THE POWER TO MAKE THINGS GROW

Nitrogen Placement Method for Cereal Crops: Band or Broadcast?

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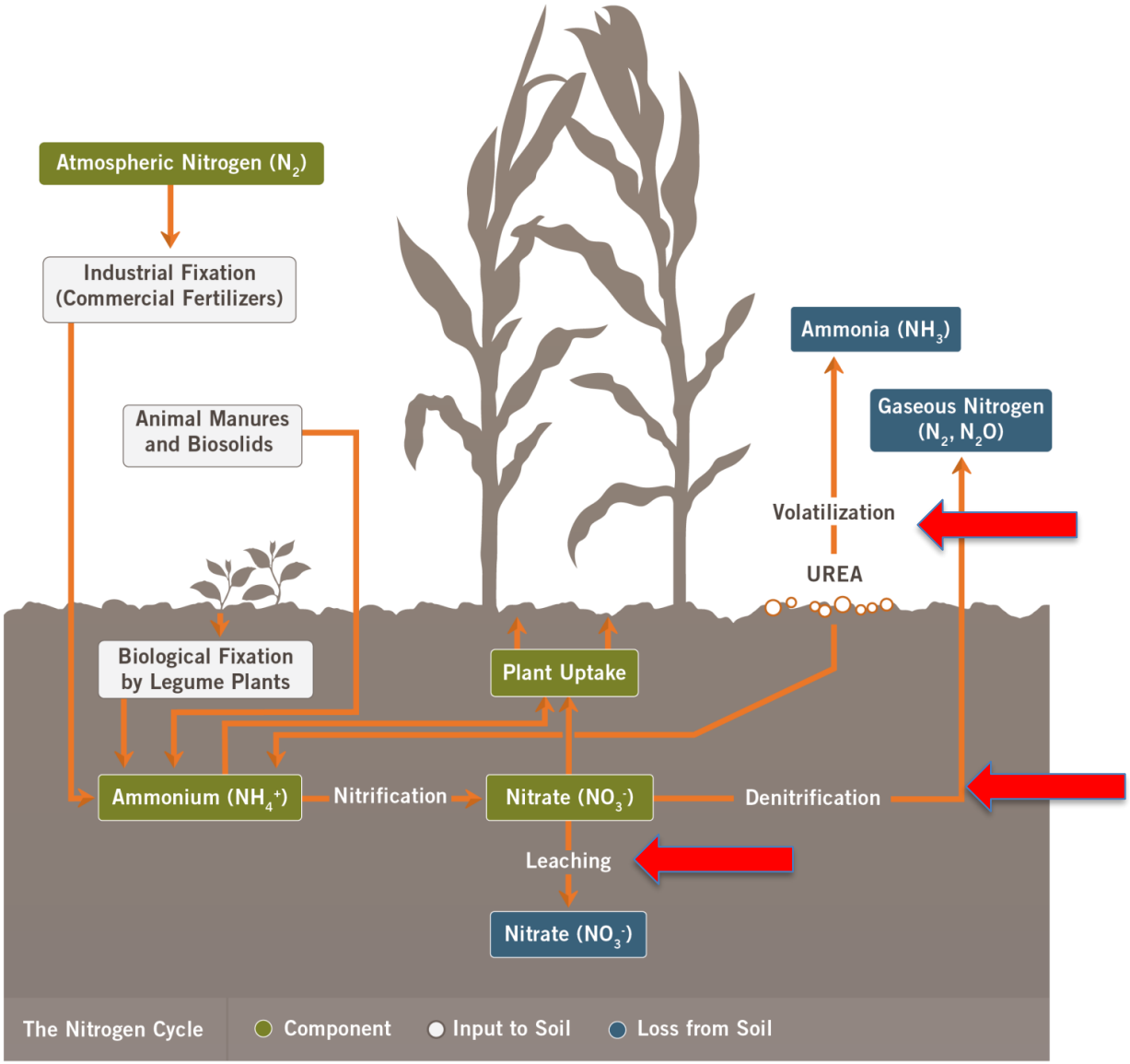
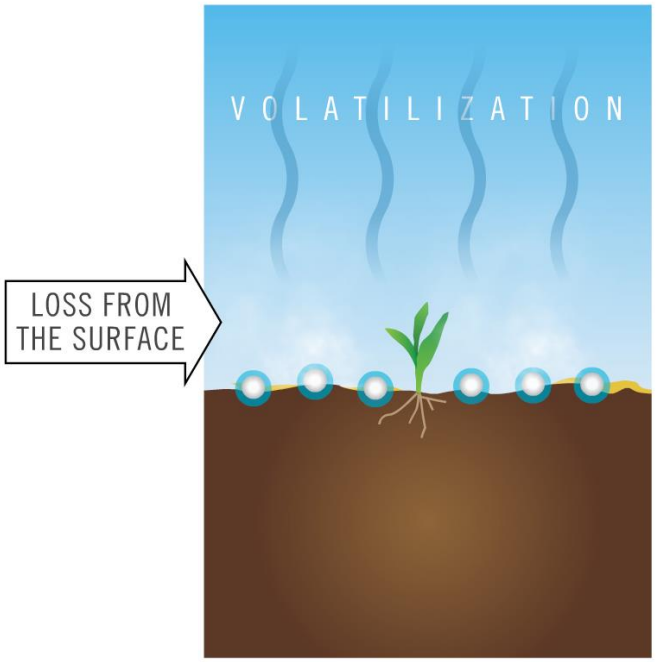
Objective

