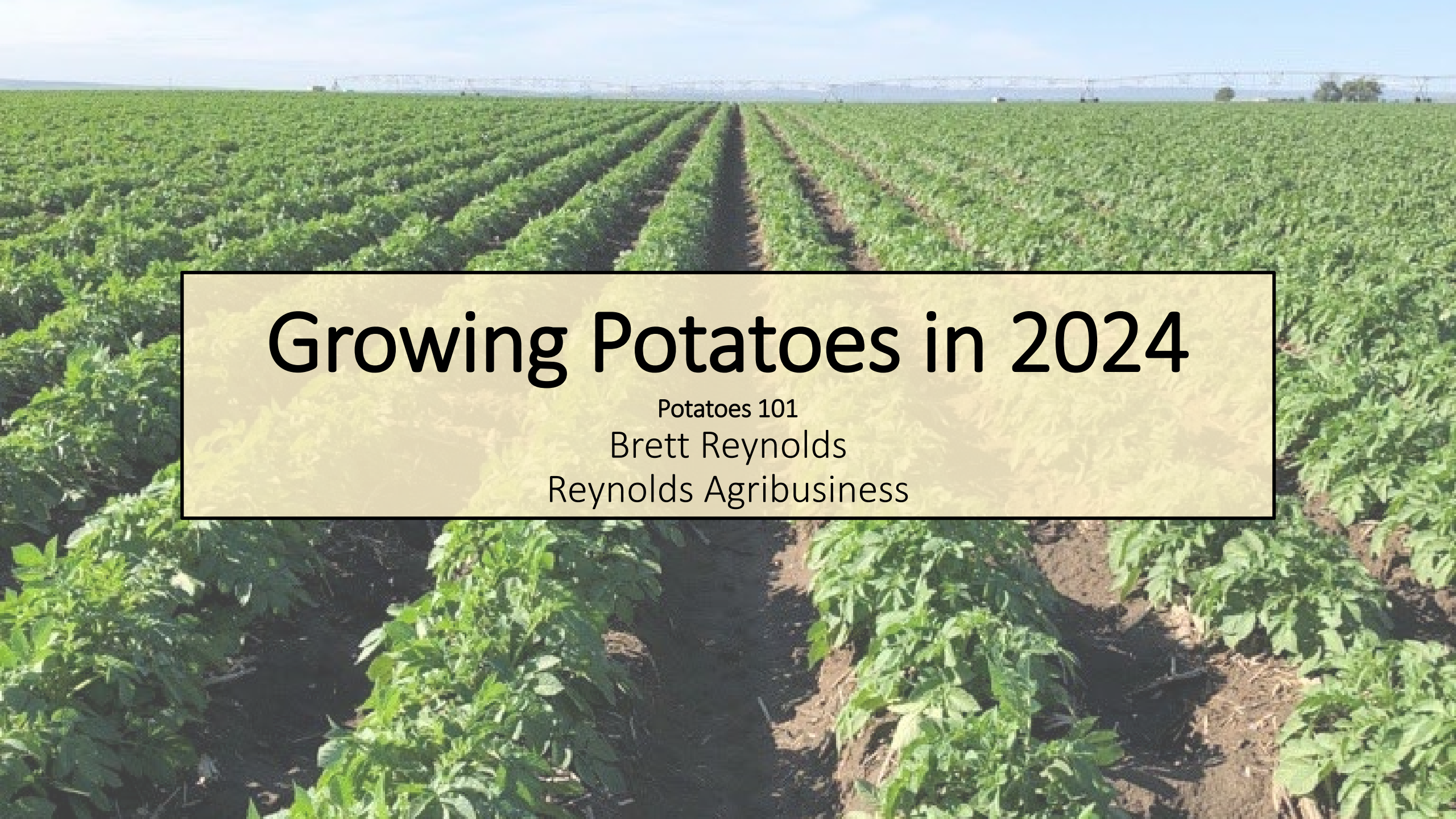


Growing Potatoes in 2024

Potatoes 101

Brett Reynolds
Reynolds Agribusiness

Growing Potatoes 101 – Today's Topics

- Soil Fundamentals
  - Deciphering a Soil Sample
  - Nutrient Availability and Soil pH
- Water/Irrigation Management
- Fertilizers
  - What Do We Need
  - Baggage
- Potato Nutrient Demand
- How to Make Sense of it All…

Soil Fundamentals

- Are you sampling ?
  - Every Year ?
  - Areas you know are different ?
  - Zone/Grid Sampling

- Places to Start
  - pH
  - Base Distribution/Saturation
  - Bulk Density
  - CEC
  - PPM or lbs/acre foot

NUTRIENTS	Soil Bulk Density	NO3N (1N KCl)	NO3N	NH4N (1N KCl)	NH4N	SO4S (DTPA-Sorb.)	SO_4S	Avail. H_2O
Depth (inches)	million lbs/acre-depth	ppm (mg/kg)	lbs/acre-depth	ppm (mg/kg)	lbs/acre-depth	ppm (mg/kg)	lbs/acre-depth	inches/depth
0/12	4.30	12.2	52	1.1	5	9	39	
Total (sum of depths) lbs/acre			52		5		39	
Estimated N Release from Organic Matter (ENROM)			52					Total Available Moisture =
Sum of Available N (NO3N + NH4N + ENROM)			109					Available Moisture % 1st Depth =

