e-GRO Alert

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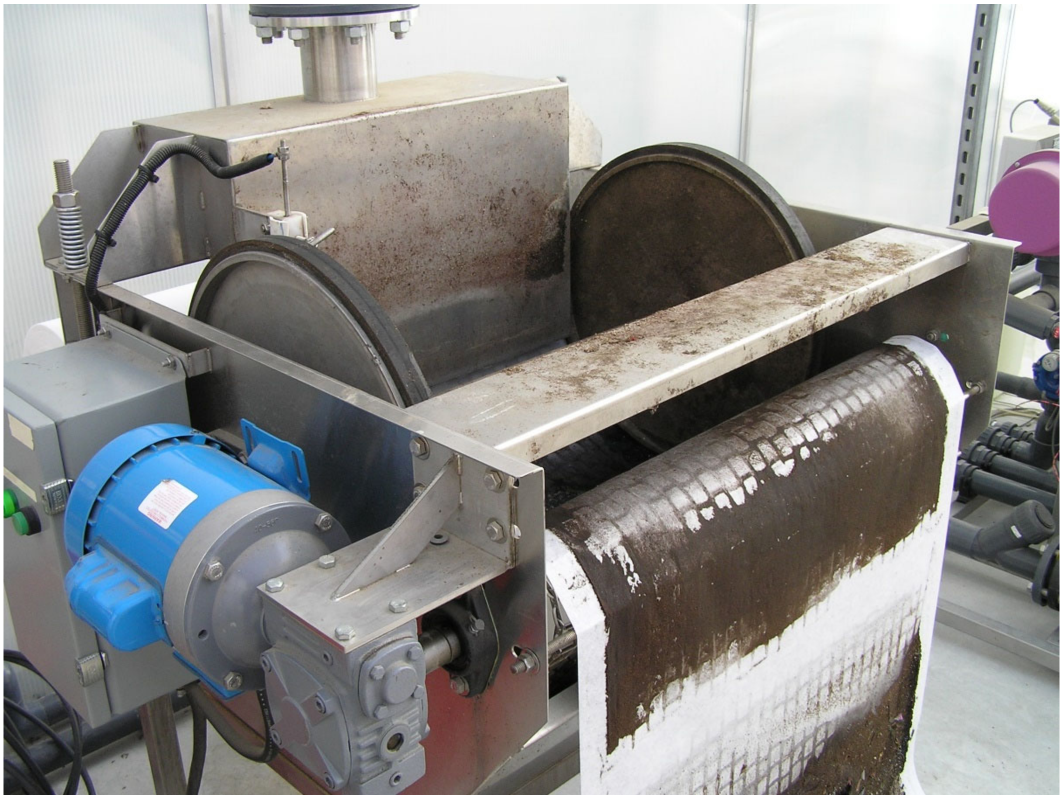
Match the Filter to the Problem

Filters are an essential component of irrigation systems. The main function of filters is to separate suspended or dissolved particles from the water. In irrigation, we aim to remove particles that affect plant health or the efficiency and uniformity of water distribution. Growers should select filters based on the target problem, compatibility with irrigation, and cost.

In this e-Gro Alert, I will discuss some water contaminants and the filters that are commonly used to remove the target problem.



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UNDERSTANDING THE UNITS

The pore size of filters are rated by the mesh number or pore diameter. Micrometers (µm) —also known as microns— are the units used to measure pore diameter. Micrometer is a length unit from the International System of Units (SI) equivalent to one-millionth of a meter or one twenty-five thousandth of an inch (Figure 1). Mesh number or mesh size refers to the number of openings in one linear inch (e.g. 100 mesh means there are 100 openings in one inch).

The numerical relationship between mesh size and pore diameter is inverse. As the pore size in microns increases, the mesh size decreases and vice versa (Table 1).

Microns are the international standard unit to communicate about filter pore size and it is useful because we can compare the diameter of the pore size of a filter with the diameter of target particles (Figure 1). In contrast, mesh number— the American standard — is not easily relatable to the target issue.

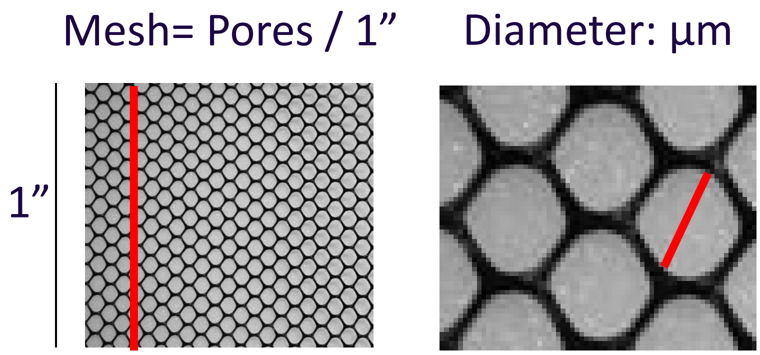

Figure 1. Pore size of filters is presented in mesh and pore size pore diameter (µm). Mesh refers to the number of openings in one linear inch.

Table 1. Mesh to pore diameter (µm) relationship.

