



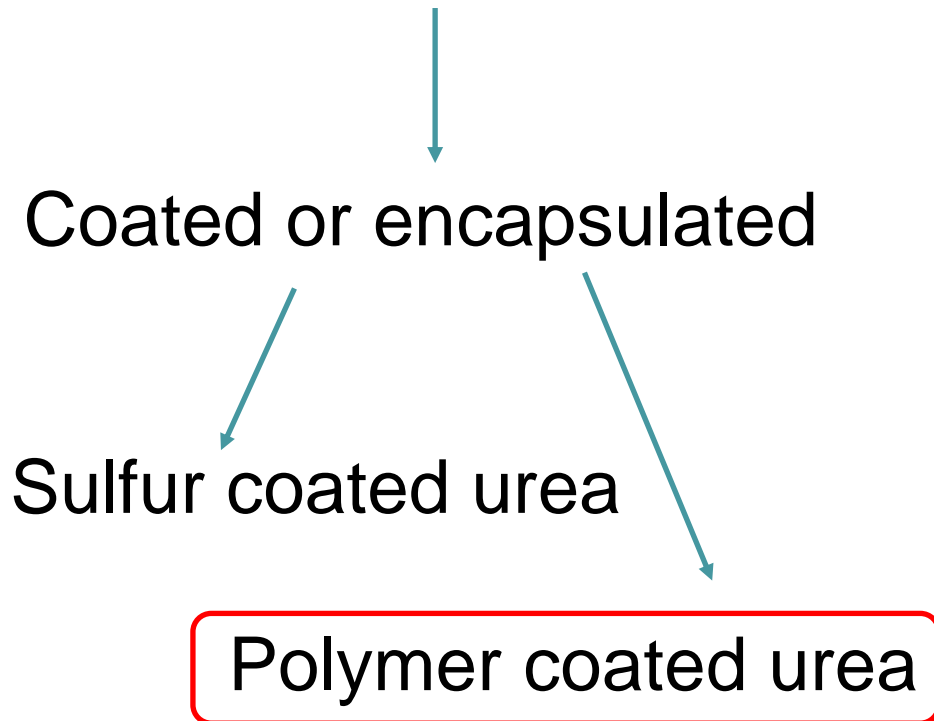
Enhanced efficiency nitrogen fertilizers: the What, When & Where

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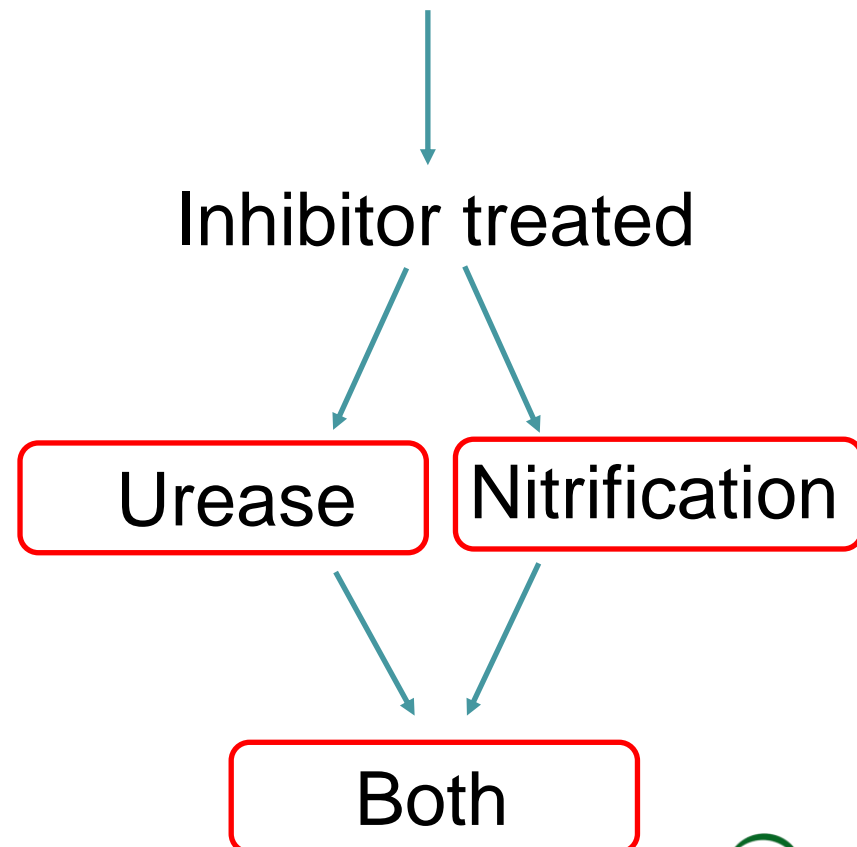
Enhanced efficiency fertilizers:

