Efficacy of Daniels Plant Food

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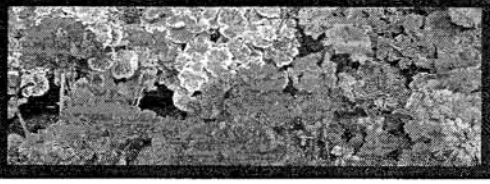


Our research was driven by three concerns

1. Daniels Formula

- The 10-4-3 ratio is unprecedented.
  - Can one odd 10-4-3 formula work for many species?

2. Low K Content

- K_2O at 30% of N in Daniels 10-4-3 is not typical of greenhouse fertilizers.
  - A 1:1 ratio is common: 20-10-20, 15-5-15, 13-2-13, etc.
  - Will 3% K_2O meet plant K needs?

3. High Level of Reduced N

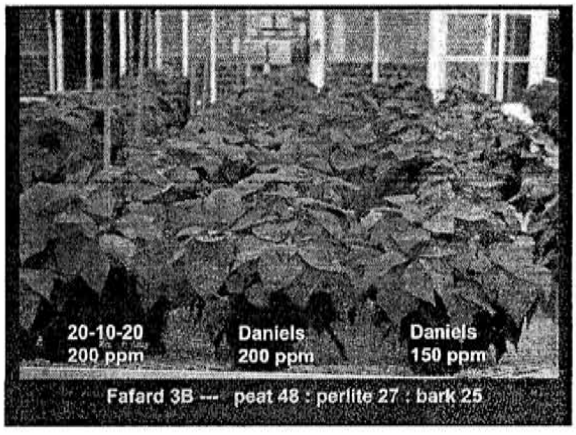
- Within the 10% N in Daniels there is 3.70% $NH4^+$, 3.65% urea, and 0.75% organic N for a total of 81% of N in reduced forms.
  - Greenhouse fertilizers are typically formulated at or below 40% reduced N to avert ammonium toxicity.
  - Is ammonium toxicity a threat from Daniels?

Daniels Plant Food Concerns

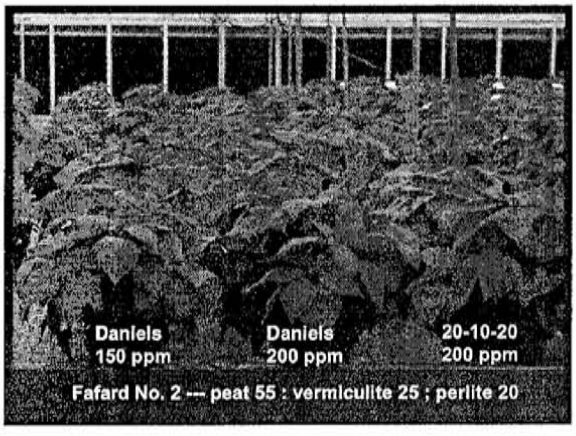
1. Can one odd 10-4-3 formula work for many species?
2. Will 3% K_2O meet plant K needs?
3. Is ammonium toxicity a threat from Daniels with 81% of its N in a reduced form?

Experiment 1

- **Fertigation:**
  - Daniels 150, 200, 250 ppm N
  - 20-10-20 200 ppm N
- **Substrate:**
  - Fafard No. 2 with vermiculite – supplies K
  - Fafard No. 3B with pine bark – tie up K



Fafard 3B --- peat 48 : perlite 27 : bark 25



Fafard No. 2 --- peat 55 : vermiculite 25 ; perlite 20

Experiment 1 Results

- **Weight and Height did not differ.**

Substrate Analysis

	pH	EC
20-10-20	5.50	0.90
Daniels	5.90 ↑	0.70 ↓ (-22%)

Poinsettia Leaf Analysis (end of crop)

