

Nitrogen and Soybeans: Friends, Foes or Just Wasted Fertility?

J. Heard¹, J. Lee² and R. Tone³

¹ Manitoba Agriculture, Food and Rural Development, ² AGVISE Laboratories, ³ Tone Ag Consulting



Background

- Excessive levels of soil nitrate-N may reduce nodulation and increase iron deficiency chlorosis (IDC) of soybeans.
- Rescue N application is recommended if nodulation fails but some suggest it is also needed to support high soybean yields.
- So a simple, unreplicated demonstration was done at 13 sites in farmer fields in North Dakota and southern Manitoba.

Table 1. Soil features and soybean cropping history of sites.

Site	Text-ure	CCE %	EC ds/m	NO ₃ -N lb/ac 0-24"	pH	# Yrs soys	Inoculant
Northwood	cl	0.7	0.27	47	8.1	many	L
Northwood	cl	0.2	0.18	52	7.7	many	L
Northwood	sl	0.1	0.04	9	5.5	many	L
Northwood	sl	0	0.05	15	5.6	many	L
Northwood	cl	0.2	0.32	31	7.9	many	L
Aubigny	c	1.0	0.6	44	7.5	1st	L,G
Blumenort	c	9.2	0.7	17	8.3	4th	L,G
Morris	c	5.0	0.6	59	8.2	1st	L,G
Petersfield	c	4.2	0.4	37	8.0	1st	G
Sperling	c	10	0.8	74	8.3	3rd	L,G
Barnsley	sl	0.3	0.23	58	6.3	1st	L
Roseisle	sl	2.4	0.14	16	8.3	2nd	L
Carman	sl	0	0.07	34	5.7	1st	G

- CCE = calcium carbonate equivalent
- EC = soluble salts in mmho/cm in 0-6"
- Inoculant : L = liquid, G = granular, P = peat
- IDC risk factors include high CCE, high EC and high soil nitrate
- Nodulation risk factors include high soil nitrate, low pH, 1st year fields and improper inoculation.

- 10' x 10' plots were fertilized to create a range in soil nitrate.
- 3 N rates (0, 50, 100 lb N/ac) and 2 N Sources (Agrotain treated urea (46-0-0) and ESN polymer coated urea (44-0-0))
- N was surface broadcast after seeding (raked in at some sites)
- Soil was sampled before N, 2 weeks later and at maturity.
- IDC severity, plant growth (height), leaf N concentration and nodulation counts were made at flowering (Figure 1).
- Some sites were harvested for yield but seed protein has not yet been measured.



Figure 1. Rhizobium nodules on soybeans at Carman site, from left: 0, 50 and 100 lb N/ac as urea.

The following figures show individual observations using green symbols to indicate 1st year soybeans, red symbols for fields with a history of soybeans and an open box for the mean.