Combining right source, time, and place

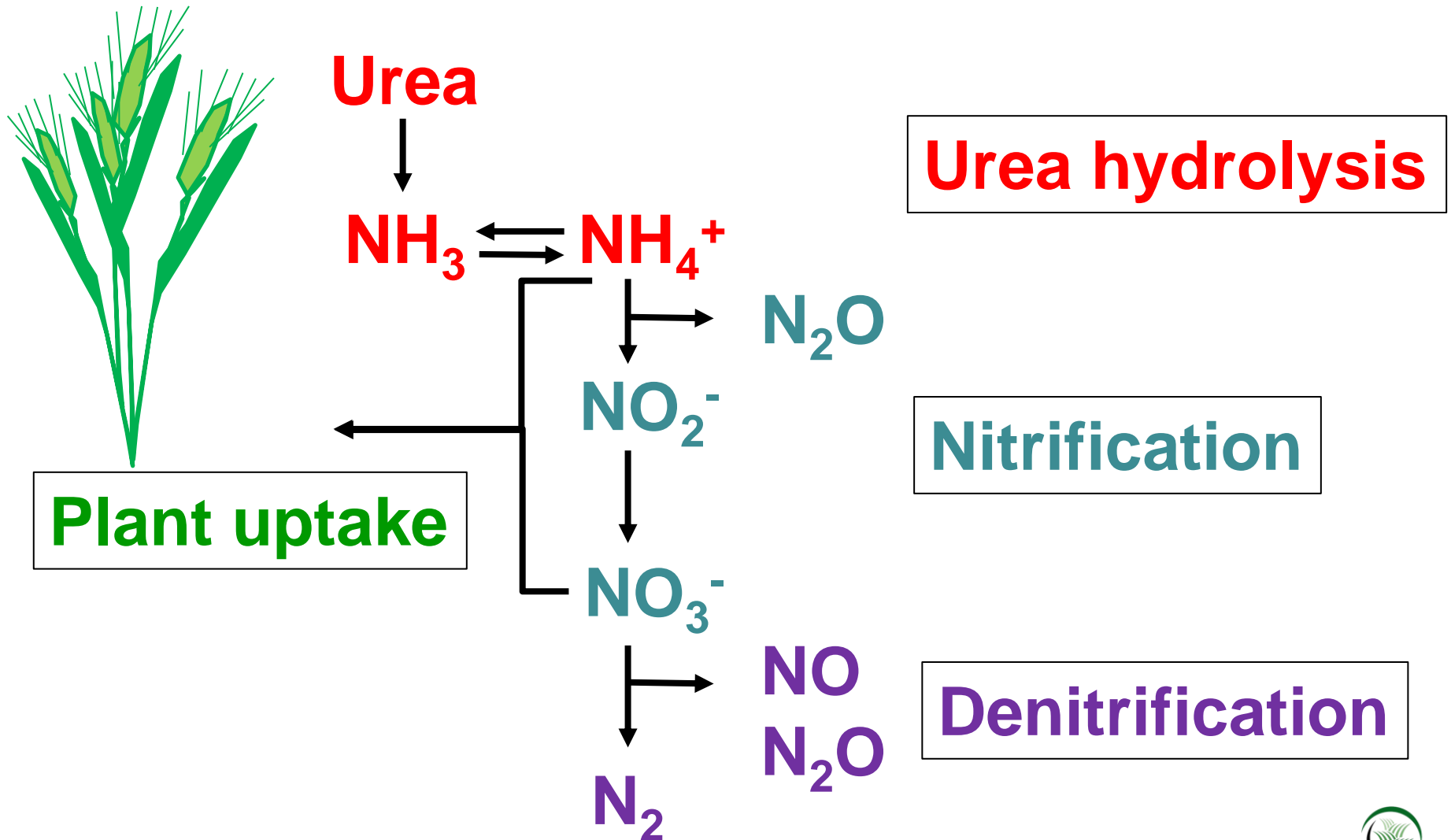
Controlled release



Stabilized N

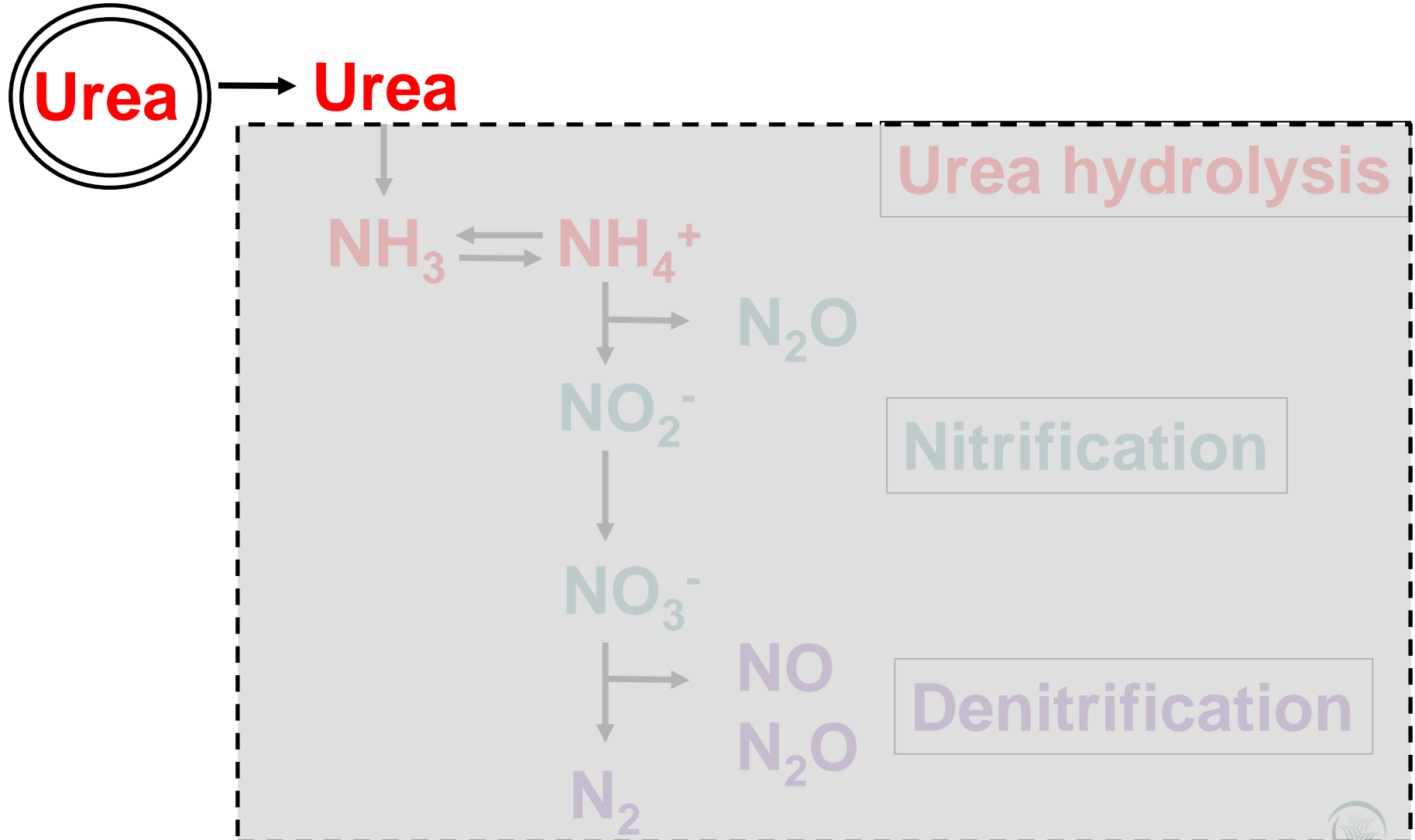


Mechanisms

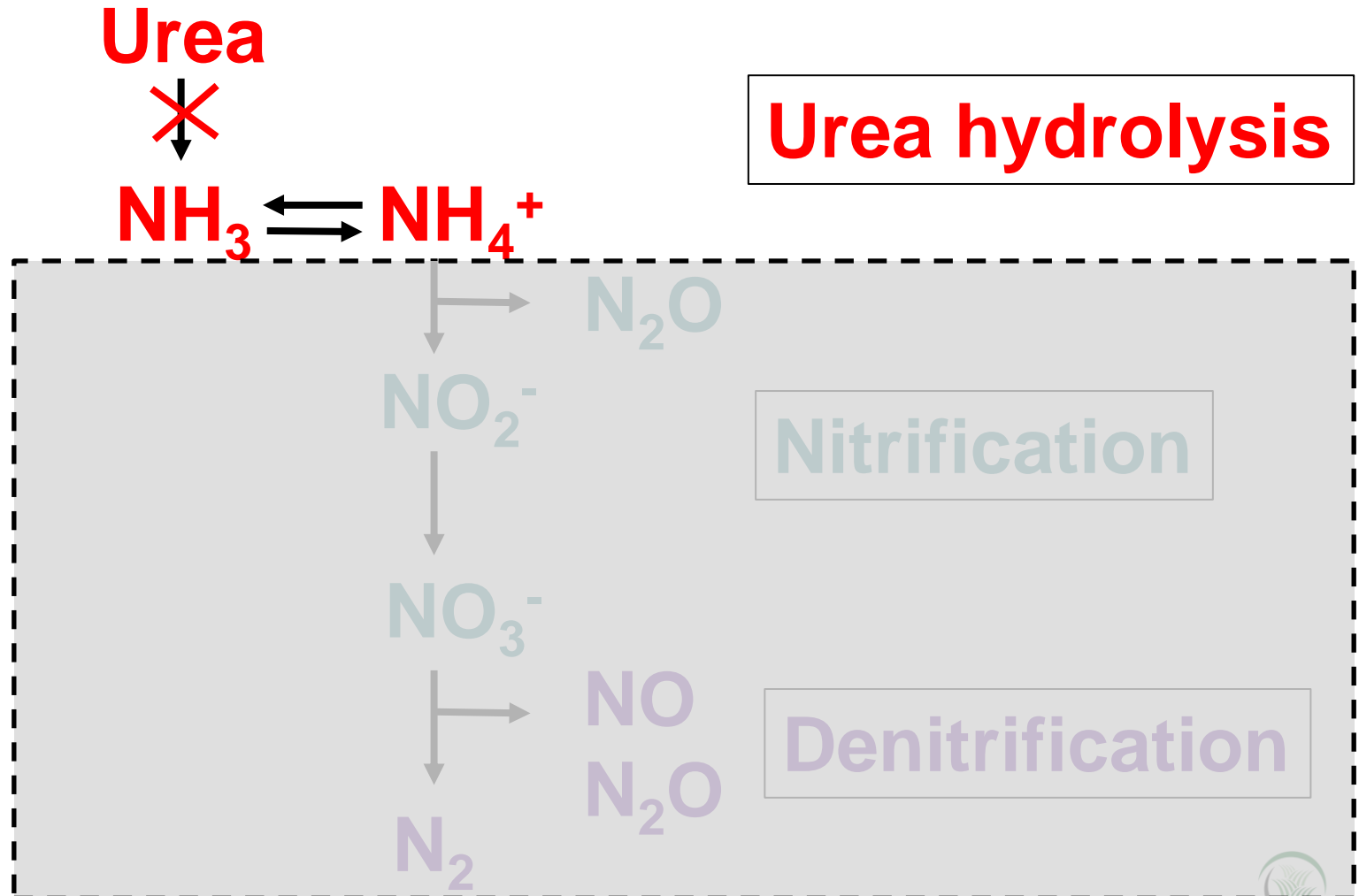


Mechanisms: Controlled release

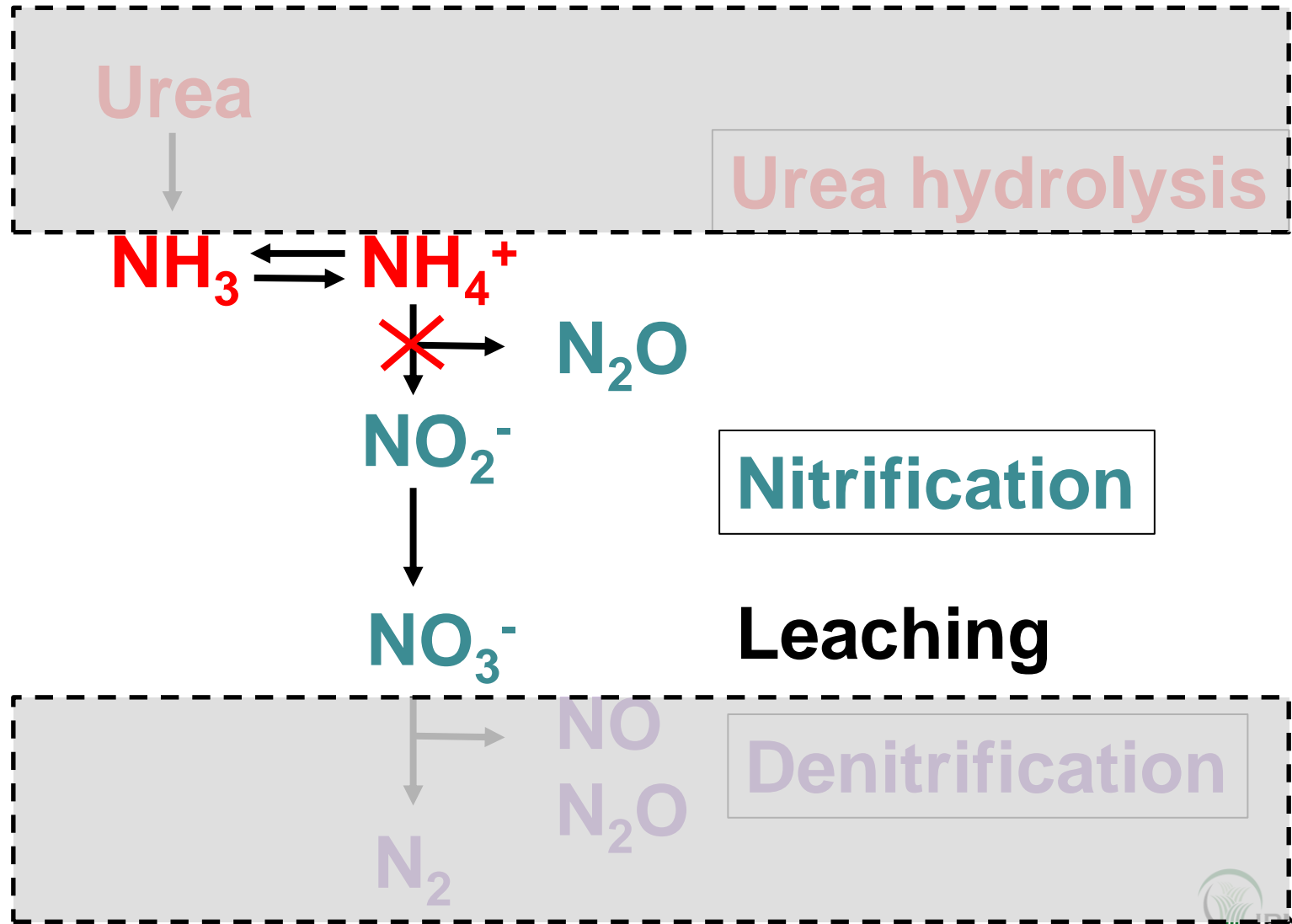
Polymer coated



Mechanisms: Urease inhibition

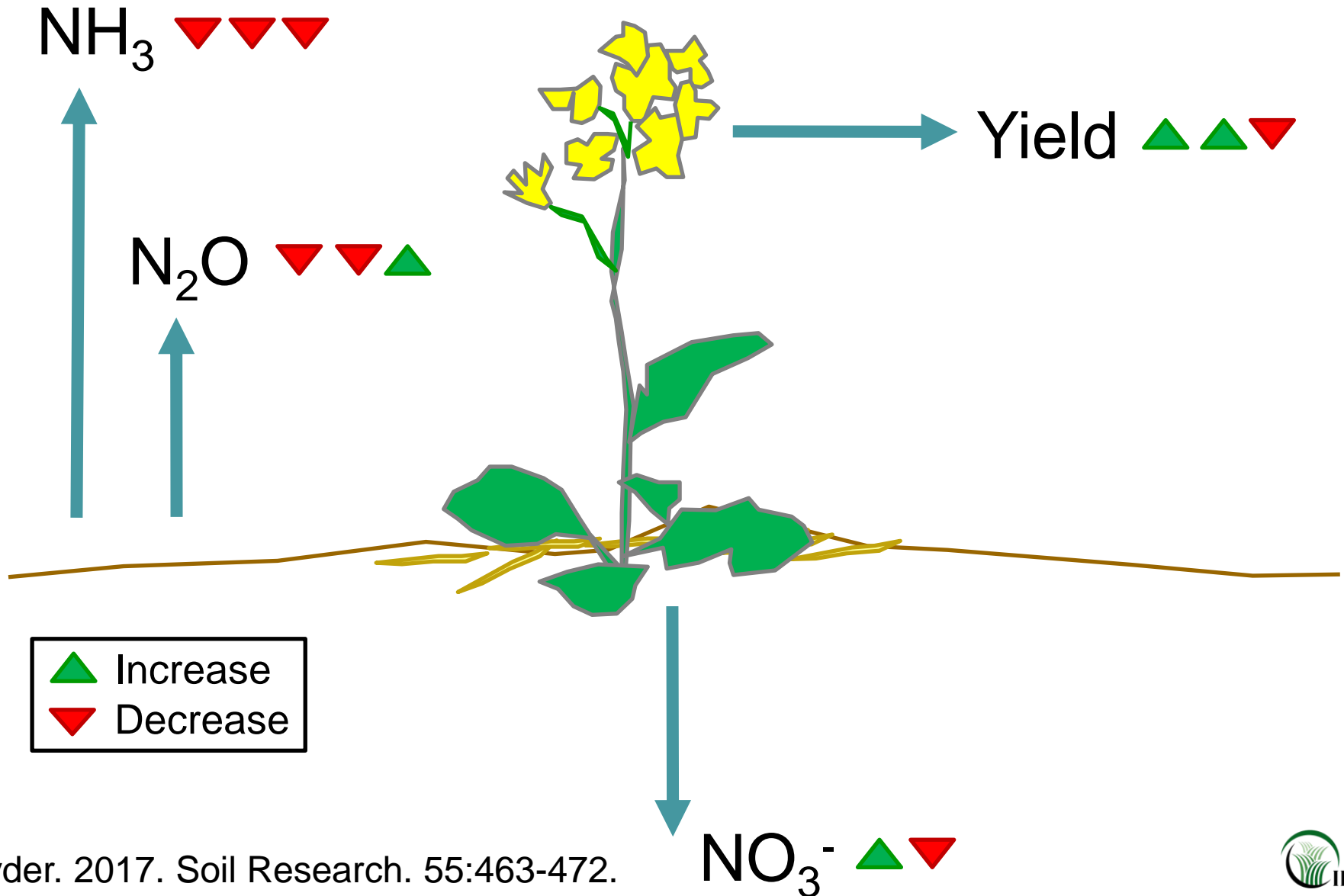


Mechanisms: Nitrification inhibition

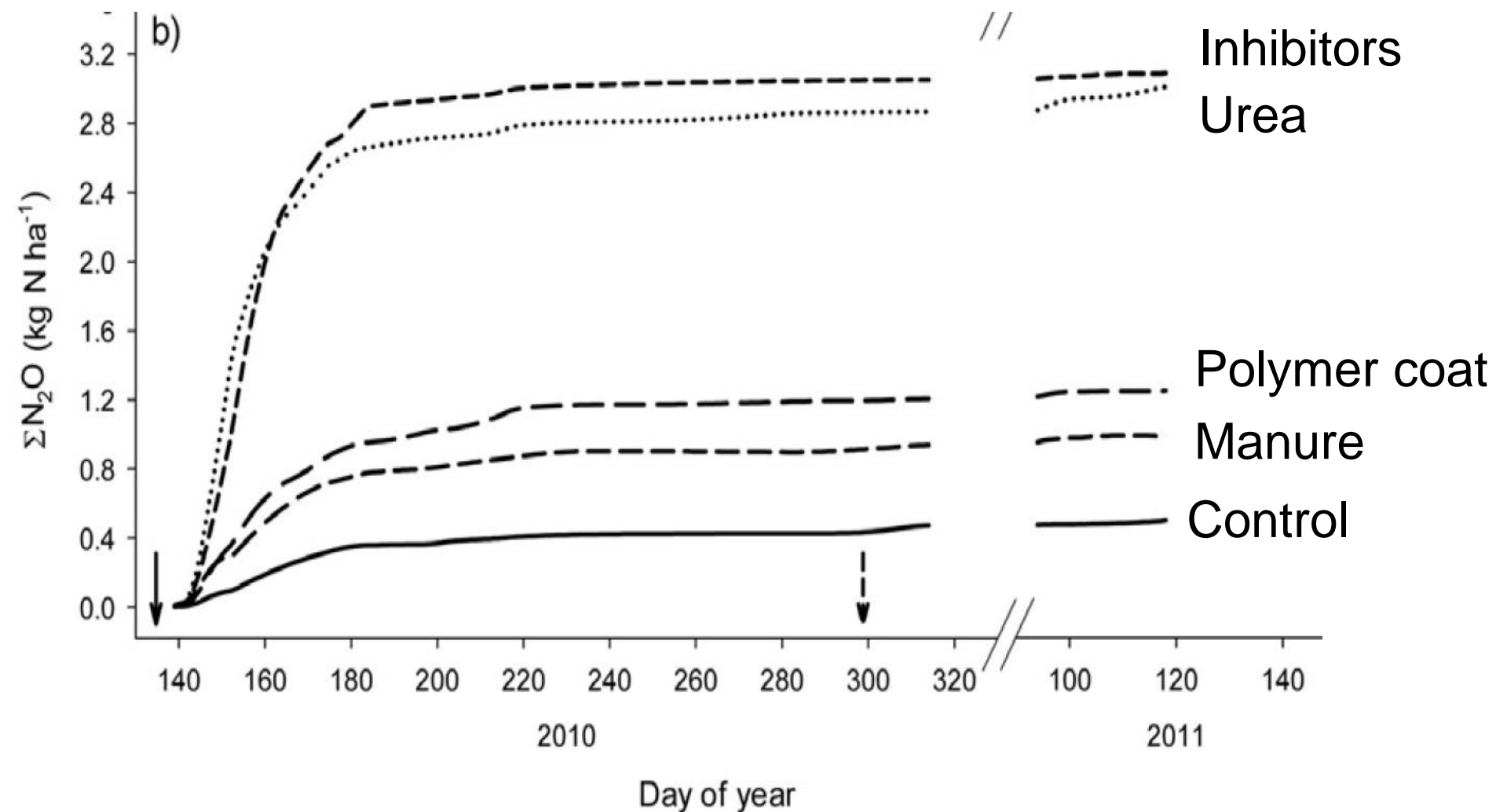


