agriculture
& rural development
Department:
agriculture
& rural development
PROVINCE OF KWAZULU-NATAL

Research & Technology
BULLETIN
2018-19/06

Management of Plant Pathogens in Irrigation Water

Archana Nunkumar

Introduction

Water is a precious commodity which is essential to agriculture. The biological, physical, and chemical characteristics of a water source impacts its suitability for irrigation. With water conservation becoming a priority, recycling irrigation water in plant nurseries and greenhouses is a reasonable practice. The quality and quantity of the water available for agriculture varies, depending on the surrounding environment, season and use by industries. Plant pathogenic microorganisms may be present in the initial water source or accumulate and disperse from various points throughout the irrigation system, creating a risk of disease to the plants. To reduce the spread of plant pathogens in recirculating irrigation systems, water decontamination has become a priority for agriculture. It is extremely important for growers to know which plant pathogens are present in the water system, so that they can assess the extent of the threat posed by plant pathogens to the crop.

Why test water for plant pathogens?

- Water can be contaminated with plant pathogens, which, in turn initiate the rapid spread of plant diseases. Testing the irrigation water will aid in detecting contamination in the water.
- Testing will help identify the source of contamination thereby allowing for effective treatments to be implemented.
- Testing the water will help determine the efficacy of the treatment systems.

Rivers, streams, outdoor reservoirs and ponds have a high risk of plant pathogens.

Type of plant pathogens in irrigation water

- **Fungi**

  Many fungi have been found in recycled irrigation water and have been associated with causing diseases on various crops. Some of the most important plant pathogenic fungi that have been detected in water include: *Phytophthora*, *Pythium*, *Alternaria*, *Botrytis*, *Rhizoctonia*, *Fusarium oxysporum*, *Colletotrichum*, *Phomopsis*, *Thielaviopsis*, *Verticillium* and *Sclerotinia sclerotiorum* spp.

- **Bacteria**

  Various plant pathogenic bacteria can be present in water. *Erwinia* species, which cause soft rots, *Pseudomonas* species, *Clavibacter* and *Xanthomonas* species have all been reported to be found in irrigation water.

- **Viruses**

  The following viruses have been found in recycled irrigation systems: cucumber mosaic virus, lettuce big vein agent, melon necrotic spot virus, tobacco mosaic virus, tobacco necrosis virus, tomato mosaic virus and tomato sotted wilt virus.

A variety of water treatment methods are available and can be categorized into physical, chemical and ecological treatments.

1. Physical Treatments

- **Filtration**

  Physical removal of plant pathogens from irrigation water is accomplished by filtration. Filters remove contaminants through interception

and flocculation, characterized by differing pore sizes or reverse osmosis. Filtration systems are most effective at controlling pathogens when combined in a series of multi-stage filters from large to small pore size.

- **Heat pasteurization**

High temperatures are very efficient as a treatment for contaminated water. This method involves passing water through a series of heat exchangers until the desired temperature is reached at the final exchanger (90 °C for 30 seconds). It is energy intensive and a costly process.

- **Ultraviolet (UV) radiation**

Ultraviolet (UV) radiation involves exposure of the water in tubular chambers to UV light, which kills living cells (including pathogens) by disrupting their DNA or RNA.

2. Chemical Treatments

Many chemical treatment options are available to growers to eliminate the pathogens found in irrigation water. These are greatly influenced by pH, organic and inorganic compounds.

- **Hydrogen peroxide-based material**

Hydrogen peroxide is known for its sterilant and antiseptic properties, however it is unstable and has a short shelf life in irrigation water due to its reactivity with other substances in the water system. Hydrogen peroxide products kill most bacteria and fungi in irrigation water on contact, though it has very little to no effect on bacterial endospores, encapsulated bacterial cells and fungal sclerotia.

- **Chlorine**

This treatment depends on the reactivity of the chloride ion on the bacterial and fungal cell. Levels of chlorine in these products can remain toxic to pathogens several hours after treatment.

- **Quaternary Ammonium Compounds**

This treatment is the most persistent and effective of all chemical disinfection treatments. It destroys vegetative microorganisms on contact and can kill persistent fungal spores and viruses. If used at higher than the recommended rates it can be toxic to several crops.

- **Ozonation**

Ozonation deploys the unstable gas ozone (O_3), which is electrically generated and bubbled through the water, allowing rapid reaction with microorganisms and organic matter. This method involves generating ozone (O_3) and mixing it with the irrigation water. The process is highly effective against bacteria, fungi, viruses and algae. It leaves no residual activity post-action.

3. Ecological Treatment

- **Slow sand filtration**

Slow sand filtration involves passing water through layers of fine sand. The filtration process effectively removes virus particles, bacteria, pathogen spores and organic matter through a combination of biological, physical and chemical reactions. Slow sand filtration contains biofilms (a type of microbial ecosystem) between the sand grains in the filter.

As water passes through the filter, particles of organic matter and pathogens are intercepted by the sticky biofilms and consumed by microorganisms. This method is not rapid enough to supply large volumes of filtered water, therefore storage in a clean water reservoir is recommended.

There is no single method that allows for complete control of pathogens in the irrigation water; using two or more approaches will provide the best opportunity to control the plant pathogens in the irrigation water.

References

Krause, M.S. 2013, **Irrigation water disinfection**. http://www.greenhousemag.com/article/bioworks-enews-irrigation-water-disinfestation/

Contact

Archana Nunkumar

Professional Scientist: Plant Pathology

Tel: 033 343 8094

Archana.Nunkumar@kzndard.gov.za

KZN Department of Agriculture & Rural Development

Directorate: Agricultural Crop Research Services

Sub-directorate: Crop Scientific Research Services

Division: Crop Protection Services, Cedara

Published March 2019