- To leave a historical record of the work carried out by Westco from 1982 to 1994.
- Only 112 of the 732 trials conducted on N placement are included here
  - Not all records were digitized
  - A variety of designs would not have allowed carrying statistics for the total population.

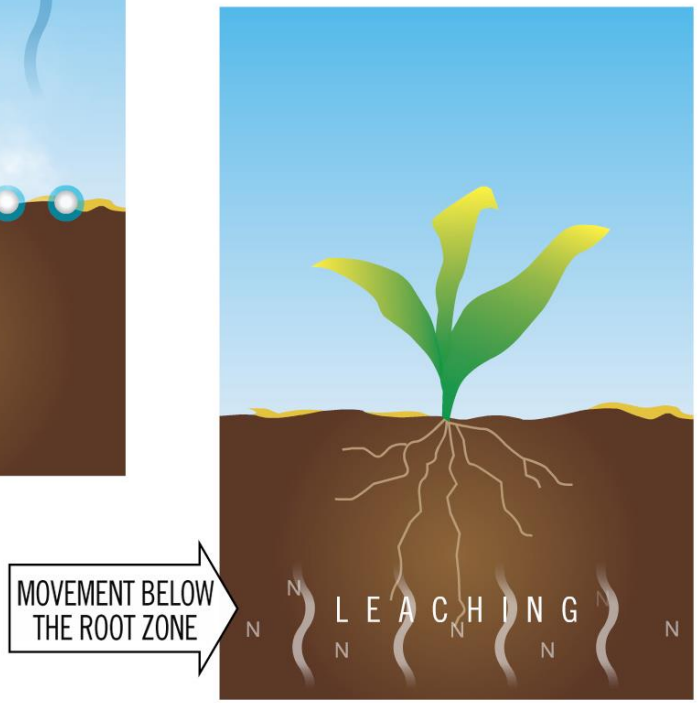
Losses during N cycling



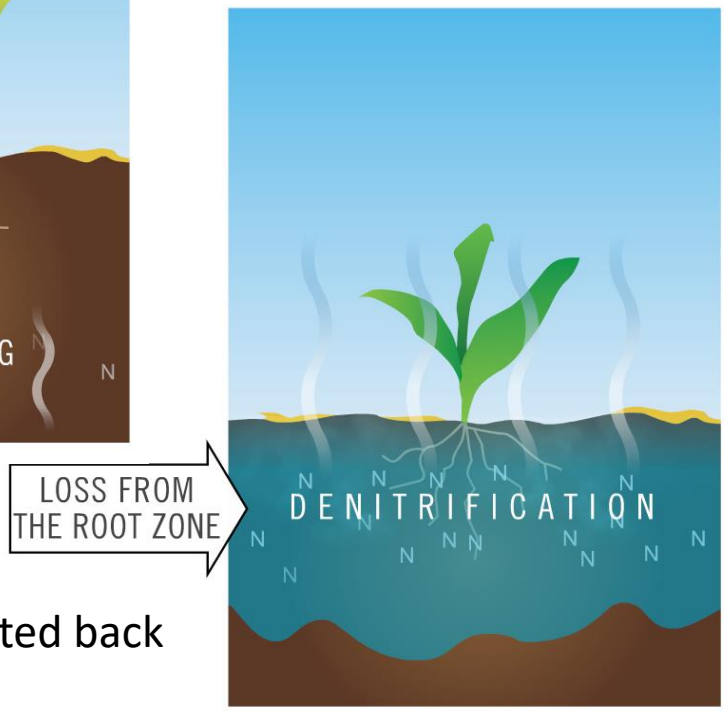
Fertilizer nitrogen losses from the field