Polymer coated urea

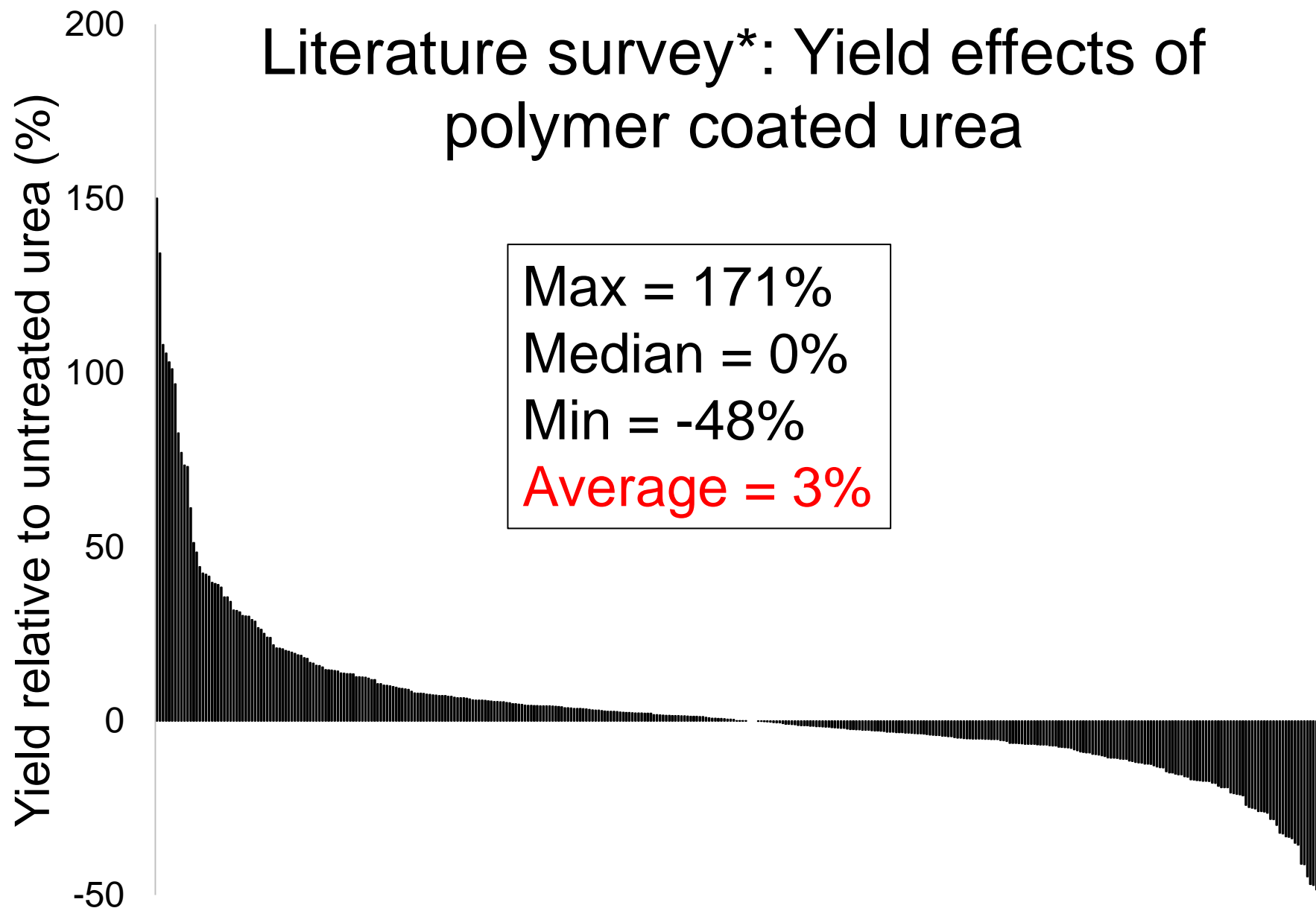
Impacts of polymer coated urea



Effects on N₂O emissions

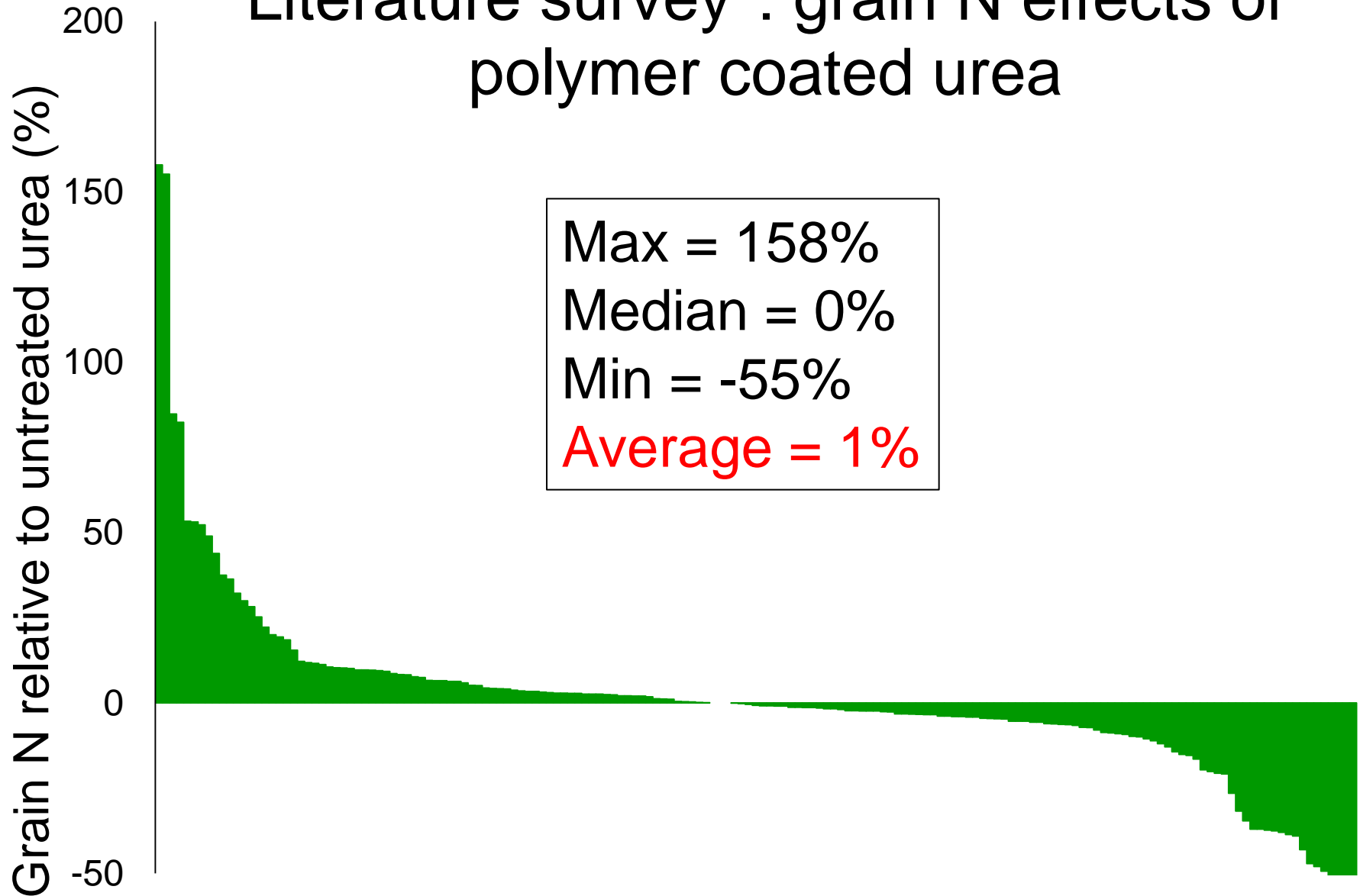


Literature survey*: Yield effects of polymer coated urea



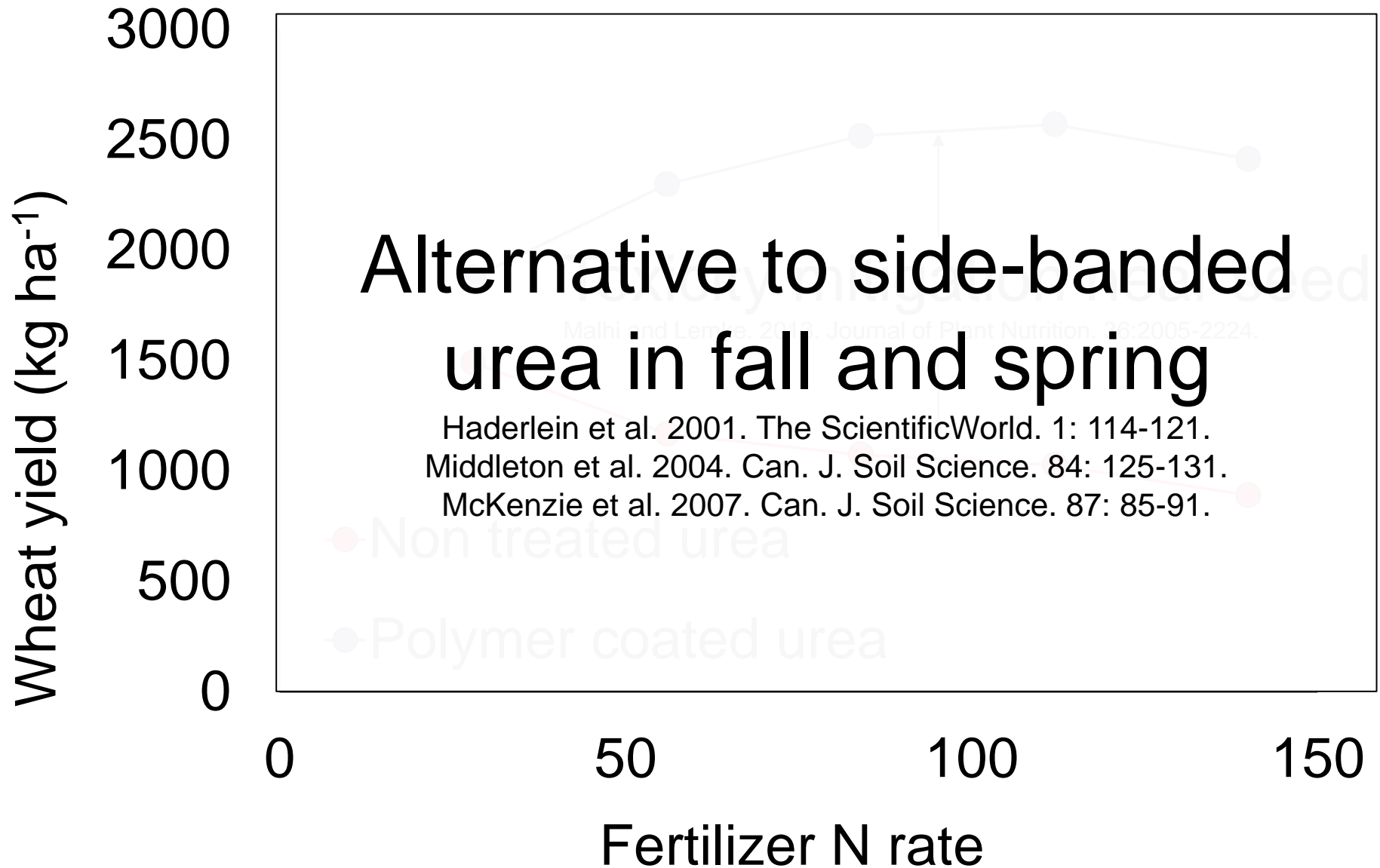
*381 observations. 21 published studies conducted in Alberta, Saskatchewan, Manitoba, Montana, or North Dakota

Literature survey*: grain N effects of polymer coated urea



