



EFFECT OF MODIFIED SURGE IRRIGATION ON FOXTAIL MILLET CULTIVATION

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Introduction

Surge irrigation has the strategies to enhance the equality of surface irrigation by rising rates of advance and reducing differences in duration of infiltration opportunity throughout the field, as water reaches the downstream end more quickly. It also decreases the soil water intake rate at the upstream points. Surge flows intermittently wet and dry the soil, causing soil sealing or crust formation at the surface. This helps compensate for the typically longer infiltration opportunity times at the starting points of furrows. This dual effect enhances uniformity by balancing water distribution across the field and reducing excessive infiltration near the water source.

Surge irrigation is increasingly being adopted as a technique for optimizing irrigation performance. yet, it does not always fulfill its objectives, and a greater awareness of the underlying systems that provide interruptions to decrease infiltration is necessary. This knowledge can aid in determining the factors that lead to considerable reductions in infiltration rates and subsequent improvements in uniformity will occur.

Research has shown that soil moisture variation structure during interruptions in water application elevates surface soil moisture tension, contributing to reduced infiltration rates. Surge irrigation offers the possibility to significantly enhance irrigation application uniformity and efficiency, offering greater versatility to irrigators compared to conventional

continuous-flow systems. However, it requires a higher level of management and careful scheduling to realize its benefits effectively.

Why use Modified surge irrigation?

Surge irrigation demonstrated the greatest water savings, outperforming cutback irrigation (19.3%) and continuous irrigation (14.3%). It also reduced the time required to complete the advance phase by 14% when compared to conventional methods. Additionally, surge watering lowered both the infiltration rate and application time, contributing to further water savings. Surge irrigation flow rate of 2.7 l/s, achieved water savings ranging from 32% to 52%,

Surplus runoff and downward water flow in top of irrigated fields result in wastewater and can cause elevated levels of dissolved salts and fertilizer remnants, which can contaminate both subsurface water and surface water. Farmers are placing more emphasis on conserving limited water resources while sustaining crop yields. Simultaneously, they must comply with more stringent water quality regulations. Considering irrigation management techniques that reduce runoff and deep percolation can help with environmental concerns and water conservation.

Role of Modified surge irrigation in millet

In millet cultivation, supplemental irrigation can effectively increase soil moisture, boosting productivity and water-use efficiency. Water conservation and storage strategies, such as modified surge irrigation and other micro-

irrigation techniques, can further enhance these benefits. Achieving high and consistent millet yields requires the development and investigation of these irrigation methods. Specifically, after the late flowering stage in millet fields, supplemental irrigation improves soil moisture, which in turn influences the physical and chemical properties of the soil, including pH, temperature, organic matter content, and microbial biomass.

Working principle in Modified Surge irrigation

A technique known as "surge irrigation" involves applying water to furrows periodically throughout a sequence of comparatively brief ON and OFF periods. With clay-textured soils in particular, this technique may increase the effectiveness of furrow irrigation application.

Surge irrigation utilizes a butterfly valve placed at the top center of the field, connected to gated pipes that distribute water in alternating directions. The valve oscillates water flow at predetermined intervals, creating cycles of wetting and soaking in the furrows. This process allows soil particles to settle, forming a partial seal that reduces water infiltration rates. Consequently, water advances more uniformly down the furrows, minimizing deep percolation at the start and runoff at the end of the rows.

The system is typically powered by a solar battery, and the valve controller enables growers to customize oscillation durations, resulting in more efficient water use and uniform application. This method improves water conservation and reduces waste compared to traditional continuous-flow irrigation.

Recommended Crops for Surge Irrigation

✓ **Wheat**

Surge irrigation can save between 27% and 37.4% of irrigation water while boosting yields by 12.7% to 17.7%, depending on land types. It can achieve a water use efficiency (WUE) of up to 1.59 kg/m³ under optimal conditions.

✓ **Cotton**

Surge irrigation results in a 15% reduction in water usage compared to traditional methods, along with a 17% improvement in water use efficiency.

✓ **Maize**

Surge irrigation provides the highest water use efficiency (WUE), reaching up to 1.63 kg/m³, showcasing its effectiveness in optimizing water productivity.

✓ **Fennel**

Surge irrigation allows for a 44% reduction in water usage compared to conventional methods, while significantly increasing water productivity from 0.27 kg/m³ to 0.49 kg/m³.

✓ **Capsicum(BellPepper)**

Surge irrigation achieves a maximum water productivity of 16.5 kg/ha/mm, greatly outperforming conventional irrigation methods.

✓ **Onion**

Surge irrigation can increase water productivity by 35% compared to continuous flow systems, making it an effective method for onion cultivation.

Modified surge irrigation benefits

- ✓ More uniform application of irrigation water
- ✓ Reduced water use through reductions in deep percolation and runoff
- ✓ Reduced costs through reductions in water use and labour
- ✓ Reduced nitrogen leaching
- ✓ Reduced sediment loss
- ✓ Reduced surface water contamination

Conclusion

This study aimed to assess the impact of surge irrigation on water application, foxtail millet grain yield, and net returns over irrigation costs across different soil types. The results indicate that surge irrigation does not negatively affect the grain yield of foxtail millet on any soil type. However, this method reduces the amount of water used for irrigation and shortens the time required to irrigate a given area. Additionally, the findings show that the higher capital investment associated with surge irrigation is offset by the water savings it provides.