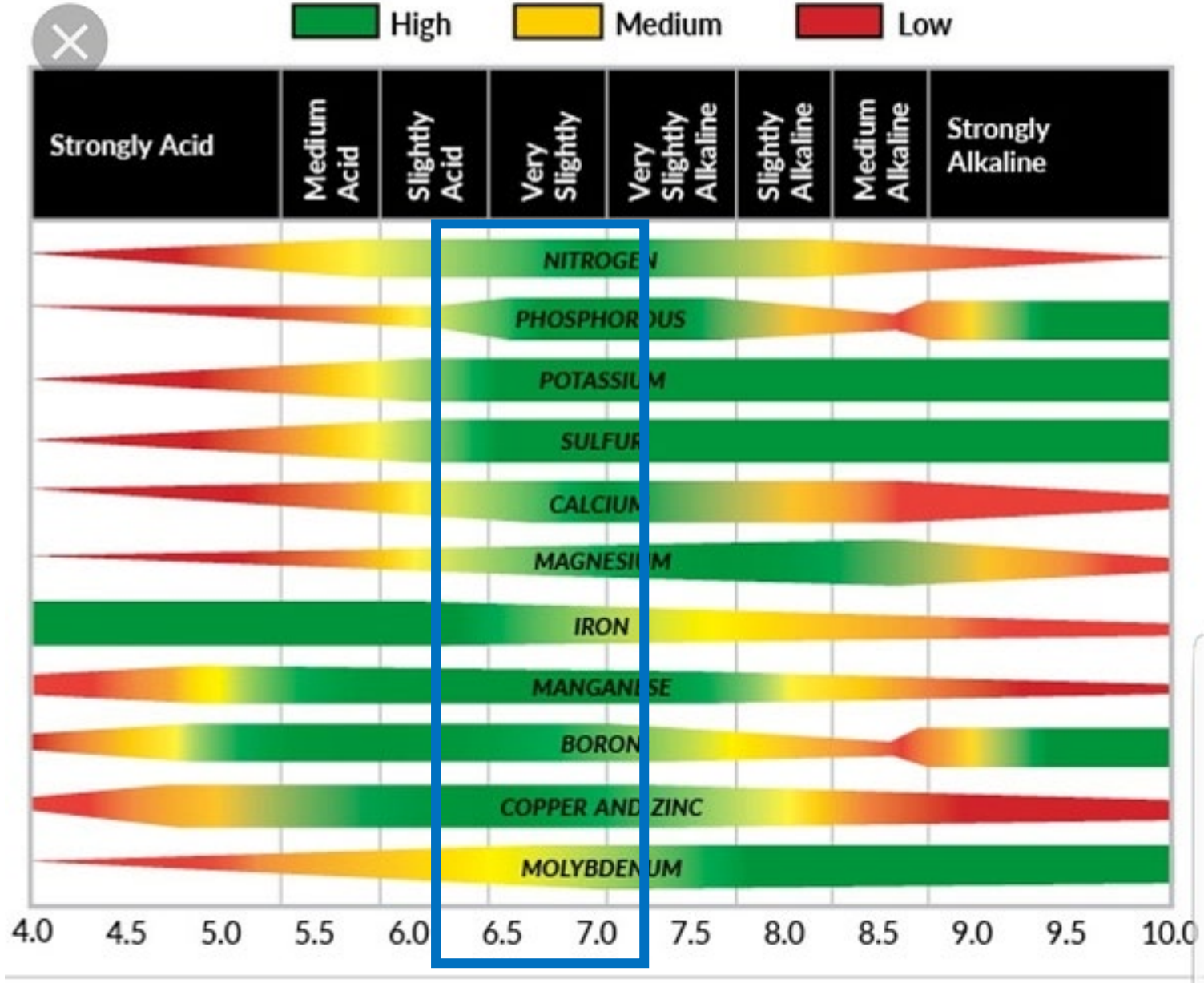
1st depth results	Extraction Method		ppm (mg/kg)	lbs/acre-depth		*Interpretation (1st depth)*
Phosphorus, Olsen	(0.5N $NaHCO_3$)	(PO_4P)	**25**	246	(P_2O_5)	Medium High
Phosphorus, Bray P1	(NH_4F, HCl)	(PO_4P)			(P_2O_5)	
Phosphorus, Bray P2	(NH_4F, HCl x 4)	(PO_4P)			(P_2O_5)	
Potassium, Olsen	(0.5N NaHCO3)	(K)	**137**	710	(K_2O)	Medium
Boron	(DTPA-Sorb)	(B)	**0.3**	1.3	(B)	Low
Zinc	(DTPA-Sorb)	(Zn)	**1.9**	8.1	(Zn)	Medium High
Manganese	(DTPA-Sorb)	(Mn)	**1.8**	7.7	(Mn)	Low
Copper	(DTPA-Sorb)	(Cu)	**1.1**	4.7	(Cu)	Medium
Iron	(DTPA-Sorb)	(Fe)	**78**	335	(Fe)	Very High
Molybdenum	(DTPA-Sorb)	(Mo)	**0.008**	0	(Mo)	Very Low
Aluminum	(DTPA-Sorb)	(Al)			(Al)	
Aluminum	(1N KCl)	(Al)			(Al)	
Chloride	(ISE Buffer)	(Cl^-)			(Cl^-)	

SOIL CHARACTERISTICS		1st Depth	2nd Depth	3rd Depth	4th Depth	*Interpretation (1st depth)*
pH		**6.03**				Slightly Acidic
Electrical Cond.	(EC 1:1) (dS/m)	**0.24**				
~ Soluble Salts	(Sat. Paste) (dS/m)	**0.62**				Negligible salt effects
Organic Matter %	(Walkley-Black)	**1.30**				Medium Low
Effervescence	(Scale = 0 to 7)	**0**				Very Low
%Lime (Calcium Carbonate (CaCO3))						