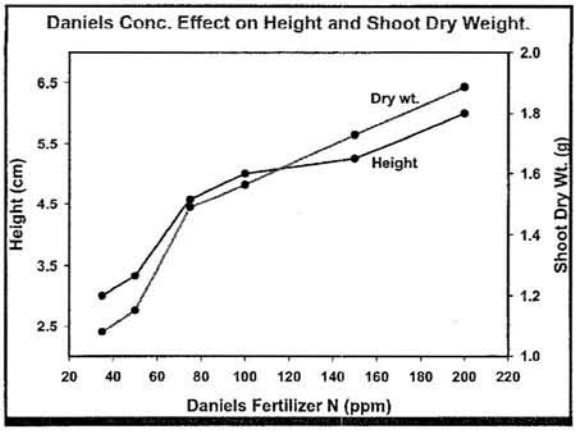
Fertilizer	N (%)	P (%)	K (%)	Mg (%)	Cu (ppm)
20-10-20	4.50	1.01	3.14	0.46	5
Daniels	5.35 ↑	1.20 ↑	2.51 ↓	0.54 ↑	3 ↓
Stds.*	4.00-6.00	0.20-1.00	1.50-5.00	0.20-1.00	5-10

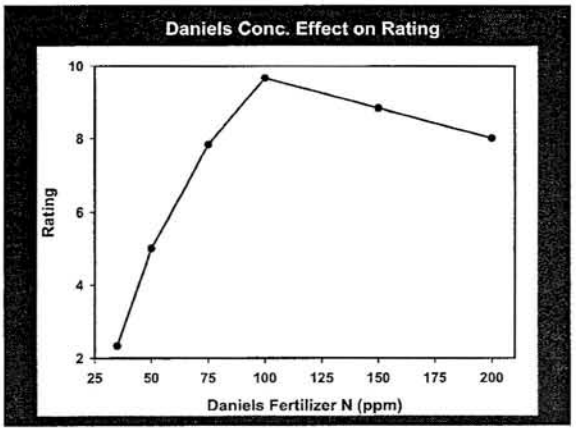
Up: N, P, Mg; Down: K, Cu

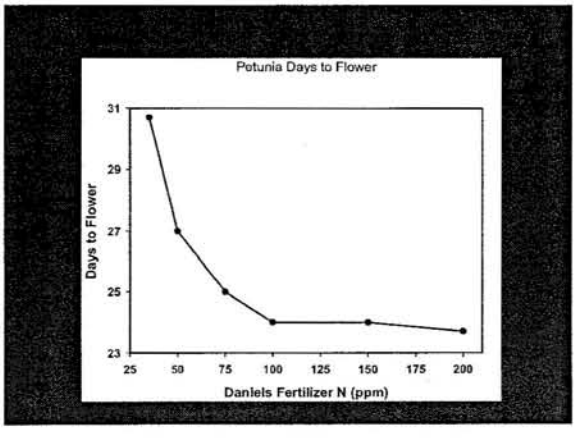
*Mills & Jones: flowering plants

Experiment 2

- Petunia 'Dreams Midnight'
- Fertilizers:
  - Daniels
  - A40 (20-10-20 with 40% of N as NH_4^+)
  - A70 (20-10-20 with 70% of N as NH_4^+)
- N concentrations:
  - 50, 100, 200 ppm
  - Daniels also at 35, 75, 150 ppm N
- Fertigation (except weekends)

