Enhanced Efficiency Fertilizers

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MONTANA STATE UNIVERSITY
EXTENSION

AGRICULTURE

MAKING A DIFFERENCE IN MONTANA COMMUNITIES

Enhanced Efficiency Fertilizers EEFs

- Any fertilizer designed to:
  - Increase fertilizer availability
  - Decrease fertilizer losses

- 3 major methods of action
  - Stabilized - alter soil microbial or enzymatic reactions
  - Slow release - have additives which require chemical or biological decomposition to release nutrients
  - Controlled release - a semipermiable coating, usually a polymer, regulates release

Questions

- Who sells EEFs?
- Who has used or recommended EEFs?

Objectives

- Explain types of EEFs
- Describe how they work
- Show their benefits and limitations

Stabilized Urease Inhibitors

N_2 and N_2O

Plant Uptake

Volatilization

Plant Uptake

Denitrification

NH_3

NO_3^-

Nitrification

NO_2^-

Leaching

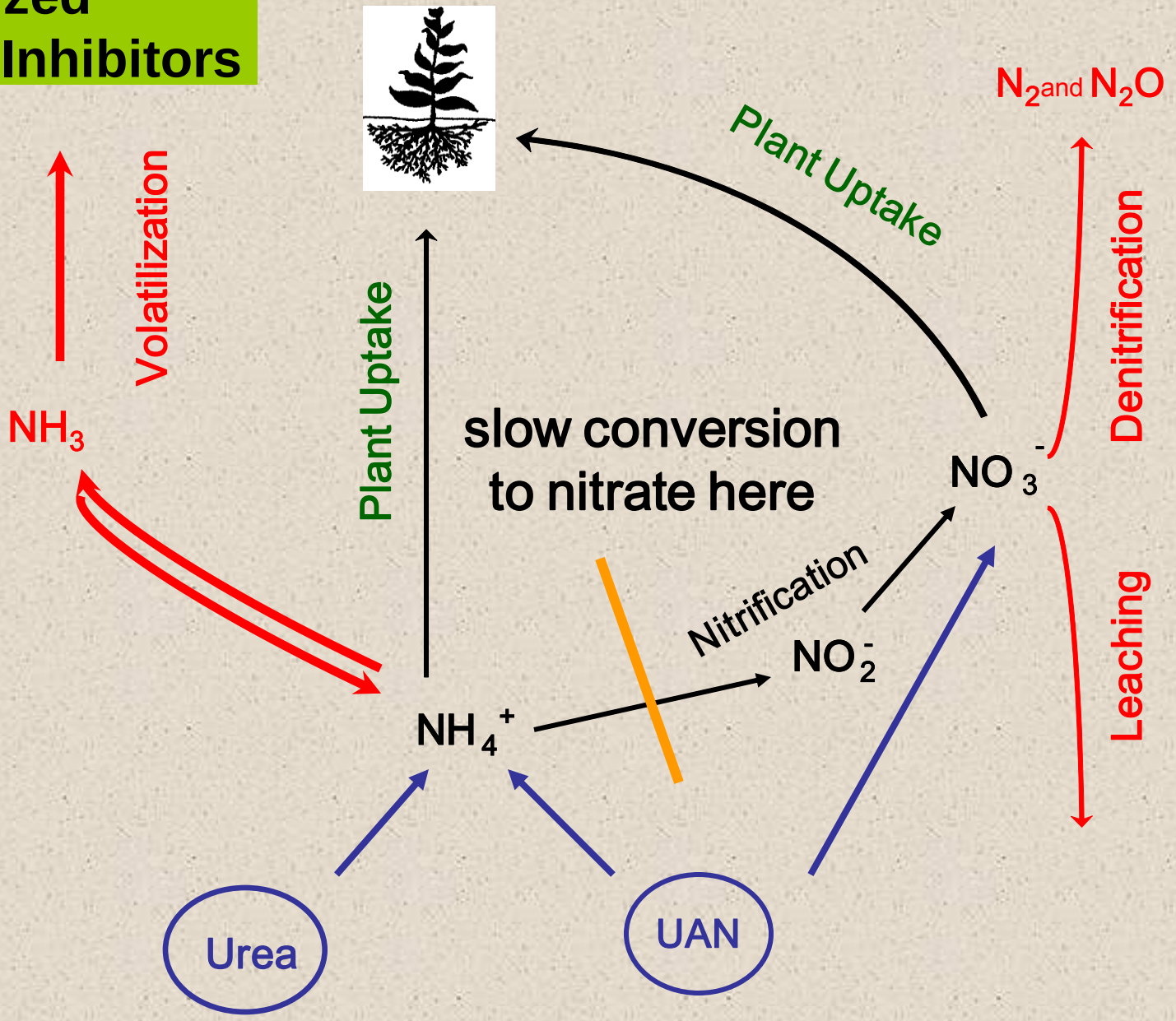
slow urea hydrolysis here, most common is NBPT

NH_4^+

Urea

UAN

Stabilized Nitrification Inhibitors



Slow and Controlled Release

Plant Uptake

N_2 and N_2O

Volatilization

Plant Uptake

Denitrification

NH_3

NO_3^-

Nitrification

NO_2^-

NH_4^+

Leaching

Urea

UAN

Slow/control release here

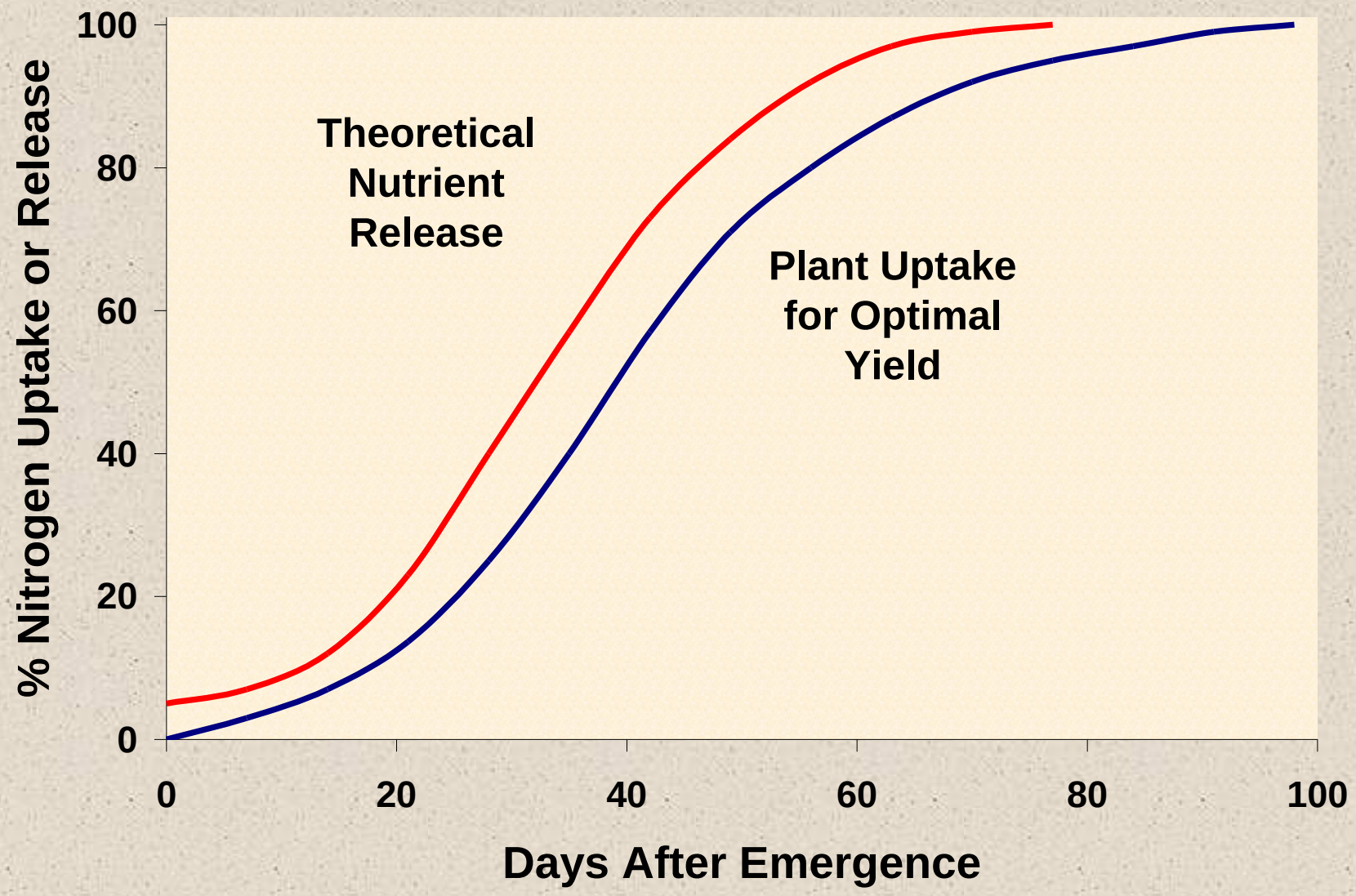
Partial list of available stabilized EEFs

