Nutrient Application Tips for No-Till Crop Production

Mark Alley

W. G. Wysor Professor Emeritus

Virginia Tech

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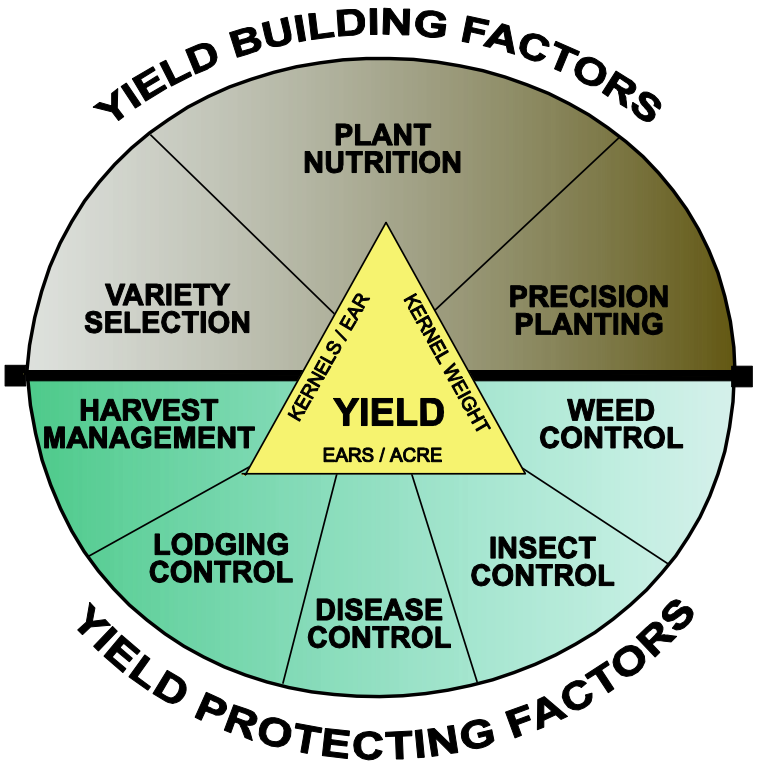
Nutrients Are Part of An Overall Crop Production Program







Plant Nutrition Program Goals

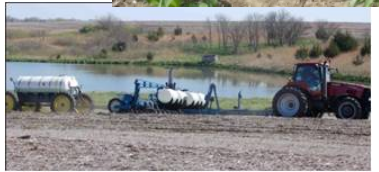
- Available nutrients do not limit crop yields
- Fertilizer program provides nutrients efficiently
- Fertilizer and crop production program minimizes potential environmental concerns
- Fertilizer program maintains soil productivity





Building an Effective and Efficient Fertilizer Program

- Soil Productivity Evaluation
- Soil Testing
- Plant Tissue Analysis
- Crop yield analysis



Soil Productivity Evaluation

- Not all soils are created equal
- Identify soils that have economically correctable physical problems, i.e. drainage, compaction, that could provide higher yield potential.
- Identify pest problems, i.e. weed and nematodes, that limit yields in specific fields.
- Correct the major problems prior to using more fertilizer!!





Soil Productivity

Replication 1										Replication 2							Replication 3						
Trt. 1	Trt. 4	Trt. 6	Trt. 2	Trt. 5	Trt. 3	Trt. 7				Trt. 6	Trt. 2	Trt. 3	Trt. 1	Trt. 7	Trt. 4	Trt. 5	Trt. 3	Trt. 2	Trt. 1	Trt. 4	Trt. 7	Trt. 5	Trt. 6
STRIP 1	STRIP 2	STRIP 3	STRIP 4	STRIP 5	STRIP6	STRIP 7	BORDER	ROAD	BORDER	STRIP 8	STRIP 9	STRIP 10	STRIP 11	STRIP 12	STRIP 13	STRIP14	STRIP 15	STRIP 16	STRIP 17	STRIP 18	STRIP 19	STRIP 20	STRIP 21

Dividing line between Bojac and Wickham soils

Mean Yields by Crop, Cropping System and Soil – 1998-2002

Crop	Crop System	Soil			
		B1	B2	W3	W4
		---Yields (bu/acre)---			
FS Corn	1	124a	80a	168a	161a
FS Corn	2	126a	74a	164a	155a
DC Corn	3	94b	54b	105b	104b

*Values followed by different letters within columns differ at 5% level of significance.

Soil Testing and Fertilizer Application Rates

- Understand the basic of soil testing.
- Extractable nutrient levels & Crop Response

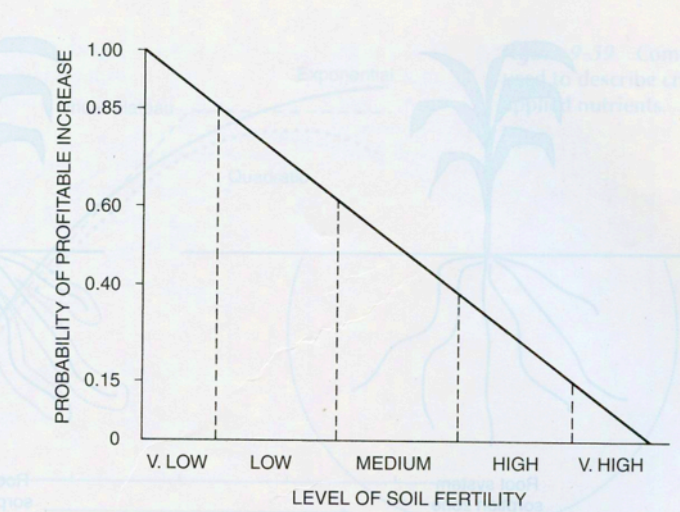
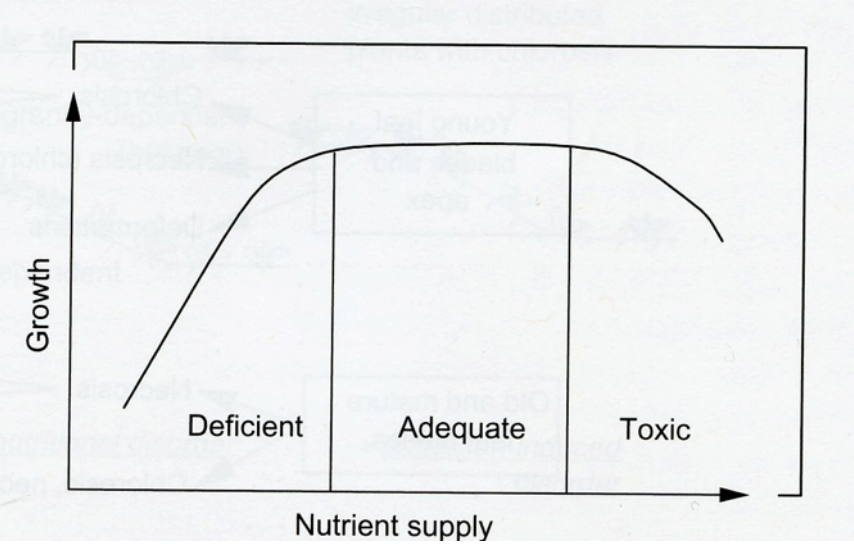