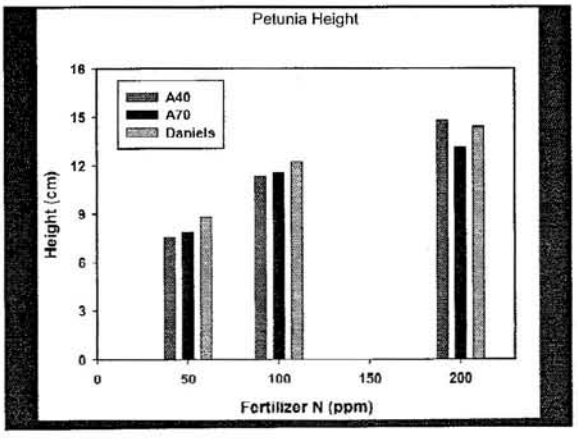


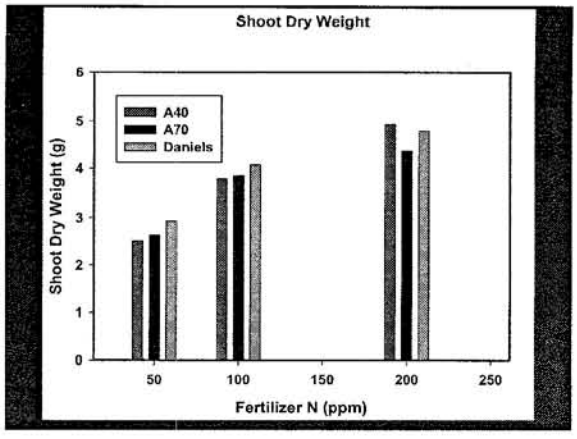


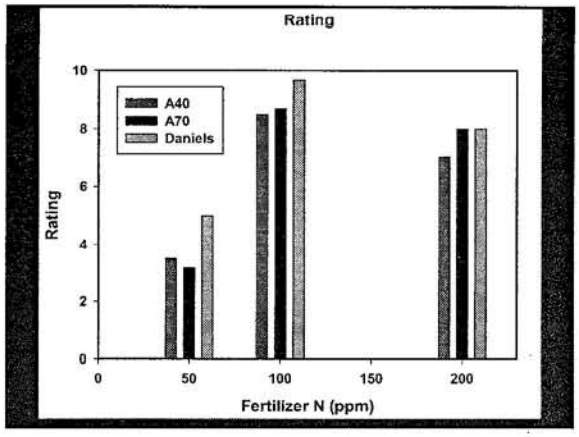


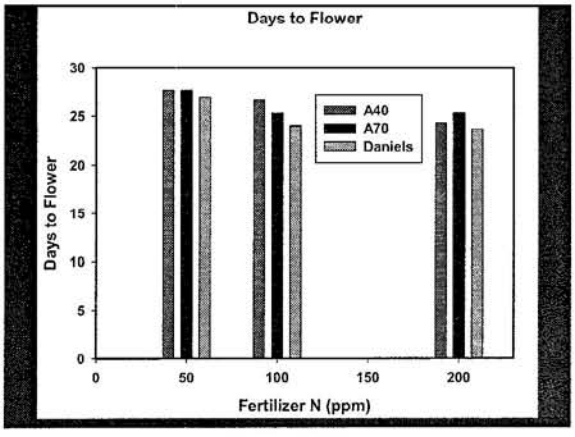
Daniels Concentration Conclusions

- 100 ppm N worked well for fertigaiton.
  - At this level growth was not excessive for a 48 cell flat
  - Rating was highest
  - Days to flower were at a minimum