EXCHANGEABLE BASES	Typical ranges in %	% of Total Bases	% of CEC	Quantities of Exchangeable Bases meq/100g	ppm (mg/kg)	lbs/ac-depth
Calcium (Ca)	(55 - 75)	71.4%	55.0%	**5.5**	1100	4730
Magnesium (Mg)	(15 - 30)	22.1%	17.0%	**1.7**	207	889
Sodium (Na)	(0.1 - 5)	2.2%	1.7%	**0.17**	39	168
Potassium (K)	(2 - 8)	4.5%	3.5%	**0.35**	137	588
Total Bases (Ca + Mg + Na + K)		100.3%		**7.7**		
~ Cation Exchange Capacity (CEC)				**10.0**		
~ Percent Base Saturation (TB/CEC)			**77%**			

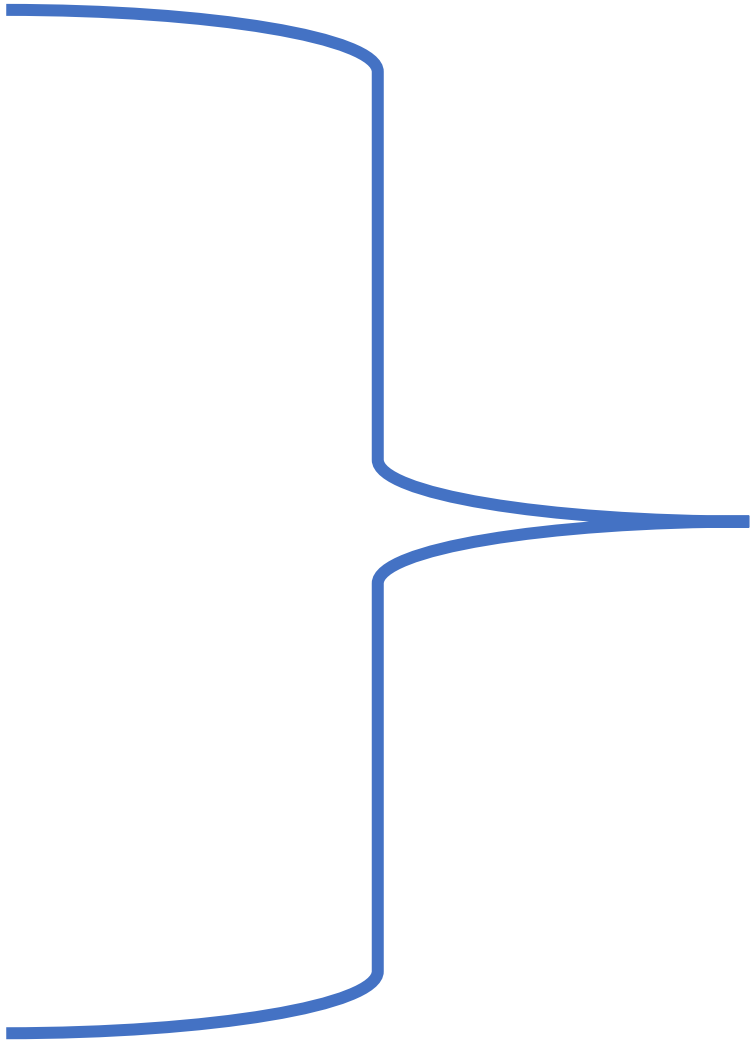
Buffer pH for lime req.	
pH_{Ca} =	
pH_{Sikora}	
pH_{A-E} =	
Texture	
Sand%	
Silt%	
Clay%	