- Nitrogen loss through surface applied urea breaking down to ammonia (NH_3) gas

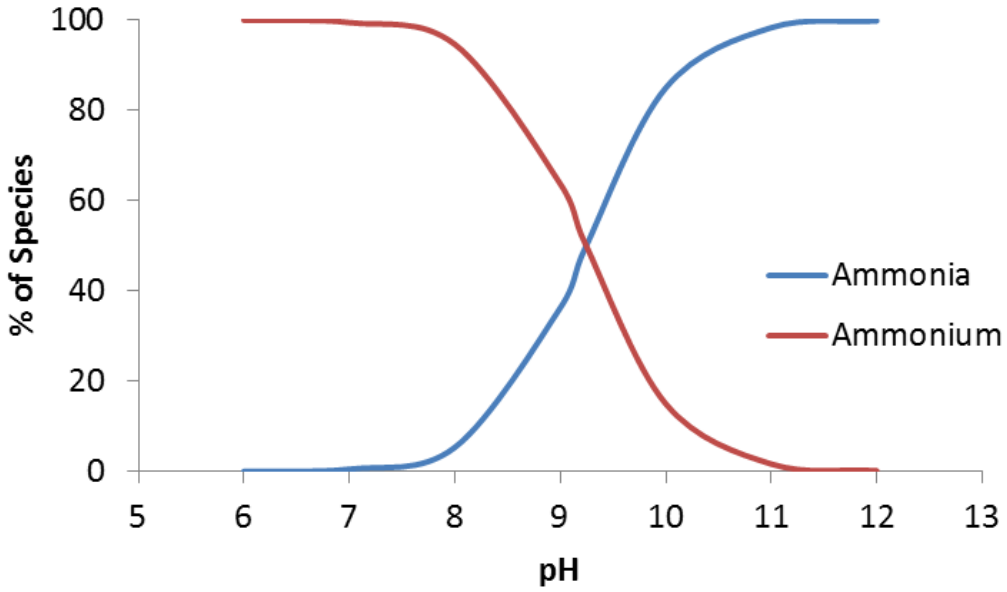


- Nitrogen loss through nitrate (NO_3^-) being moved below plant's root zone

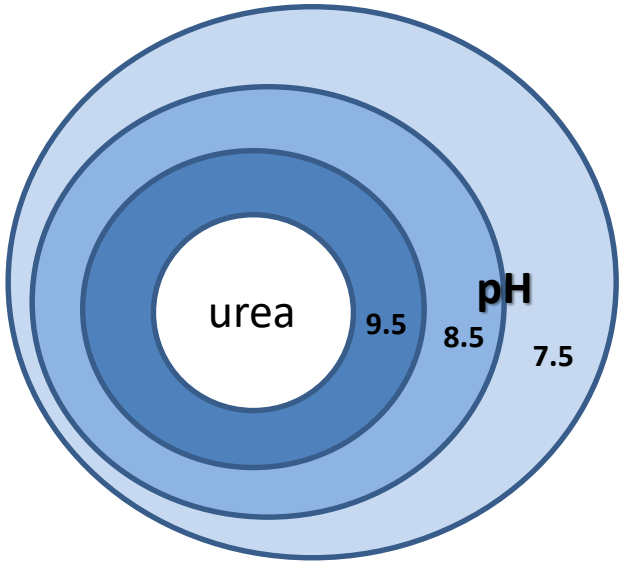


- Nitrogen loss when nitrate is converted back to gaseous forms (N_2, N_2O)