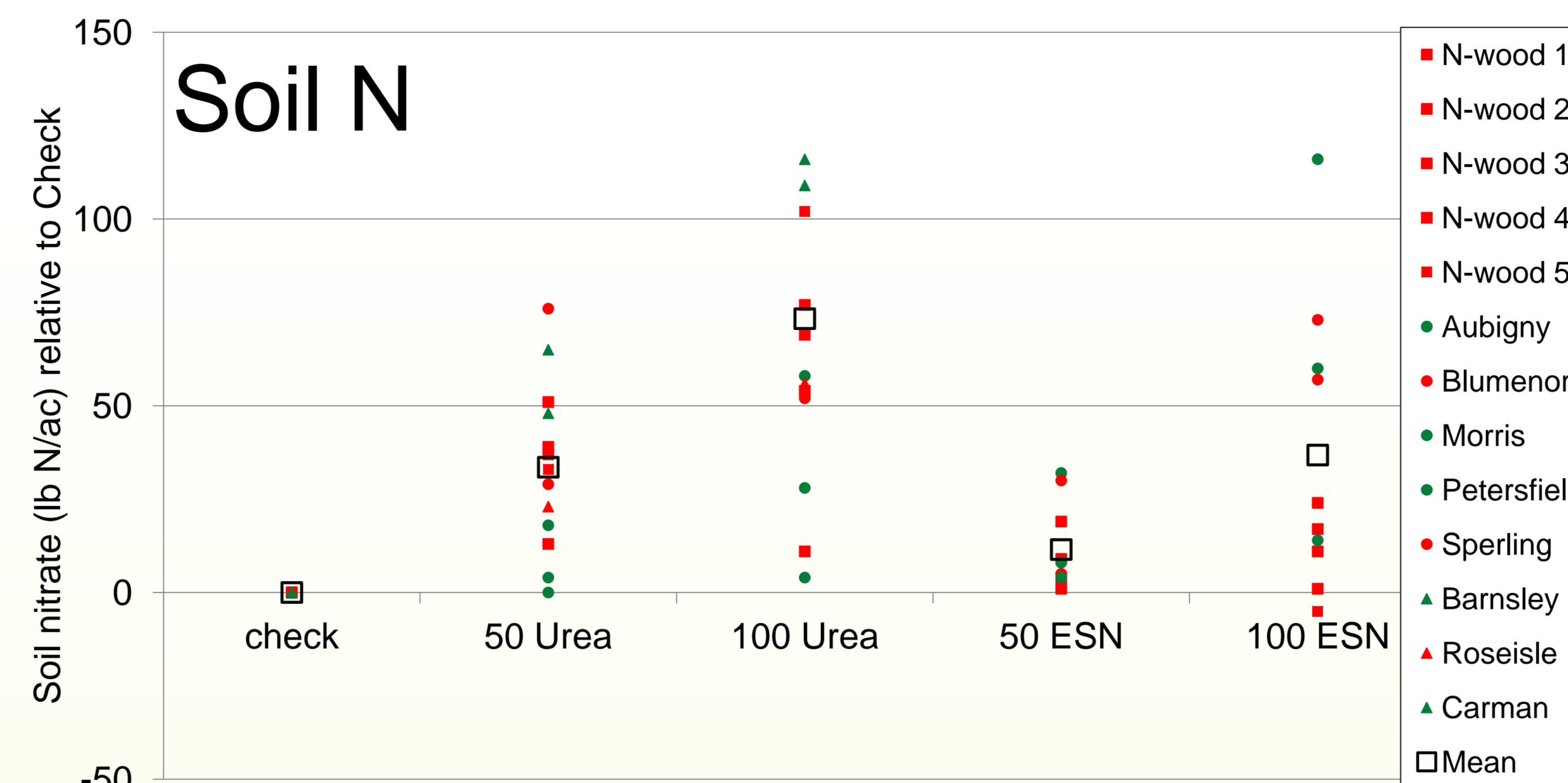


Figure 2. Change in soil nitrate levels (0-24") following N application

- N application increased soil nitrate vs. the check as expected
- IDC was not seen in any plots, including those with higher risk factors (higher CCE and EC), ie Blumenort, Morris, Petersfield and Sperling.