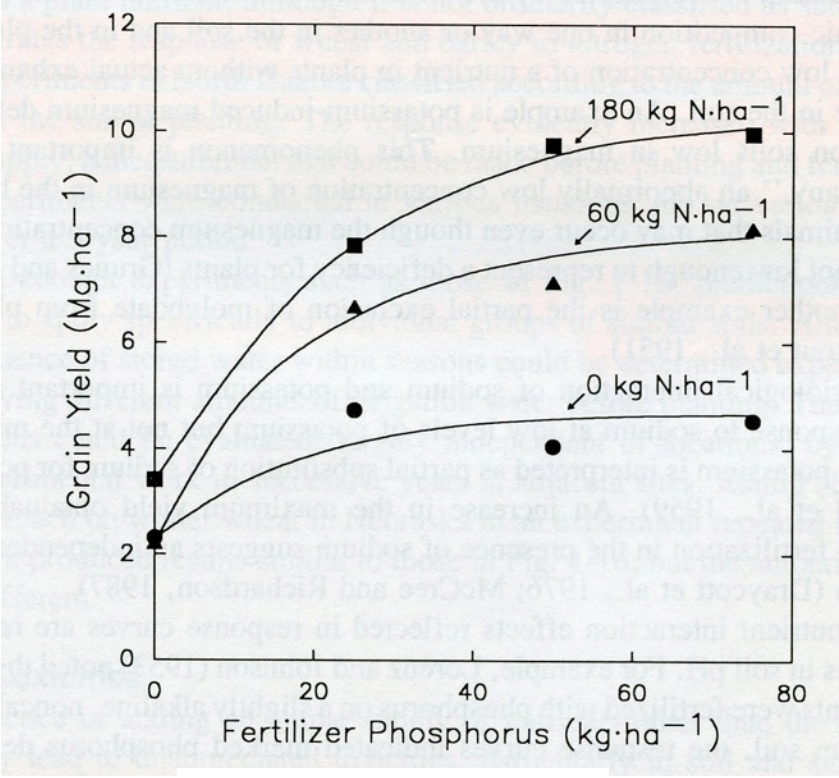
Figure 9-56 The probability of obtaining a profitable response from nutrient addition increases with decreasing soil test level.







Crop Yield Response to Applied Fertilizer



Black, C.A. 1992.

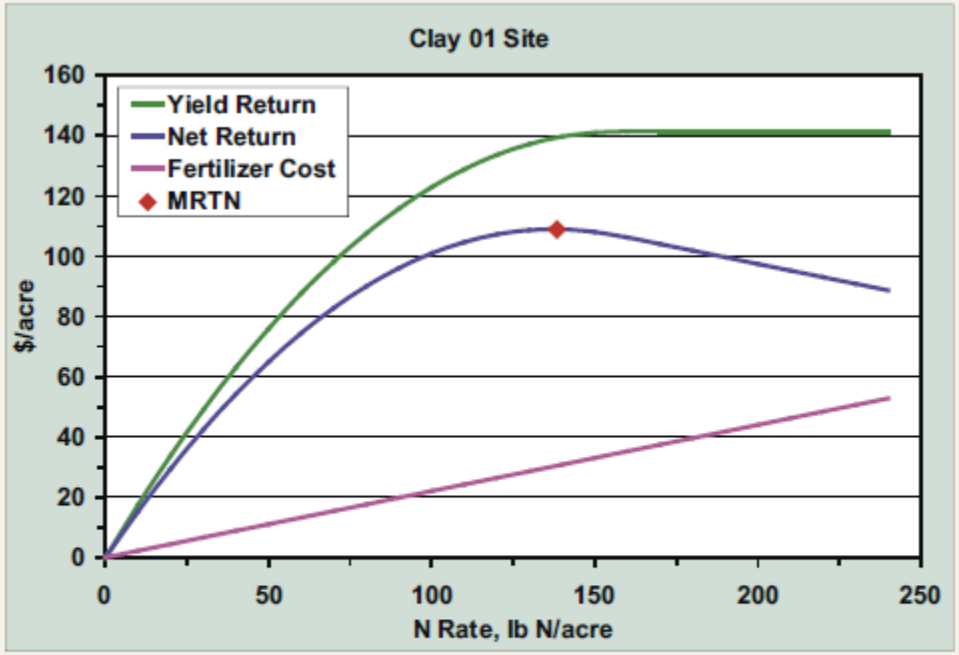


Figure 8. Corn grain yield and fertilizer economic components of calculated net return across N rates; example SC site with MRTN indicated at 0.10 price ratio (N price $0.22/lb N and corn price $2.20/bu).

Sawyer et al. 2006. IA PM 2015

Methods of Fertilizer Application

- Broadcast
  - Surface – non-incorporated
  - Surface – incorporated (we do not do this as we are continuous no-till or "never-till")
- Band
  - Subsurface – "injected"
  - Surface – "dribble"
- Foliar

Surface Broadcast In No-till

- High rates of nutrients
- Maintenance of soil fertility levels of P and K, and N(?)
- Lime to neutralize soil acidity
- Treats largest soil volume
- Nutrients incorporated into soil through rainfall, earthworms, root channels
- Stratification of P and K probable





Band Application of Fertilizers

- Concentrates fertilizers
- Reduces interaction of soil with fertilizer
  - P – reduces "fixation" by clay minerals
  - K – can reduce "fixation" in some soils
- Creates a zone of high nutrient concentration
  - Potentially higher rates of uptake

Subsurface Bands

- "Starter" placement – 2 x 2
- "Strip-till" placement – deeper under the row
- Create zone of high nutrient concentration
  - Reduces interaction of nutrients with soil
  - Placement of zone maximizes root interception
  - Plant roots proliferate in high nutrient content