- **Stabilized**
  - Nutrisphere-N® (NSN)
  - Agrotain®
  - Avail®
  - NSource®
  - NServe®
  - Instinct®
  - SuperU®
  - Nitamin Nfusion®

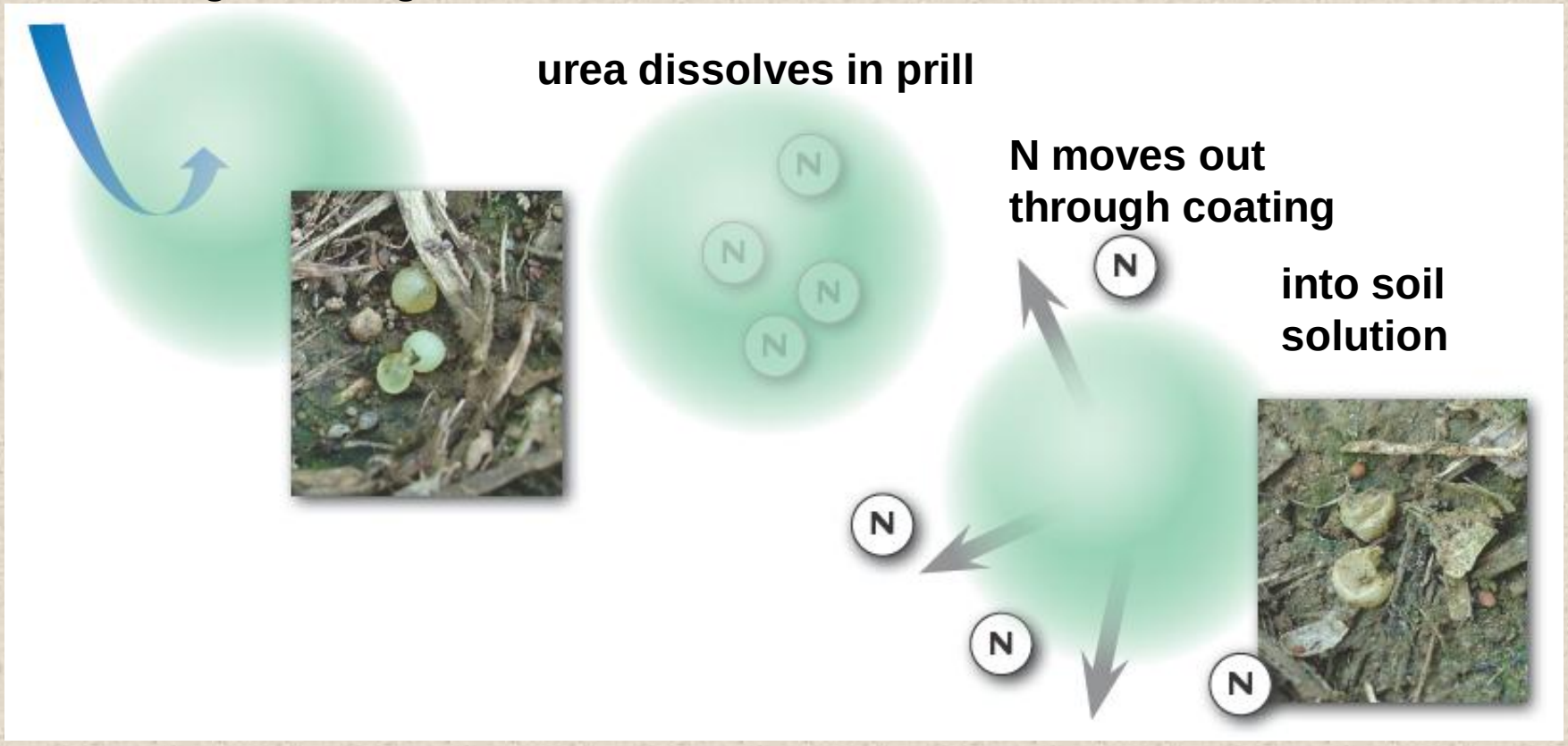
Partial list of available controlled and slow release EEFs

- **Controlled Release**
  - ESN®
  - Polyon®
  - PolyS®
  - Duration®
- **Slow Release**
  - NSure®
  - Nitroform®
  - Nutralene®