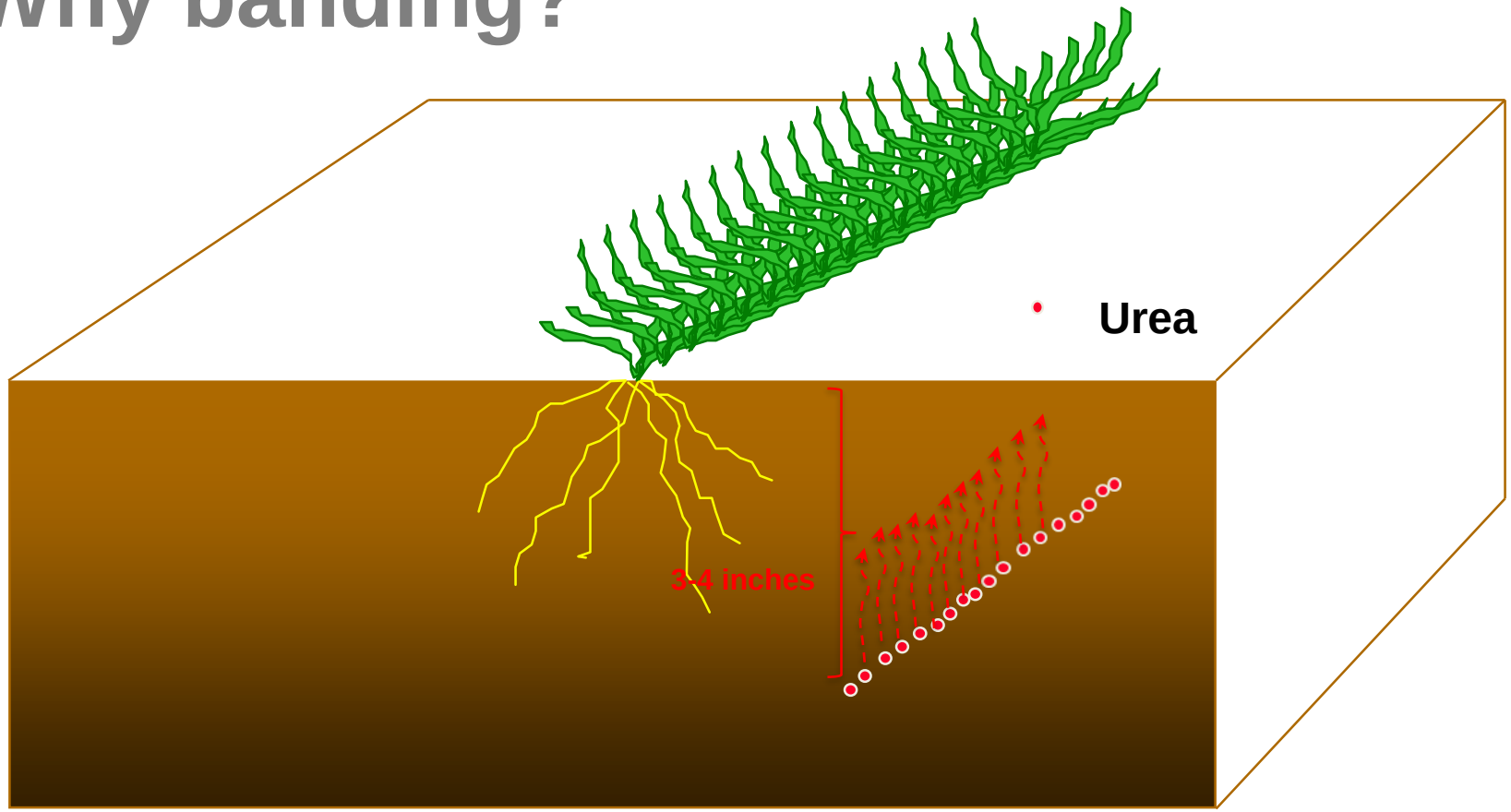
Nitrogen Loss: Ammonia Volatilization occurs due to rapid rise in pH around unprotected urea prill. The high pH results in more ammonia.



$$NH_4^+ \longleftrightarrow NH_3 + H^+$$



Why banding?



Because of increased resistance to the upward diffusion of ammoniacal N in the liquid and gaseous phases and **the retention of NH_4^+–N on soil** when urea is placed at depth (Sommer et al., 2004)