*169 observations. 21 published studies conducted in Alberta, Saskatchewan, Manitoba, Montana, or North Dakota

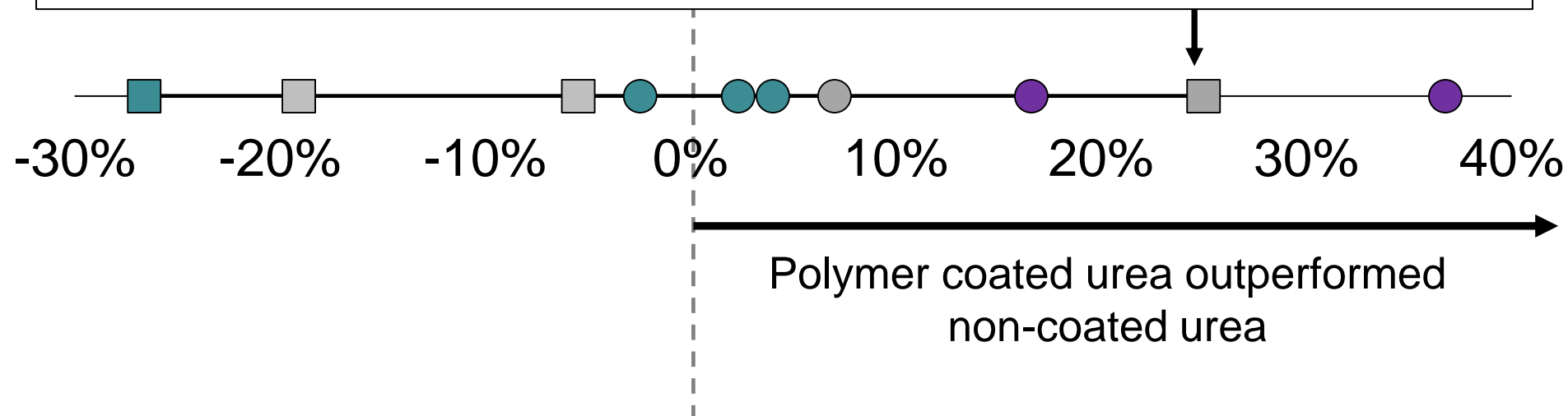
Effects of placement: In the seedrow



Mean effect of polymer coated urea relative to uncoated urea on yields

Blending of polymer coated urea and non-coated urea may increase grain yield *under high moisture conditions of Boreal Transition and Aspen Parkland*

Grant et al. 2012. Field Crops Research. 127: 170-180.