Nutrient availability from ideal slow release fertilizer



N release by polymer-coated fertilizers

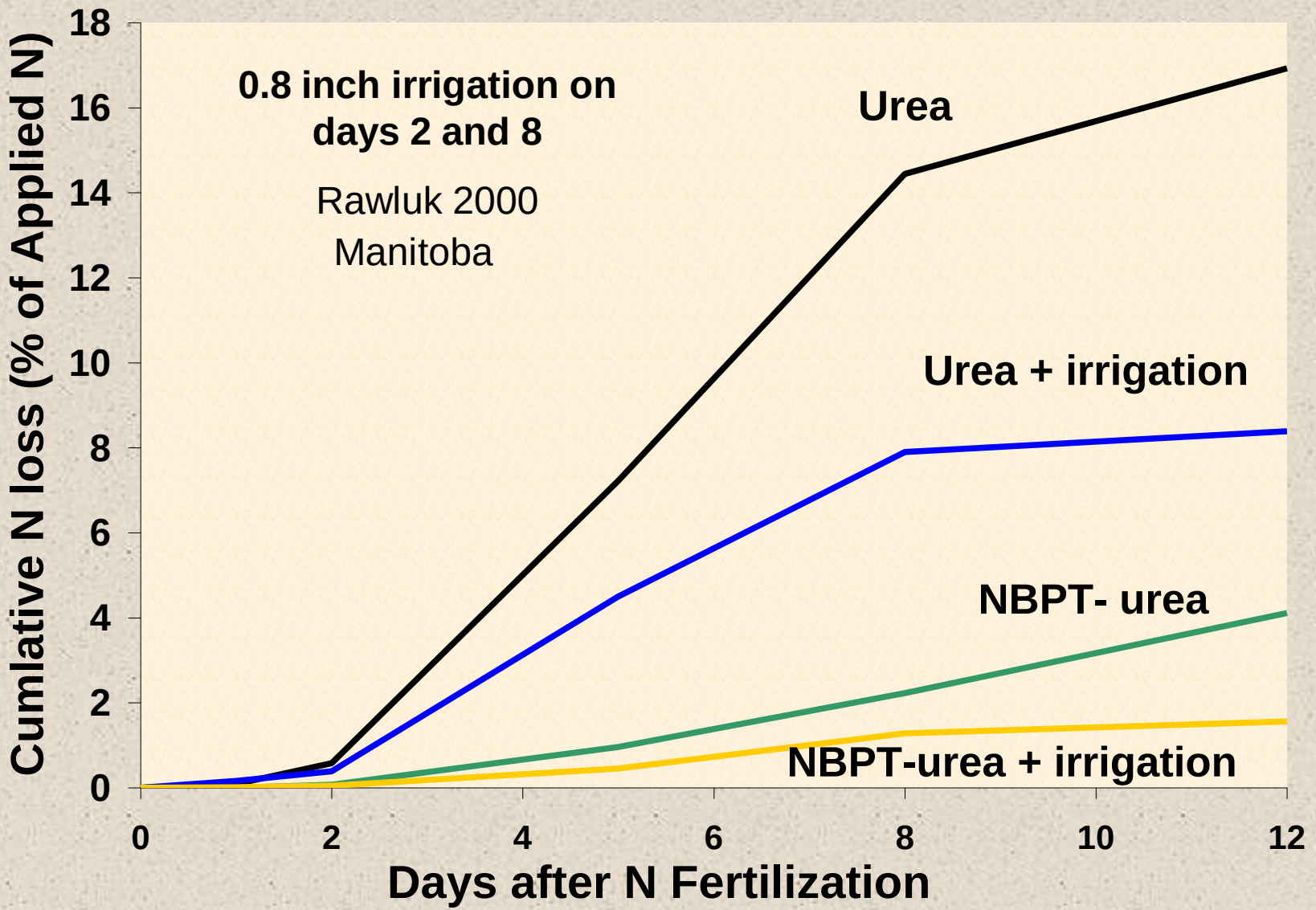


Questions?

Under what growing conditions would you expect EEFs to work better?

- High potential volatilization loss
  - coarse soils
  - moist surface
  - warm temps
  - long time between application and incorporation
- High potential leaching
  - coarse soils
  - high moisture content/irrigation/rainfall

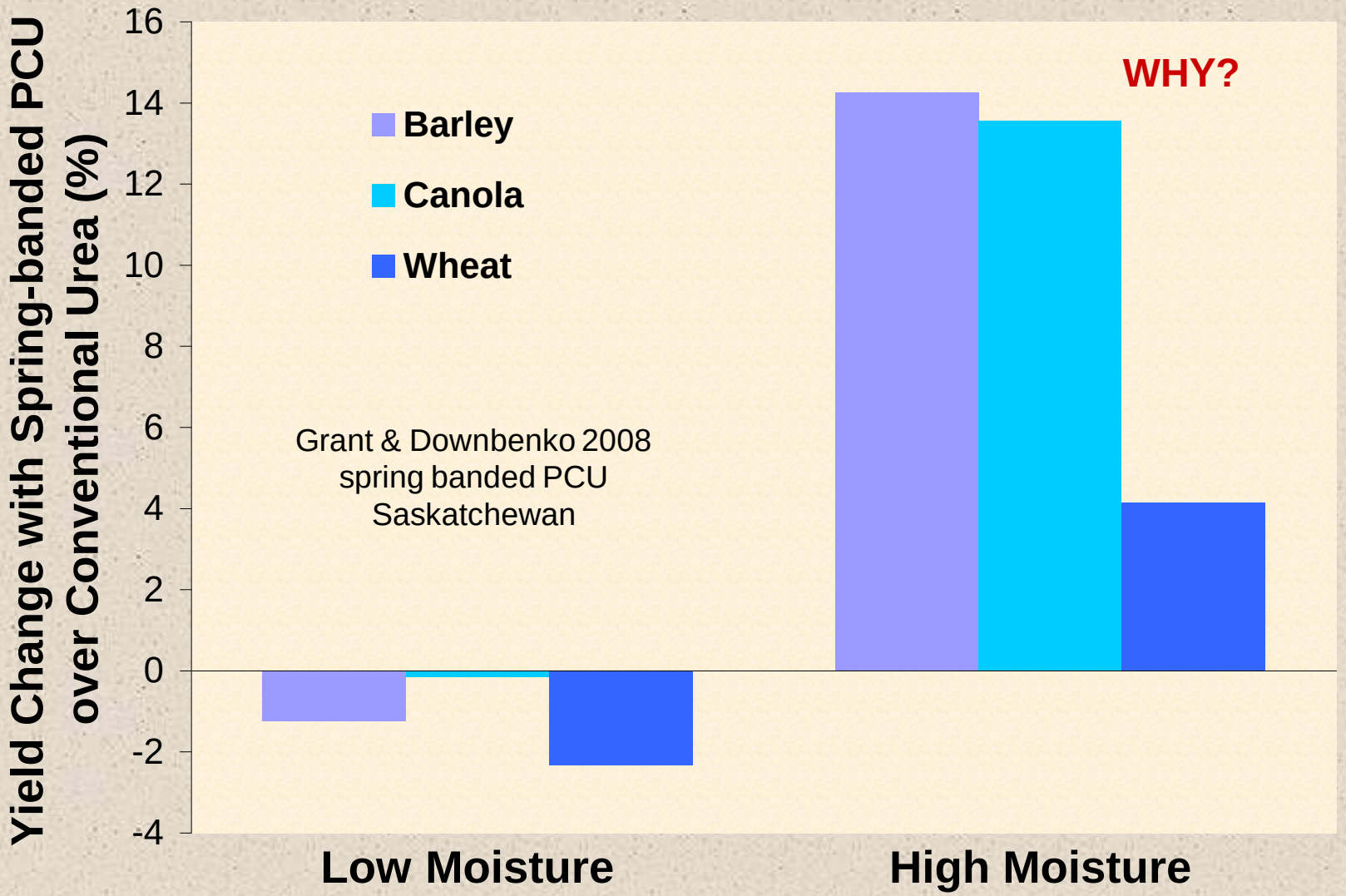
Effect of irrigation and NBPT on volatilization