Soil pH and Nutrient Availability



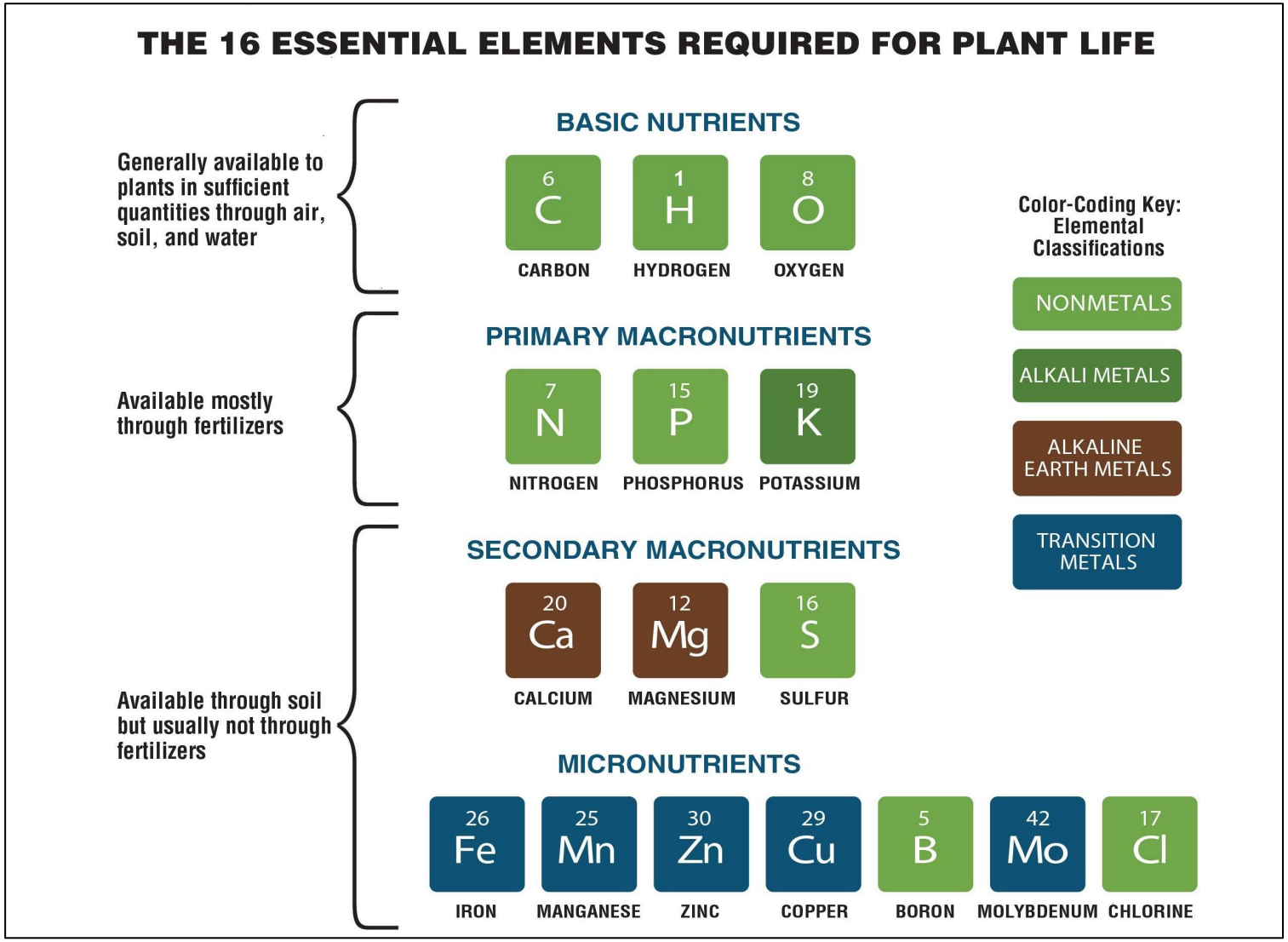
Water and Irrigation Management

- Know Your Water
  - Surface Water or Well Water
- Know Your Soil
  - Soil Type
  - Holding Capacity
- Know Your Equipment
  - Sprinkler Package
    - Uniformity
    - Can it Keep Up?
  - Machine Speed



