The Effects of Nutrient Deficiencies On Bedding Plants

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The nutrient deficiency study experiment was set up so we could observe the symptoms of six different nutrient deficiencies- plus the control and two different unknown solutions- on four common bedding plants.

The four bedding plants we used in this study were petunia, tomato, marigold, and zinnia. The petunias and tomatoes were germinated in plug trays and later transplanted into a pot containing a mixture of perlite and water works. We direct seeded the zinnias and marigolds into the pots.

The pots were then placed in a plastic tub with four holes cut into the lid, with a cloth wick hanging down into the container to make sure that the plants had a constant supply of water.

The control group had all the macro and micro elements provided in their solution. The other six studies had one macro element missing, for example my plant was only missing magnesium and was supplied with all the other macro and micro elements. The other plants were missing nitrogen, phosphorus, potassium, calcium, and iron.

This experiment was run for eight weeks, which was long enough so that we could observe the different distinguishing deficiency symptoms of all the nutrients on all the plants.

Our professor mixed up two different solutions missing one of the nutrients in order to make us use our observations of the other symptoms to determine what nutrient was missing from that solution.

My observations from this experiment follow.
Control
Petunia Leaves are slightly red
Petunia Leaves are slightly purple
Petunia Good green color; full
Petunia Green leaves; no chlorosis
Petunia One leaf has marginal chlorosis; very full and bushy plant
Petunia Leaves are full; one flower bud; green leaves
Petunia Very good growth; two flower buds; upright and bushy; deep green color

Tomato Stems are purple
Tomato About 6-7 inches high
Tomato Starting to have flower buds
Tomato Has flower buds; plant is tall; healthy looking green leaves
Tomato Blooming soon; green leaves
Tomato Have several flowers; very tall, upright; deep green colors

Marigold Sprouted- 1/12
Marigold First set of true leaves
Marigold Two sets of true leaves
Marigold Deep green color leaves
Marigold Two flower buds; deep green color; small and compact

Zinnia Sprouted- 1/28
Zinnia One set of true leaves; dark green
Zinnia Full, deep green color; one flower bud
Zinnia Four sets of true leaves; good green color
Nitrogen

**Petunia**
- Lower leaves are yellow
- Lower leaves are yellow; purple along veins
- Extreme stunted growth; lower leaves are yellow
- EXTREME stunted growth; young leaves are green, older leaves yellow
- Has not grown in the last week; EXTREME stunted growth
- No growth in the last week; tough leatherly textured leaves

*At the eighth week, the test plant is extremely stunted, and does not seem to have grown any since they were transplanted. The lower leaves are yellow, and turning necrotic.*

*Symptom progression: upward from the lower leaves*

**Tomato**
- Leaves are slightly yellow
- Yellowing; white spots; lighter veins on lower leaves
- Severe stunted growth; yellowing leaves; purple/red stem
- EXTREME stunted growth (about half the size of control); dark purple stems; lower leaves chlorotic
- EXTREME stunted growth; lower chlorosis; young leaves are looking better than older leaves
- Not grown in the last week; the stem is deep purple, almost black
- No growth in the last week; chlorotic; purple; hardened growth

*At the eighth week, the test plant has no lower leaves, as they have died and dropped off. The stems and the underside of the leaves are extremely purple. They also have extremely stunted growth.*

*Symptom progression: chlorosis upward from the lower leaves to the upper leaves*

**Zinnia**
- Sprouted- 1/12
- One died- 1/28; there is necrosis on one
- Lower necrosis
- Plant is completely dead- 2/9

*Symptom progression: chlorosis was from the lower leaves up to the upper leaves*
Phosphorus

Petunia Leaves coming in white; intervenial chlorosis
Petunia Purpling around the edges of leaves
Petunia Lighter lower yellow leaves
Petunia Lower leaves are yellow, with some purple pigmentation
Petunia Some stunting. Older leaves are chlorotic; leaves are cupping
Petunia SEVERE stunting; cupping of leaves; necrosis along margins
*At the eighth week, the test plant is extremely stunted; it does not appear to have grown since they were transplanted; The lower leaves are necrotic, and all the leaves are cupped
*Symptom progression: chlorosis and necrosis was from the lower leaves upward

Tomato Like control
Tomato Extremely dark green leaves; deep purple veins
Tomato Deep purple color/ dark green leaves
Tomato Deep purple color; some stunted growth
Tomato EXTREME stunting; dark purple. Older leaves chlorotic. Purple underside of leaves
Tomato Bottom leaves are necrotic; extremely purple
*At the eighth week, the test plant is extremely stunted; the stems and leaves are extremely dark purple, almost black, with the lower leaves becoming necrotic and curling up.
*Symptom progression: from lower leaves up towards the younger leaves

Zinnia Sprouted- 1/12
Zinnia Distorted leaves
Zinnia Lower leaves are necrotic; young growth looks better than older growth
Zinnia Bottom leaves are necrotic
Zinnia Necrosis
*At the eighth week, the test plant has two true leaves, with the bottom leaves becoming necrotic.
*Symptoms progression: moved from the lower leaves up to the younger leaves
Calcium