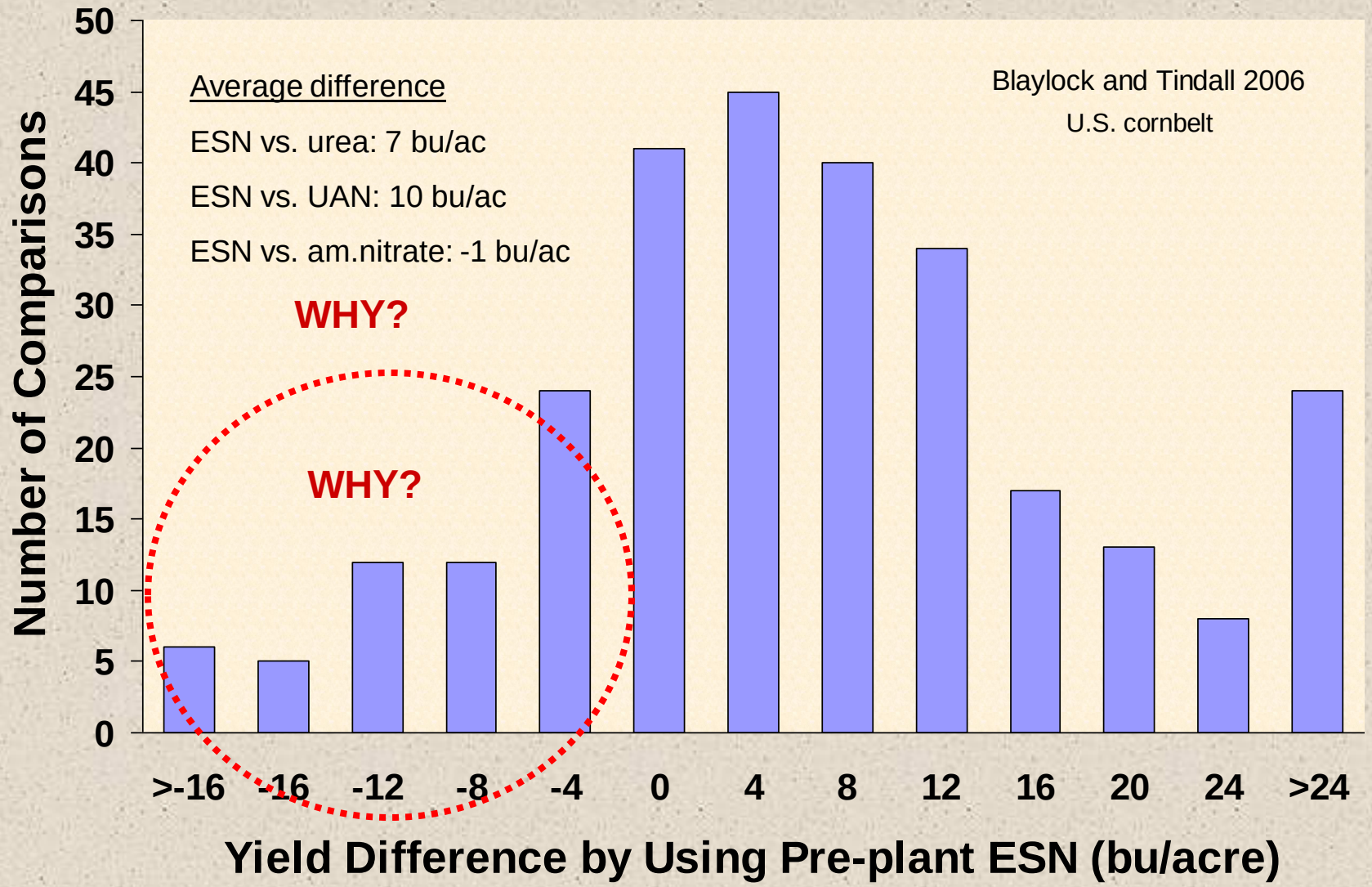
NBPT uses

- Can minimize urea volatilization for up to 14 days
- ‘Buys’ time for rainfall, irrigation or mechanical incorporation to protect urea
- Warm weather top-dressing
- Cool weather broadcast

Effects of over-winter moisture conditions on effectiveness of PCU



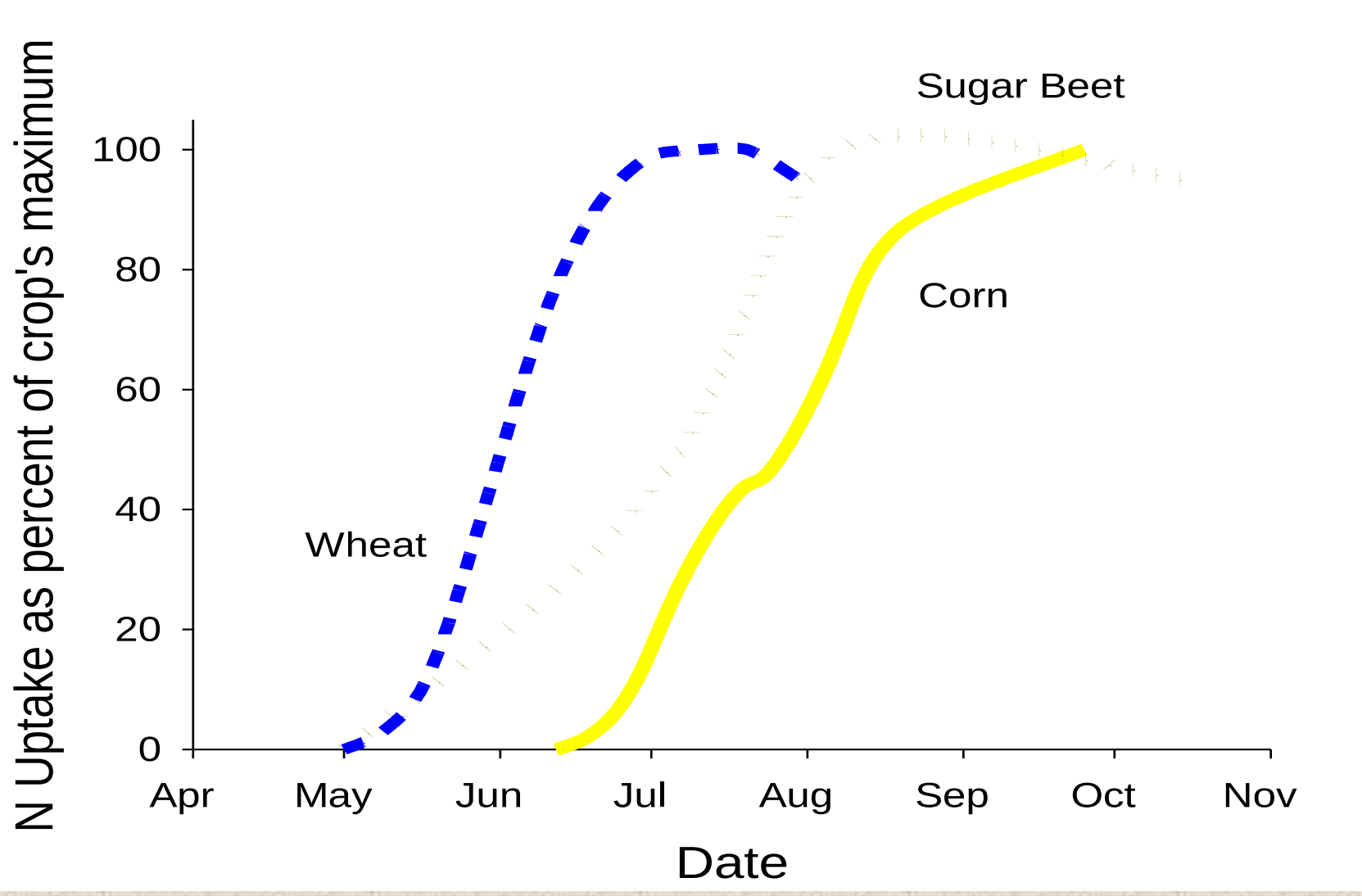
Distribution of corn yield response to ESN®



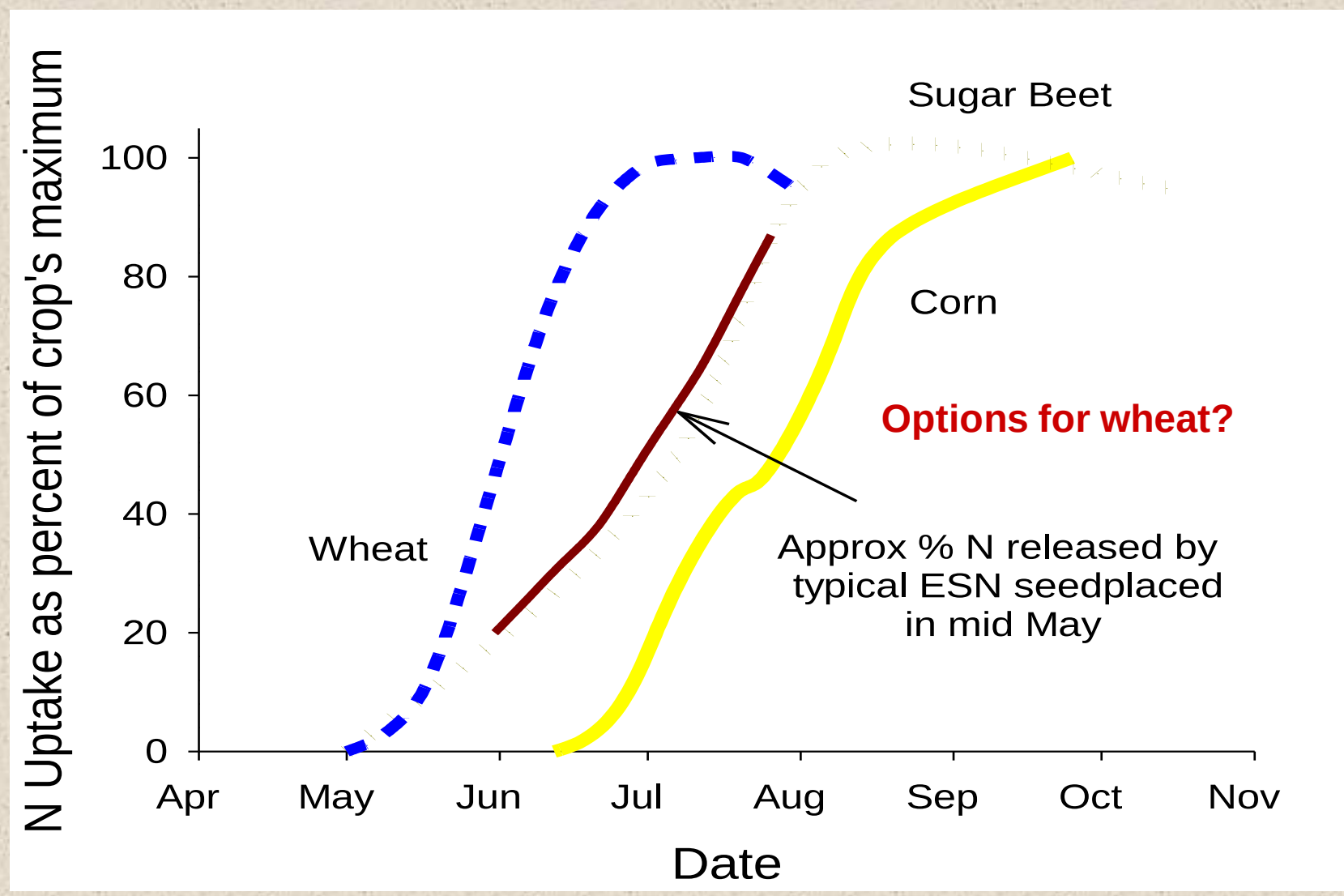
What type of crops would you expect slow release to work better?