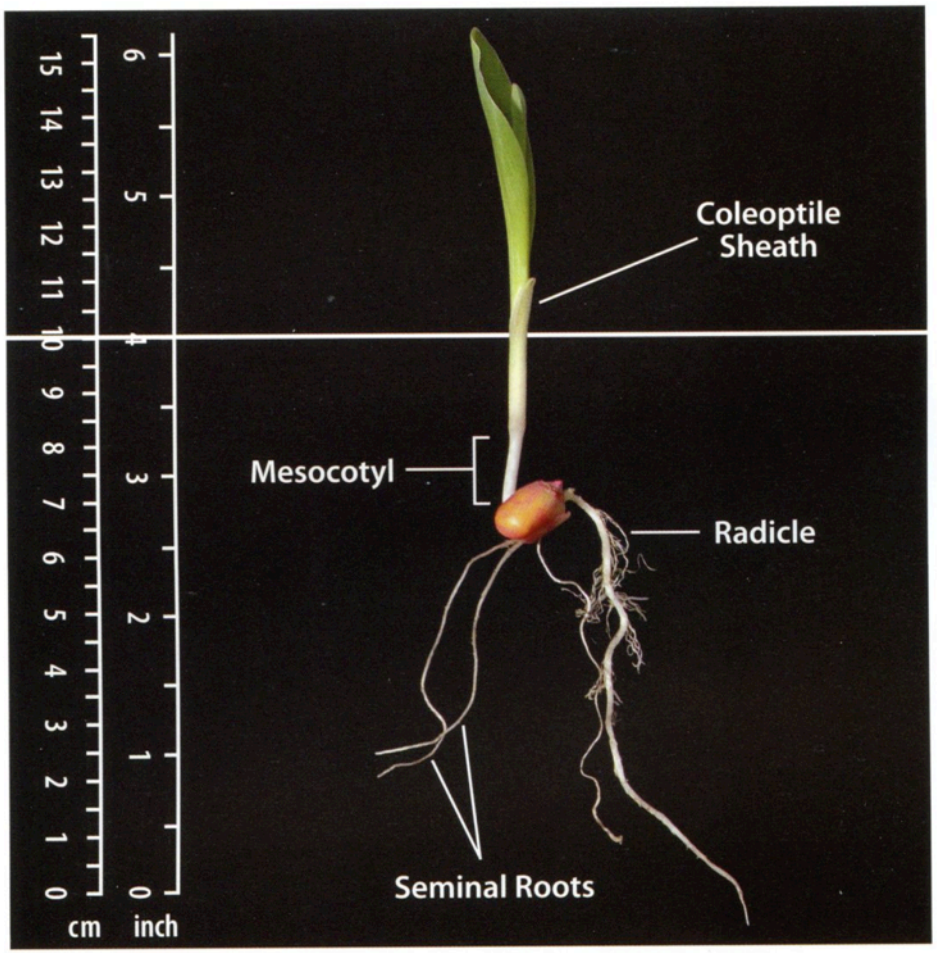
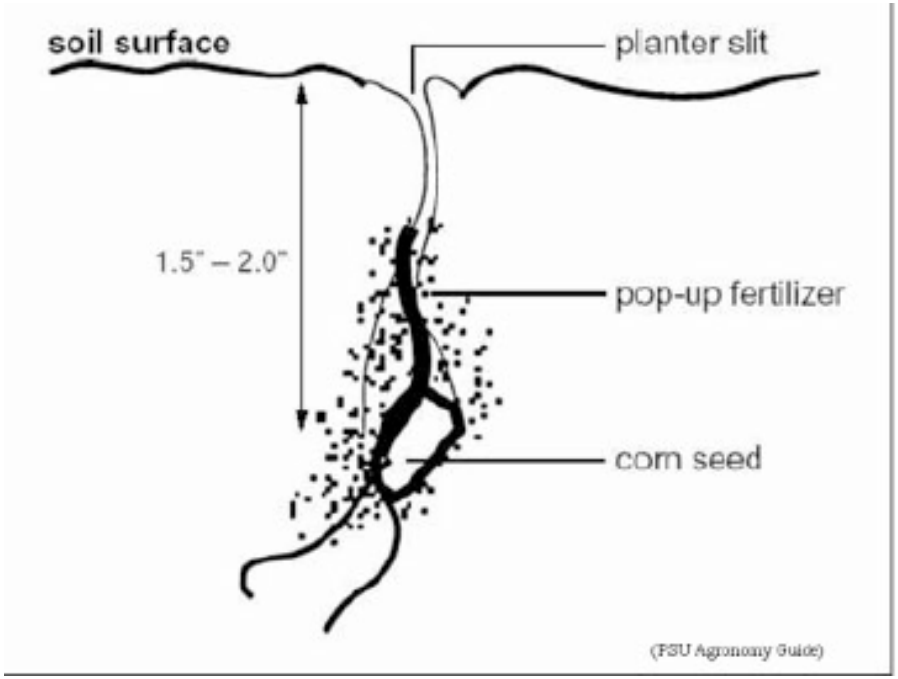


Figure 12. Emerged (VE) plant.

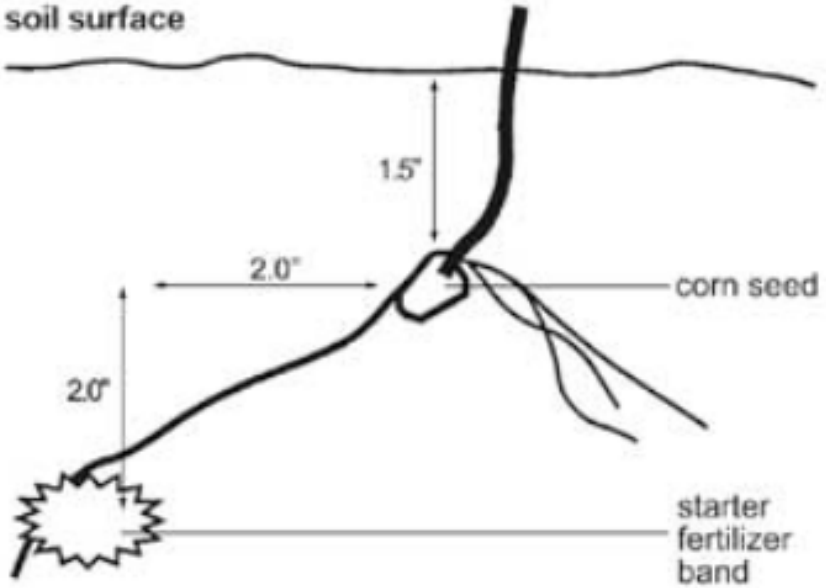
Corn Growth and Development. 2011. Iowa State Univ. PMR 1009

"Pop-up" and "Starter" Fertilizers for Corn

Pop-up



Starter



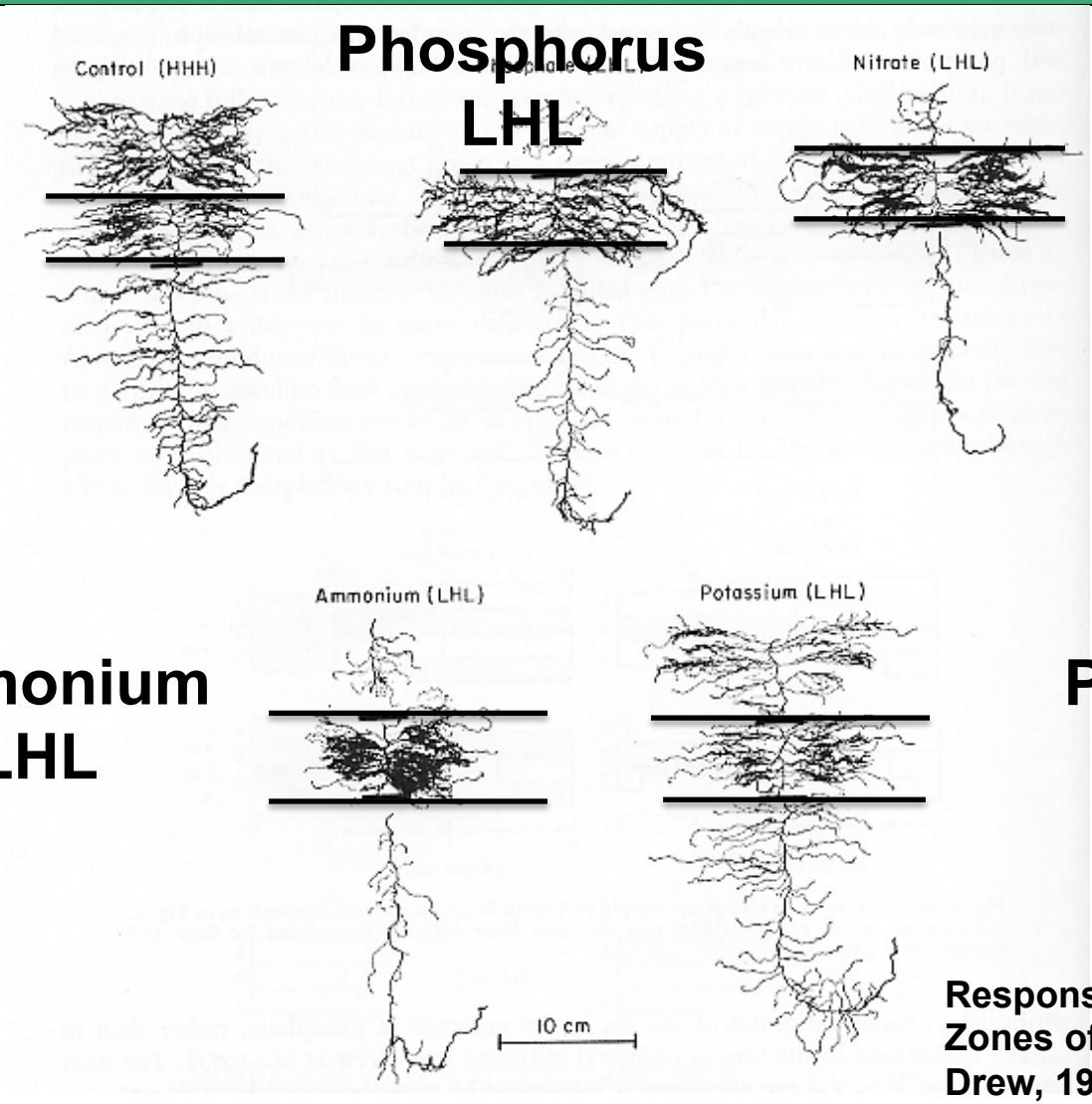
Control HHH

Phosphorus LHL

Nitrate LHL

Ammonium LHL

Potassium LHL



Response Of Plant Roots to Zones of Nutrient Enrichment Drew, 1975

Salt Injury

- Desiccation of plant tissue when high salt content in the soil solution results in water moving out (osmosis) of the plant roots to dilute the salt concentration in the soil solution.
- Toxicity of free ammonia