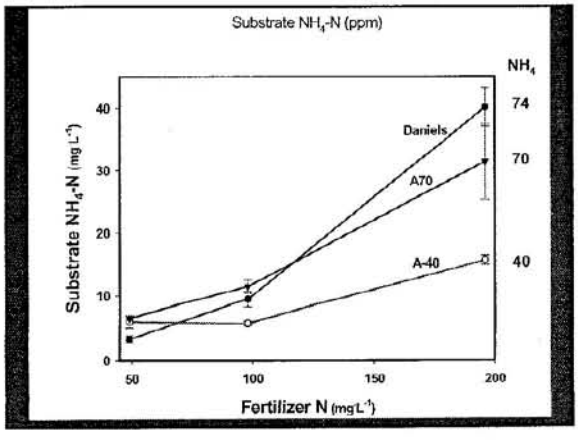


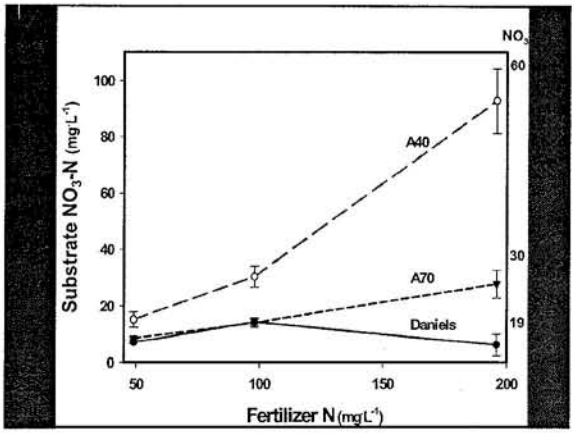


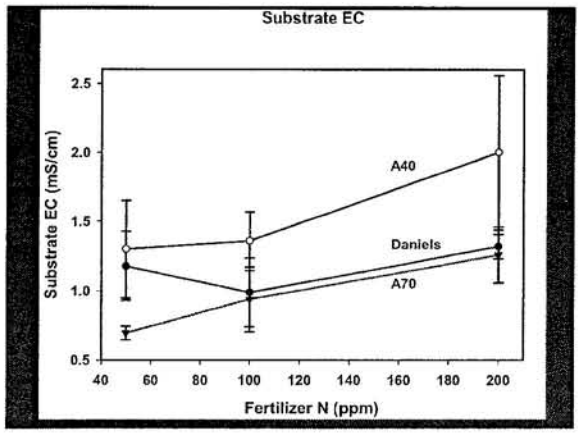
Growth Summary

- At sub-optimal fertilization plants grew larger in height and weight with Daniels.
- Rating peaked at 100 ppm N for all fertilizers and was highest with Daniels at that concentration.
- Days to flower reached a minimum plateau at 100 ppm N and was lowest for Daniels.

- Ammonium toxicity did not occur in any treatments.
- No signs of K deficiency occurred at 100 and 200 ppm of any of the fertilizers.







Substrate Summary

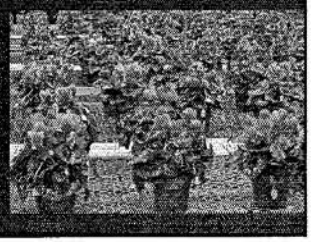
- Daniels resulted in concentrations of NH_4 and NO_3 in the substrate similar to A70.
- EC from 100 ppm Daniels was only 72% as high as from 100 ppm A40.
- EC from 200 ppm Daniels was only 66% as high as from 100 ppm A40.

Experiment 2 Summary

- The best fertigation rate of Daniels was 100 ppm N.
- Daniels rated higher than the other fertilizers.
- Daniels flowered 3 days earlier, a 10% gain over A40.
- Substrate EC was lower with Daniels compared to A40.

Experiment 3

- Cyclamen (high K requirement: 1N:2K_2O)
- Fertilizers:
  - Daniels, 20-10-20
  - 125 ppm N first 6 wks. then 175 ppm next 6 wks.



Growth Results

- No differences in:
  - plant canopy height
  - flower height above canopy
  - plant diameter
  - plant fresh weight
  - corm fresh weight
  - no. of shoots, leaves and flower buds.

Growth Results

- Flowers per plant at end of 12 weeks.
  - Daniels 9.7
  - 20-10-20 6.6
  - A gain of 47% over 20-10-20