Winter wheat, S. Alberta: McKenzie et al. 2010. Agron. J. 102: 1210-1216.

Winter wheat, Montana: Mohammed et al. 2016. Agron. J. 108: 905-912.

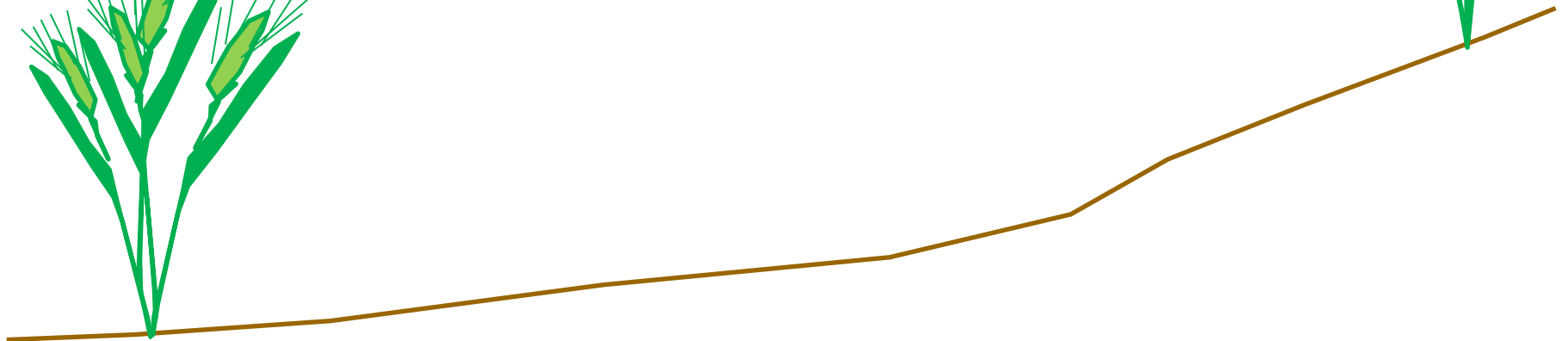
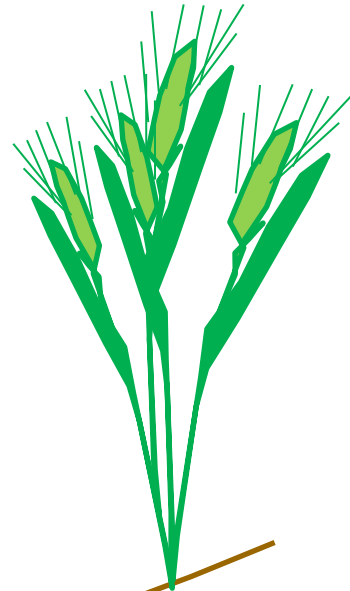
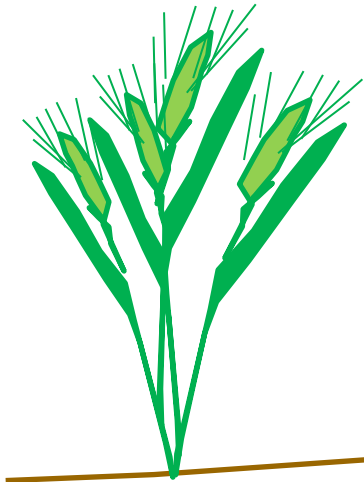
Barley, C. Alberta: Nyborg et al. 1999. Comm. Soil. Sci. Plant. Anal. 30: 1963-1974. *Relative effects minus control

Winter wheat, S. Alberta: Middleton et al. 2004. Can. J. Soil Sci. 84: 125-131.