- Irrigated
- Warm season

Timing of nutrient uptake by crops



Timing of ESN® nutrient release



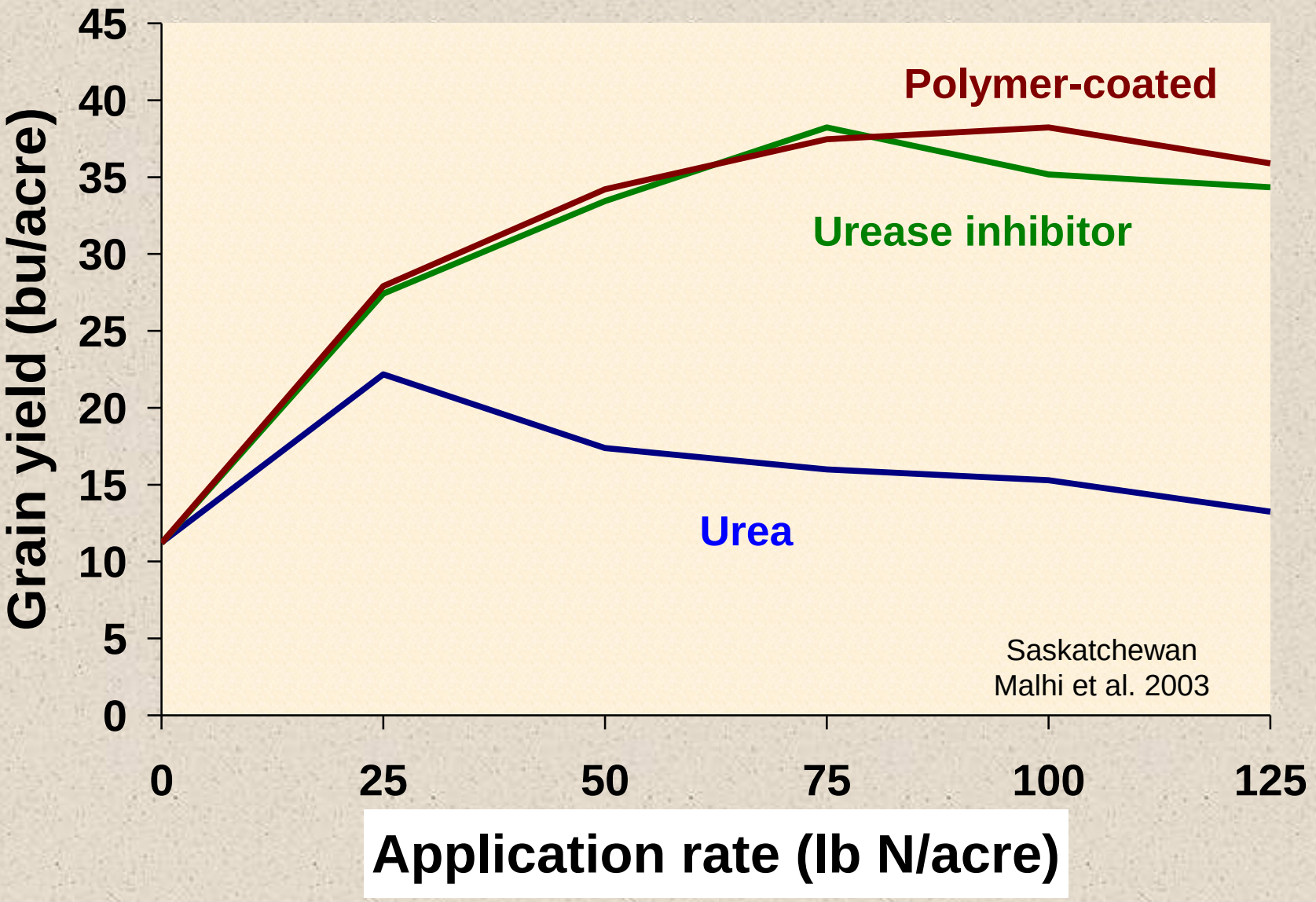
How does PCU work for small grains?

- Fall/winter pre-plant works well. PCU is in soil long enough to dissolve in time for plant need.
- Late winter/spring broadcast PCU does not - may dry out, release is too slow.
- Incorporation is important, especially late winter/spring.
- Blending is recommended with late winter/spring surface applied PCU.