STRATEGY

Fertilizers – What Do We Need



?? Nickel and Cobalt

Fertilizers – Baggage

1. What **ALL** is in there ?
   - Do We Want “it” **ALL** or Not ?

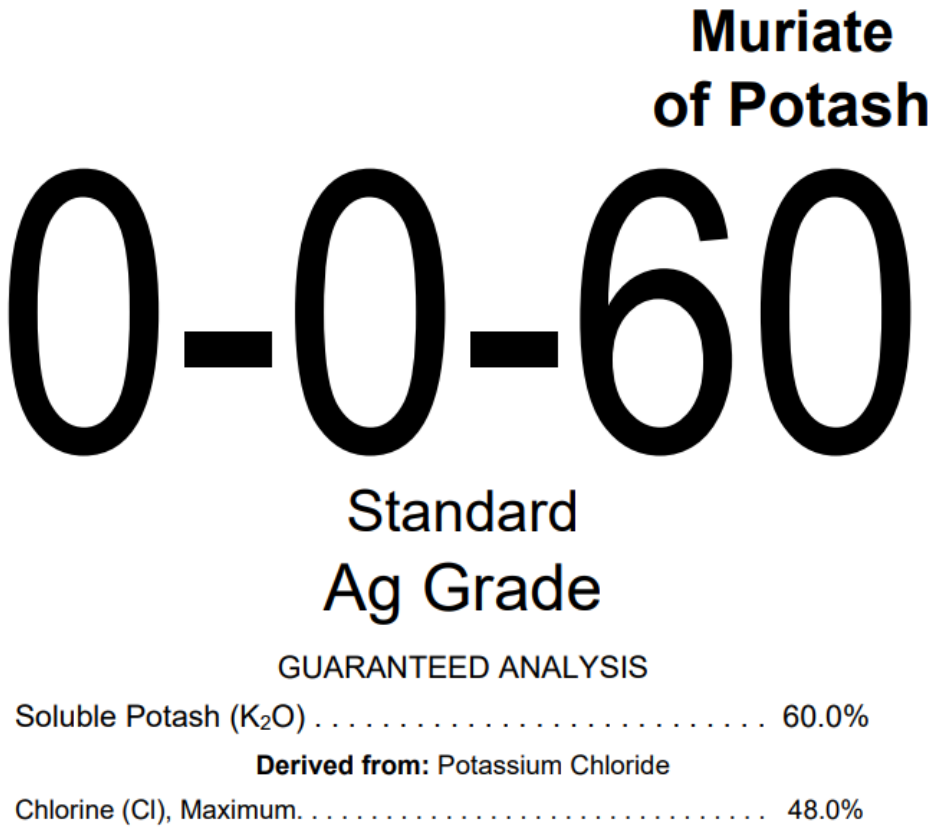
2. Intended vs Unintended Effects

Other Considerations in Fertilizer Choice

- Salt Index
- 4 R’s (Source, Rate, Placement, Time)
- **Budget**

Fertilizers – Baggage

For every 1 pound of K, we will get
0.8 pounds of Cl

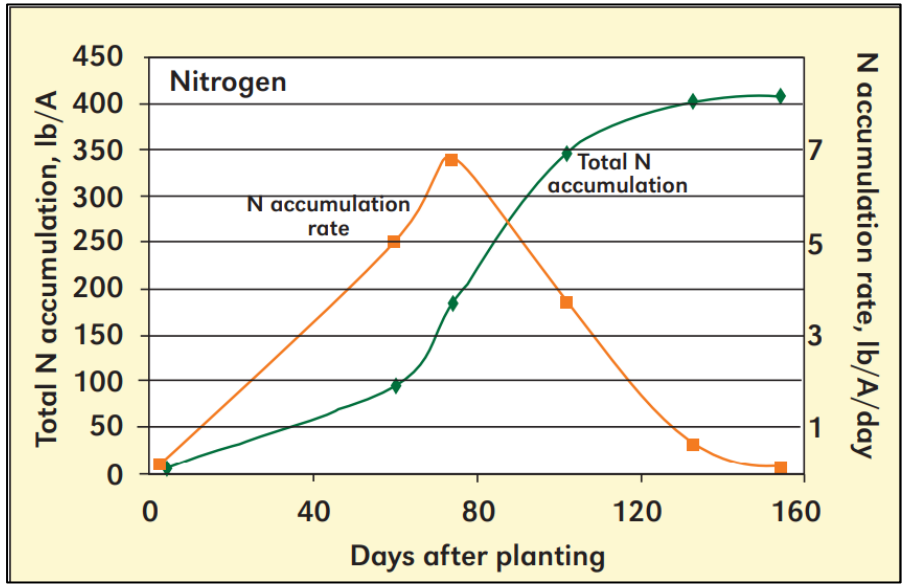


Example: 400lbs of K needed

400/0.6 = 667 lbs of 0-0-60

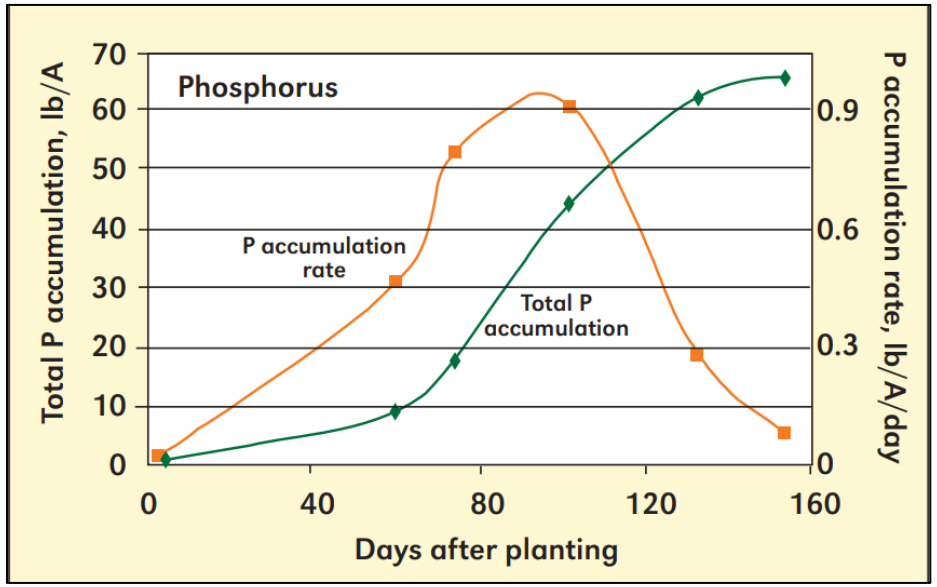
How much Chloride do we get ? Does the plant want it?