Differences across the topography

Yields* (kg ha⁻¹) at different slope positions

	<u>Lower</u>	<u>Upper</u>
Fall banded urea	2805	2505
Fall banded coated	2900	2660
Spring banded urea	3005	2795
Spring banded coated	2910	2685

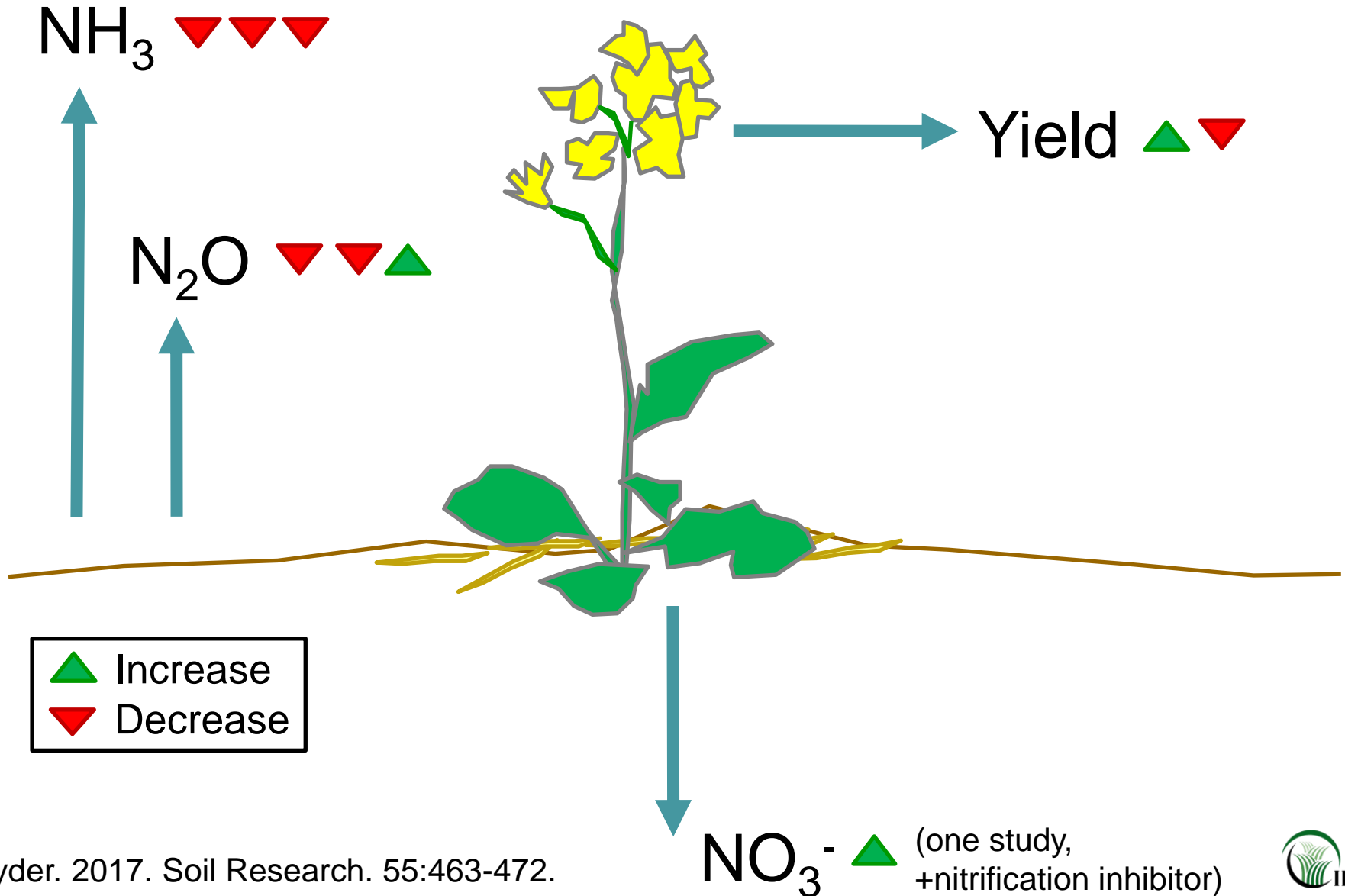


*Mean effect for 2 of 6 site years

Spring wheat, SW Manitoba: Grant et al. 2016. Agron. J. 1246-1256.