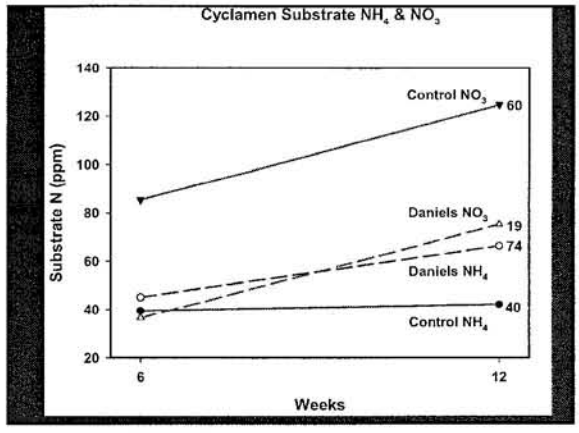
Growth Results

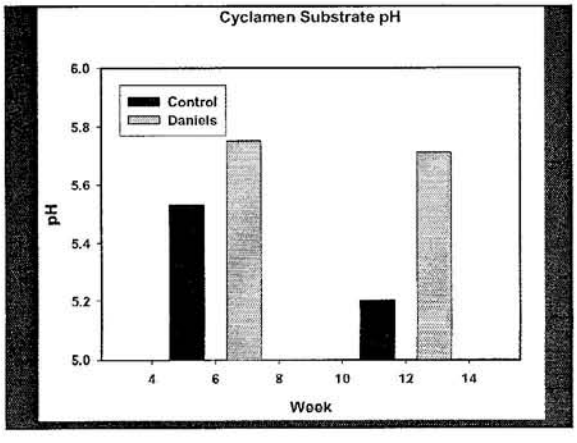
- No signs of ammonium toxicity.
- No signs of K deficiency.

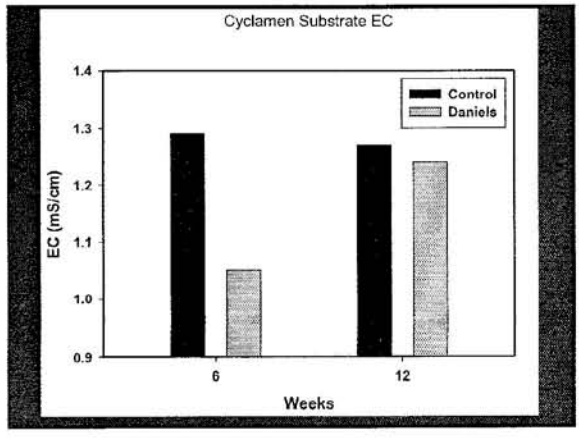
Cyclamen Leaf Analyses

	N	K	Fe	Mn	Zn
6 wks					
Control	3.49	3.70	49	130	48
Daniels	3.48	2.69 ↓	85 ↑	127	24 ↓
12 wks					
Control	3.48	3.54	99	92	84
Daniels	3.77 ↑	2.66 ↓	146 ↑	119 ↑	35 ↓

K, Zn Down; N, Fe, Mn Up K2.26% acceptable, Mills & Jones

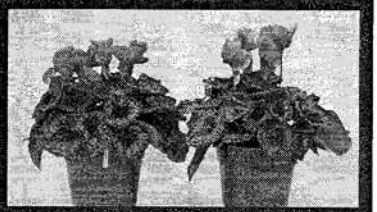






Cyclamen Summary

- Similar growth.
- Increased flowering.
- Higher pH.
- Lower EC.