Mesh size	Microns (µm)
60	250
100	149
200	74
400	37
625	20

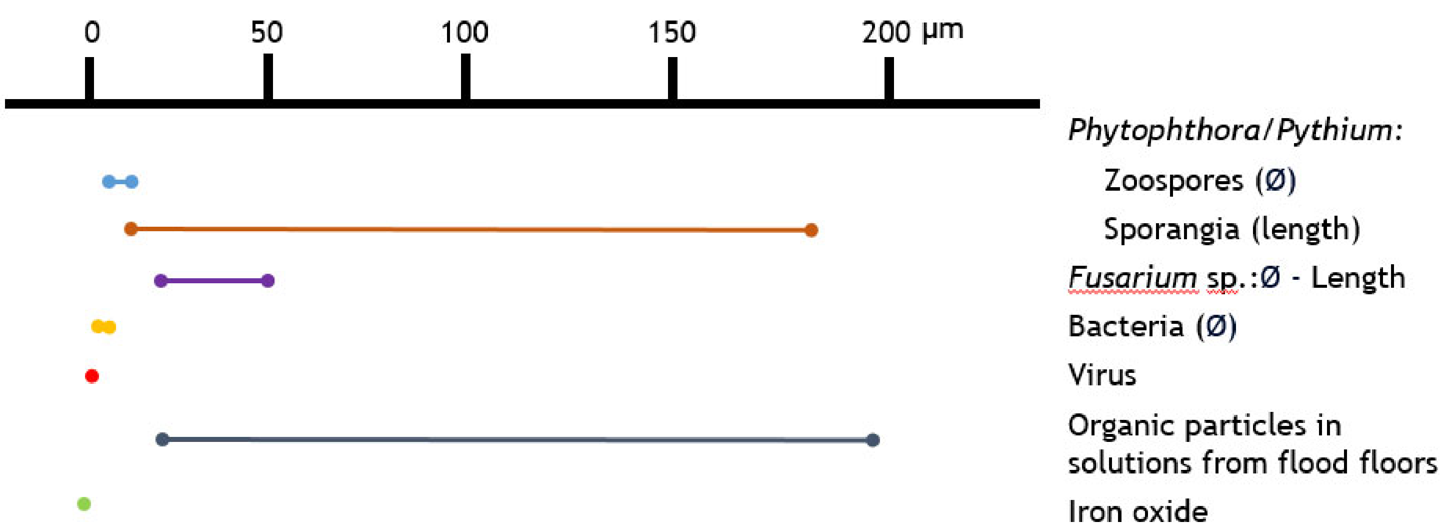

Figure 2 Particle size of different irrigation water contaminants. Ø indicates diameter**. Pathogen particle size references: Agrios, 2005; Drechsler, 1952; Hardham, 2001; Erwin and Ribeiro, 1996; Gergerich and Dolja, 2006; Toussoun and Nelson, 1976.**

TARGET PROBLEMS & FILTRATION OPTIONS

Organic particles include debris, algae, and pathogens.

Most pathogens are extremely small (Fig. 2) and catching them with a filter would require an extremely small pore size —such as ultra fine membrane filtration or smaller (Table 2). Because of the cost, membrane filtration is rarely used for this application.

Dr. Loren Oki and Dr. Mary Hausbeck have tested slow and rapid sand filters for removal of *Phytophthora* sp. and *Pythium* sp. and observed good results. These filters remove pathogens most likely by a combination of physical and biological mechanisms. Slow sand filters are known to form a layer of biofilm that reduces or inhibits pathogens through multiple mechanisms.

Screen and media filters are effective in removing large organic debris and weeds. However, consider that media filters can easily clog if the debris is too coarse (e.g. weeds).

Table 2. Filtration options for greenhouses.*

Type of filter		Pore size (μm)
Screen or Mesh	Coarse	300 - 5000
	Fine	<300
	Disc	<400 micron
DISC	Fine	< 400
Media	Sand or crushed glass	N/A
	Slow sand/ bio-filter	N/A
	"Paper"/ fabric	20 - 250
	Sock or cartridge	5 - 50
Membrane	Micro	1 - .1
	Ultra	.1 - .01
	Nano	.01 - .001
	Reverse osmosis	<.001
Carbon		N/A

Source: Fisher, P (Ed). 2013. Water Quality & Treatment: A growers' guide for nursery and greenhouse irrigation. Water Education Alliance for Horticulture

Inorganic particles or debris include fine granular minerals such as sand, clay, and silt. These contaminants can be removed with "paper" (page 1), sock, screen, or disc filters. Sock filters (Figure 3) remove suspended inorganic particles very well, but because of the small surface area they might clog easily. Therefore, sock filters are recommended as final stage of filtration.

Figure 3. Example of a the sock filter.

Do not use membrane filtration to remove suspended inorganic particles/debris. These contaminants can physically damage the membranes.

Dissolved inorganics include salts such as iron. Membrane filtration is recommended to remove dissolve salts from water. Reverse osmosis will remove all ions, except boron, from the water. Alternatively, a combination of oxidation (chlorine or permanganate), followed by filtration with greensand filters can remove iron and manganese.

Dissolved organics include agrochemicals and humic acids. Carbon filtration removes a vast amount of agrochemicals from water. More information: https://tinyurl.com/CarbonArticle

Additional pointers about filtration:

- Install multiple stages of filtration — from coarse to fine — to avoid clogging of the system and to increase the efficacy of removing particles. This is especially important when using membrane filters, not doing this will damage the expensive membranes.
- Maintain the filters. Clean the filters frequently to avoid clogging or tearing the filters. Choose filters with automatic backwash when filtering organic and inorganic debris.
- For more information about the cost of filtration go to: https://tinyurl.com/FiltrationArticle
- Find more articles and videos on water treatments at: https://greenhouse.uconn.edu/water/

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