e-GRO Edible Alert

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Volume 8 Number 11 August 2023

Visual symptoms of N, P, K, and Mg deficiency in hemp

The objective of this project was to demonstrate visual symptoms of common nutritional disorders of hydroponically grown hemp (*Cannabis sativa* L.) Four macronutrients (nitrogen, phosphorus, potassium, and magnesium) were selected. To generate the images used in this article, nutritionally deficient fertilizer was implemented in a deep water culture (DWC) hydroponic system in 1-gallon containers.

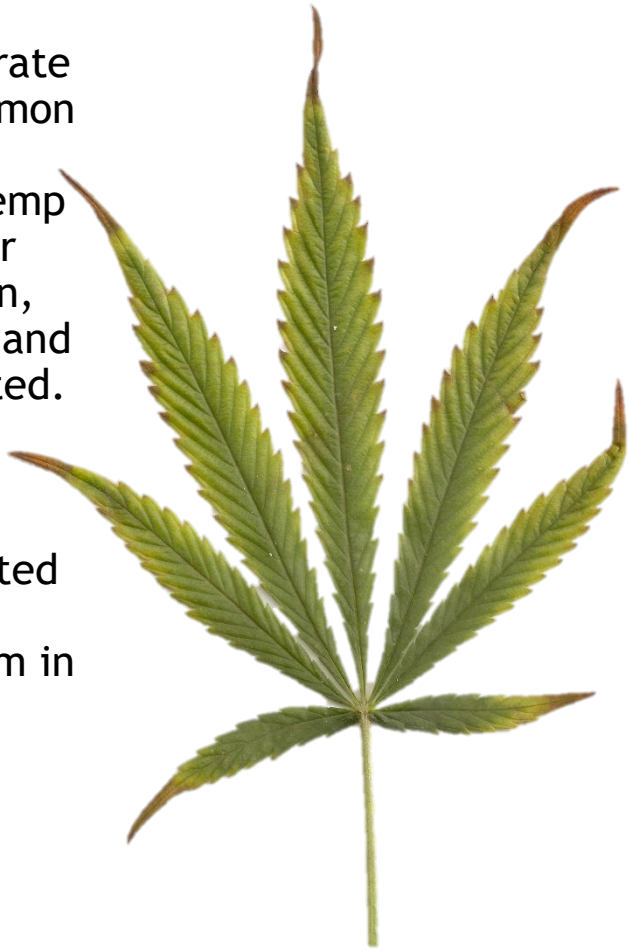

Figure 1. Hemp leaf exhibiting symptoms of potassium deficiency: leaf tip and margin chlorosis/necrosis.

Hemp cultivar 'TJ's CBD' was propagated vegetatively and rooted for 2 weeks before placement in the DWC system. There were two replicate plants per treatment. Table 1 lists the control fertilizer recipe, deficient nutrition solutions had 0 ppm for their respective N, P, K, or Mg deficiency. The plants were monitored, the DWC water was replaced, and data was collected weekly for 6 weeks. This article presents clear visual symptoms (leaf and whole plant) of nutrient disorders.

Element	Name	ppm
N	Nitrogen	210
P	Phosphorus	31
K	Potassium	235
Ca	Calcium	200
Mg	Magnesium	98
S	Sulfur	64
Fe	Iron	4.0
Mn	Manganese	0.5
Zn	Zinc	0.1
B	Boron	0.5
Cu	Copper	0.10
Mo	Molybdenum	0.01

Table 1. Control nutrient solution used during the experimental period. Single elements were removed to impose N, P, K, and Mg nutrient deficiencies.

Discussion

Once a plant is beginning to show visual symptoms of nutritional problems, there is likely already a negative change in overall plant health and productivity. If found early enough, growers can implement a change in fertilizer regimen. Identifying and tracking visual symptoms is very important for growers because various nutritional symptoms may look very similar, change in appearance/location, etc. Correct diagnosis of a crop's nutritional problems may pose a great challenge. Therefore, it is important to use laboratory tissue testing to definitively diagnose a disorder. Proactively monitoring crop fertility including weekly substrate testing for pH and EC and periodic laboratory tissue analysis (Table 2) can help identify nutrient disorders before they present obvious visual symptoms.