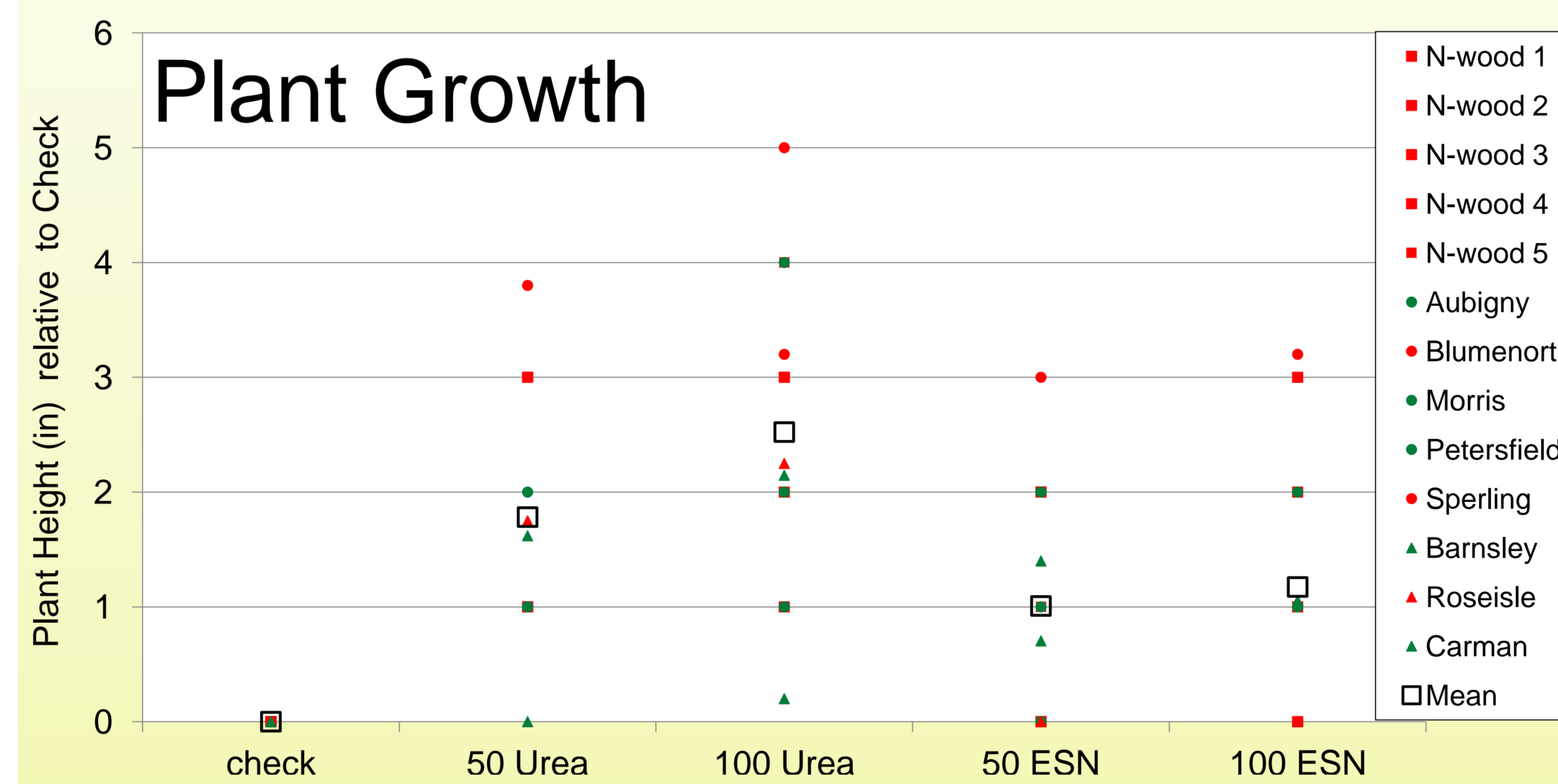


Figure 3. Plant height (inches) relative to check at flowering.

- N consistently produced taller plants at flowering.
- When measured, leaf N rated sufficient for all N rates (data not shown).