Salt Injury to Corn

Kaiser, D. 2008. U. MN. http://minnesotafarmguide.com/app/blog/?p=220

Salt Index

- Measure of the salt concentration that fertilizer induces in the soil solution.
- Ratio of the increase in osmotic pressure produced by a fertilizer to that produced by the same weight of $NaNO_3$
  - SI concept developed in 1943
  - $NaNO_3$ was common fertilizer and 100% water soluble

Salt Index of Selected Common Liquid Fertilizers

Formulation	Salt Index
2-20-20‡	7.2
3-18-18‡	8.5
6-24-6‡	11.5
6-30-10‡	13.8
9-18-9‡	16.7
10-34-0	20.0
7-21-7	27.8
4-10-10	27.5
28-0-0 UAN	63.0

‡Potassium phosphate is the K source.

Laboski, C. 2008. www.soils.wisc.edu/extension/wcmc/proc/2008_wfapm_proc.pdf





Using Liquid Fertilizers Near Seed

- Avoid formulations with salt index >20
- Apply no more than 10 lbs/acre of N +K_2O in the furrow.
- Avoid application to dry soil
- Coarse textured soils have greater potential for injury

Maximum Fertilizer Material to Apply with Seed

R. Gelderman, 2008

Select Crop

Corn
Soybean
Wheat-hard red spring
Wheat-durum
Alfalfa
Barley
Canola
Cotton
Flax
Lentil
Mustard
Oats
Pea
Safflower
Sorghum
Sunflower

Select Fertilizer

Urea (46 - 0 - 0)
Urea NBPT *
28-0-0
Ammonium Nitrate (34 - 0 - 0)
DAP (18 - 46 - 0)
MAP (11 - 55 - 0)
TSP (0 - 46 - 0)
10-34-0
7-21-7
9-18-9
3-18-18
4-10-10
KCl (0 - 0 - 60)
KSMg (0-0-22-22S-11Mg)
K Sulfate (0-0-50-17S)
ATS (12-0-0-26S)

Fertilizer Rate (F)

8.3	lbs/a with the seed
0.8	gal/acre

Yellow Boxes are Calculated

This rate will have:

1.0	lbs/a of Nitrogen (N)
	lbs/a of Phosphorus (P_2O_5)
	lbs/a of Potassium (K_2O)
2.2	lbs/a of Sulfur (S)
	lbs/a of (Mg)

Parameters

2.0	Soil Moisture & Texture (MX)
-0.30	Coefficient (C)

Enter Values in Boxes

Seed Furrow Opening Width (S)	1	inches
Row Spacing (R)	30	inches
Tolerated Stand Loss (T) (due to fertilizer)	5	%

Select: Soil Texture

Fine-Medium
Coarse

Planting- Soil Moisture

Moist
Borderline
Dry

South Dakota Cooperative Extension Service
SDSU

Equation: F = 30S(-T)/CRMX
Where:
F = fertilizer material in lb/a
S = seed furrow opening width in inches
T = is the tolerated stand loss, as a percent, due to fertilizer applied with the seed over typical stands - where no fertilizer is applied.
C = negative regression coefficient for the selected crop x fertilizer: (% / lb a^{-1})
R = row spacing in inches
MX = planting soil moisture and soil texture coefficient.