This report focused on visual symptoms of N, P, K, and Mg deficiency. An excellent resource for a more comprehensive assessment of macronutrient and micronutrient disorders in hemp is presented by Cockson et al. (2019).

Element	min	max
N %	2.5	4.0
P %	0.2	2.0
K %	2.0	4.0
Ca %	0.5	4.0
Mg %	0.5	1.5
S %	0.1	1.5
Fe ppm	100	300
Mn ppm	60	275
B ppm	30	150
Zn ppm	35	100
Cu ppm	2	20
Mo ppm	0.5	5
Na ppm	0	5000
Si ppm	0.2	6.5

Table 2. Sufficiency ranges for elemental tissue analysis of hemp/cannabis. Adapted from: Dr. Cari Peters, J. R Peters Laboratory. 6656 Grant Way, Allentown, PA 18106.

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Nitrogen (N)

Role in Plant:

N is a mobile nutrient that is needed in high amounts because it is the major component in chlorophyll, amino acids, and nucleic acids. In fiber hemp, higher levels of nitrogen increased plant leaf weight and decreased leaf THC content (Bosca et al., 1997).

Deficiency Symptoms:

Symptoms appear first in lower (mature leaves) initially as a lighter green color and progress as uniform chlorosis (yellowing) across the entire leaf blade (Figure 3). Eventually lower leaves may abscise. Plant exhibits overall smaller/stunted growth (Figure 2).

Figure 2. Nitrogen deficient hemp (right) compared to control plant (left) after six weeks of deficient conditions.

Figure 3. Progression of nitrogen deficiency symptoms

Phosphorus (P)

Role in Plant:

Potassium, a mobile nutrient, regulates the movement of water and nutrients in plant tissues. Potassium may play a role in creating sturdy stems.

Deficiency Symptoms:

Lower leaves are impacted first and develop irregular brown spots that eventually develop into water-soaked lesions (Figure 5). Plant size is somewhat smaller than control plants and leaves appear overall smaller/dark green (Figure 4).

Figure 4. Phosphorus deficient hemp (right) compared to control plant (left) after six weeks of deficient conditions.

Figure 5. Progression of phosphorus deficiency symptoms

Potassium (K)

Role in Plant:

N is a mobile nutrient that is needed in high amounts because it is the major component in chlorophyll, amino acids, and nucleic acids. In fiber hemp, higher levels of nitrogen increased plant leaf weight and decreased leaf THC content (Bosca et al., 1997).

Deficiency Symptoms:

Initial symptoms appear as leaf tip and leaf edge chlorosis/necrosis (yellowing/browning) of lower leaves (Figure 6). Over time the yellowing advanced inward into the areas between veins (Figure 7).

Figure 6. Hemp after six weeks of potassium deficiency. Note symptoms on lower leaves of leaf edge yellowing/browning.