Inhibitors

Urease inhibitor



Urease inhibitor effects on NH_3 volatilization

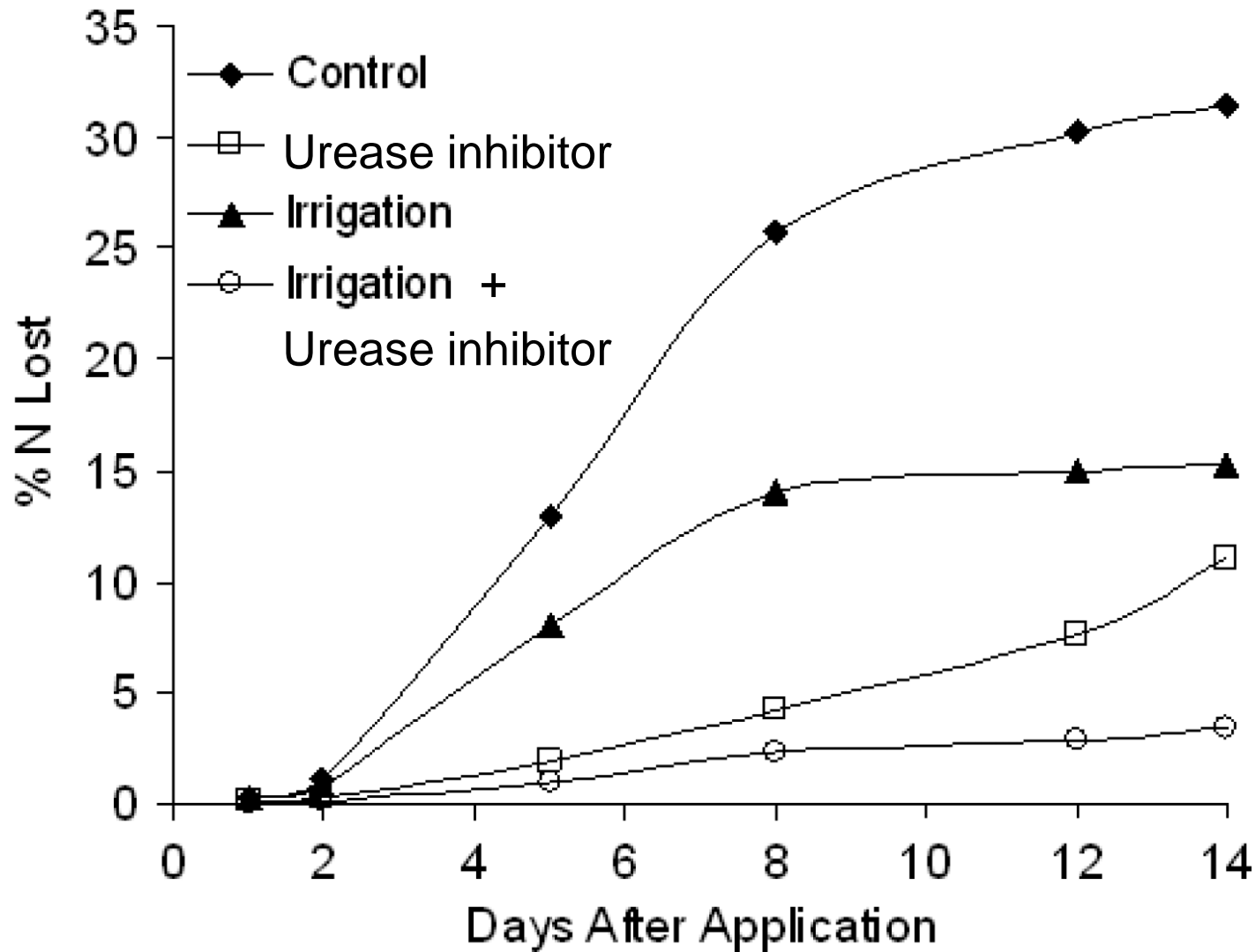
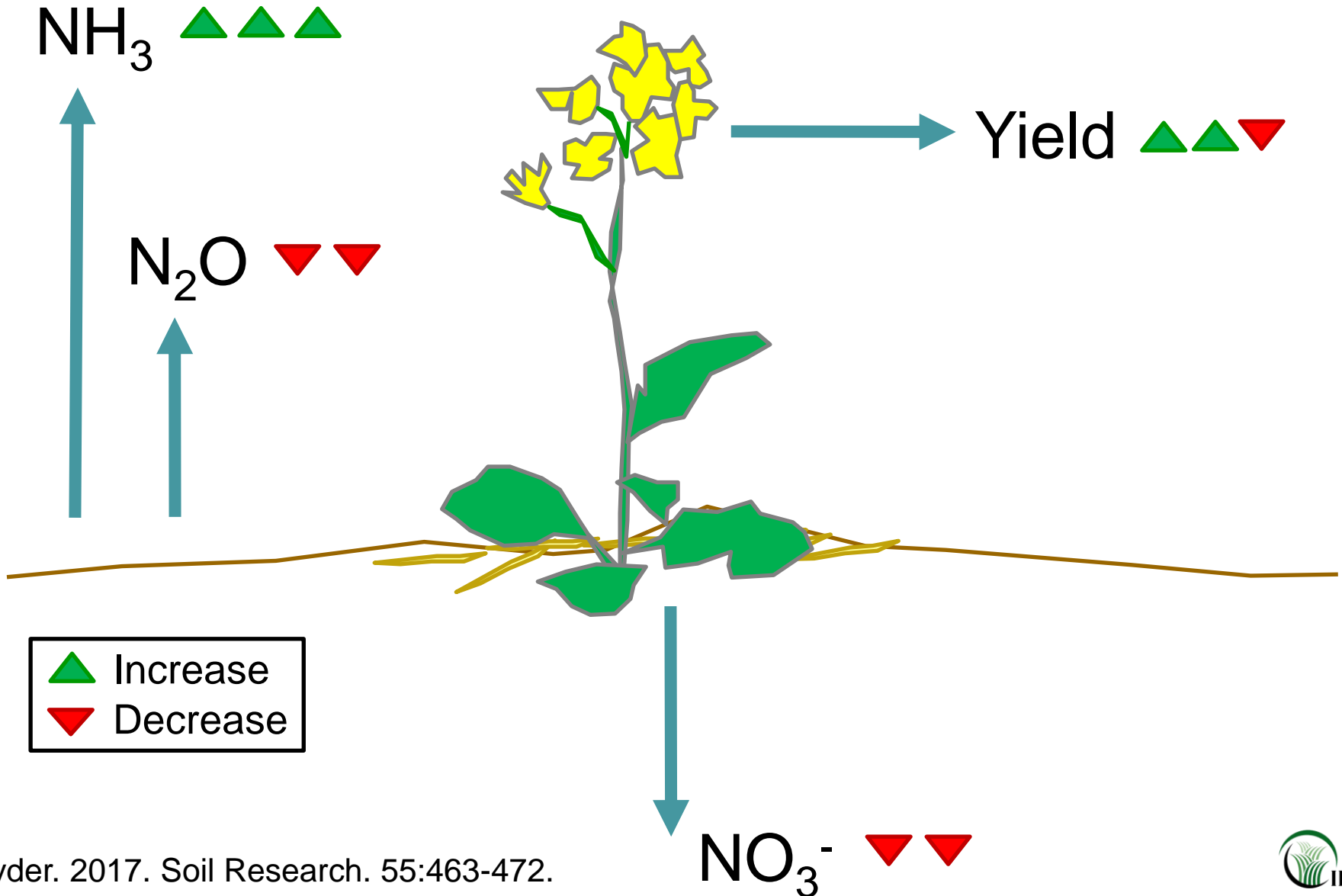
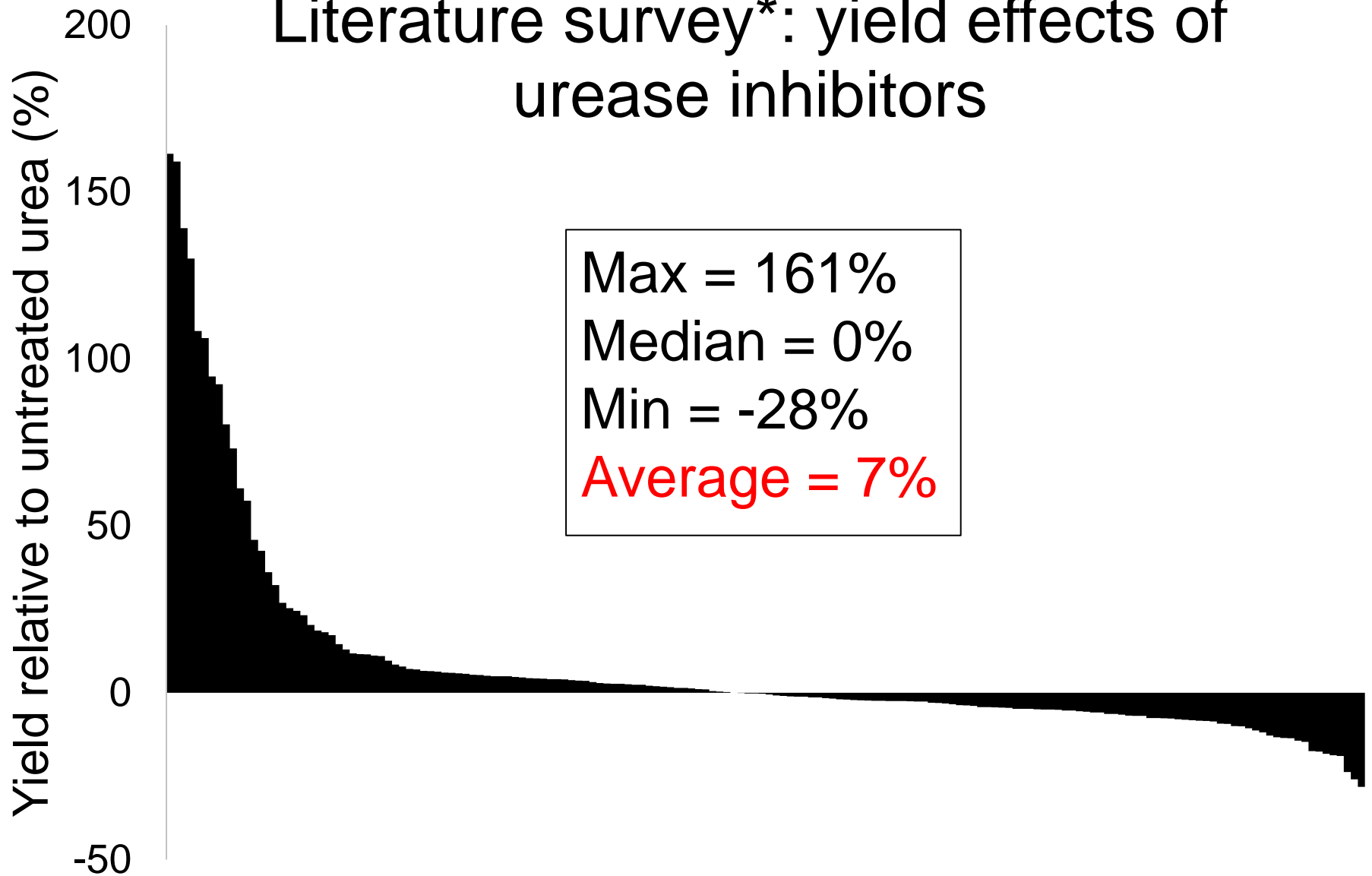


Fig. 2. Effect of N-(*n*-butyl)thiophosphoric triamide (NBPT) and simulated rainfall (2.0 cm on day 4 and day 7) on volatilization losses from surface applied urea fertilizer (29).