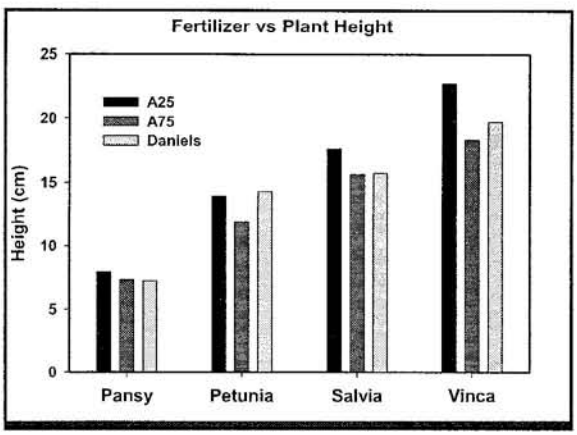
Experiment 4

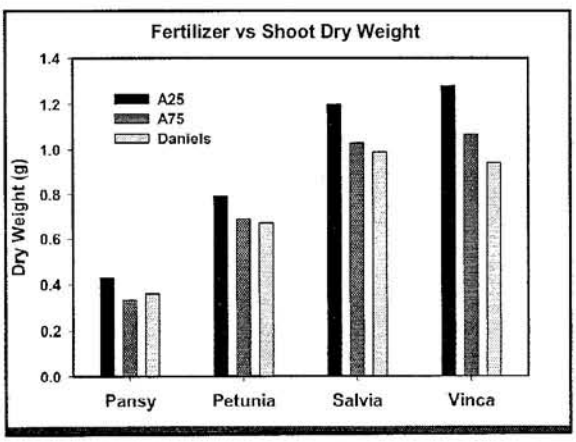
- 7 species
  - dianthus, pansy, petunia, salvia, snap, verbena, vinca
- 3 fertilizers
  - A25 (20-10-20 with 25% of N as NH_4)
  - A75 (20-10-20 with 75% of N as NH_4)
  - Daniels
- 2 pH levels 3.3 and 10 lbs limestone/yd^3
- Fertilizer concentration: 100 ppm N
  - (Daniels also at 200 ppm N)

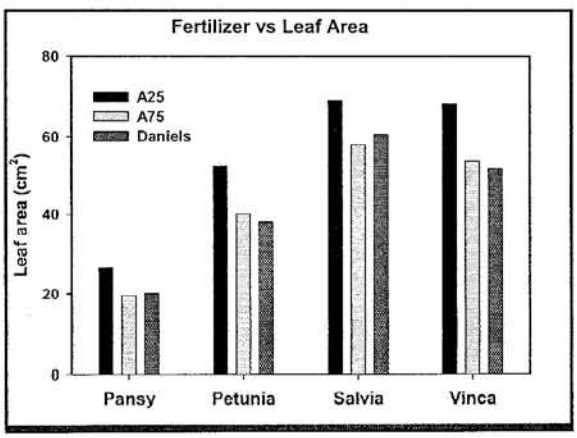
Depth of Green

	dianthus	pansy	petunia	salvia	snap	verbena	vinca
A25	3	3	3	3	3	3	3
A75	3	2	4	3	2	3	2
Daniels	3	4	5	3.5	4	4	4

Rating 1 = chlorotic; 6 = deep green.



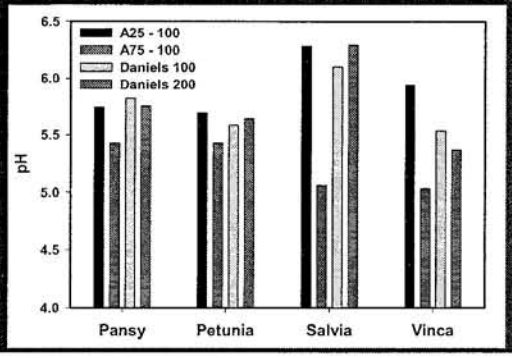




Overall Impact of Daniels on Growth

- Daniels bedding plants range from equivalent height to modestly shorter.
- Dry weight modestly lower.
- Leaf area much less:
  - leaves thicker and deeper green.
- Response to Daniels is somewhat similar to a high ammonium fertilizer.

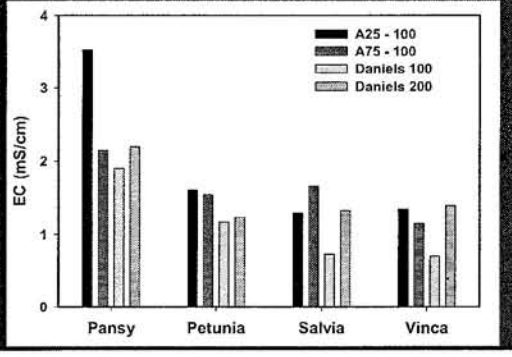
Impact of Fertilizers on pH



Overall Impact of Daniels on pH

- A75 at 100 ppm N caused a large decrease in pH.
- Daniels at 100 ppm N resulted in no pH decrease or only a modest decrease.
- Daniels at 200 ppm N generally resulted in similar pH to 100 ppm, suggesting buffering by organic matter.

Impact of Fertilizers on EC



Overall Impact of Daniels on EC

- At equal N concentration, Daniels has an EC level of 52 to 73% that of 20-10-20.
- When Daniels N concentration is 200 ppm its EC is only 62 to 104% that of 20-10-20 at 100 ppm.

