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BACTERIA IN CLIMATE SMART AQUAPONICS

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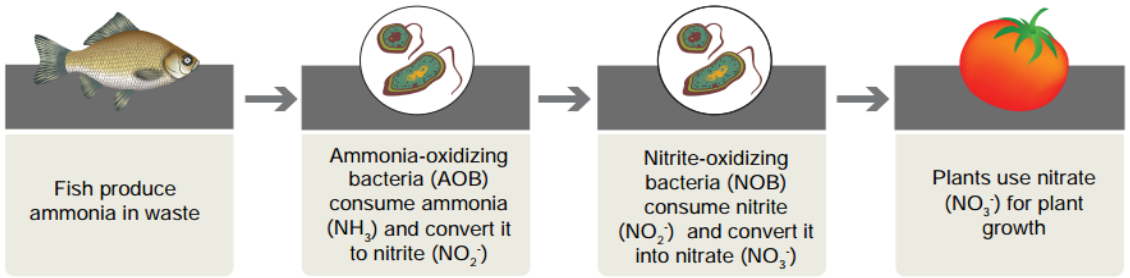
Groups of Bacteria in Aquaponics

- Aquaponics involves water running from an aquaculture unit to hydroponics unit.
- Fish waste has 50–70% released as ammonia which is used as nutrients for plants
- Two groups: **wanted and unwanted** bacteria occur in aquaponics.

Common Bacteria in Aquaponics

1. Wanted nitrifying bacteria

- Oxidise ammonia to nitrite in the biofilter
- Colonies can be established after few days
- Can tolerate a pH ranging from 6–8.5



2. Wanted heterotrophic bacteria

- It is an anaerobic bacteria which mineralizes solid waste, uneaten feed and plant detritus.
- Results in more nutrients available for plants
- Grow fast (hours) in the presence of carbon

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Common Bacteria in Aquaponics (Cont…)

Unwanted denitrifying bacteria	• ***Anaerobic bacteria*** – converts nitrate to nitrogen • Grows fast in large systems
Unwanted sulphate-reducing bacteria	• Produce foul odor of hydrogen sulphide and grey color of sediment • Occurs when solid wastes accumulate at a faster speed than the mineralization
Unwanted pathogenic bacteria	• Anaerobic bacteria responsible for diseases in plants, fish and humans (*Salmonella sp*.) • Bacteria can be mitigated by ensuring good biosecurity • Preventing birds, dogs and cats from coming close to the system

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Factors Affecting Bacterial Growth

Dissolved Oxygen (DO)

- 4–8 mg/L DO – required by fish and plants.
- Nitrification does not occur below 2 mg/L.
- Flood-and-drain cycles and air-stones are commonly used for extra aeration

UV light

- Wanted bacteria are photosensitive.
- Cover the fish tank and filtration. components with UV protective material.
- Less threatening after 3–5 days.

Water pH

- pH 6–7 is a compromise for bacteria, fish and plants.
- *Nitrosomonas* group prefer 7.2–7.8 and *Nitrobacter* group prefer 7.2–8.2 pH.
- However both groups can adapt at pH 6–8.5.

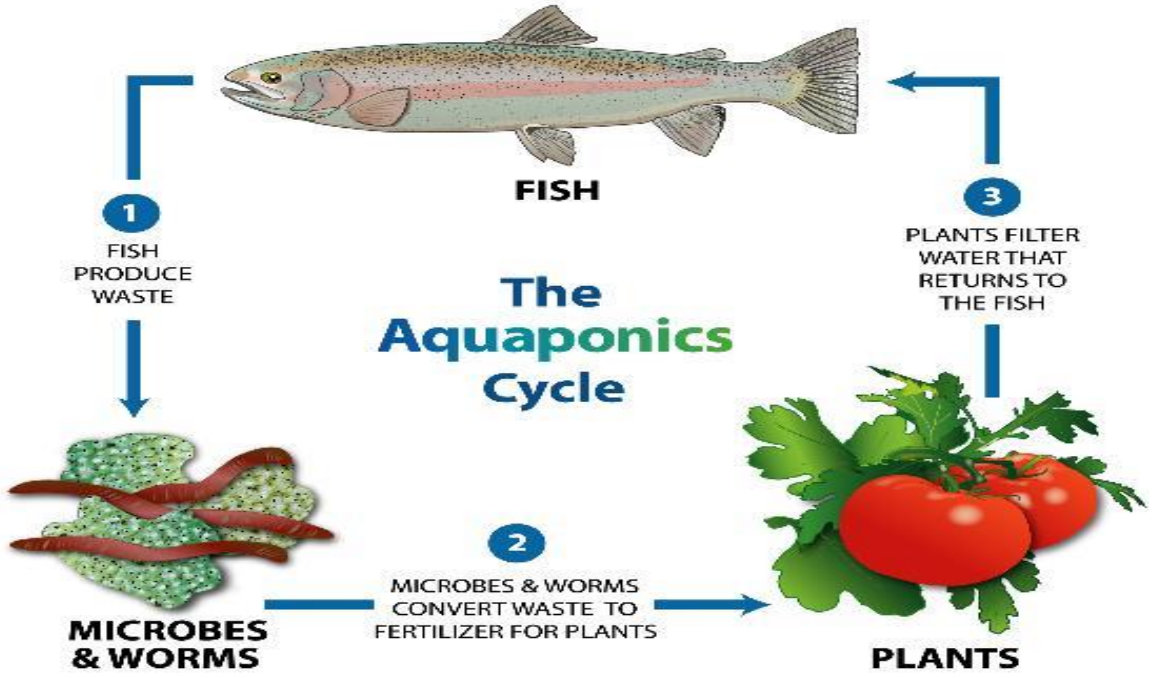
High Surface Area

- Bacteria will thrive on plant roots, tank walls and inside each grow pipe, media.
- Greater surface required for bacteria to colonize - efficient biofiltration.

