
Chapter 13

Quality of Water Supply

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(a) General

Water quality is a major consideration when selecting an irrigation method. Adequate water quality data is essential in the selection process. Water suitability for irrigation is determined by the potential to cause soil, plant, or management problems. Appropriate management practices should be selected to avoid unacceptable levels of biomass or yield reduction. Suitability must be evaluated at the farm level for specific use and potential hazard to crops and personal health. If contaminants are present, the type and concentration must be determined.

Undesirable contaminants in irrigation water can include the following: dissolved salts, suspended sediment, gypsum, toxic elements, nematodes, and water born diseases.

Tailwater runoff from irrigation systems (particularly container nursery operations in hoopouses), can be reused as a water supply, but can also contain contaminants such as sediment, fertilizers, pesticides, and organic material. Grey water from other sources such as treated municipal sewerage, industrial wastes, agricultural food processing, and wastes from confined livestock and fish feeding operations can also be used to supplement supplies. Caution must be taken when applying treated wastes to cropland.

These sources can contain pathogens, viruses, coliforms, salts, toxic metals, or acids.

Refer to the NRCS National Irrigation Guide, Chapter 13, for detailed discussion on water quality effects as it relates to salinity and sodicity, infiltration and permeability, toxicity, suspended sediment, and wastewater reuse. Also refer to NRCS National Engineering

Handbook, Part 623, Chapter 2, Irrigation Water Requirements.

b) Water Quality

The irrigation water supply should be tested for the following: iron, sulfur, manganese, calcium, pH, sand, organic matter, algae, pesticides, contaminants from industrial effluents, disease organisms, and salts. Concentrations may be found in water from wells, rivers, streams, ponds, or tidal inlets or streams. If they are present in sufficient concentrations, the water may be unfit for irrigation use on some crops. Water containing salts is often referred to as "brackish." Saline water is another term which usually designates contamination by salts to some degree. Sodium is the element in salt or saline water that has the greatest effect on the crop and the soil in which it may accumulate in harmful quantity if not leached below the root zone by fresh, percolating rainwater. Where sodium salts are the major contaminant, the potential for crop damage from salt residues on crops can be reduced by night application.

Sulfur may be present in some seepage waters in amounts large enough to cause burning of the foliage and fruit and to corrode irrigation equipment. Iron precipitants are a common concern in New Jersey with both drip irrigation and sprinkler systems. Iron can be treated through oxidation and good filtration or ionization processes to keep it in solution.

The amount of any contaminant that can be tolerated in irrigation water depends on: (1) the kind of contaminant present, (2) the tolerance of the crops to be irrigated, (3) the texture and permeability (internal drainage) of the soil being irrigated, (4) the amount of contaminant already accumulated in the soil, and (5) the type of irrigation system used.

Water sources can vary considerably in quality depending on the season, demand, rainfall, etc. Water contaminants include both inorganic and organic materials. Physical contaminants include organic matter such as algae, bacteria, leaves, fish, etc., and organic matter such as silt and sand. Chemical contaminants are soluble and only become a problem when they precipitate as a solid particle or when they stimulate organic growth. For example, temperature or pH change may cause iron or sulfur precipitation to occur.

Irrigation water quality is important for three main reasons. First is the effect of poor water quality on the crop. Chapter 3 gives limits on the use of saline or brackish water for irrigation to minimize crop damage. When irrigating with waste water, the nutrient content, the content of salts, and the content of solids must be known and the irrigation system designed within these constraints. The second reason is excessive wear on the system components. Normally this would be excessive wear of pumps and sprinkler nozzles caused by sand in the irrigation water. The third reason is plugging of the systems. The smaller the openings in the system, the greater a concern plugging becomes, such as with microirrigation systems. Clogging in these systems may be due to algae, bacterial slime, precipitates, and sediment. In general, adequate filtration, line flushing, and chemical treatment are used to avoid clogging.

Algae

Algae can be found in almost all quiet surface waters. Sunlight and water high in nutrients encourage its growth. Algae even grows in water that stands in an emitter after the system is turned off. Once algae gets into a trickle line, it is almost impossible to remove. Screening to remove algae is not satisfactory since screens and filters can be plugged very

rapidly. It is best to prevent algae from forming in the first place. Alternately, algae should be killed and settled at the source before it enters the system.

