

### 1.1.1. Spinach

The demand for greenhouse hydroponic baby leaf spinach has led to considerable research on growing techniques. However, to date there is limited commercial production in the United States, and overseas. The primary reason for this lack of production is the water mold *Pythium aphanidermatum* (further referred to as *Pythium*). This organism is present in the natural environment and attacks roots in a variety of field-grown crops. However, it is particularly virulent in hydroponic production systems due to its ability to spread through the nutrient solution.

Optimal temperature degree of Pythium disease might be 30°C but as we know they are still effective even around 20°C. So we are trying to set below 20°C even close to 16°C temperature and supporting by pH 5.0 .

So especially hot regions under risk of pythium and the farmers are in that region should be care about temperature and pH level if they would like to grow spinach.

Spinach like to grow under high O<sub>2</sub> level. This is even necessary for germination stage and in pond water. Otherwise, you will see slower germination and not uniform germination and again slower grow in the pond. Normally spinach seeds germination power is below 90% which is lower rather than other crop types. My advice is firstly you have to do germination test before growing and also get lab test about disease free or not.



Picture 15. Well germinated seeds



Picture 16. Very good quality spinach crop by

DWC

Our advice on this subject are:

- ✓ Dedicate a climate zone to spinach and other cooler crops. Spinach is actually winter type of crop as you know.
- ✓ A separate zone will permit to maintain a cooler air temperature regime better adapted to spinach without slowing down the rest of production; keep cooler nigh temperature.
- Make sure that the cooling exchanger capacity in those pools has been designed to maintain 18 to 20 °C degree temperature; maintain such temperature, targeting 18 °C
- Use recommended beneficial bacteria on seed and in media; it has been validated by our experimentation that some of the beneficials' tend to populate pool water, increasing their level. Previcur is a good chemical too which you can use also seeding time.
- Use liquid oxygen instead of venturis, either year-round or in the summer only; maintain 15 ppm if possible.
- Make quick growing cycle, not letting any plants growing over 15 days.
- Be sure you are using sanitized & dried board or equipments for spinach crop production always against to spreading disease.
- If necessary, as last recourse keep sanitizing spinach pool water; different methods exist like ozone, UV, Micro Bubble, Peroxide, but all those methods have the inconvenient to let pool water free of all bacteria, including the protecting ones, making it a good target for rapid 100% infection.
- Don't mix the things with other ponds if you have contaminated pond.



Advised Spinach fertilizer formula like below.

Spinach / ppm	
<i>N</i>	167
<i>P</i>	63
<i>K</i>	247
<i>Ca</i>	147
<i>Mg</i>	51
<i>Fe</i>	3
<i>Mn</i>	2
<i>Zn</i>	0.15
<i>Cu</i>	0.15
<i>Mo</i>	0.1
<i>Br</i>	0.25
<i>S</i>	35

*Table 4. Spinach fertilizer formula*

#### Practical recommendations for commercial spinach production

1. Dedicate a climate zone to spinach and other cooler crops
2. A separate zone will permit to maintain a cooler air temperature regime better adapted to spinach without slowing down the rest of production; keep cooler high temperature
3. Make sure that the cooling exchanger capacity in those pools has been designed to maintain 18 to 20 C degree temperature; maintain such temperature, targeting 18 C
4. Continue to use high light intensity and sum to support an active plant
5. If necessary, as last recourse keep sanitizing spinach pool water; different methods exist like ozone, UV, Micro Bubble, Peroxide, but all those methods have the inconvenient to let pool water free of all bacteria, including the protecting ones, making it a good target for rapid 100% Infection. Copper sulfate especially obtained by Nano tech is also good solution that we experienced.

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