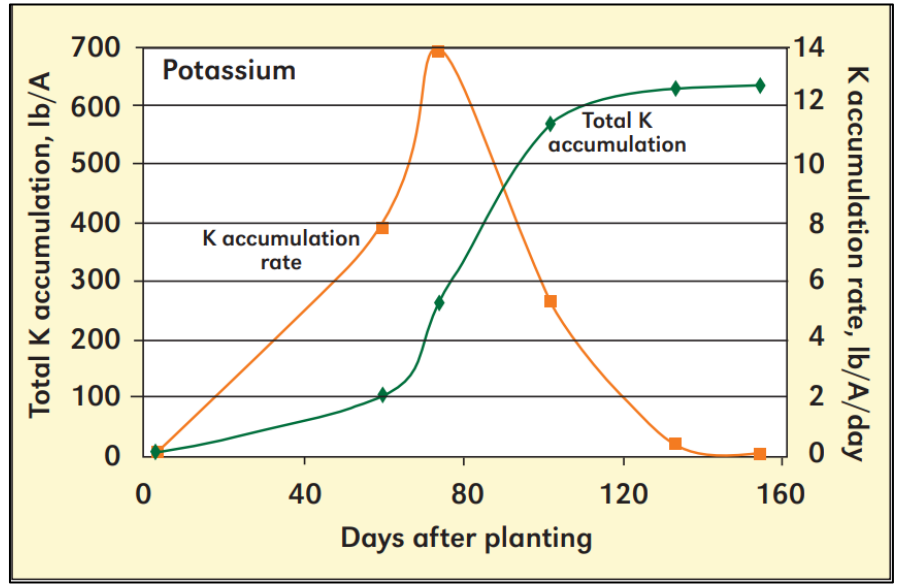
Nutrient Demand in Potatoes



N

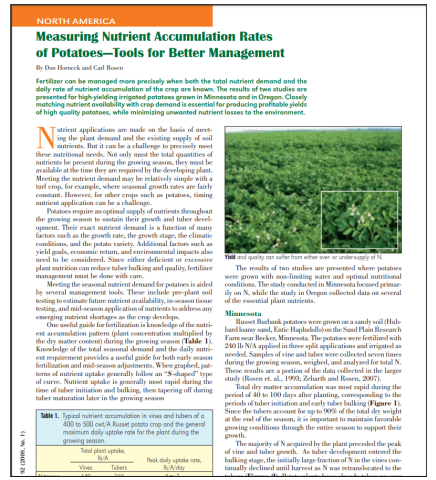
P





K

Horneck & Rosen 2008



NORTH AMERICA

Measuring Nutrient Accumulation Rates of Potatoes—Tools for Better Management

By Dan Horneck and Carl Rosen

Fertilizer can be managed more precisely when both the total nutrient demand and the daily rate of nutrient accumulation of the crop are known. The results of two studies are presented for high-yielding irrigated potatoes grown in Minnesota and in Oregon. Closely matching nutrient availability with crop demand is essential for producing profitable yields of high quality potatoes, while minimizing unwanted nutrient losses to the environment.

Nutrient applications are made on the basis of meeting the plant demand and the existing supply of soil nutrients. But it can be a challenge to precisely meet these nutritional needs. Not only must the total quantities of nutrients be present during the growing season, they must be available at the time they are required by the developing plant. Meeting the nutrient demand may be relatively simple with a turf crop, for example, where seasonal growth rates are fairly constant. However, for other crops such as potatoes, timing nutrient application can be a challenge.

Potatoes require an optimal supply of nutrients throughout the growing season to sustain their growth and tuber development. Their exact nutrient demand is a function of many factors such as the growth rate, the growth stage, the climatic conditions, and the potato variety. Additional factors such as yield goals, economic return, and environmental impacts also need to be considered. Since either deficient or excessive plant nutrition can reduce tuber bulking and quality, fertilizer management must be done with care.

Meeting the seasonal nutrient demand for potatoes is aided by several management tools. These include pre-plant soil testing to estimate future nutrient availability, in-season tissue testing, and mid-season application of nutrients to address any emerging nutrient shortages as the crop develops.

One useful guide for fertilization is knowledge of the nutrient accumulation pattern (plant concentration multiplied by the dry matter content) during the growing season (**Table 1**). Knowledge of the total seasonal demand and the daily nutrient requirement provides a useful guide for both early season fertilization and mid-season adjustments. When graphed, patterns of nutrient uptake generally follow an "S-shaped" type of curve. Nutrient uptake is generally most rapid during the time of tuber initiation and bulking, then tapering off during tuber maturation later in the growing season

Yield and quality can suffer from either over- or under-supply of N.

The results of two studies are presented where potatoes were grown with non-limiting water and optimal nutritional conditions. The study conducted in Minnesota focused primarily on N, while the study in Oregon collected data on several of the essential plant nutrients.

Minnesota

Russet Burbank potatoes were grown on a sandy soil (Hubbard loamy sand, Entic Hapludolls) on the Sand Plain Research Farm near Becker, Minnesota. The potatoes were fertilized with 240 lb N/A applied in three split applications and irrigated as needed. Samples of vine and tuber were collected seven times during the growing season, weighed, and analyzed for total N. These results are a portion of the data collected in the larger study (Rosen et. al., 1993; Zebarth and Rosen, 2007).

Total dry matter accumulation was most rapid during the period of 40 to 100 days after planting, corresponding to the periods of tuber initiation and early tuber bulking (**Figure 1**). Since the tubers account for up to 90% of the total dry weight at the end of the season, it is important to maintain favorable growing conditions through the entire season to support their growth.

The majority of N acquired by the plant preceded the peak of vine and tuber growth. As tuber development entered the bulking stage, the initially large fraction of N in the vines continually declined until harvest as N was retranslocated to the

Table 1. Typical nutrient accumulation in vines and tubers of a 400 to 500 cwt/A Russet potato crop and the general maximum daily uptake rate for the plant during the growing season.