If water is not exposed to sunlight, algae will not grow; so use of dark colored, opaque tanks, pipe, and emitters are recommended.

In ponds, minimize the formation of algae by decreasing the sediment and nutrient concentrations. Treatment with copper sulfate will prevent algae formation and control slime. However, do not apply chemical treatments to surface waters without first consulting the appropriate regulatory agencies.

Bacterial Slime

Certain bacteria can secrete a slime that can eventually plug emitters and small lines in a microirrigation system. Conditions that favor its development include low pH, but not below 4.5; low oxygen level; temperature above 46 degrees F; organic matter; dissolved ferrous (iron) concentrations of 0.2 to 1.0 ppm; and hydrogen sulfide in concentrations or 0.1 ppm or greater. Clogging is generally not a problem if there is no iron or sulfide in the water.

Extra tubing may be added in a trickle system at the end or along a lateral for checking slime buildup. A small piece of tubing may periodically be cut and inspected. The slime often has the same color as the tubing but will have a greasy feel.

The treatment for bacterial slime is disinfectant. The most common treatment is chlorination, either with sodium hypochlorite or calcium hypochlorite. For hard water, sodium hypochlorite is preferred to reduce calcium carbonate precipitation in the lines. The hypochlorites are relatively safe and easy to handle by conventional injection methods,

but are expensive when needed at higher injection rates. Gaseous chlorine is less expensive for use on large scale operations but is extremely dangerous, requires special equipment, and special handling by trained personnel. Injection of chlorine at the end of the irrigation cycle is sometimes called superchlorination. It can be just as effective as continuous chlorination since most bacterial slime develops during the off-cycle. The injection time should be long enough to fill all of the lines.

Particle Agglomeration

Particles near the 2 micron size tend to stick together (agglomerate) and rapidly clog lines and orifices. A chemical dispersant, such as hexametaphosphate, or a settling basin can help control the problem as will flushing the lines and using emitters that will pass large particles.

Suction on Steep Terrain

On steep terrain, when the zone valve is turned off, emission points at low elevations may drain the system quite rapidly and create a suction on emission points at the higher elevations. If the emission points are buried, or if the outlet is submerged in the small surface puddle that often forms, muddy water can be sucked back into the lateral. To avoid this problem, install outlets above the ground and above the puddle. If the emission points are buried, it will help to lay laterals on the contour at nearly the same elevation.

Pond Sediment

Runoff into ponds introduces sediment and agitates the water. Natural convection currents can keep fine silt and clay particles (1 to 25 microns) in suspension for some time. As a result, microirrigation systems using a pond as a water supply must be designed to

handle occasional changes of fine suspended particles. Sand media filters that have automatic back-flush are typically used.

Because open basins accumulate floating debris, it is important to use a coarse screened floating intake located one to two feet below the water surface. The intake should be frequently inspected and cleaned.

Precipitates

Wells drilled through limestone may yield water high in calcium bicarbonates. If the temperature or pH of the water is raised above certain critical points, calcium carbonate precipitates and forms a scale that adheres to the inner wall of pipes. This buildup caused by hard water occurs slowly but can become severe in time. Hardness cannot be treated by filtering or flushing. Acid can be used for cleaning but will never completely remove scale from blocked lines and emitters.

Water in laterals placed on the ground or under plastic can become heated, especially under no-flow conditions. When the water is hard, the high temperature will cause carbonate precipitation. Burying laterals will help to avoid the temperature rise.

To test for calcium carbonate stir a teaspoon of household ammonia into a quart of the supply water in a glass container. Allow to sit overnight. Formation of an almost white, sparkling crystalline precipitate that can neither be disturbed by agitation or rinsing is an indication of calcium carbonate.

Precipitation can also occur when certain chemicals are mixed. For example, chlorine will cause iron in water to precipitate. Most phosphate fertilizers react with the calcium in hard water and form a precipitate.

If precipitating chemicals must be used, inject them 100 to 200 feet upstream from the filtration system. At least two elbows should be used in the section of pipe between the injector and filtration to create extra turbulence for complete mixing and to allow time for the precipitate to form before reaching the filters.

With some fertilizers, like phosphates, if the injection is stopped an hour or so before the end of the irrigation cycle, there is a better chance of flushing out the chemicals before they have a chance to react and form precipitates.