



Nutrient Management for Cannabis Gets Real

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Legal Preamble

Due to US Federal regulations,
Nutrien does not knowingly sell inputs for
the production of cannabis.

This presentation is not to be associated
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Disclaimer

- I am NOT a cannabis nutrition expert!
- “Real” experts won’t speak in public.
- Nutrien briefly considered selling into the fertilizer market.
- I was tasked with developing a fertilizer program for hydroponic production of cannabis.



Introduction

- Hydroponic dealers have supplied custom fertilizer management for cannabis for years. This will continue for hobby growers.
- As production scales up in a regulated market, it is time to treat cannabis like any other crop.



Mystical Fertility

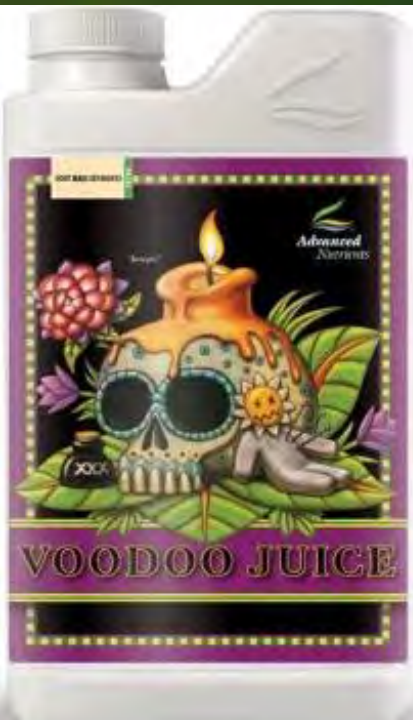
- Cannabis is (apparently) a mystical plant.
- Growing must require mystical fertilizer!
- Hobby growers have little knowledge of chemistry nor access to the technical grade fertilizers needed to create their own hydro programs.



Hydro Programs

- Current programs are all effective at producing quality cannabis, if used as directed.
- Most programs have multiple products that make it easier to follow plant needs for nutrients as it grows.
- Products are very expensive!





Myth Busting

- Cannabis needs the same essential nutrients as any other crop.
- Cannabis has nutrient requirements very similar to determinant greenhouse tomato.
- Successful production can take place with just two different fertilizer blends by varying injection rates over time.



Plant Essential Nutrients

- These are the elements a plant MUST have available to complete a life cycle from seed to flower to fruit to viable seed.
- Determined in nutrient culture by growing the plant with all nutrients except one.
- Currently, there are 17 essential nutrients:
C H O P K N S Ca Fe Mg B Mn Cu Zn Mo Ni Cl



N Nitrogen

- In hydroponics, nitrate should dominate with a ratio of around 70:30 $\text{NO}_3:\text{NH}_4$
- Urea not acceptable for media.
- Most important during vegetative growth.
- Reduce N during flowering.
- Ammonium, potassium, calcium and magnesium nitrates



P Phosphorus

- Helps with root development and flower formation.
- Solution concentrations increase sharply with the onset of flowering.
- Mono potassium phosphates



K Potassium

- Similar to tomato, cannabis has a very large requirement for K.
- Moving sugars from leaves to flowers, water relations, etc.
- Concentrations increase substantially beginning at flowering.
- Do not use thiosulfates in media. Potassium nitrate and phosphates are main sources.



Ca Calcium

- Calcium is included in media as gypsum and lime, but need supplementation in liquid feed.
- Calcium nitrate is common fertilizer, supplying both nitrate-N and Ca.
- Used most during vegetative stage.



Mg Magnesium

- Important for chlorophyll.
- Found in dolomite lime (media) and Epsom salts, magnesium nitrate (liquids).
- Important throughout cycle but required in low amounts.



S Sulfur

- Critical for several essential amino acids.
- Should be in a ratio of 5:1 as N:S.
- Sulfates are main source, found in micronutrients, ammonium and potassium sulfate, gypsum, etc.
- Elemental sulfur is not acceptable in media!



Micronutrients

- Metals (Fe, Mn, Zn, Cu, Ni)
 - Important for chlorophyll, reactions, stress management, etc.
 - Fe and Mn concentrations higher than Zn
 - Want compact plant with no seeds; low auxin
 - Chelates or sulfate forms
- B, Mo, Cl
 - trace amounts required



Silicon?

- Some growers believe that boosting silicon will stimulate trichome formation, leading to increased terpenes (flavor compounds).
- This seems to be incorrect.
- Silicon may make stronger trichomes but is not linked to terpene formation.
- Plenty of silicon in water naturally.