Values should match "Enter Values in Boxes" entries

1	30	5	Verify

with support from IPNI International Plant Nutrition Institute

Press: Seed Furrow Width & Stand Definitions

Press: Fit Program to Screen

https://www.sdstate.edu/ps/extension/soil-fert/index.cfm





N and P Uptake by Corn

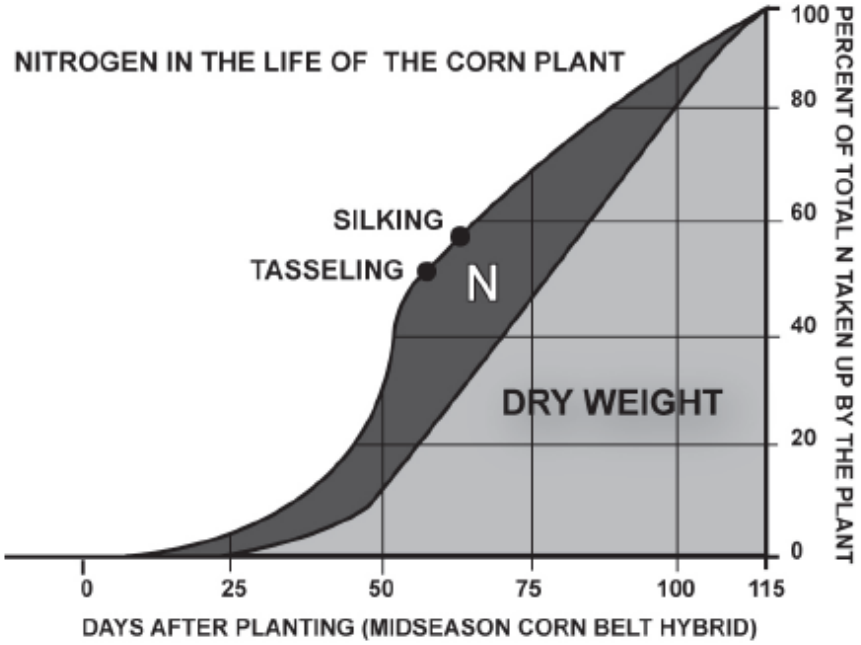


Figure 1. Nitrogen in the Life of the Corn Plant

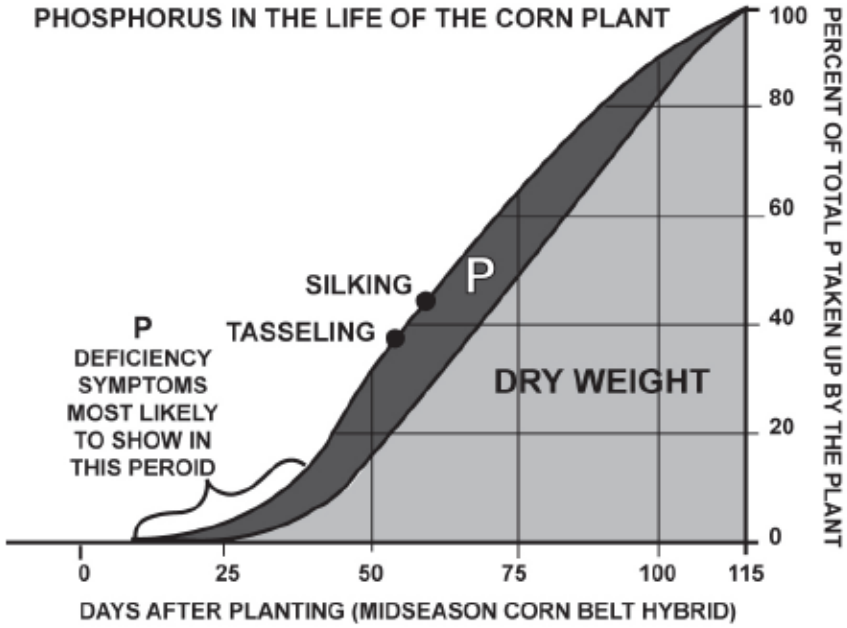


Figure 2. Phosphorus in the Life of the Corn Plant

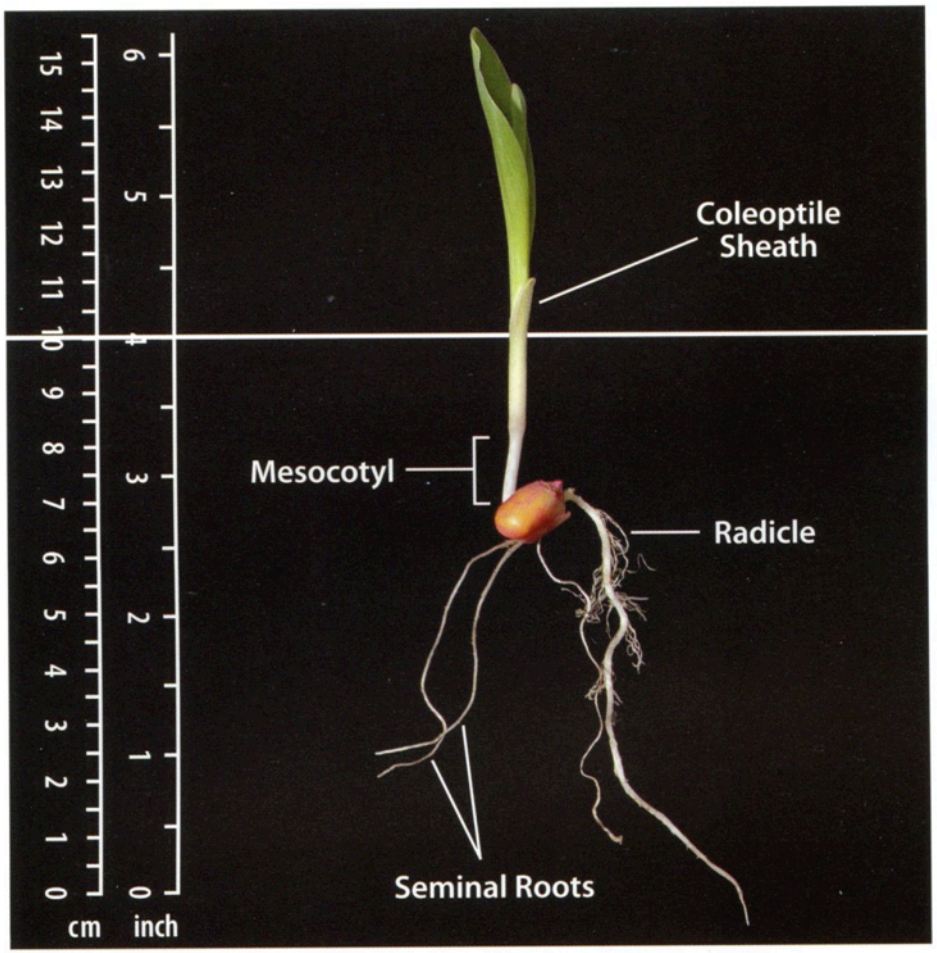
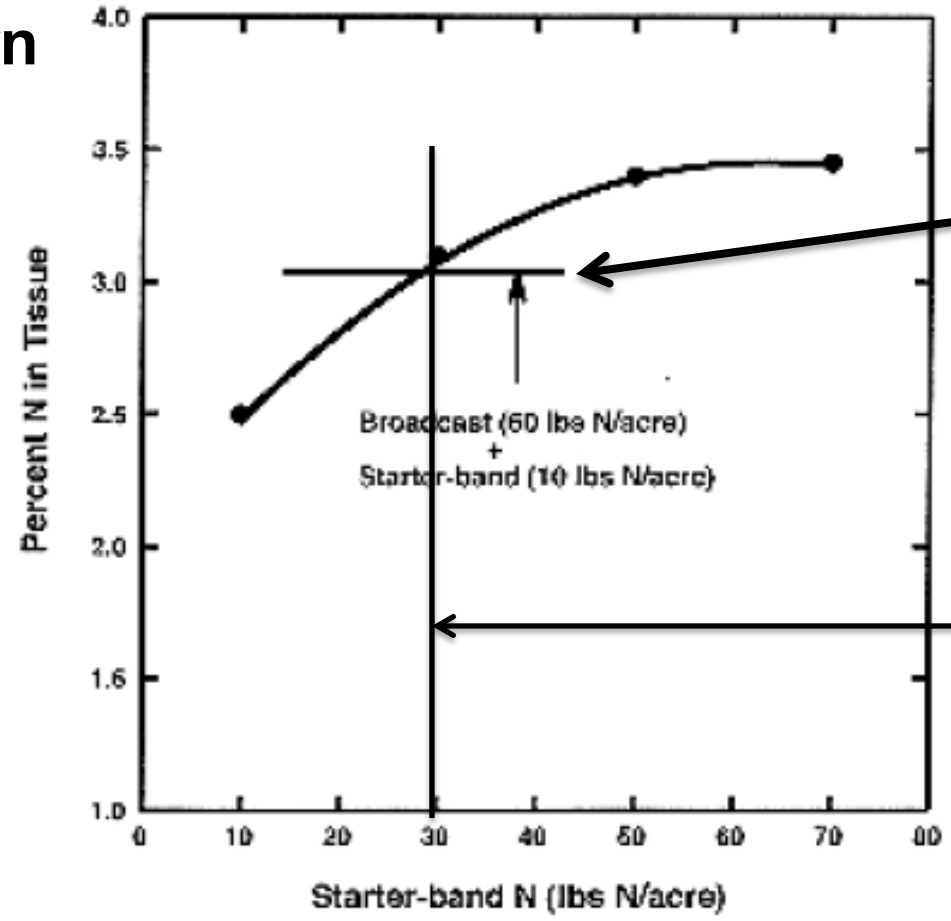


Figure 12. Emerged (VE) plant.

Corn Growth and Development. 2011. Iowa State Univ. PMR 1009

Whole corn plants, 10-12 inches



Broadcast (60 lbs N/acre) + Starter-band (10 lbs N/acre)

Starter-band (30 lbs N/acre)