Pansy Leaf Analysis

	K (%)	Ca (%)	Mg (%)	Fe (ppm)	Mn (ppm)	Zn (ppm)
A25	3.78	1.83	1.36	279	2517	393
A75	3.91	0.81 ↓	0.87 ↓	274	1677 ↓	344
Daniel	2.88 ↓	0.83 ↓	0.90 ↓	619 ↑	1116 ↓	183 ↓

Fe Up; K, Ca, Mg, Mn, Zn Down

Petunia Leaf Analysis

	P (%)	K (%)	Ca (%)	Mg (%)	Fe (ppm)
A25	0.43	1.99	1.97	1.63	105
A75	0.57 ↑	3.81 ↑	0.91 ↓	0.72 ↓	109
Daniel	0.63 ↑	2.08	0.92 ↓	0.69 ↓	251 ↑

P, Fe Up; Ca, Mg Down

Salvia Leaf Analysis

	N (%)	K (%)	Mg (%)	Fe (ppm)	Mn (ppm)	Cu (ppm)
A25	4.91	2.21	1.68	80	762	11.3
A75	4.04 ↓	2.83 ↑	1.00 ↓	151	1205 ↑	16.3 ↑
Dan	4.43 ↓	1.81 ↓	1.33 ↓	552 ↑	1242 ↑	16.3 ↑

Fe, Mn, Cu Up; N, K, Mg Down

Vinca Leaf Analysis

	P (%)	K (%)	Ca (%)	Mg (%)	Fe (ppm)	Zn (ppm)
A25	0.50	1.81	2.22	1.19	113	119
A75	0.61 ↑	2.60 ↑	1.30 ↓	0.62 ↓	111	170 ↑
Daniel	0.57 ↑	1.41 ↓	1.24 ↓	0.62 ↓	129 ↑	102 ↓

P, Fe Up; K, Ca, Mg, Zn Down

Overall Effects of Daniels on Bedding Plant Nutrient Uptake

- Increased: P, Fe, (Cu)
- Decreased: K, Zn, (Ca, Mg)

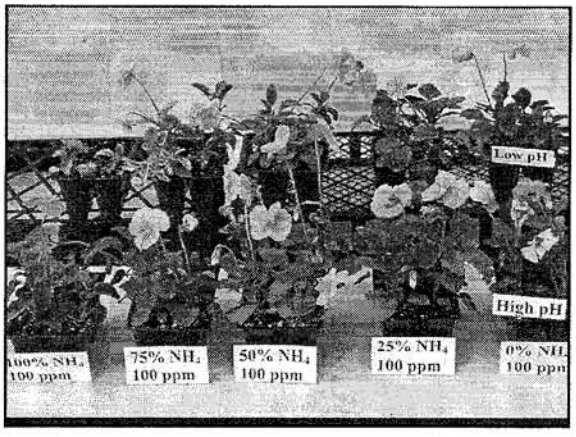
Leaf K Standards

	Pansy	Petunia	Salvia	Vinca
NCSU* min critical	1.17	0.69	0.22	0.73
Mills & Jones	2.39	3.13	2.90	1.88
A25	3.78	1.99	2.21	1.81
Daniels	2.88	2.08	1.81	1.41

*Gibson, et al. 2007. Nutrient deficiencies in bedding plants. Ball Pub.

NH_4 Toxicity Increased by:

- High level of substrate NH_4 and/or urea N.
  - from high proportion in fertilizer or high concentration of fertilizer.
- Low substrate pH.
- Low substrate temperature.
- Low substrate oxygen (water logged)



Ammonium Toxicity

- Young plants
  - Young leaf margins curl
  - Interveinal chlorosis – young leaves
  - Necrosis – young leaves
  - Fewer roots
  - Root tip burn
- Older Plants
  - Older leaf margins curl
  - Irregular chlorosis – mid & old leaves
  - Necrosis - mid & old leaves
  - Fewer roots
  - Root tip burn

Ammonium Toxicity

Young plants:
interveinal chlorosis and curl of young leaves.