Total plant uptake, lb/A		Peak daily uptake rate, lb/A/day
Vines	Tubers	

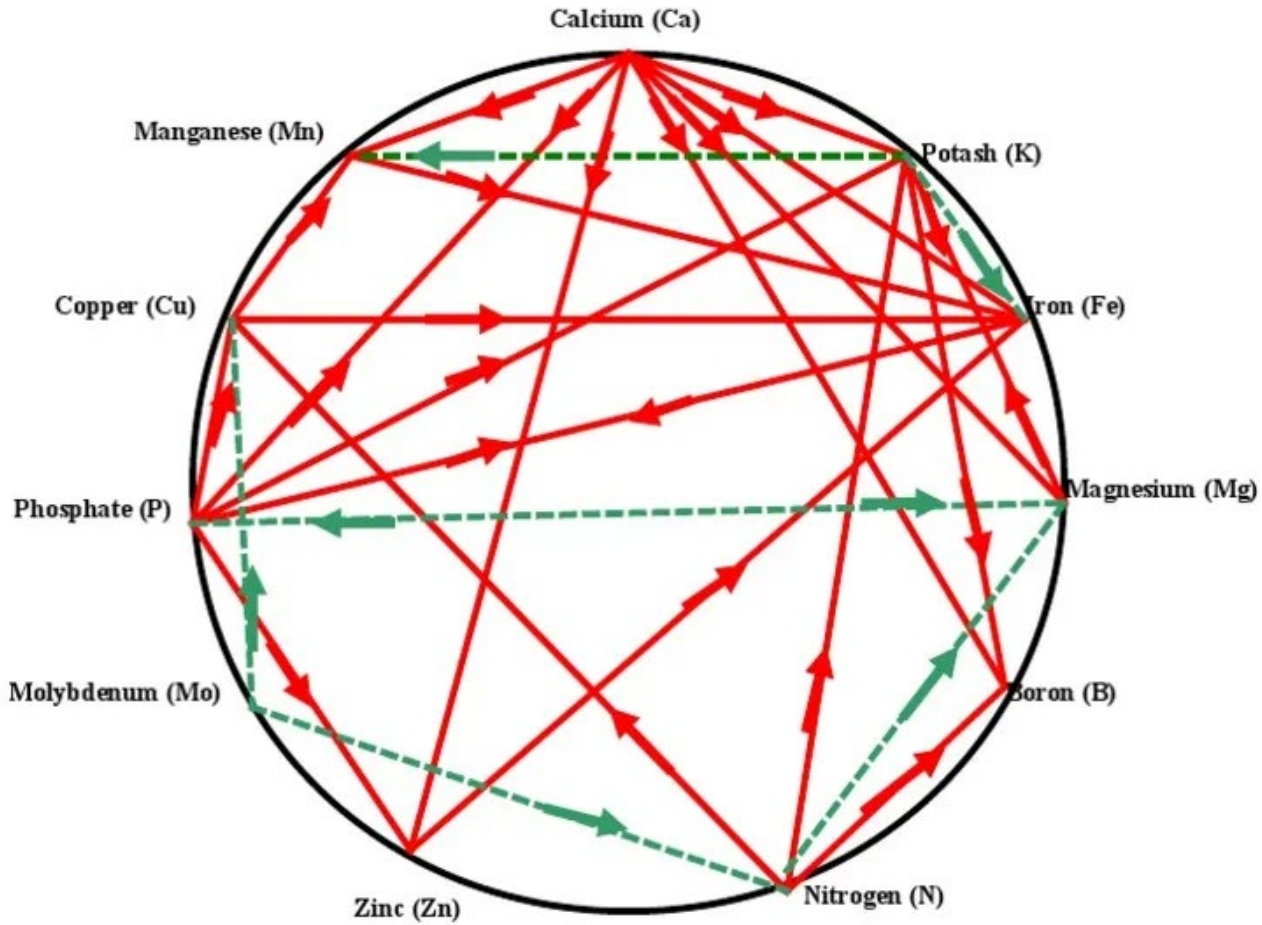
Mulder's Chart

Antagonism

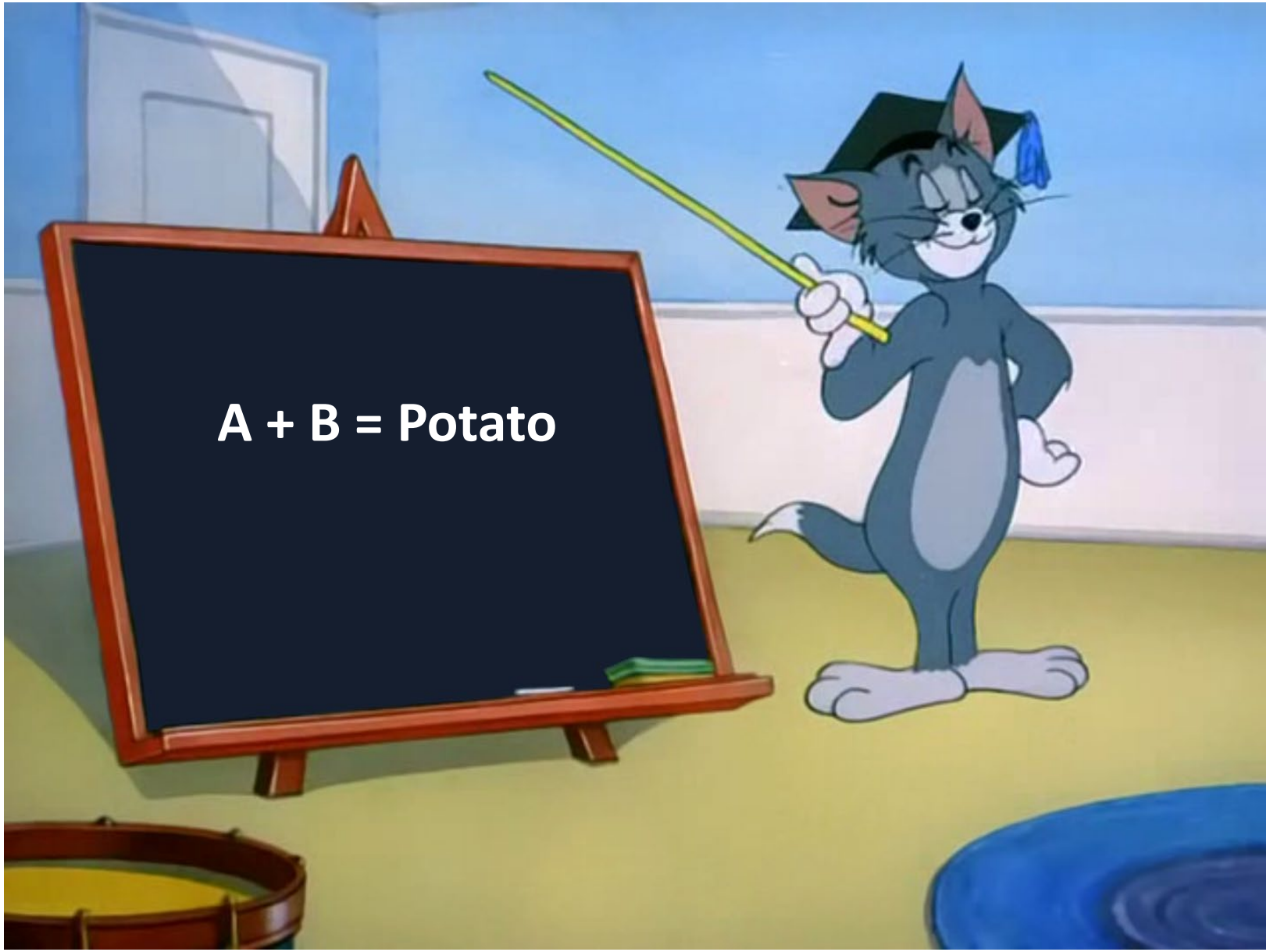
Decreased availability to the plant of a nutrient due to the action of another nutrient

