

PLANT PROTECTION IN AQUAPONICS

Aquaponics as all agronomical system brings its share of plant pests, represented by insects, nematodes, fungi, bacteria and viruses. However, the main focus of this factsheet will be on plant diseases (mainly fungi) and the ways to control them for any parts of the plant resume as the foliar (stem, leaves, flowers and fruits) or root system (collar and roots).

Genus of the most common fungal plant pathogens in soilless tomato culture	Genus of the most common fungal plant pathogens in soilless lettuce culture
<i>Pythium</i>	<i>Pythium</i>
<i>Phytophthora</i>	<i>Bremia</i>
<i>Fusarium</i>	<i>Fusarium</i>
<i>Sclerotinia</i>	<i>Microdochium</i>
<i>Alternaria</i>	<i>Rhizoctonia</i>
<i>Colletotrichum</i>	<i>Sclerotinia</i>
<i>Rhizoctonia</i>	<i>Septoria</i>
<i>Thielaviopsis</i>	<i>Stemphylium</i>
<i>Verticillium</i>	<i>Cercospora</i>
<i>Cladosporium</i>	<i>Botrytis</i>
<i>Septoria</i>	<i>Golovinomyces</i>
<i>Didymella</i>	
<i>Botrytis</i>	
<i>Leveillula</i>	
<i>Pseudoidium</i>	
<i>Penicillium</i>	



Gilles Stouvenakers - Root rot on aquaponic basil

Even if the list of plant pathogens potentially occurring is long (see table 1 as example), little attention and studies have been paid on plant pest management in aquaponic systems. Indeed, pesticides are not approved for aquaponic use because of fish toxicity risk and no bio-

pesticides were especially developed for aquaponic system. Furthermore, the fish safety of the biological control agents (BCA) introduced needs to be verified before application in the system. BCA available in the market is listed in the table 3. Consequently, in one loop aquaponic systems, control measures are based on other kinds of methods shown in the table 2. In decoupled aquaponic systems, conventional chemical pesticides and BCAs can be used, provided that water of the hydroponic part does not return to the fish rearing. We recommend using BCAs in priority.

Nevertheless some recent scientific papers (Gravel et al., 2015, Sirakov et al. 2016) report an in vitro suppressive action of recirculating aquaculture water or aquaponic water against plant pathogens. It means that biological control agents could be identified, developed and formulated for specific aquaponic use.

Table 2. Plant diseases control measures in aquaponics

Control measure	Examples of actions
Preventive actions	Fallow period, specific room for sanitation, respect of sanitation rules, specific clothes, specific room for plant germination and physical barriers against insect vectors.
Respect of good agricultural practices	Use of resistant varieties, tools disinfection, limit plant abiotic stresses, plant spacing and avoid algae development.
Environmental conditions management	Manipulate the heating, the ventilation, the shading, the supplement of lights, the cooling and the fogging to find the optimal compromise allowing both plant production and disease control.
Physical water treatment	Filtration with pores size under 10µm, heat, and UV treatments

Table 3. Biological control agents available in the market against plant pathogens (NB. check the fish safety before use).

Plant diseases	BCA	Crops
Powdery mildew	<i>Ampelomyces quisqualis</i>	Strawberry, tomato, pepper, cucurbits
Powdery mildew, grey mold, white mold (<i>Sclerotinia</i>)	<i>Bacillus amyloliquefaciens</i> ssp. <i>Plantarum</i> strain D747, <i>Bacillus subtilis</i> strain QST 713	Strawberry, tomato, cucumber, pepper, cucurbits, watercress, lettuce, spinach, aromatic herbs
White mold (<i>Sclerotinia</i>)	<i>Coniothyrium minitans</i>	Any crop
Grey mold, downy mildew, fusarium wilt, damping off	<i>Gliocladium catenulatum</i>	Strawberry, tomato, cucurbits, pepper, watercress, lettuce, spinach, aromatic herbs
Soil cryptogam	<i>Streptomyces</i> K61	Any crop
Damping off	<i>Trichoderma asperellum</i> ,	Any crop

References

Gravel, V. et al., 2015. Fish effluents promote root growth and suppress fungal diseases in tomato transplants. *Canadian Journal of Plant Science*, 95, pp.427–436.

Sirakov, I. et al., 2016. Potential for combined biocontrol activity against fungal fish and plant pathogens by bacterial isolates from a model aquaponic system. *Water*, 8, pp.1–7.

Pictures proposition

- ➔ Drawing of non-curative measures
- ➔ Beneficial bacteria



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