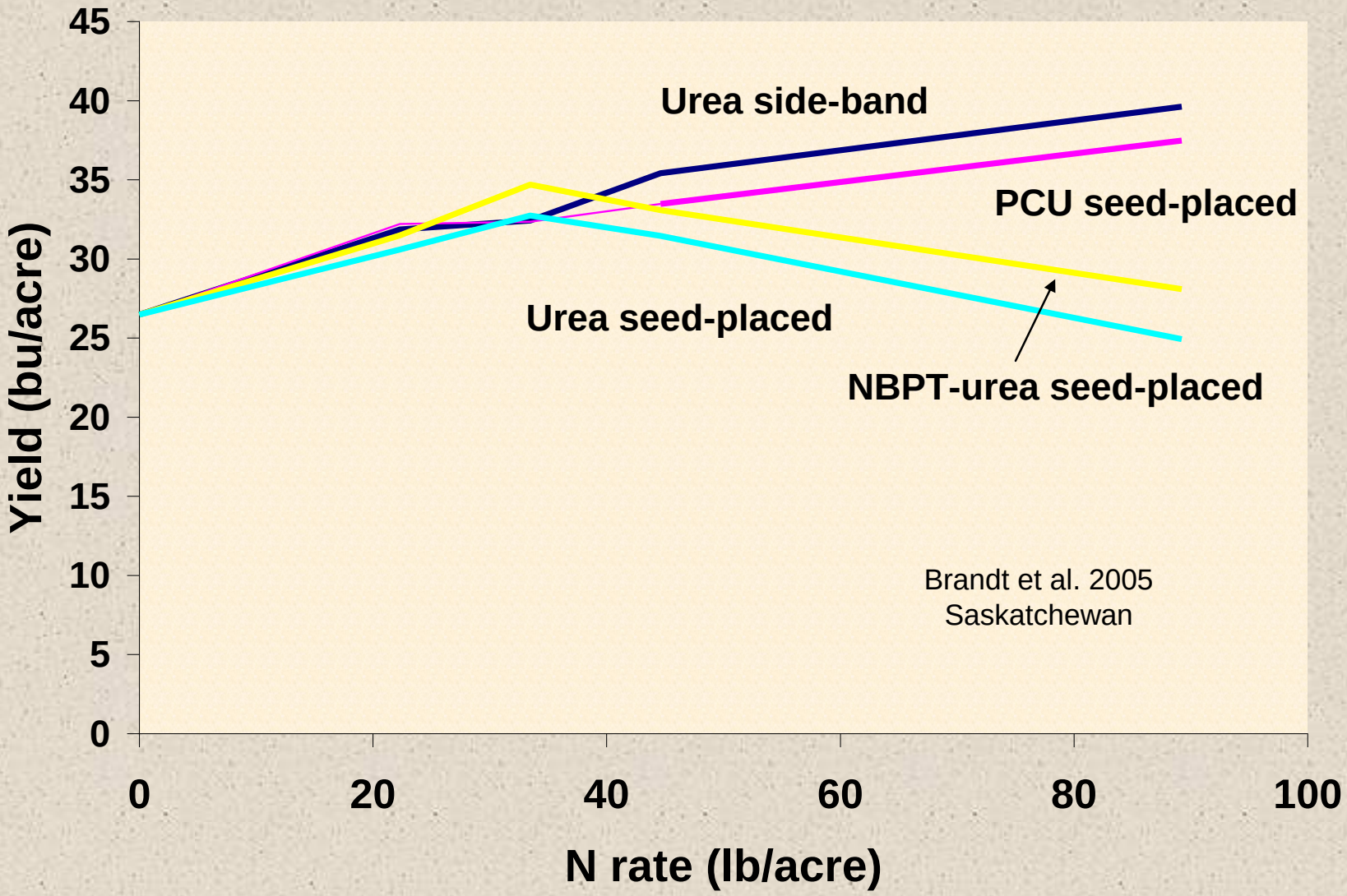
Seed placing EEFs

- Can apply ~ 2 – 4x as much slow release product as urea directly with small grain seeds
- Saves on field passes – fuel, labor, soil disturbance

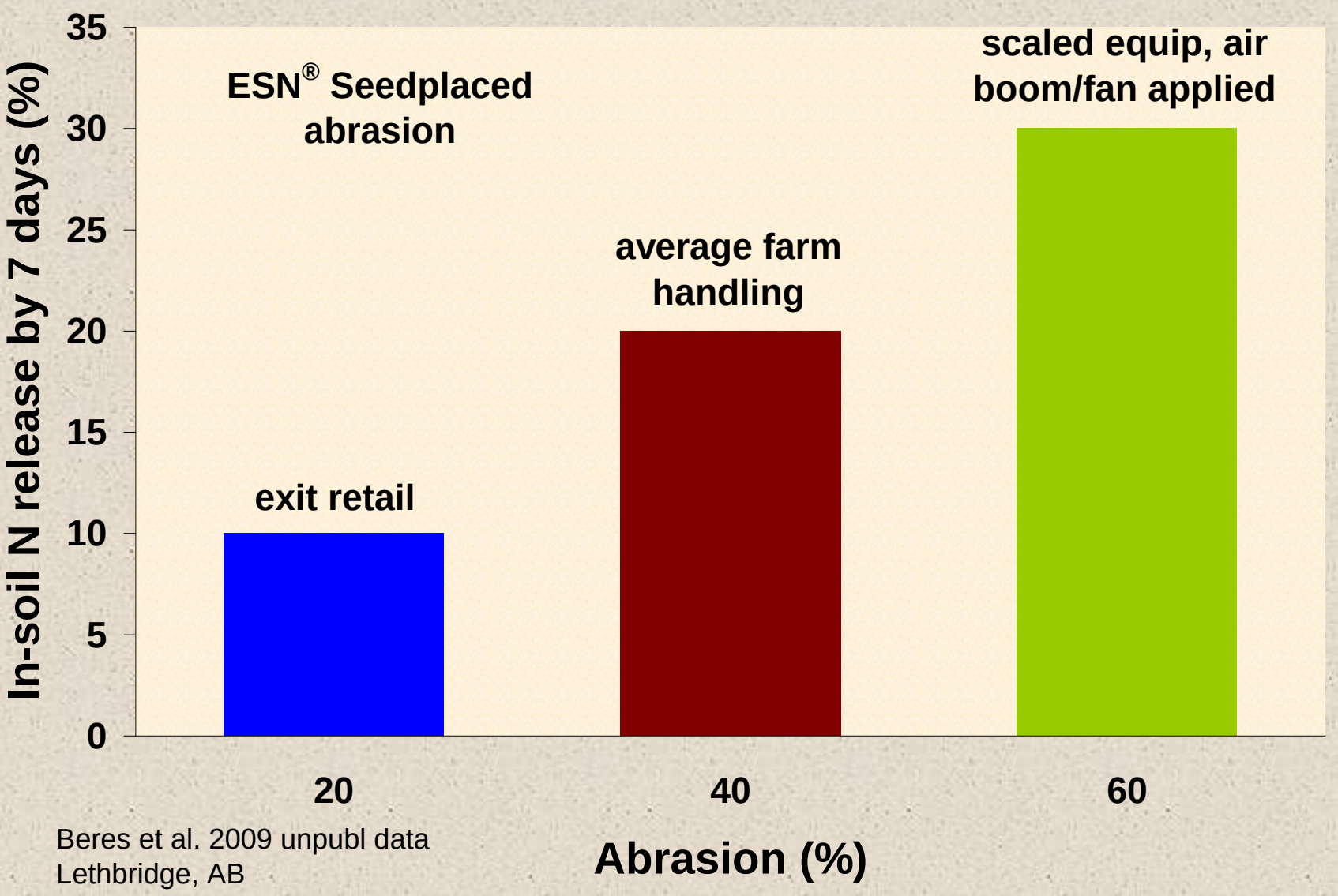
Effect of N source applied with the seed on dryland spring wheat yield