Nitrification inhibitor

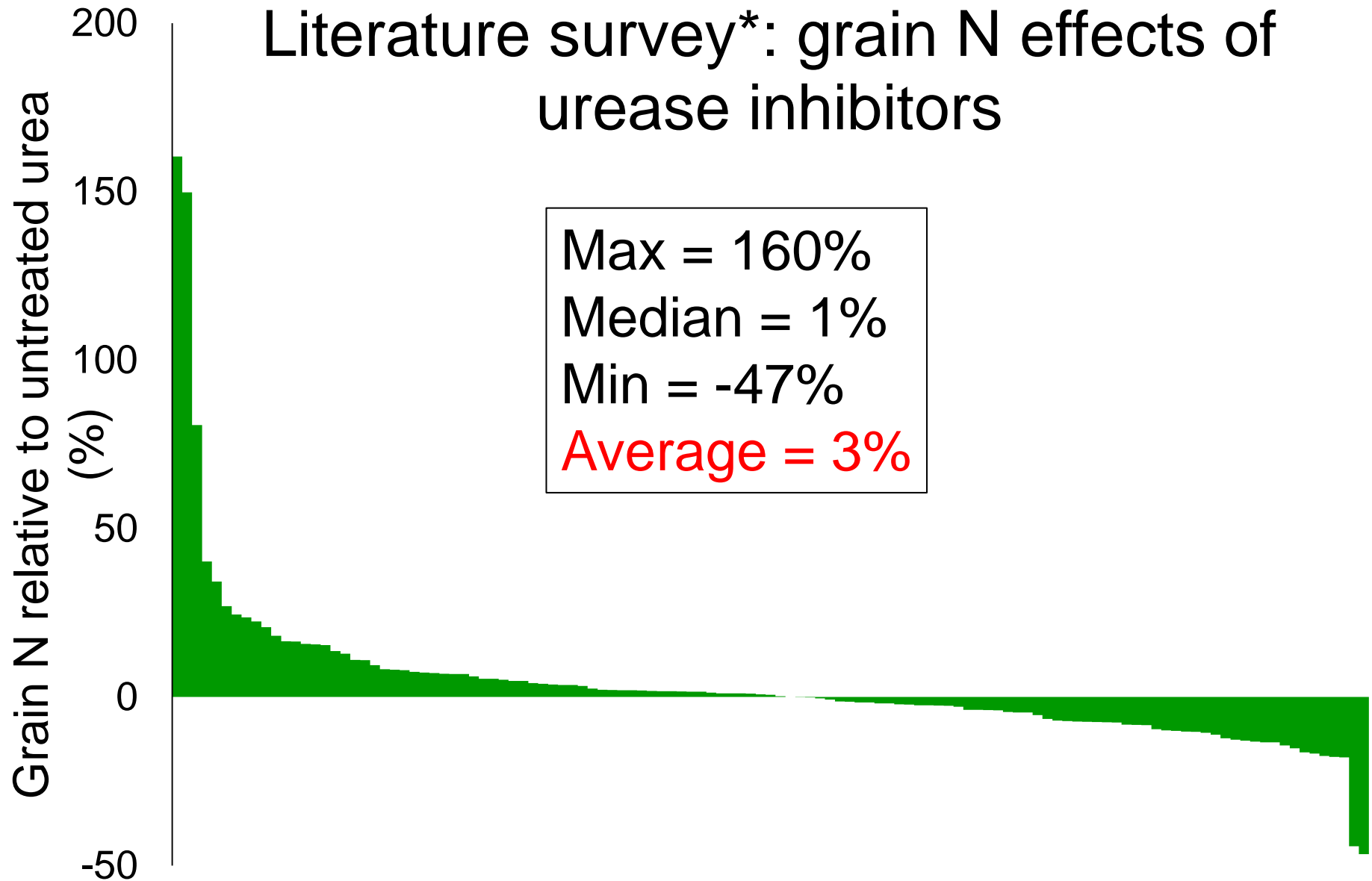


Literature survey*: yield effects of urease inhibitors



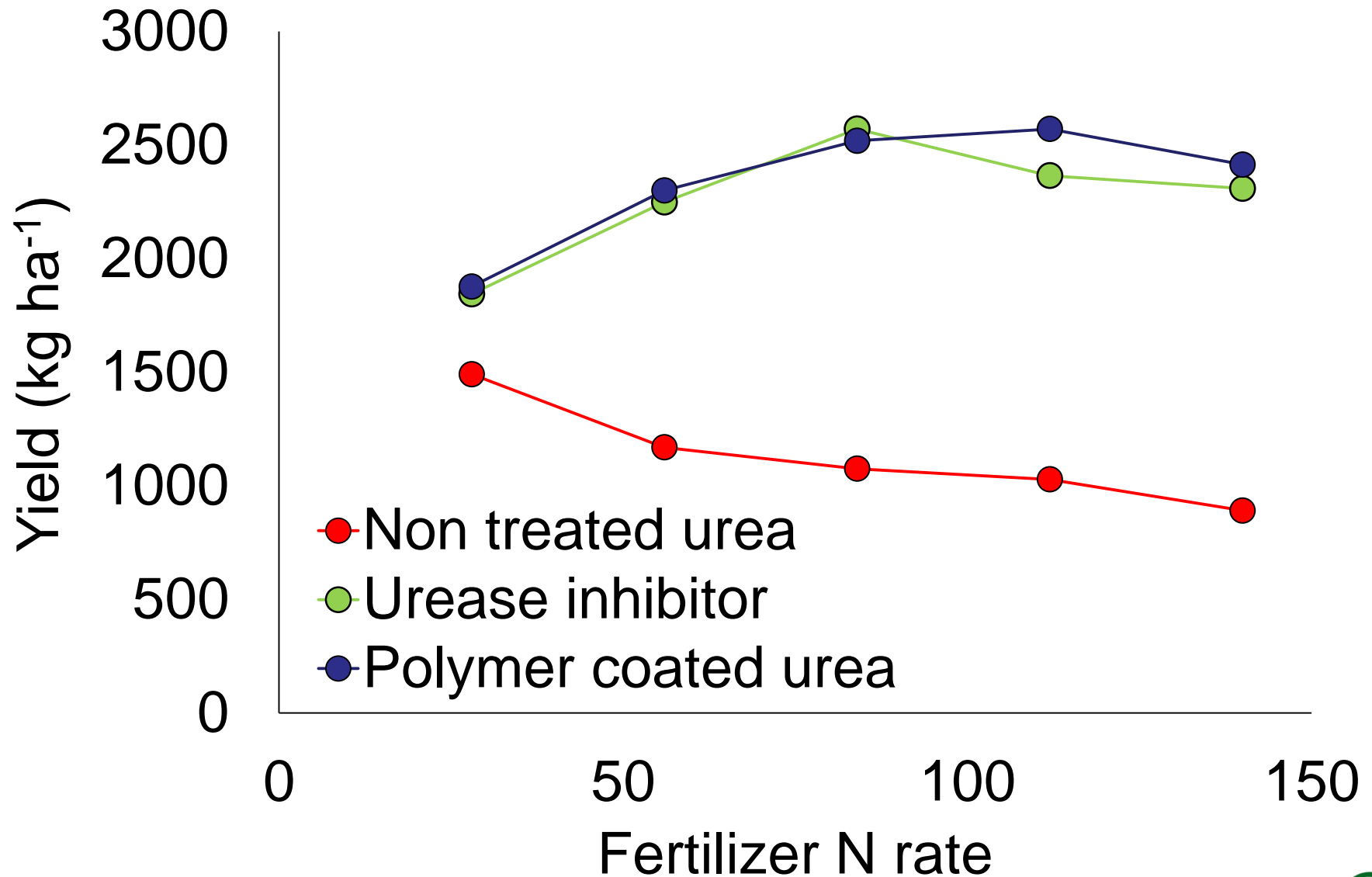
*171 observation, 16 published studies conducted in Alberta, Saskatchewan, Manitoba, Montana, or Dakotas

Literature survey*: grain N effects of urease inhibitors



*121 observation, 16 published studies conducted in Alberta, Saskatchewan, Manitoba, Montana, or Dakotas

Effects of placement: In the seedrow



Effects of timing: Fall vs Spring

Other studies comparing effects of urease inhibitor:

Fall broadcasted treated urea: Yields increased by 3 to 8%

Spring broadcasted treated urea*: Yields decreased by 0 to -1%

*Winter wheat, S. Alberta: McKenzie et al. 2010. Agron. J. 102: 1210-1216. *Spring only data
Winter wheat, Montana: Mohammed et al. 2016. Agron. J. 108: 905-912.
Forages, Alberta: Karamanos and Stevenson. 2013. Can. J. Plant Sci. 93: 151-160

Winter wheat, Montana: Romero et al. 2017. SSSAJ. 81: 331-340.

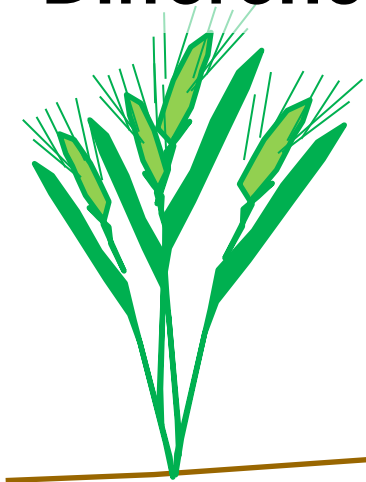
Effect across topography

Well drained:

- Yields were 3% less with urea + urease inhibitor
- Differences not significant

Poorly drained:

- Yields were 1% more with urea + urease inhibitor
- Differences only significant 1 of 4 site years



Effect of combining with a nitrification inhibitor

Yield relative to
non-treated urea

Urease inhibitor

-1 to -7%

Urease + nitrification inhibitor

5 to 29%

Winter wheat, Montana: Mohammed et al. 2016. Agron. J. 108: 905-912.
Winter wheat, Beiseker, Alberta: Jensen. 2007. Personal communication.
Forage, Youngstown, Alberta: Jensen, 2012. Personal communication.

Summary

- Enhanced efficiency fertilizers can reduce nitrogen losses in high risk environments, but consider modes of action [1]
- Variable effects on yields
 - Polymer coated urea and urease inhibitors
 - Placement in the seed row
 - Fall application with high loss risk
 - Blending of non- and polymer coated urea in spring
 - Combining urease and nitrification inhibitors may provide additional benefits for enhanced efficiency of urea



Thank you

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