Fertigation management to optimize the required fertilizer input considering the nutrient input from irrigation with treated wastewater
Module Six

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Introduction

- The most important nutrients for crops are nitrogen, phosphorus, potassium, zinc, boron, and sulfur.
- Usually, recycled water contains enough of these elements to supply a large portion of a crop's needs.
- Nitrogen is a macronutrient for plants that is applied on a regular basis.
- Nevertheless, at very high concentrations (over 30 mg Ntot/L) it can overstimulate plant growth, causing problems such as lodging, excessive foliar growth and delay maturity or result in poor crop quality.
- Excessive application of nitrogen in areas having permeable soils will cause nitrogen percolation deep in the soil and pollute the groundwater which presents a health concern.

Introduction

- Washed nitrogen from soils will reaches streams, lakes, canals, and drainage ditches, stimulating algae growth, which can result in plugged filters, valves, pipelines, and sprinklers.
- Excessive nitrogen application to pastures may be hazardous to livestock that consume the vegetation.
- The phosphorus content in recycled water is too low to meet a crop's needs.
- Over time, phosphorus can build up in the soil and reduce the need for supplementation.
- Potassium in recycled water has little effect on crops, it may affect future land use because some plants species are sensitive to high phosphorus concentrations.
- Phosphorus can also be a problem in surface water runoff as a limiting factor in eutrophication.

Adjusting fertilizer applications

The fertilizer value of recycled water is of great importance.

The typical concentrations of nutrients in treated wastewater effluent from conventional sewage treatment processes are:

- Nitrogen 50 (20–85) mg N/L,
- Phosphorus 10 (4–15) mg P/L, and
- Potassium 30 (10–35) mg/L.

Adjusting fertilizer applications

In general, irrigation with recycled water (treated urban wastewater) at an application rate of 100 mm/ha would provide the following quantity of fertilizing elements:

- **Total nitrogen (N): 16–62 kg (in arid and semi-arid regions up to 90–300 kg)**
- **Phosphorus (P): 4–24 kg**
- **Potassium (K): 2–69 kg**
- **Calcium (Ca): 18–208 kg**
- **Magnesium (Mg): 9–110 kg**
- **Sodium (Na): 27–182 kg (in arid and semi-arid regions up to 200–600 kg)**

Adjusting fertilizer applications

Assuming an application rate of 5000m3/ha year, the fertilizer contribution of the effluent would be:

N: 250 kg/ha year

P: 50 kg/ha year

K: 150 kg/ha year

- Thus, all the nitrogen and much of the phosphorus and potassium normally required for agricultural crop production would be supplied by the effluent.
- In addition, other valuable micronutrients and the organic matter contained in the effluent will provide complementary fertilizing benefits.
- Farmers should consider the fertilizer value of recycled water and save money by reducing consumption of fertilizers.

Adjusting fertilizer applications

Note

A case study as an exercise for each country participated in the training course to calculate the nutrient requirement of Citrus when irrigating with reclaimed water and if supplemental fertilizer is needed or not?

Should fertilizer be applied when irrigating with reclaimed water?

- The nutrient uptake efficiency of a plant is defined simply as the amount of a nutrient taken up by the plant divided by the amount applied.
- The nutrient uptake efficiency is an effective metric to quantify the added nutrients used by the plant and not lost to leaching or runoff.

Should fertilizer be applied when irrigating with reclaimed water?

- The factors that influence the nutrient uptake efficiency include the water uptake efficiency and the timing and amount of nutrient applications.
- The water uptake efficiency of a plant is simply the quantity of water taken up by the plant divided by the quantity of irrigation applied.

Should fertilizer be applied when irrigating with reclaimed water?

- The higher the water uptake efficiency, the better nutrients are held in the root zone where they can be taken up by plants.
- Maximizing water uptake efficiency will also improve nutrient uptake efficiency.
- The timing of nutrient applications affects the nutrient uptake efficiency, depending on how well it matches plant uptake patterns.
- The more similar nutrient applications are to the uptake pattern of the plant, the higher the nutrient uptake efficiency will be.

Should fertilizer be applied when irrigating with reclaimed water?

- The nutrient uptake efficiency is usually lowest in highly/excessively fertilized plants.
- To take advantage of the N and P in reclaimed water more fully, it is recommended that high fertilizer rates not be followed.
- Effective utilization of nutreints will depend on the timing of the supply and proper irrigation practices.

What are the concerns when irrigating with reclaimed water?

Several significant issues with using reclaimed water for irrigation include:

- the timing of the supply of nutrients,
- the relative amounts of N to P in the reclaimed water compared to the relative amounts beneficial to plants, and
- the potential to over-apply a nutrient (P in particular) in the process of meeting the irrigation needs of the landscape.

Final Remark

Effectively utilizing the N and P in reclaimed water and avoiding unintended environmental impacts will depend on the following:

- **Knowing the amount and timing of the supply of N and P in reclaimed water**
- **Knowing the N and P uptake pattern of the plants irrigated with reclaimed water**
- **Practicing proper irrigation to avoid over-irrigation, maximize nutrient uptake efficiency.**

Questions