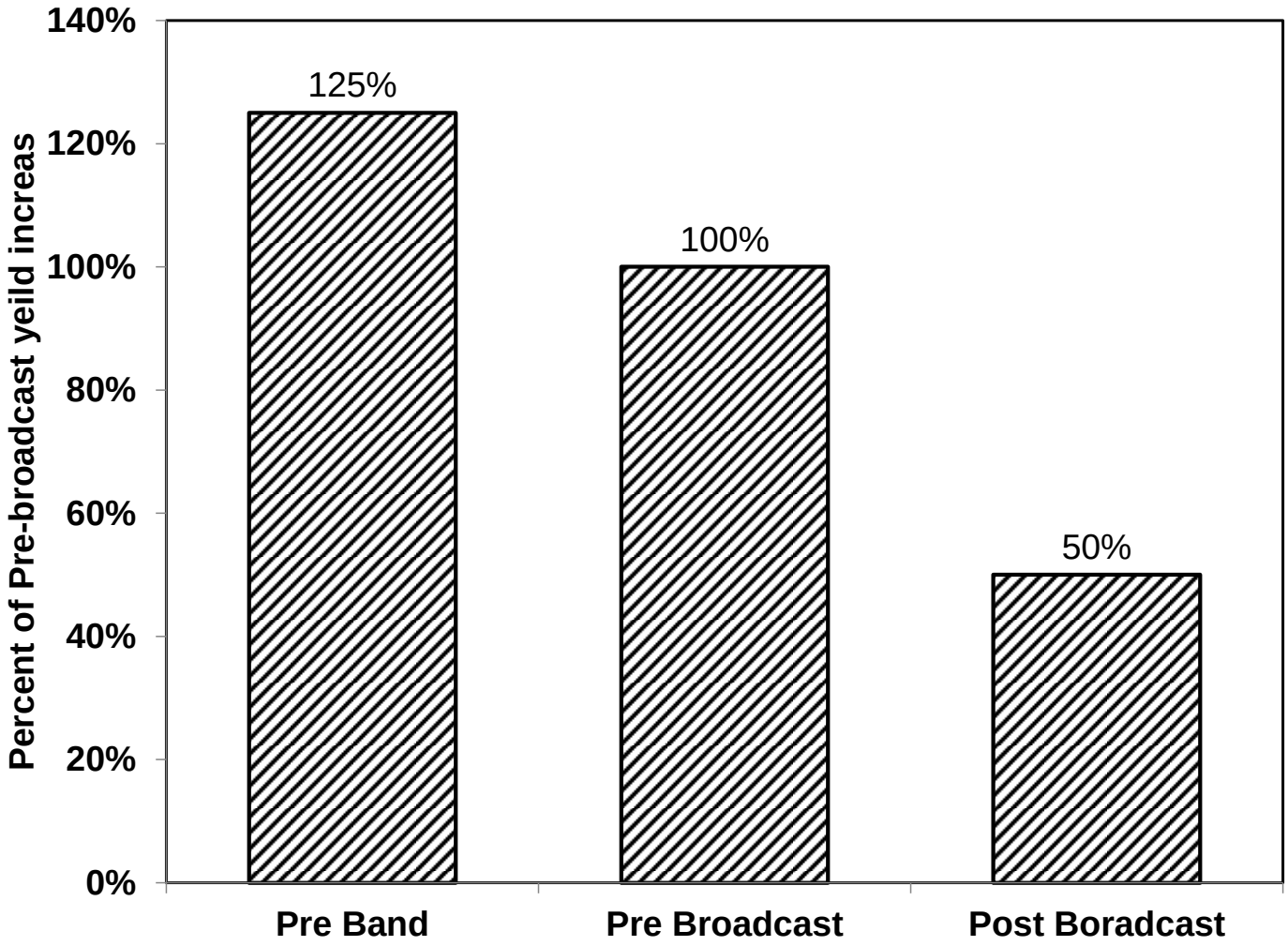
Recommended practices to lower volatilization

- Use of urease inhibitors (Watson,1990)
- Slow-release forms (Rao, 1987), and,
- Irrigation shortly after application (Holcomb et al., 2011)
- **However, the most common practice has been the incorporation of the fertilizer into the soil.**

… but we knew that way before!

- Research by John Harapiak (Westco) goes some 35 years ago
- Research in the 70's with Anhydrous Ammonia showed higher yields than broadcasting other N sources making people believe that it was a better N form, but it turned out that it was banding rather than the form that was providing the advantage
- In 1985 Harapiak published the average ratings from 28 trials carried out between 1977 and 1980.

Rating of N placement methods



cited by Harapiak et al. 1986. Nitrogen sources and placement in wheat production p 87-135 in A.E. Slincard and D.B. Fowler (eds) Wheat Production in Canada. A Review, University of Saskatchewan, Saskatoon, SK.