Effect of side-banded and seed-placed N source on dryland wheat yield

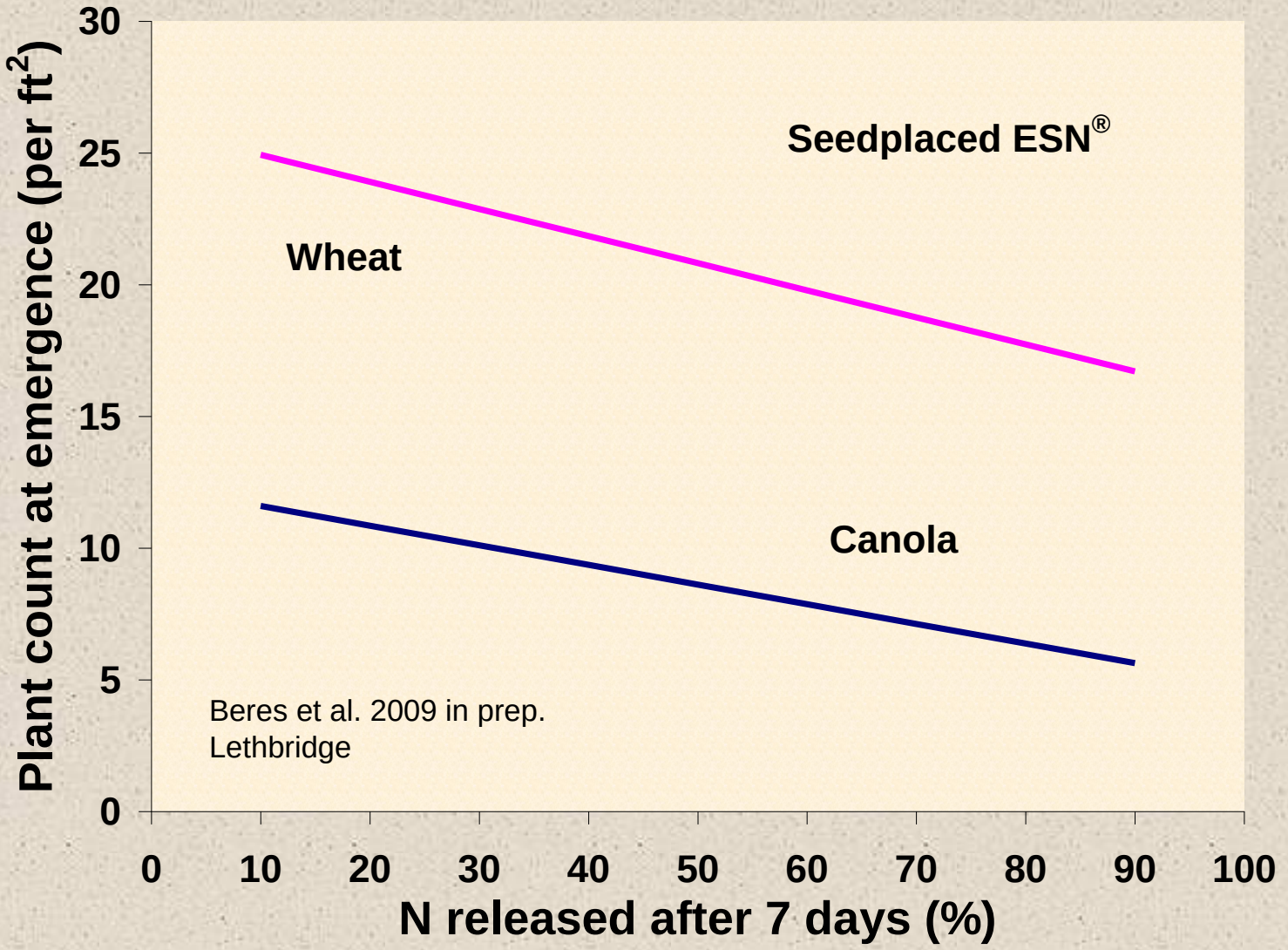


Handling abrasion of PCUs increases in-soil N release

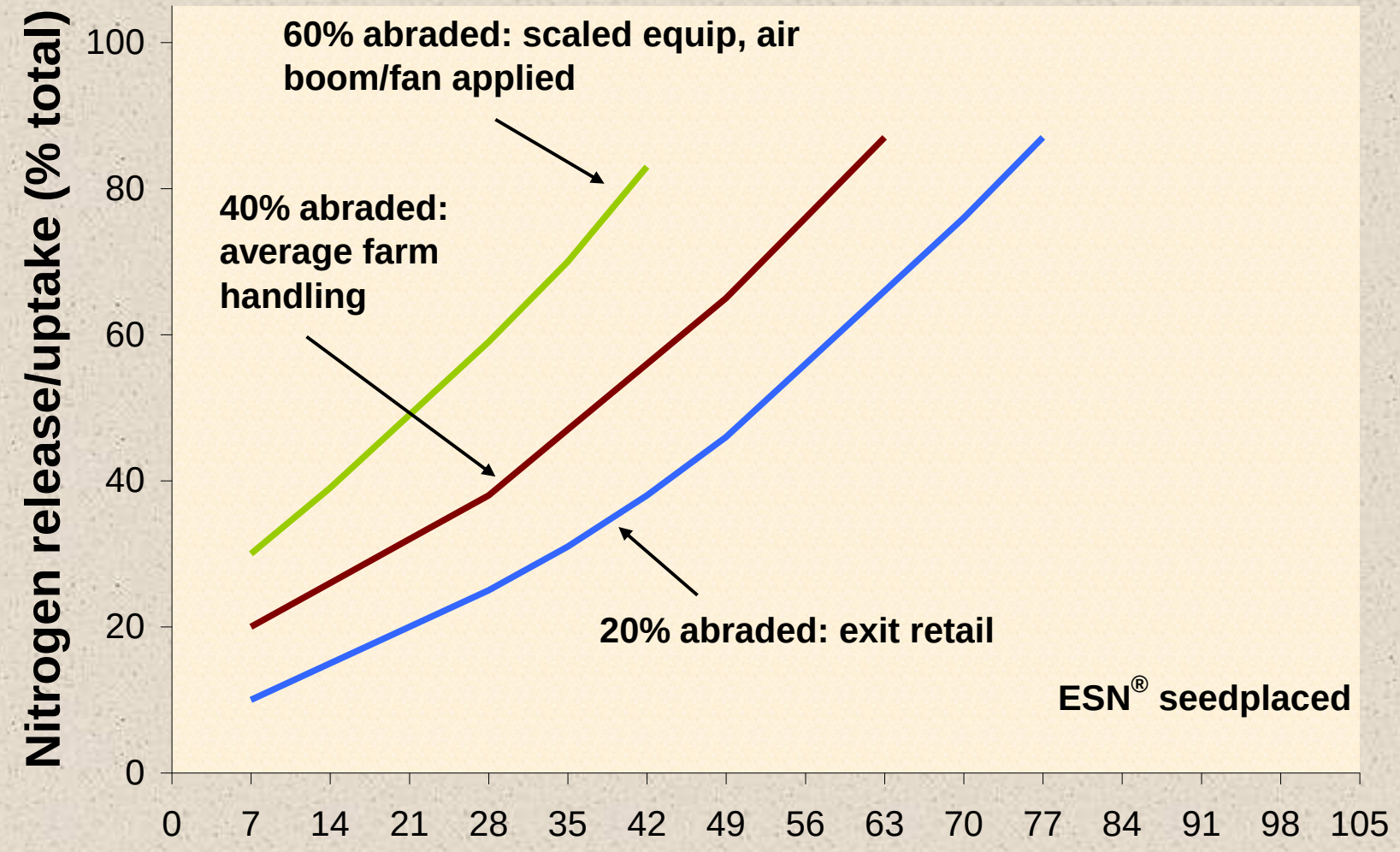


Beres et al. 2009 unpubl data
Lethbridge, AB

Plant emergence decreases with increased N released within 7 days by seedplaced PCU



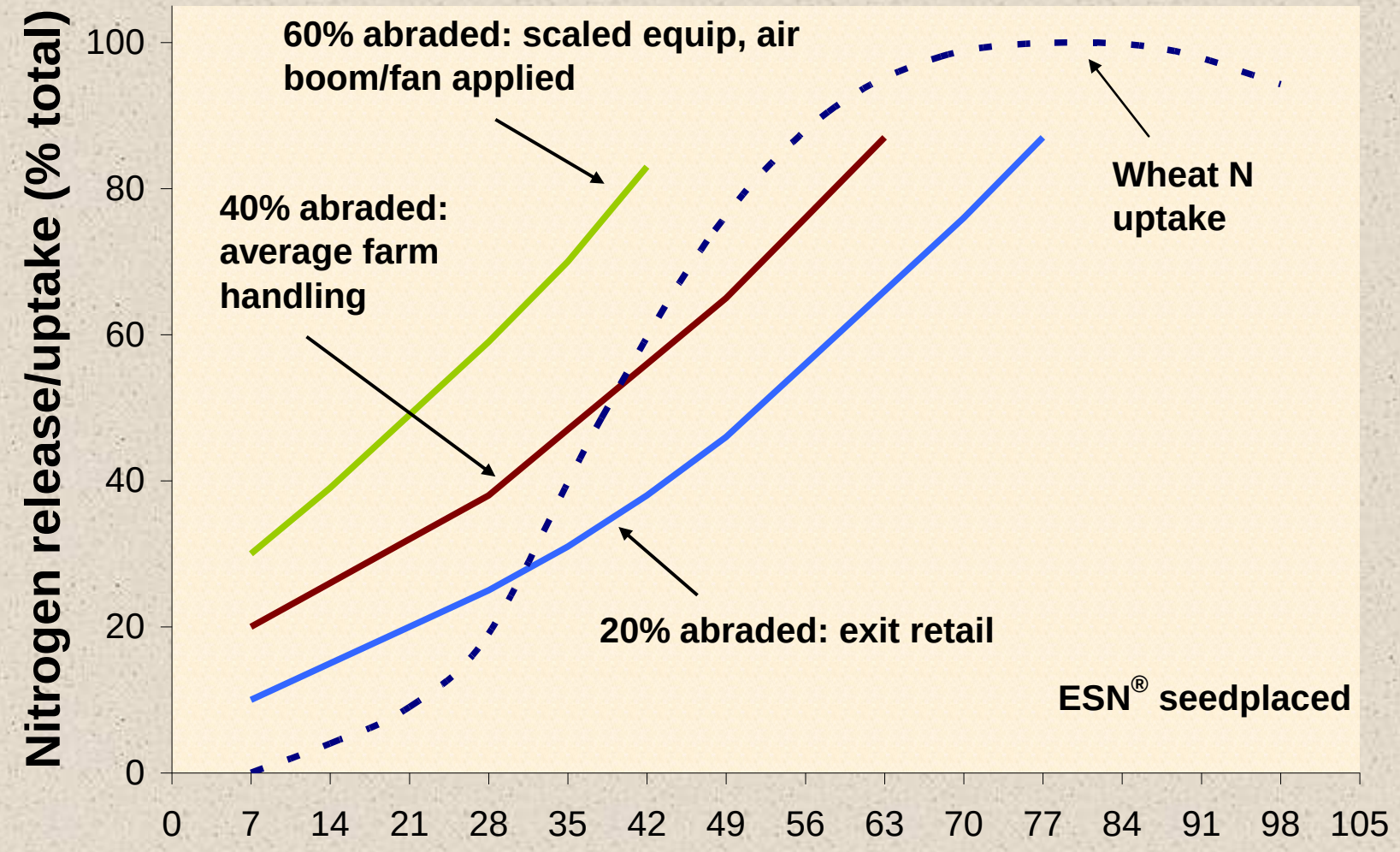
Some abrasion increases early release from PCU