Hydroponic Fertility Program

- Need all essential nutrients.
- Some fertilizers incompatible.
- Can't mix everything together in a concentrated form.
- We can inject incompatible products at low rates enough for plant growth, without precipitation



Reverse Engineering

- Access to a “premium” hydro program
 - 13 different products, all way under analysis
 - One 2.5 gal jug had a \$589 price sticker
 - Between 4 – 7 different products per week
- Nutrient solution analysis of the program at four or more growing stages.
- Used tomato “model” to develop a program that fit the points.

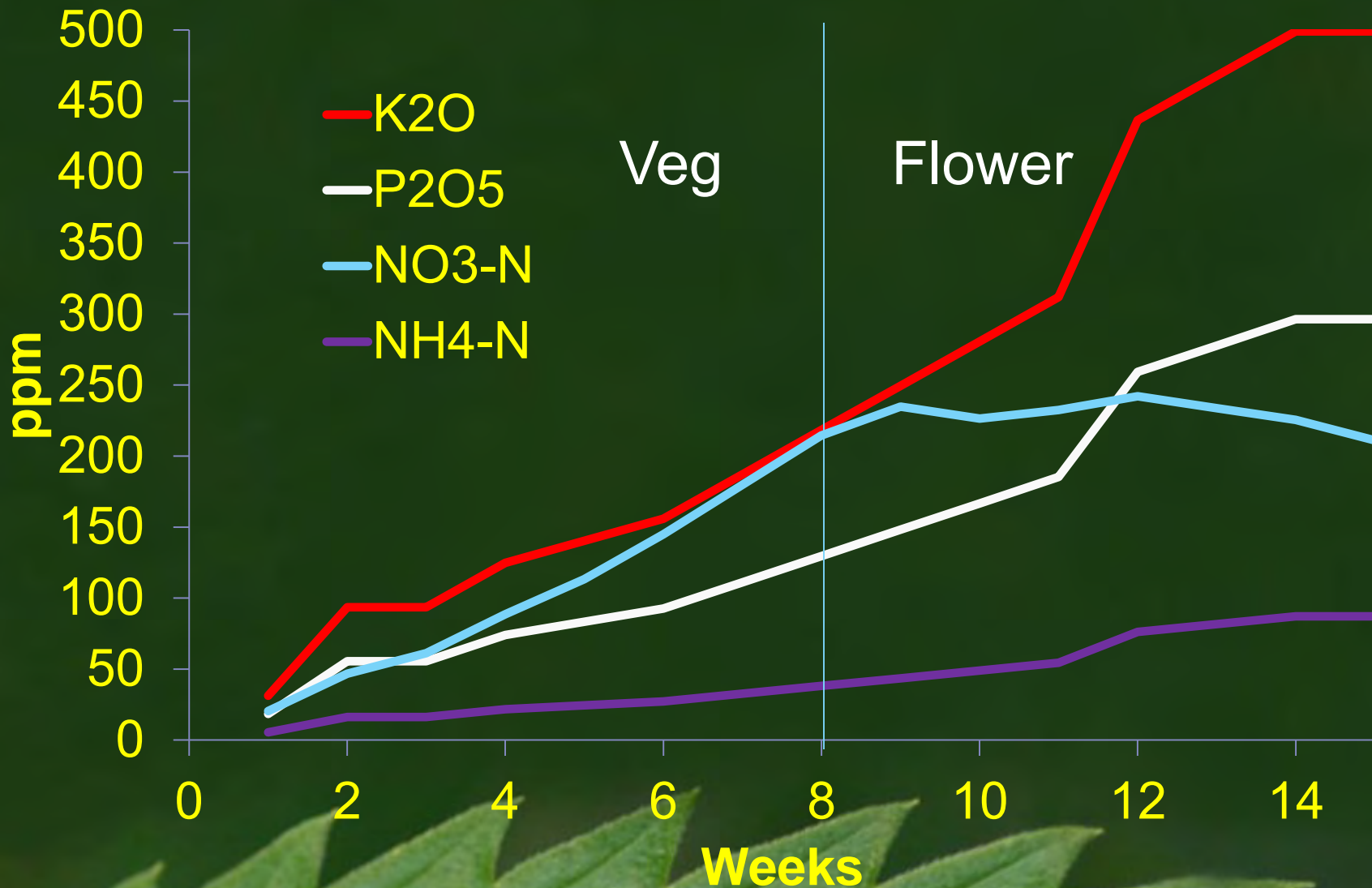


Fertility Program

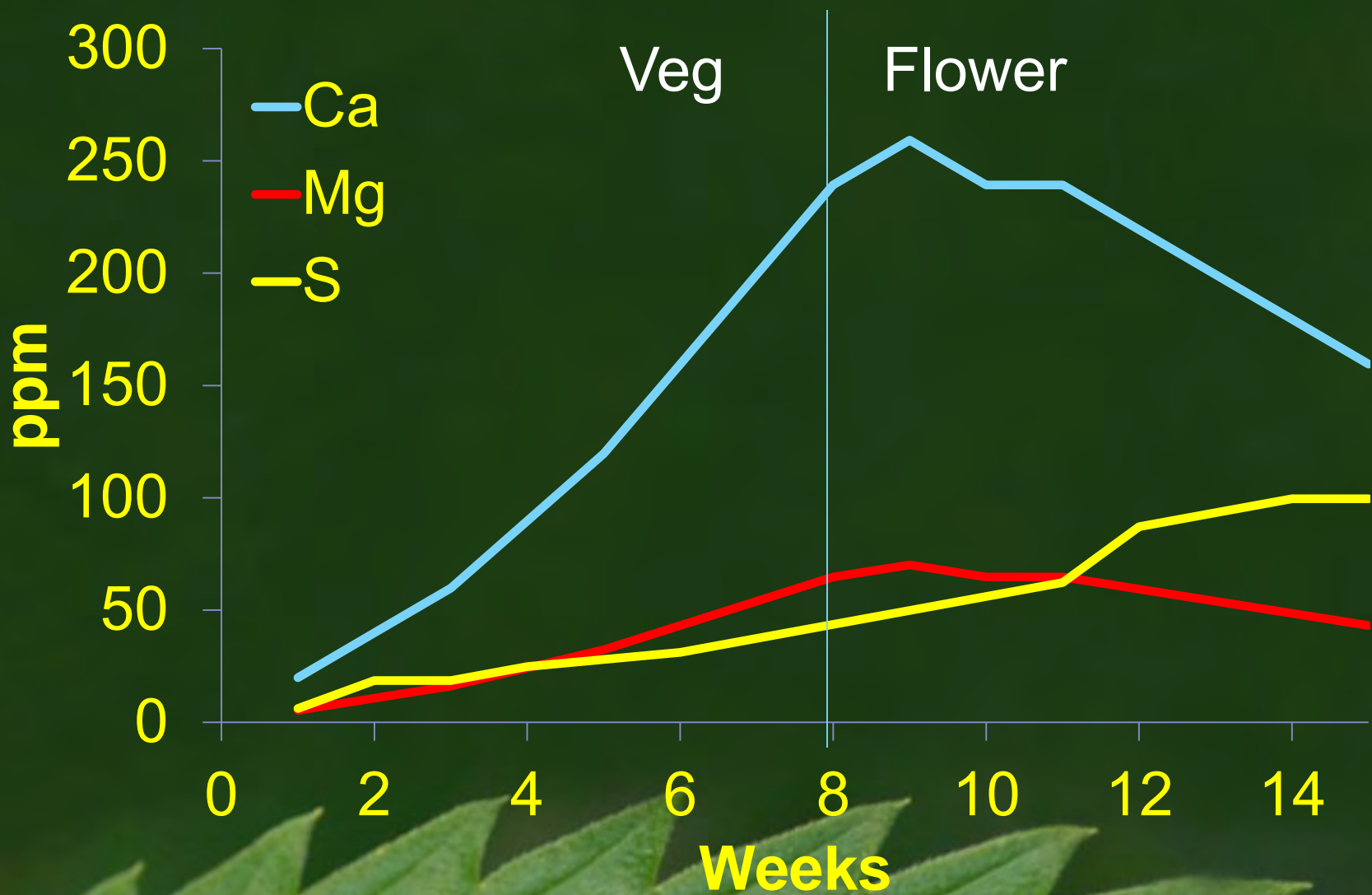
- Typical hydroponic programs can have two blends:
 - Grow Formula
 - High in Nitrate-N, Ca, Mg. Contain B and Mo
 - Higher rates during vegetative development.
 - Flower Formula
 - Low N, high P, K, S, Fe, with Mn, Zn, Cu
 - Higher rates during flowering.
- The two are run simultaneously at varying rates.