Time and Method of Fall Application Impacts N Performance (AB AG*)

Method and time of application	Soil-climatic categories			
	1 (dry) [a]	2 (medium)	3 (wet) [b]	4 (Irrigated)
Spring broadcast and incorporated	100%	100%	100%	100%
Spring banded	120%	110%	105%	110%
Fall broadcast and incorporated [a]	90%	75%	65%	95%
Fall banded	120%	110%	85%	110%

[a] Although spring and fall banded nitrogen were equally effective in research trials, fall banding may be more practical under farm conditions. The extra tillage associated with spring banding may dry the seedbed and reduce yields.
[b] In research trials conducted in the higher rainfall areas, spring broadcast nitrogen was well incorporated and seeding and packing completed within a short period of time. Under farm conditions, shallow incorporation or loss of seedbed moisture resulting from deeper incorporation may cause spring broadcasting to be somewhat less effective than shown here.

* http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex621

Time and Method of Fall Application Impacts N Performance (Sask. AG*)

	Wetter conditions		Drier conditions	
	1986	1995	1986	1995
Spring Broadcast	100%	100%	100%	100%
Fall Broadcast	75%	75%	90%	90%
Spring Band	105%	115%	115%	130%
Fall Band	90%	110%	115%	135%

*Nitrogen in Crop Production. 1995. Saskatchewan Agriculture and Food Fact Sheet.

Relative Ratings of Various N Application Options – Manitoba*

Time and Method	Relative Values
Spring broadcast	100%
Spring banded	120%
Fall broadcast	80%
Fall banded	100%

*http://www.gov.mb.ca/agriculture/soilwater/nutrient/fbd02s02.html

Wheat experiments

- Sixty eight trials in 26 locations:
- Arrowwood, Binscarth, Calgary, Cardale, Champion, Churchbridge, Crossfield, Foxwarren, Gladstone, Indus, Irricana, Kane Site, Langdon, Langenburg, Marchwell, Minnedosa, Neepawa, Newdale, Orknay, Shoal Lake, Solsgirth, Sperling, Strarbuck, Strathclair,Tonkin, Yorkton

Barley experiments

- Forty four trials in 18 locations:
- Airdrie, Bentley, Bentley, Calgary, Camrose, Carstairs, Conrich, Crossfield, Dawson Creek, Didsbury, Irricana, Lacombe, Lethbridge, Munson, Olds, Orknay, Red Dee, Wetaskiwin

Analysis of variance summary for crop responses to N fertilizer treatments

Effect / Contrast	Barley	Wheat
	(P value)	
Placement (P)	< 0.001	< 0.001
Time of application (T)	0.967	0.002
T x P	0.109	0.199
Early fall	< 0.001	
Mid fall	< 0.001	
Late fall	< 0.001	< 0.001
Spring	< 0.001	< 0.001
	(Variance estimates)z	
Site	3.04	1.01
Site x T x P	0.07	0.03

Spring application only

Crop	Band	Broadcast	LCL (bu/acre)	Difference	UCL	$LSD_{0.05}$	P value
Barley	101.1	91.9	6.9	9.2	11.5	2.3	< 0.001
Wheat	46.4	43.4	2.1	3.0	3.9	0.9	< 0.001

Barley

Time	Band	Broadcast	LCL	Difference	UCL	LSD0.05	P value
			(bu/acre)				
Mean	97.9	85.8	9.5	12.1	14.8	2.6	< 0.001
Early fall	100.0	84.1	10.1	15.9	21.8	5.8	< 0.001
Mid fall	98.4	85.1	7.5	13.3	19.2	5.8	< 0.001
Late fall	97.0	86.0	6.8	11.1	15.3	4.3	< 0.001
Spring	96.3	88.1	5.1	8.2	11.3	3.1	< 0.001