Enhanced N Availability from Starter-band Placement

NO-TILL FARMER





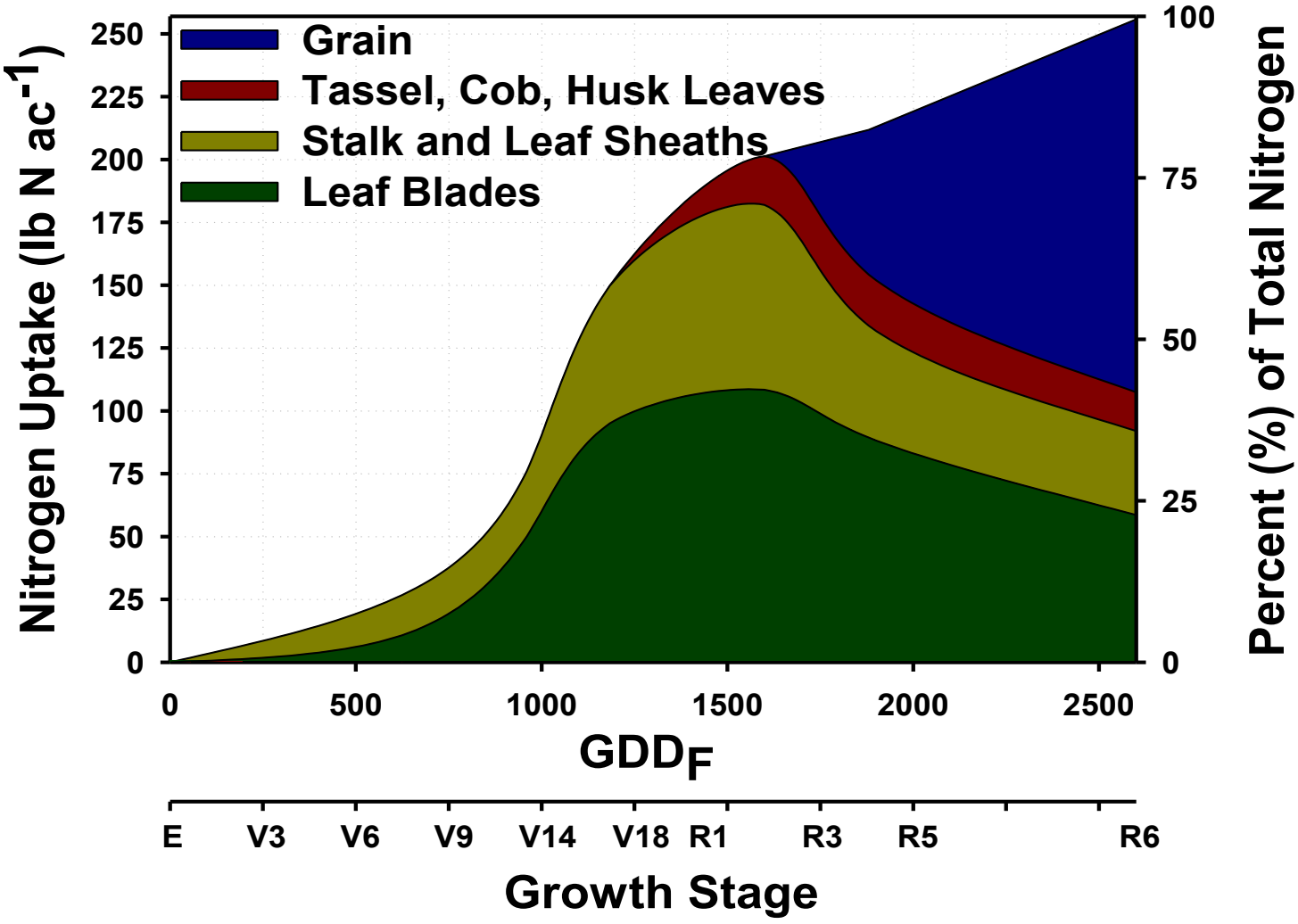
Starter Band Placement
2 x 2 – N-P

- Supply large amount of N and P efficiently
  - 40 lbs N/acre
  - 40 lbs P_2O_5/acre
- Enhance early season N and P efficiency
  - Reduced fixation in surface residue
  - No runoff of applied N
  - Increased availability to young plants vs. broadcast
  - Longer window for side-dress N applications.