Petunia  Slightly reddish leaf
Petunia  A purple leaf
Petunia  Severe stunting; one plant is dead; deformed new growth
Petunia  Two plants died- 1/28; EXTREMELY stunted; leaves are becoming strap shaped
Petunia  Strapped shaped leaves
Petunia  Strapped shaped leaves; extremely low to the pot; EXTREMELY stunted
Petunia  All three plants are dead- 2/18
* At the end of the eighth week, all the plants were dead.
* Symptom progression: apical death started at the top of the plant with the younger leaves

Tomato  Like control
Tomato  A bit of purpling in the leaves/stem
Tomato  Some stunting; Deep purple under leaf
Tomato  Distorted new growth; apical meristem distorted
Tomato  Apical meristem dying; deformed new leaves
Tomato  Apical meristem dead; new growth is deformed and curled
* At the end of the eighth week, the test plant is reduced to one stem with no leaves at the top; the apical meristem is completely dead.
* Symptom progression: started at the apical meristem.
Magnesium
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**Petunia**
- Lower leaves are yellow around edges
- Chlorosis on bottom leaves
- Veins are obvious
- No stunting; interveinal chlorosis in older leaves; some necrosis
- Lower leaves are yellowing; interveinal chlorosis; younger leaves look good
- Older leaves have interveinal chlorosis

*At the end of the eighth week, the test plant is about ¼ of the size of the control, but is full and most of the younger leaves have a dark green color. The lower leaves have signs of necrosis, and some of the leaves have purpling along the margin of the leaf.*

*Symptom progression: chlorosis started on the lower leaves*

**Tomato**
- Leaves are turning yellow-ish green
- No stunting what so ever, just as tall or taller than control
- No stunting; old leaves are interveinal chlorotic; deformed growth
- Interveinal chlorosis on older leaves; mild stunting
- Lower leaves are yellowing; interveinal chlorosis of older leaves; leaves are curling up and getting brown spots on them
- Necrotic lower leaves; interveinal chlorosis of older leaves

*At the end of the eighth week, the test plant is only slightly stunted, and the lower leaves are necrotic and are curling up. The younger leaves are green, but are curled up.*

*Symptom progression: chlorosis and necrosis progressed up the plant, starting with the older leaves up to the younger leaves*

**Zinnia**
- One seed sprouted- 1/19
- Seed died- 1/28
**Iron**

- **Petunia**
  - Leaves are yellow
  - Stems are light green
  - Minimal interveinal chlorosis
  - No stunting; some lighter yellow top leaves (young leaf chlorosis)
  - Young leaves have interveinal chlorosis
  - Interveinal chlorosis of young leaves
  - Newer leaves have chlorosis; lighter yellow leaves
  - *At the end of the eighth week, the plant is about the height of the control. The younger leaves are almost white, and have pronounced interveinal chlorosis.
  - *Symptom progression: interveinal chlorosis starting with the younger leaves

- **Tomato**
  - Light green leaves
  - No stunting; interveinal chlorosis on younger leaves
  - Intervenial chlorosis younger leaves
  - Middle leaves have interveinal chlorosis (spotty); older leaves look better
  - Have flower buds; same height as control; leaves are no longer spotty
  - *At the end of the eighth week, the test plant is about the same height as the control, and even has some flower buds. The younger leaves have a hint of interveinal chlorosis, and the older leaves have a more consistent green coloring.
  - *Symptom progression: interveinal chlorosis from the middle leaves from the top of the plant

- **Zinnia**
  - Sprouted- 1/28
  - Young leaves are chlorotic
  - Young leaves have interveinal chlorosis
  - *At the end of the eighth week, the test plant has four true leaves and a good green coloring.
  - *Symptom progression: the symptoms appeared first on the younger leaves
Unknown A- Phosphorus deficiency

- I conclude that the Unknown A is an example of phosphorus deficiency because many symptoms match with the symptoms of the minus phosphorus test plant.
- The severe, extreme stunting that affected all the plants is indicative of phosphorus deficiency.
- Severe purpling of the leaves
- The petunias had yellowing and necrosis of lower leaves, which followed the pattern of phosphorus deficiency.

*At the end of the eighth week, only one petunia was still alive, and had extreme stunting of growth. The tomato is a deep purple color with necrosis of the bottom leaves. The zinnia is dead. 
*Symptom progression: From the lower leaves to the younger leaves
Unknown B

- I believe that these plants suffered from calcium deficiency.
- The major symptom that helped me reach this conclusion was the obvious death of the *apical meristem* on the tomato was dead, resulting in *deformed new growth*.
- Also, neither the zinnia or the marigold sprouted, and the calcium deficiency was the only study in which neither the zinnia or the marigold sprouted
  *At the end of the eighth week, the petunias are all dead. The tomato has no apical meristem and the leaves that it does have are curled, and have a deep purple underside.
  *Symptom progression: from the apical meristem down the plant.