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Drip Irrigation Automation

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Abstract

In conventional irrigation system, large quantity of irrigation water is being wasted, leading to a high cost of electricity to run the pump set for irrigation. Automation can help save water, electricity as well as human efforts. This can be achieved with the help of a soil-moisture sensors and microcontroller. The adoption of automated drip irrigation makes possible to grow advanced high value cropping system with new technologies which are difficult to grow by conventional means. Using automation one can control the irrigation valves, pump and fertigation equipment.

Introduction

Water and fertilizers are two important inputs to agriculture which are main factors deciding the productivity and production with soil and seeds. In the changing climatic conditions, the water resource has become very limited. Agriculture is consuming almost 80% of its total water resources for agriculture sector, needs to reduce the consumption of water and fertilizers to sizable levels using advanced scientific methods of drip irrigation systems and real time sensor based scheduling to enhance water use and fertilizer use efficiencies.

What is Automation?

Automation of drip irrigation system refers to operation of the system with no or minimum manual involvement. Irrigation automation is well justified where a large area to be irrigated is divided into small segments and segments are irrigated in sequence to match the flow or water available from the water source.

Merits of Automation

An automated drip irrigation system increases crop yield, save water and energy and labor costs as compared with the manual system. The automated irrigation system starts watering just at the predetermined level of moisture content and stops irrigation as the desired soil moisture content or field capacity is attained. The system accounts for effective rainfall to schedule irrigation, eliminates the need to visit the farm frequently and ensures optimum soil water condition in the root zone. This prevents leaching of minerals and nutrients vital for the plant's healthy growth and eliminates the long term ill-effects of over irrigation that leads to development of the salinity. The system is useful for both arid and humid areas where unpredictable and unevenly distributed rainfall disrupts a fixed irrigation schedule. This system also facilitates high frequency and low volume irrigation.

Automation results in higher production, increased productivity,

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better quality, improved safety, shorter workweeks for labour. Automated systems typically perform the irrigation process with less variability than human workers, resulting in greater control and consistency. Also, increased process control makes more efficient use of irrigation water, resulting in less water consumption or high-water use efficiency.

• ***Reduced labour:*** As the irrigator is not required to constantly monitor the progress of irrigation, the irrigator is available to perform other tasks uninterrupted.

• ***Improved life style:*** The irrigator is not required to constantly check the progress of water down the bays being irrigated. The irrigator is able to be away from the farm, relax with the family and sleep during night.

• ***More timely irrigation:*** Irrigators with automation are more inclined to irrigate when the plants need water, not when it suits the irrigator.

• ***Assists in the management of higher flow rates:*** Many irrigators are looking to increase the irrigation flow rates they receive through installing bigger channels and bay outlets. Such flow rates generally require an increase in labour as the time taken to irrigate a bay is reduced thus requiring more frequent change over. Automation allows for these higher flows to be managed without an increase in the amount of labour.

• ***More accurate cut-off:*** Automation of the irrigation system allows cut-off of water at the appropriate point in the bay. This is usually more accurate than manual checking because mistakes can occur if the operator is too late or too early in making a change of water flow.

• ***Reduced runoff of water and nutrients:*** Automation can help keep fertilizer on farm by effectively reducing runoff from the farm. Retaining fertilizer on farm has both economic and environmental benefits.

• ***Reduced costs for vehicles used for irrigation:*** As the irrigator is not required to constantly check progress of irrigation, motor bikes, four wheelers and other vehicles are used less. This reduces the running costs of these vehicles and they require less frequent replacement.

Demerits of Automation

Automated irrigation system requires high capital expenditure to invest in automation.

• ***Cost:*** There are costs in purchasing, installing and maintaining automatic equipment.

• ***Reliability:*** Can the irrigator trust an automatic system to work correctly every time? Sometimes failure will occur. Often these failures are because of human error in setting and maintaining the systems. A reuse system is good insurance to collect any excess runoff when failures occur.

• ***Increased channel maintenance:*** There is a need to increase maintenance of channels and equipment to ensure the system works correctly. Channels should be fenced to protect the automatic units from stock damage.

Systems of Automation

• ***Time based Automated Irrigation System:*** In time-based system, time is the basis of irrigation. Time of operation is calculated according to volume of water required and the average flow rate of water. The first thing to perform before programming for time-based system is to determine the duration of irrigation required for each section. The duration of individual valves has to be fed in the controller along with system start time; also the controller clock is to be set with the current day and time.

• ***Volume based Automated Irrigation System:*** In volume-based system, the preset amount of water can be applied in the field segments by using automatic volume controlled metering valves. The volume of water required for each segment can be programmed in the controller. After providing required volume of water through first valve, the first valve, it closes down controller, then switch on the next valve in the sequence.

• ***Loop based Automated Irrigation System:*** In loop system, the operator makes the decision on the amount of water that will be applied and when the irrigation event will occur. This information is programmed into the controller and the water is applied according to the desired schedule. Open loop control systems use either the irrigation duration or a specified applied volume for control purposes.

• ***Real Time Feedback System:*** It is the application if irrigation based on actual dynamic demand of the plant itself, plant root zone effectively reflecting all environmental factors acting upon the plant. Various sensors viz., tensiometers, relative humidity sensors, rain sensors, temperature sensors etc control the irrigation scheduling. These sensors provide feedback to the controller to control its operation.

• ***Computer-based Irrigation Control Systems:*** A computer-based control system consists of a combination of hardware and software that acts as a supervisor with the purpose of managing irrigation and other related practices such as fertigation and maintenance.

Components of an Automatic Irrigation System

• Controllers
• Electromechanical Controllers
• Electronic Controllers
• Sensors
• Analog Tensiometer
• Contact Tensiometer

- Electrical resistance sensors
- Dielectric sensors
- Thermal soil matric potential sensor
- Gypsum block soil moisture sensors
- TDR (Time Domain Reflectometry) based soil moisture sensors
- Solenoid control values
- Automatic Metering Valve
- Metering pumps

Conclusion

The automatic drip irrigation system serves to reduce the consumption of water used, the human monitoring time and the labour associated with conventional methods. This system uses a timed feedback control to measure the soil moisture and turn on the valve on demand, in regular intervals. Using this system, one can save manpower, water to improve production and ultimately profit.

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