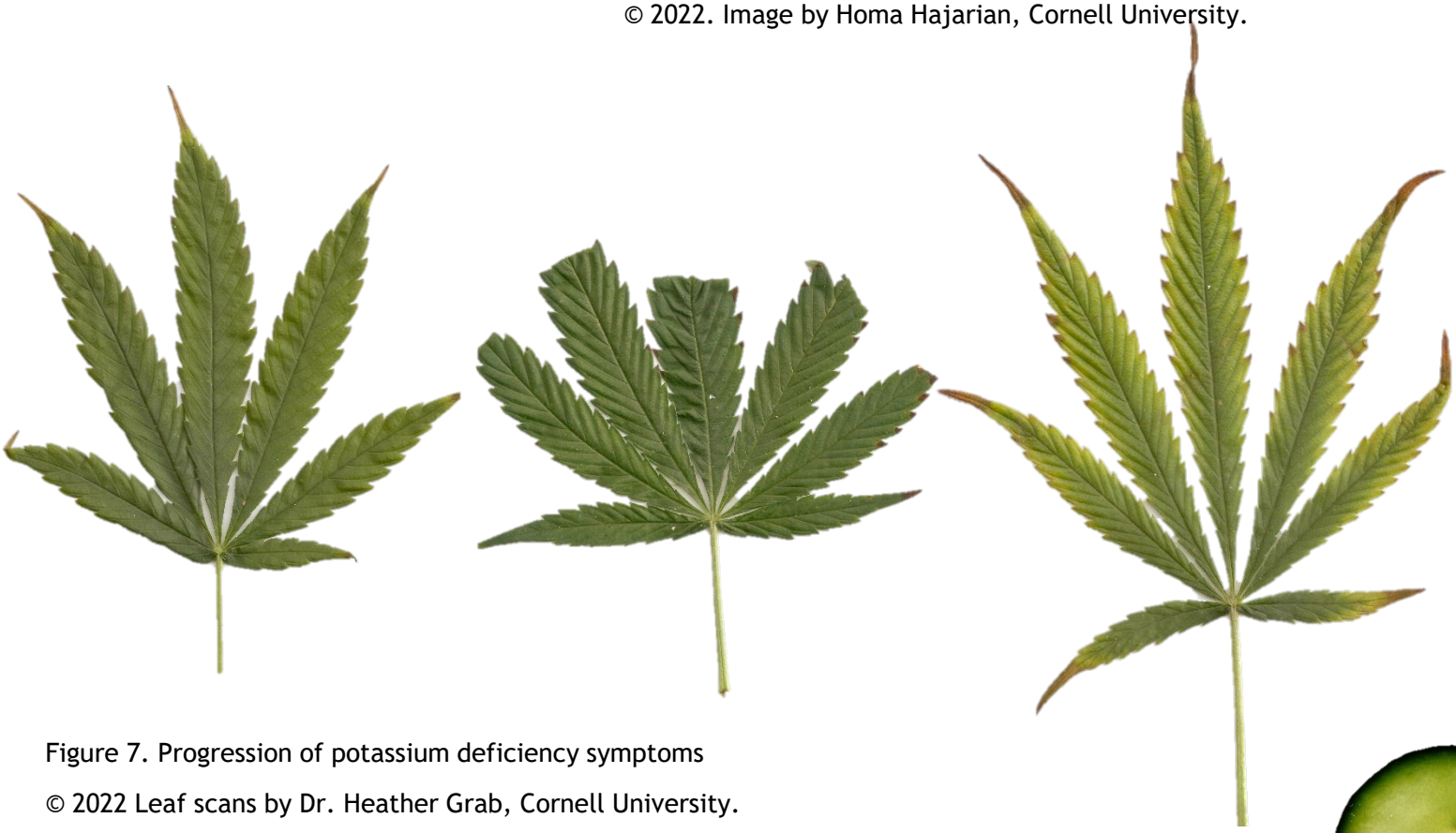

Figure 7. Progression of potassium deficiency symptoms

Magnesium (Mg)

Role in Plant:

Magnesium, a mobile nutrient, is an essential component of chlorophyll and thus required for green actively photosynthesizing leaves. Magnesium is also required for phosphorus metabolism and activation of some enzymes.

Deficiency Symptoms:

Symptoms first present as subtle interveinal chlorosis (yellowing between the veins). Over time this progress to more distinct chlorosis and eventually necrosis (Figure 9). Oldest leaves are affected first, and symptoms eventually move up the plant to affect middle-age leaves (Figure 8).

Figure 8. Hemp after six weeks of magnesium deficient conditions and is exhibited as interveinal chlorosis of lower leaves.

Figure 9. Progression of magnesium deficiency symptoms

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