According to research, DI can raise rice, maize, and wheat's WP by 10% to 42%. With rice, the AWD approach can cut methane emissions by 48% and water use by up to 30% without significantly lowering yield. In maize, critical stage-based irrigation reduced irrigation water use by 8.5 to 34.02%. The population and dry weight of monocots, dicots, and sedges in maize were reduced by irrigation at 60% depletion of available soil moisture.

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