Synergism

Increased availability of a nutrient to the plant due to the increase in the level of another nutrient



Let’s Put It All Together…



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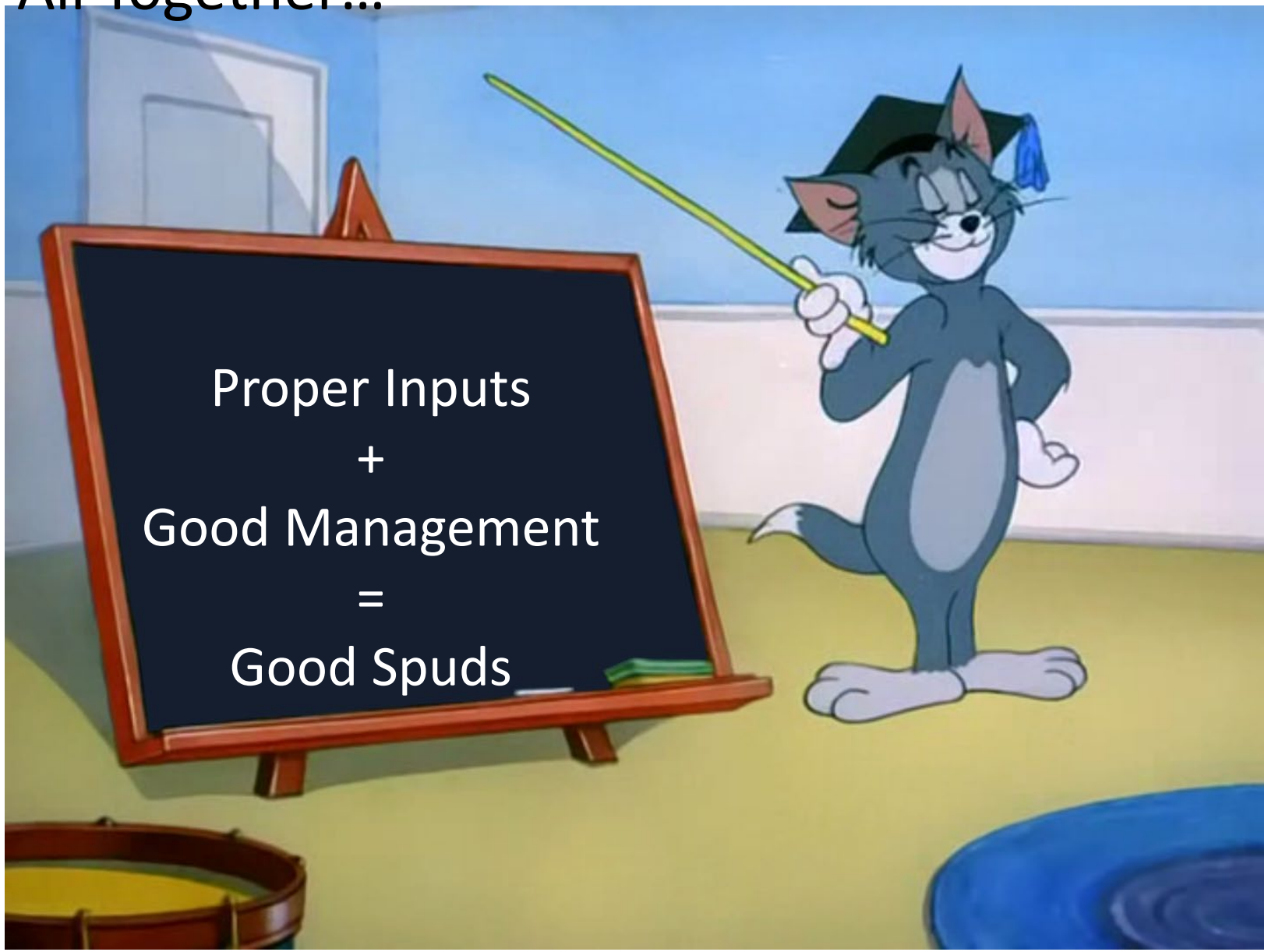

Question to You

What are two or three of the biggest agronomic challenges facing potato production today ?

How do we deal with them?