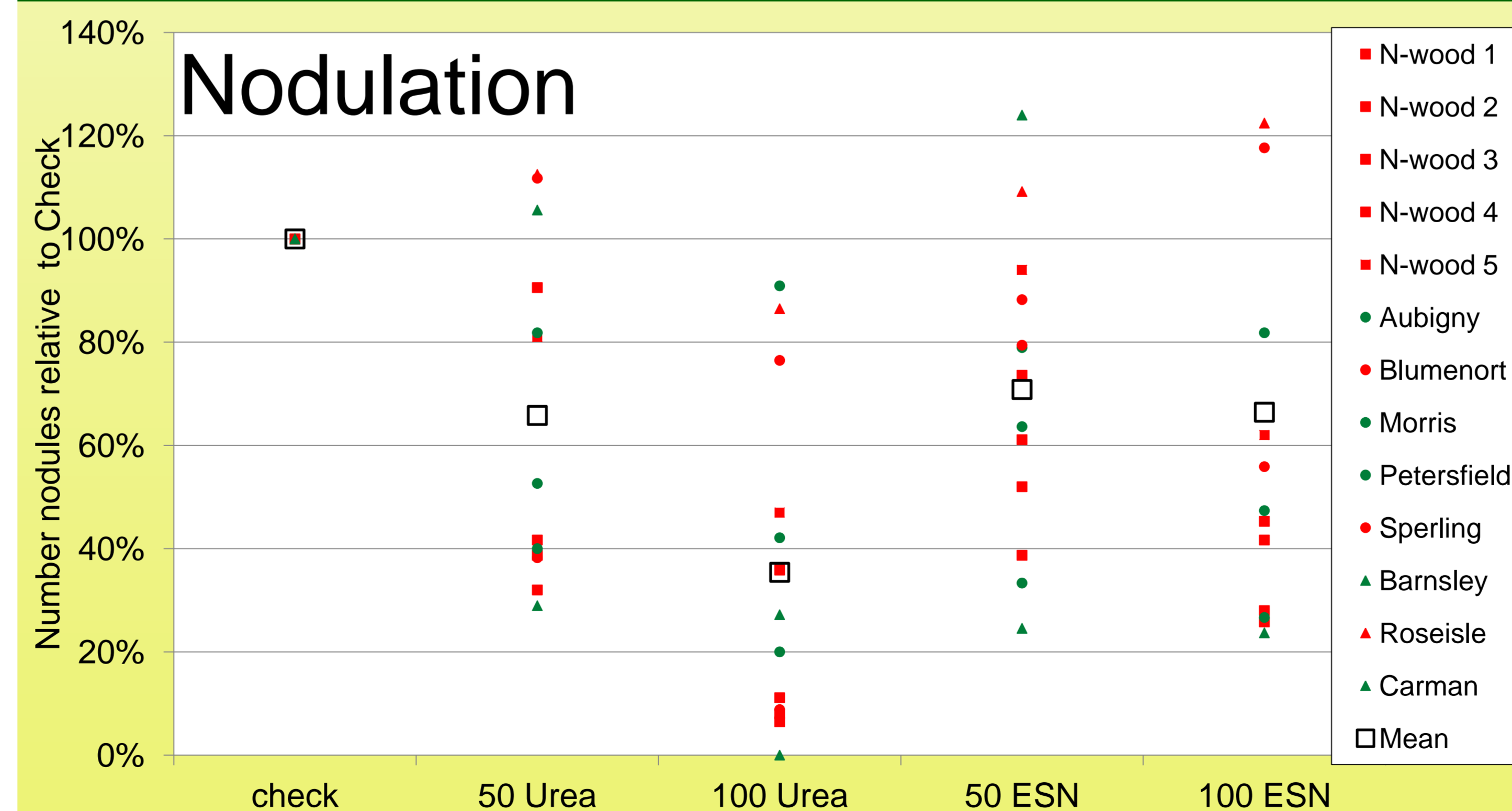


Figure 4. Soybean nodule number relative to the check

- Nodule numbers on check plants ranged from 10-100 per root.
- Nodule numbers were reduced by N application; on average by 1/3 with 50 lb N/ac as urea and by 2/3 with 100 lb N/ac as urea.
- The reduction in nodule numbers was not as severe with ESN as urea.