Cycling the System

This is a n initial process of establishing a bacterial colony (nitrogen cycle) in the system.

- Ammonia from fish feed and feces is used to kick-start the cycling process.
- At least three weeks is required to build bacterial colony in the system
- New bacterial colony should be constantly supplied and monitored.



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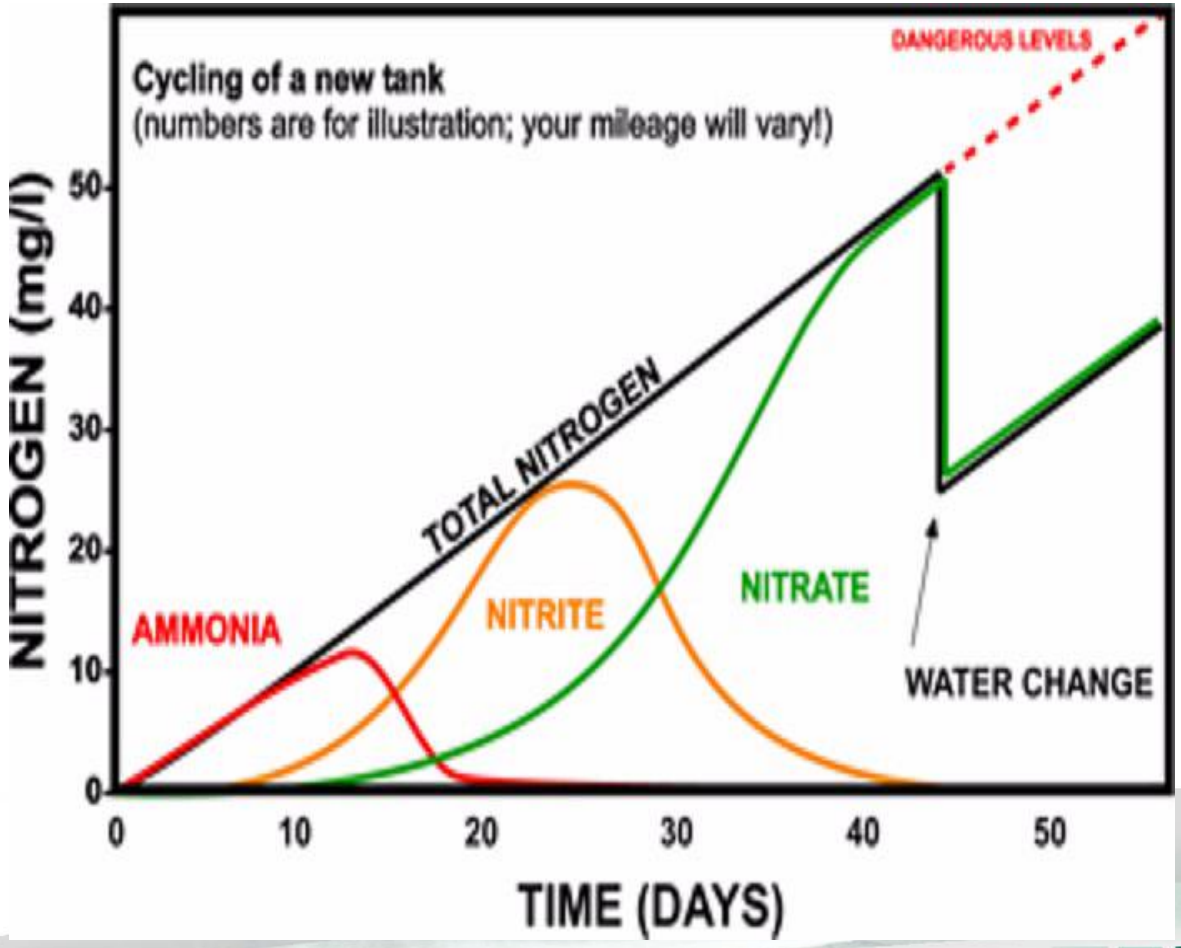
Cycling the System (Cont…)

- Nitrifying bacteria develops between 5-7 days after the introduction of ammonia
- Increasing levels of nitrite trigger the development of nitrifying bacteria after 8–14 days
- Nitrite declines as nitrifying bacteria increase
- Nutrient cycling gets completed after 20-25 days with nitrate that is readily available for plant assimilation



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Cycling the System (Cont…)

1. Cycling with fish

- Stressful to the fish and can even lead to mortalities.
- Requires very low stocking density during acclimatization and less feeding.
- ***Acclimatization*** – 2 weeks for fish to adapt to the new environment.

2. Cycling without fish

- Needing continuous addition of ammonia as there is no fish or food.
- Can be complete in 10 days to 3 weeks, which is less time compared to fish cycling.

Introducing fish and plants to the system

- Add plants and fish once the cycle is complete – to avoid fish and plant death
- Stock fish slowly to acclimatize to new environment

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Speeding up system cycling

Inoculating the system

- Using water or media sample as a seed of bacteria.

- Ensure that bacteria originates from the healthy system.

Increasing aeration

- Bacteria grow well in environments with high DO levels.

Manually adding ammonia

- Use other sources of ammonia from local markets

- Ensure that there is no additives that can harm the system.

Warming the water

- Heating water or cycle during the hot summer months to have warm conditions for fast-growing bacteria.

THANK YOU

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