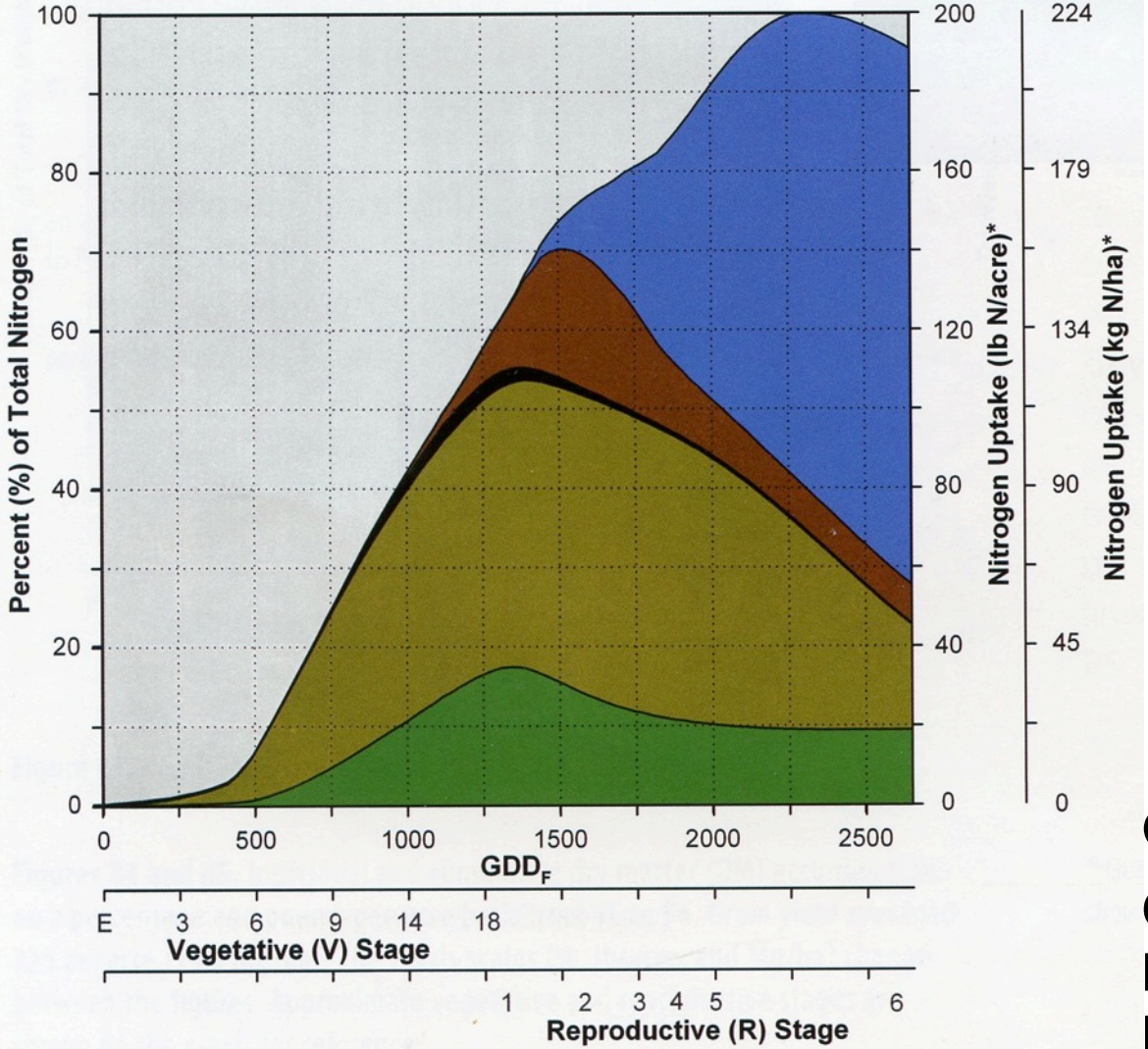




Seasonal N Uptake and Partitioning



Mean for 6 hybrids – Dekalb and Champaign, IL. F. Below, U. Of IL



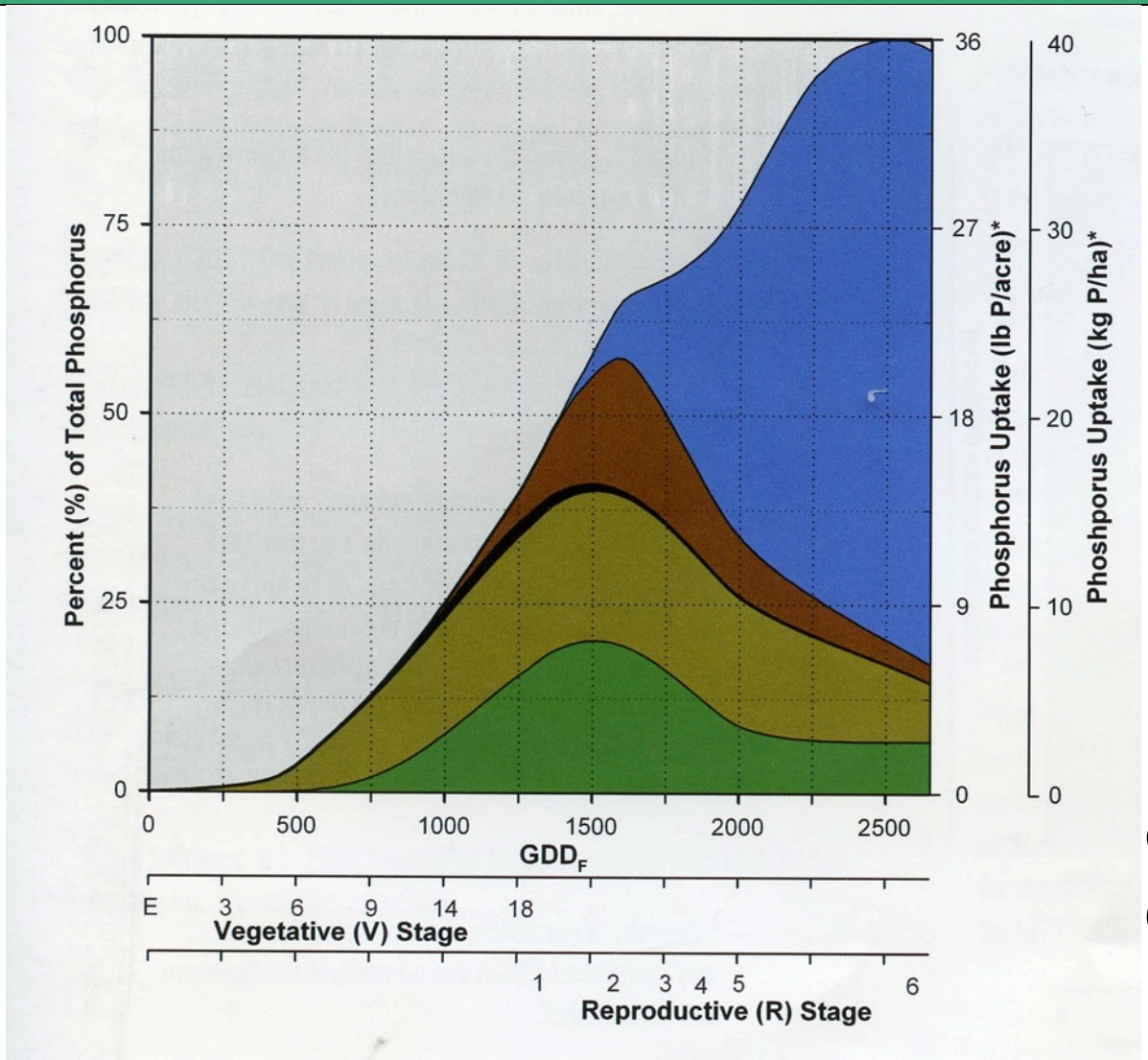
Nitrogen Uptake

Grain Yield = 225 bu/a

Corn Growth and Development. 2011 IA State Univ. PMR 1009







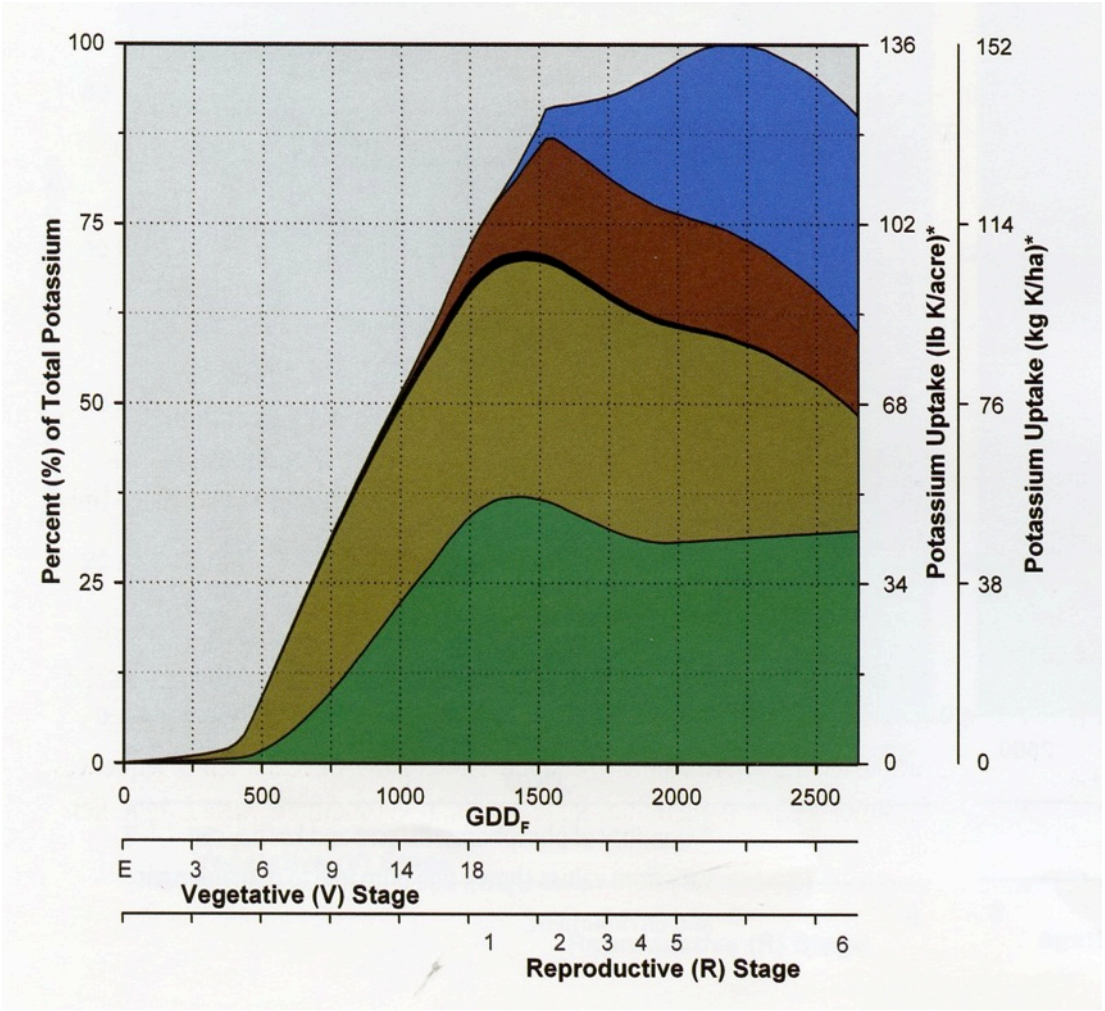
Phosphorus Uptake

Grain Yield = 225 bu/a

Corn Growth and Development. 2011 IA State Univ. PMR 1009







Potassium Uptake

Grain Yield = 225 bu/a

Corn Growth and Development. 2011 IA State Univ. PMR 1009



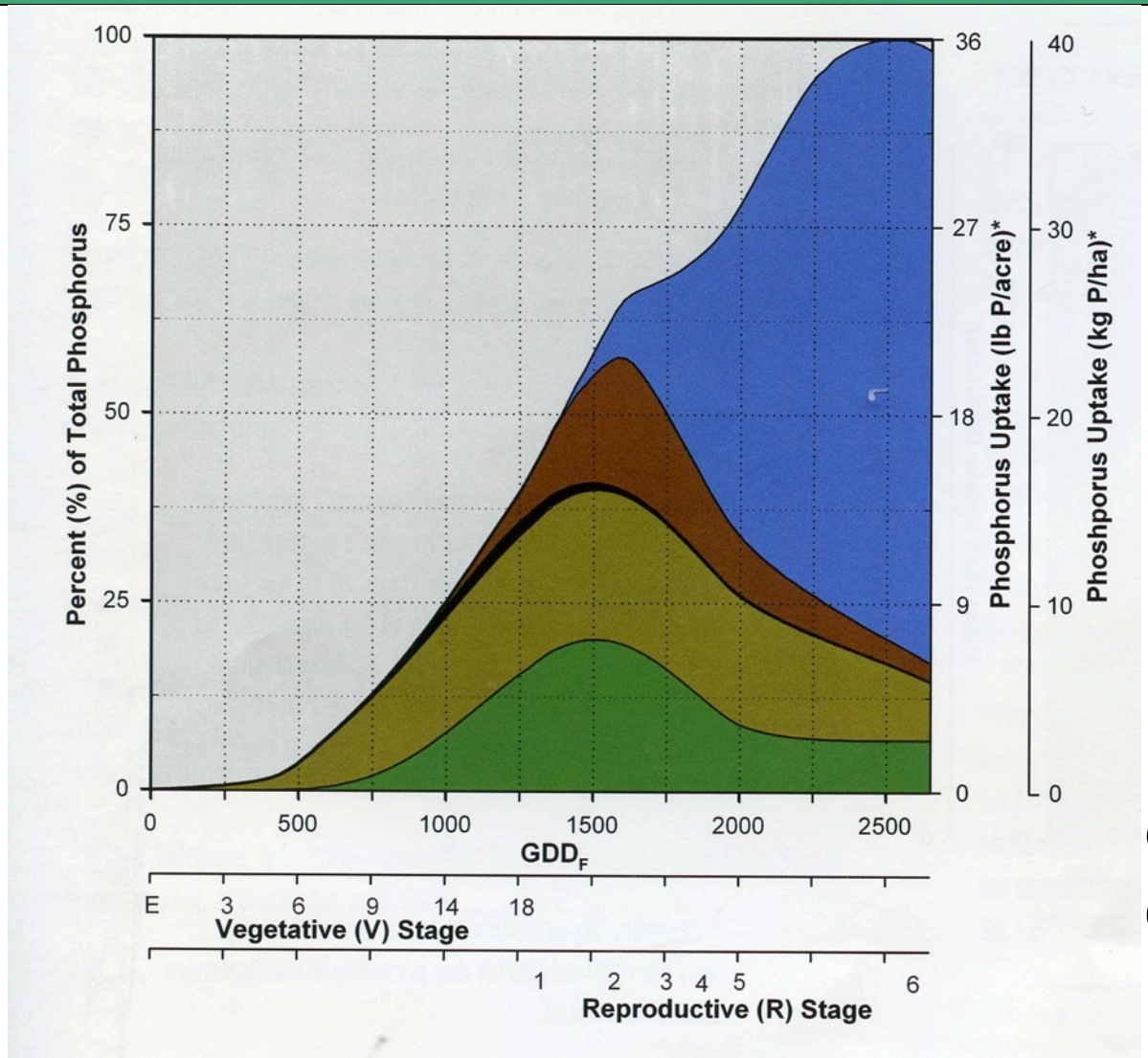


Late Season Nutrient Availability

- Important for high yields
- Build soil quality to enhance root development