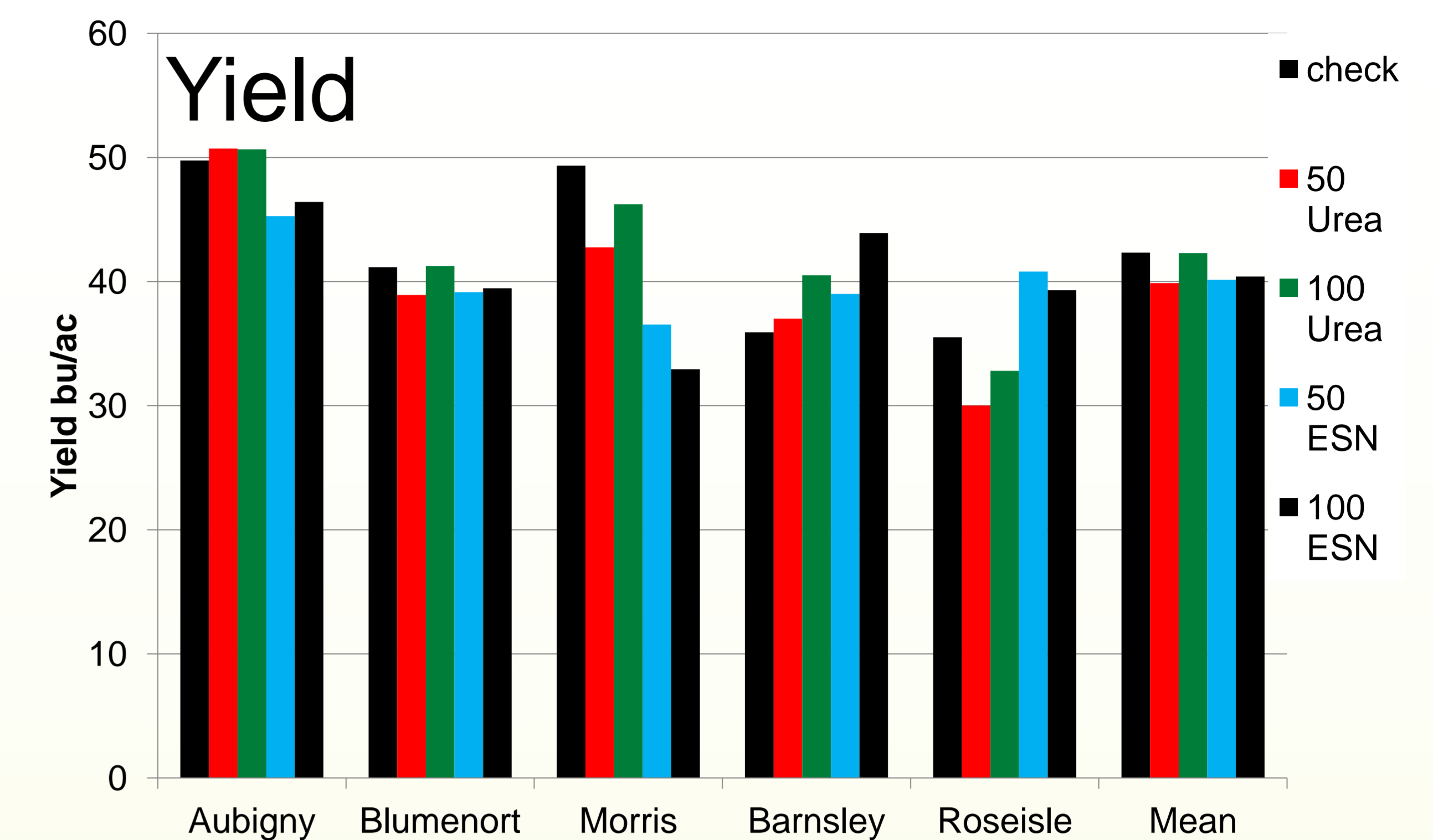


Figure 5. Soybean yield (bu/ac) from harvested sites.

- Effect of N on yield varied but appeared to reduce yield at 3 of 5 sites.
- On average there was no benefit to N but little detriment.