Wheat

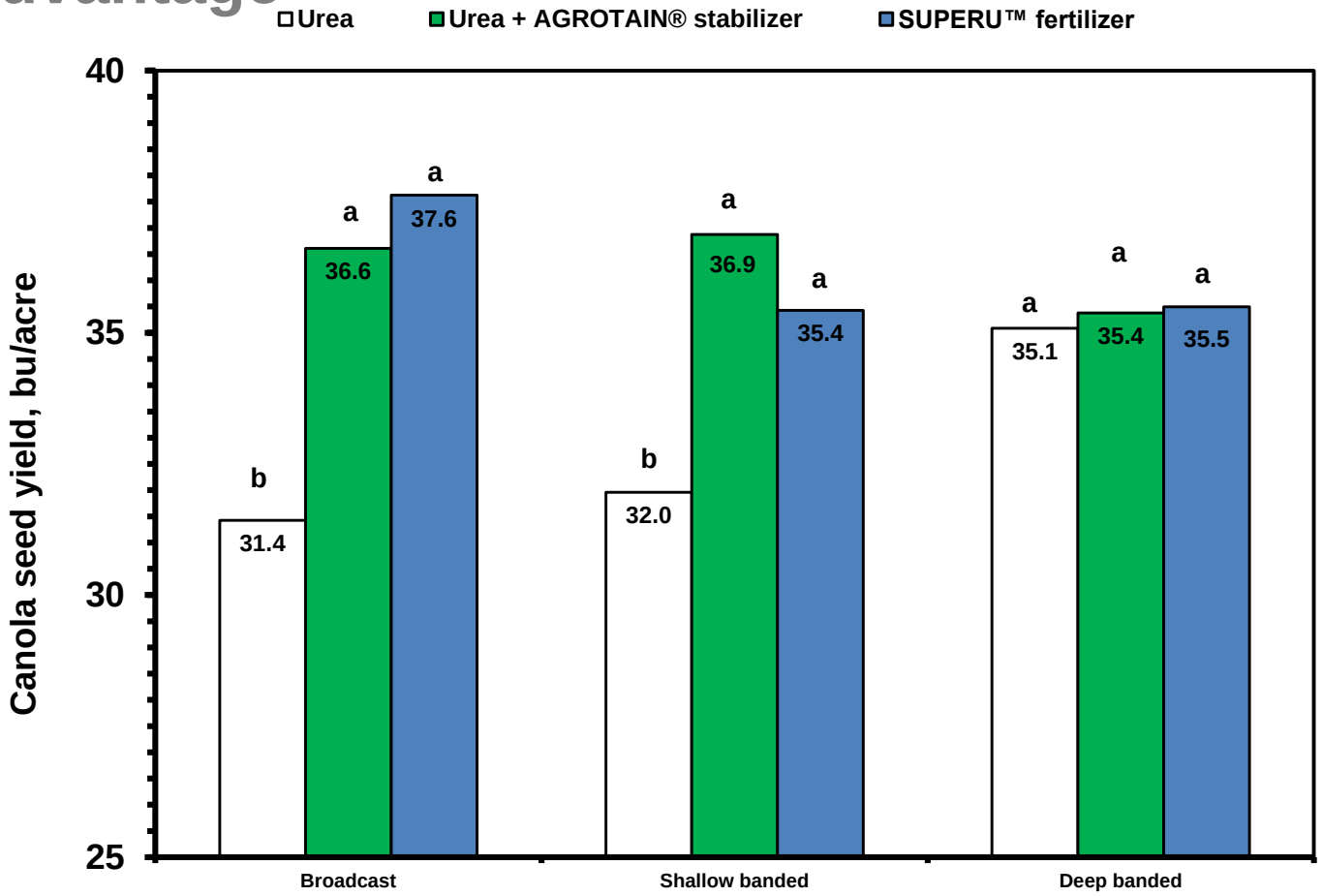
	Band	Broadcast	LCL	Difference	UCL	LSD0.05	P value
			(bu/acre)				
Mean	48.1	45.2	1.7	3.0	4.2	1.3	< 0.001
Early fall	47.7	45.2	-0.8	2.4	5.6	3.2	0.134
Mid fall	47.7	46.4	-2.0	1.3	4.6	3.3	0.439
Late fall	47.9	43.1	3.2	4.8	6.4	1.6	< 0.001
Spring	49.2	45.9	1.7	3.3	4.8	1.5	< 0.001

Relative increase band vs. broadcast

	LCL	Δincrease, %	UCL
		Spring only	
Barley	8	10	13
Wheat	5	7	9
		Barley	
Mean	11	14	17
Early fall	12	19	26
Mid fall	9	16	23
Late fall	8	13	18
Spring	6	9	13
		Wheat	
Mean	4	7	9
Early fall	-2	5	12
Mid fall	-4	3	10
Late fall	7	11	15
Spring	4	7	10

Small number of sites
6 vs. 24 for late fall

Today, a variety of technologies allow overcoming this disadvantage



- Average results across five sites in 2014 (AB, SK, and MB)
- N applied at rate recommended for each site
- Agrotain® applied at recommended rate
- Shallow banding varied from ¼ to 1½”and deep banding from 2 to 3”
- Source: KAS 2014 Canadian research



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