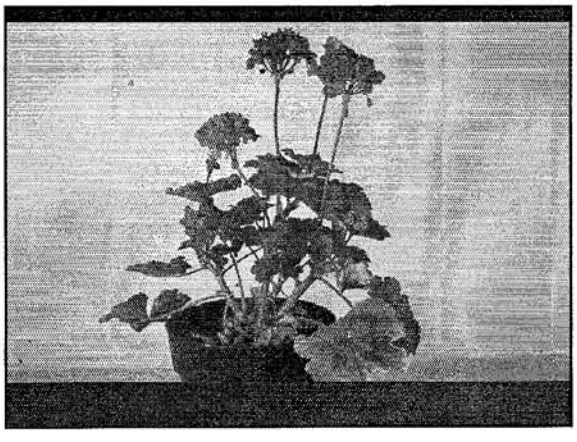
Ammonium Toxicity

Older plants

leaf curl, chlorosis, necrosis - old leaves first

Ammonium Toxicity

Older plant – lower leaves (tobacco)



Ammonium Toxicity

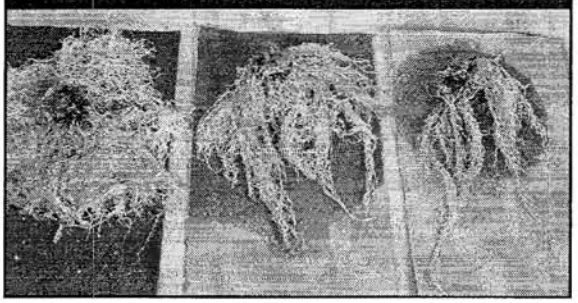
Older plant – pot mum

lower leaf chlorosis & necrosis

root tip death

Impatiens Roots

50% 75% 100% NH_4



Ammonium Toxicity in High pH Treatments

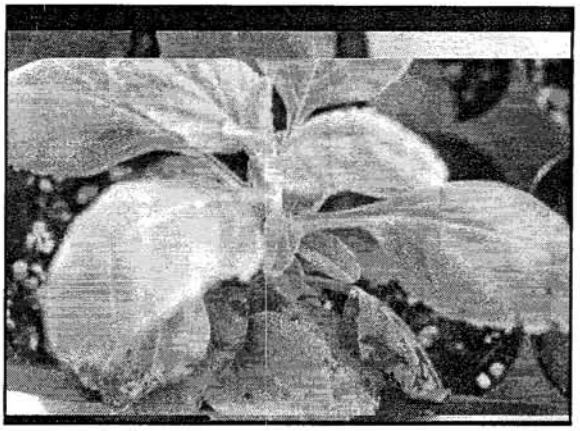
- No ammonium toxicity occurred in the high pH treatments.

Ammonium Toxicity in Low pH Treatments*

	dianthus	pansy	petunia	salvia	snap	verbena	vinca
A25-100	0	1	1	0	0	0	0
A75-100	2	3	2	2	2	3	3
Dan. 100	0	2	0	0	0	0	0
Dan. 200	0	2	0	0	0	0	0

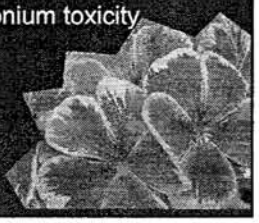
*No ammonium toxicity in high pH treatments.

Rating: 0 = no symptoms, 1 = light chlorosis and/or roll, 2 = moderate, 3 = necrosis and extensive chlorosis.



Overall Assessment of Daniels

- Effective across several plant species.
- Supplies adequate potassium.
- Very resistant to ammonium toxicity.
- Bedding plants are a little more compact.
- Some earlier flowering.



Overall Assessment of Daniels

- Substrate analyses.
  - –Higher pH
  - –Lower EC

Overall Assessment of Daniels

- Leaf analysis.
  - –Higher P, Fe
  - –Lower K, Zn, (Ca, Mg)
    - But, no toxicities or deficiencies.

Questions?

Comments?