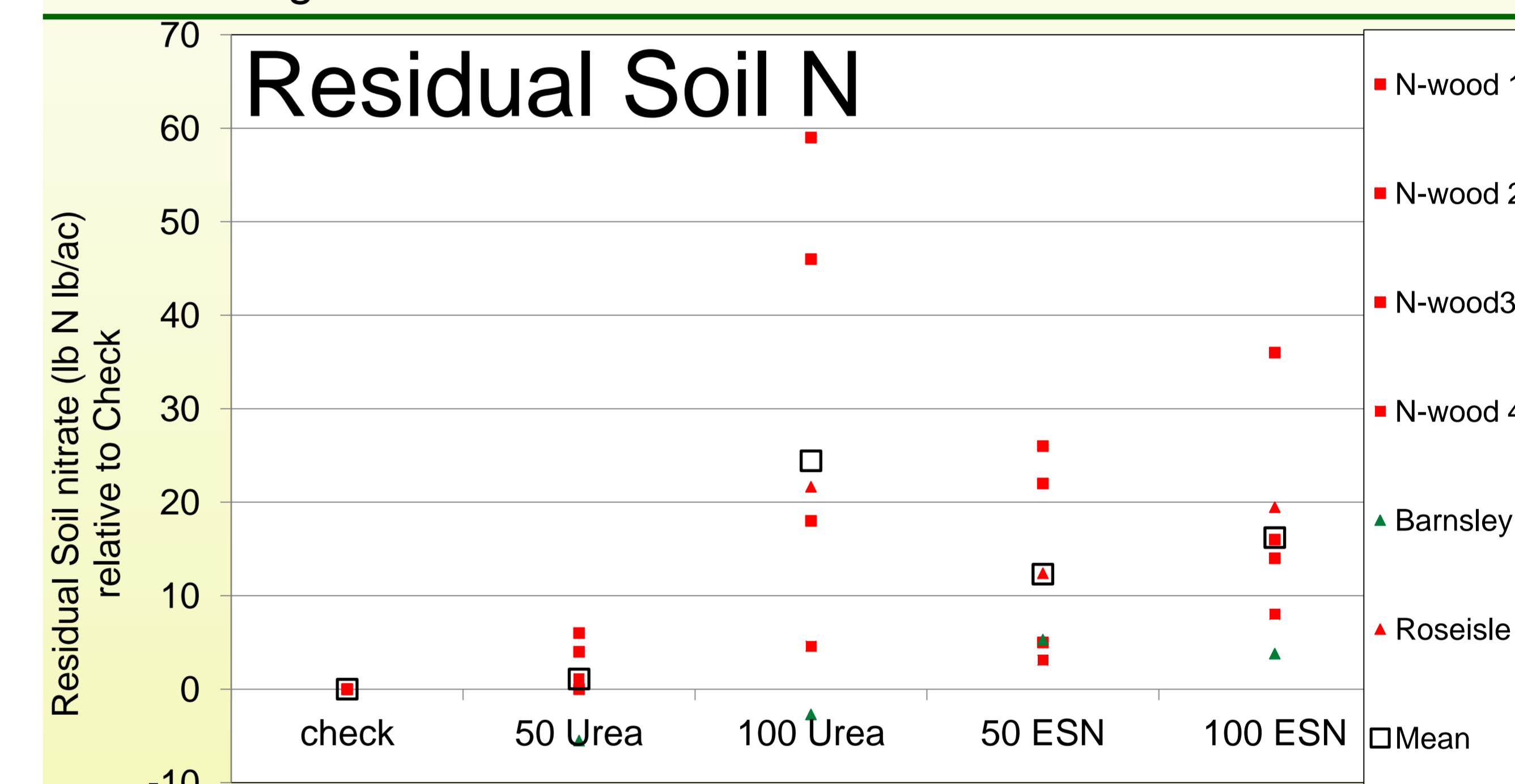


Figure 6. Post harvest soil nitrate-N (0-24") relative to the check.

- Post harvest N soil nitrate levels were greater when N had been applied, but much appears to have been depleted by the soybeans.

Summary

Applied nitrogen:

- Increased early season soil nitrate levels
- Increased plant height
- Reduced nodulation
- Tended to reduce yield at some sites
- Was largely depleted by the soybean crop by harvest time
- ESN effects on soil N, growth and nodule depression were less dramatic than similar urea rates. The surface or shallow incorporation was probably insufficient for controlled release N.

- N application on soybeans appear to be wasteful.
- Non-leguminous crops would make better use of high residual N.
- Growers planting soybeans on high nitrate fields should be aware that nodulation may suffer. This reduction may be less detrimental where previous soybeans have been grown and rhizobium populations are established.

Acknowledgements

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