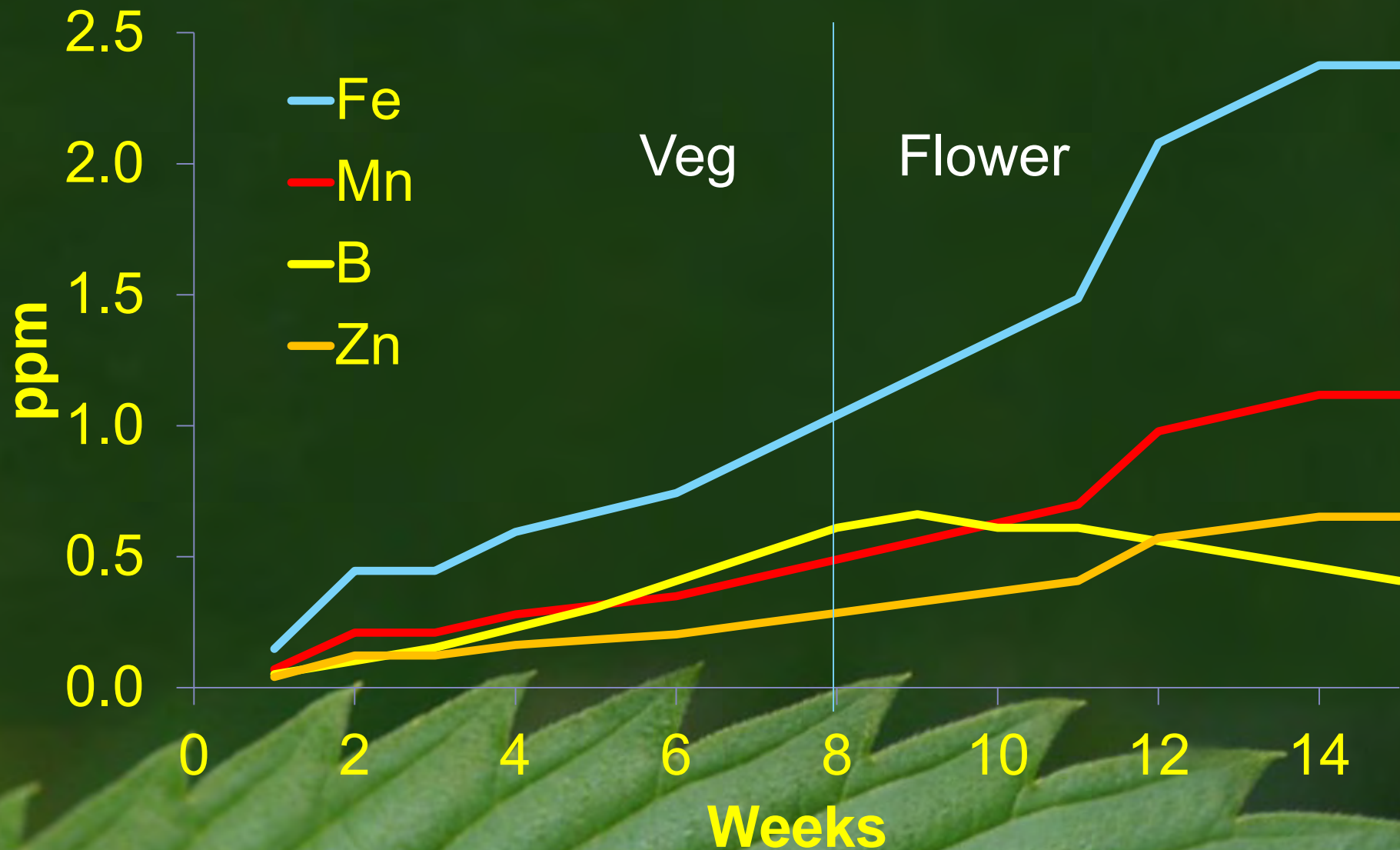
Program: NPK



Program: Ca Mg S



Program: Fe Mn B Zn




Discussion

- This program apparently works.
- Is it the “best” fertility program?
 - Need independent fertility research to determine best practices.
- The same approach should be taken for field grown hemp (CBD) and cannabis.
- Growers need to be trained in nutrient management and BMP's.



Conclusion

- Increased production of cannabis will lower the retail price of the final product.
 - Have to lower input costs.
 - Scaling up will result in more bulk sales.
 - Learning more about fertilizer and nutrient requirements of cannabis will allow for input cost savings and more control over the final product.
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- A close-up photograph of several vibrant green cannabis leaves, showing their serrated edges and prominent veins, positioned at the bottom of the slide.