Beres et al. 2009 unpubl data
Lethbridge, AB

Planting date = May 9 @ 54F

Some abrasion helps PCU meet wheat N demand



Beres et al. 2009 unpubl data
Lethbridge, AB

Malhi et al. 2006
Saskatchewan

Nitrogen EEF and forage production

- Can increase mid to late season cuttings and protein, and encourage uniform growth through season
- Can be blended with urea to meet goal
  - Large early crop? PCU too slow, but urease inhibitor can help reduce urea loss
  - Season-long forage or a late cutting?

    Delayed release of PCU desirable
- Allow application flexibility - e.g. fall broadcast on coarse soil
- Environmentally responsible but more $

How to manage PCUs

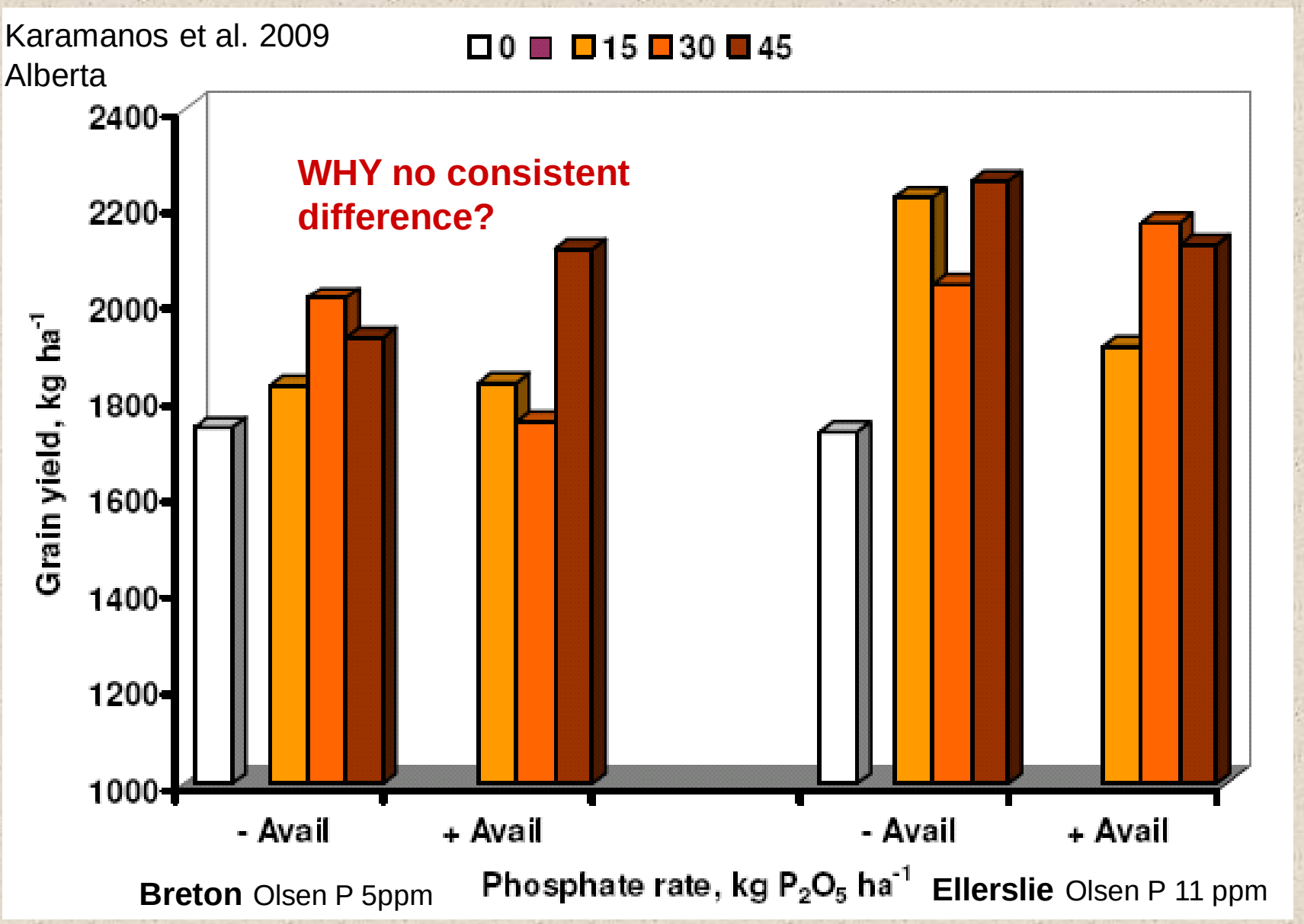
- Apply several weeks before peak crop demand
- Incorporate into the soil or seed place
- Blend with conventional fertilizer
- Adjust rates, blends and application timing for handling abrasion

Phosphorus EEF

- Types
  - Polymer coated
  - Avail® which reduces the rate of P mineral formation
- Limited regional research
  - Soil P levels often above critical

Wheat response to P and Avail®

Karamanos et al. 2009
Alberta



Potential limitations of Avail®

- Mechanism may have difficulty in highly calcareous soils
- Existing soil properties may outweigh product ability

Ex: 100 lb MAP with Avail® contains < 0.25 lb of organic acids – the active ingredient

Organic acids occur naturally in soil, and are elevated in the root zone

Additional incentive to use EEFs

- Alberta is close to adopting a Nitrous Oxide Emissions Reduction Protocol (NERP) which rewards use of EEFs.
- Other provinces may be soon adopt similar programs.

Conclusions

- Enhanced efficiency fertilizers (EEFs) will not increase yields and nutrient recovery under all circumstances.
- Improved EEFs and blending with conventional fertilizer may provide a good match between crop uptake and fertilizer availability.
- More EEF can be placed with the seed than conventional fertilizer, possibly saving a fertilizer pass and fuel costs.
- EEFs can reduce losses to the environment, especially in wet soils.

Conclusions

- EEFs show promise of increased yields, especially for warm season/irrigated crops.
- With product improvements and proper application practices, EEFs also show potential benefits for cool season crops.

Additional info in:
Enhanced Efficiency Fertilizers (EB0188)
http://landresources.montana.edu/soilfertility
Go to Fertilizer Information
(will also be in MAC Proceedings)


Questions?
Watrous, SK, 1920's