- Evaluate soil physical properties
  - Drainage
  - Compaction







Focus for Fertility?

E to V3 important, but the remainder of season is vastly more important!

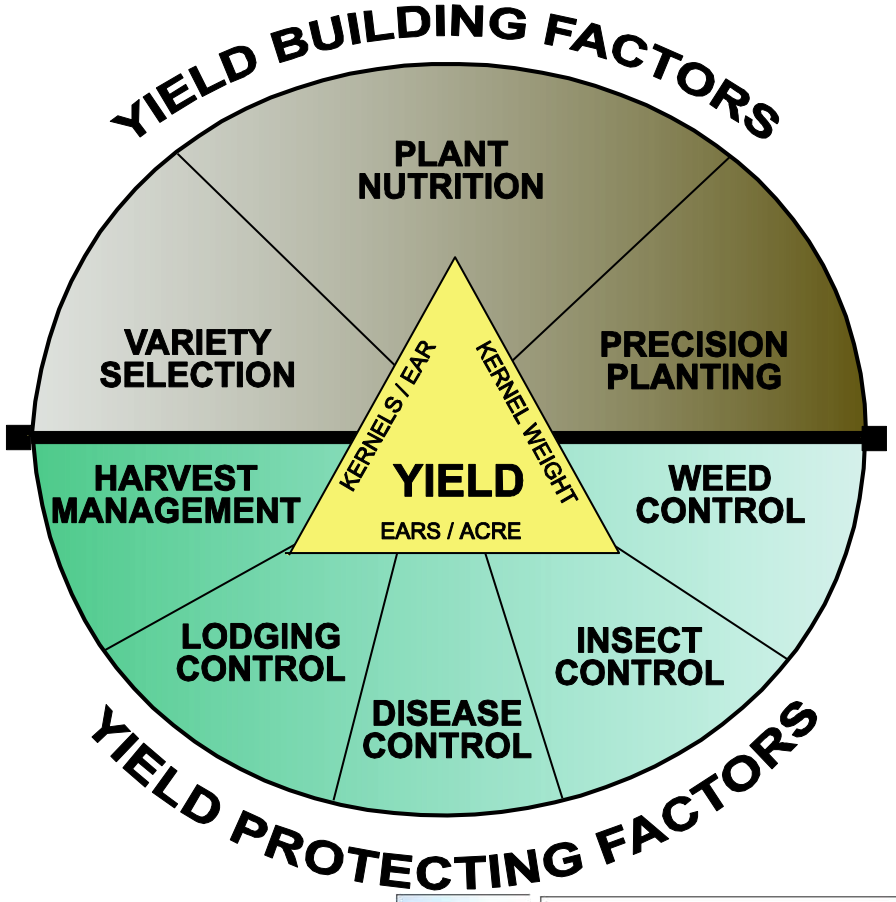
Grain Yield = 225 bu/a

Corn Growth and Development. 2011 IA State Univ. PMR 1009





Focus on the Basics



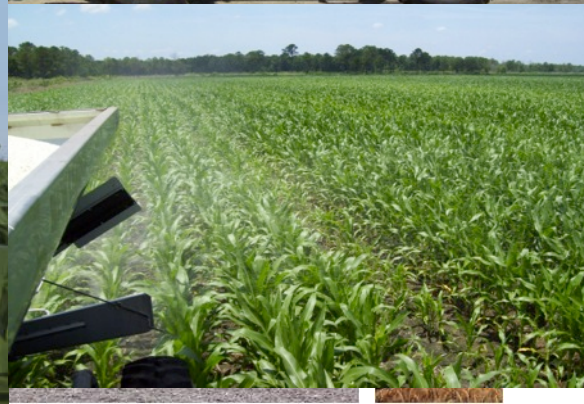
1. Good genetics
2. Precisions Planting
   - Optimum population
   - Optimum depth
   - Optimum time
3. pH, P, K, S, Mg, Zn, B
4. N management
   - Flexible
   - Optimize for season





21st Annual National No-Tillage Conference
Indianapolis, Ind.* Jan. 9-12, 2013

Flexible and Nimble Fertilizer Programs For N



All the Best for A Great Season

Questions?