Rescue applications of nitrogen for non-nodulated soybeans

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Background

- Soybeans take up large amounts of nitrogen (N) to produce high yields..
- Properly nodulated soybeans will fix this nitrogen through a symbiotic relationship with *Rhizobium* bacteria
- Occasionally inoculation failure occurs, and crop advisors and farmers question whether applications of fertilizer nitrogen are warranted to salvage yield.

Key questions are:

- How much nitrogen to apply?
- When to apply nitrogen – at early flowering[1] or pod fill?

Method:

- In 2011, a virgin soybean field (DeKalb 2510) was inadvertently seeded without inoculation on May 26.
- Most of the field was fertilized following emergence on June 14 with 100 lb N/ac as urea (46-0-0).
- Small plots were located in an adjacent unfertilized area, in a RCBD with 3 replications.
- Agrotain treated urea was applied at 50 and 100 lb N/ac at flowering (R1) on July 18 and pod fill (R4) in early August.

Observations:

1. In June, severe iron deficiency chlorosis (IDC) was observed only in the areas receiving 100 lb N/ac at emergence. (Figure 1).

Figure 1. Iron deficiency chlorosis (IDC) in portion of field fertilized following emergence.

- Risk of IDC was rated very high[2] based on soil salinity (1.7 mmho/cm at 0-6") and carbonate levels (CCE 1.9%).
- Soil nitrogen was 20 and 36 lb nitrate-N/ac (at 0-6 and 6-24", respectively). It is recognized that soil nitrate is a contributing factor of IDC[3].

Observations (cont):

2. Soybean roots in the plot area did not develop nodules (Figure 2.), however plants did not appear pale in colour or nitrogen deficient (Figure 3). Tissue N levels at early flowering (July 18) rated sufficient (5.27% N). Soil organic matter levels were high at 4.3%.

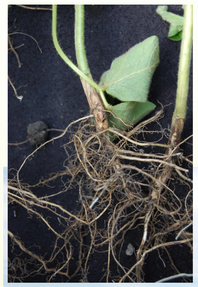

Figure 2. Soybean roots devoid of nodules.

Figure 3. Non-nodulated soybean field on July 18. Area to right of white stake has the 100 lb N/ac rate applied on

Results:

Soybean yield is displayed in Figure 4, and other quality components are listed in Table 1.

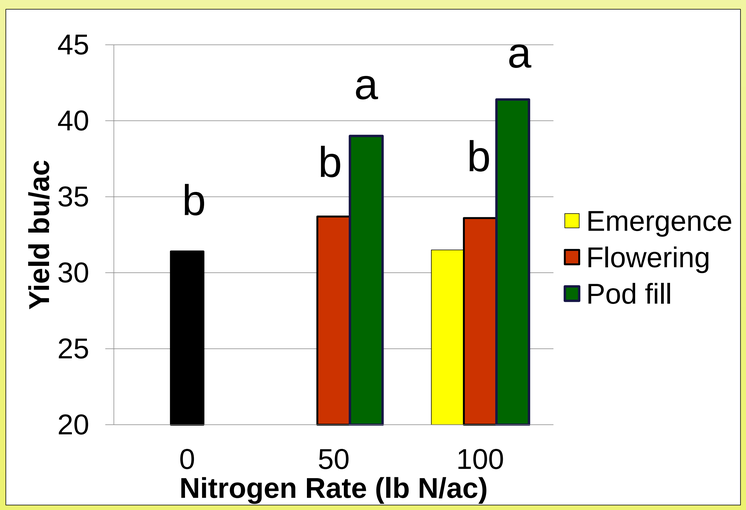

Figure 4. Soybean yield resulting from nitrogen application.
Bars under the same letters are not significantly different at the 5% probability level.

Results (cont):

Table 1. Yield and quality components. Values within columns followed by the same letters are not significantly different at the 5% probability level.

Treatment	Yield bu/ac	Protein %	N in seed lb N/ac	Oil %	Seeds per lb
Check	31.4 b	32.8 b	99	23.6 a	2996 a
50 N Flower	33.7 b	33.8 ab	109	23.2 a	2989 a
50 N Podfill	39.0 a	34.7 ab	130	23.0 ab	2915 ab
100 N Flower	33.6 b	36.5 a	118	22.2 bc	2792 bc
100 N Podfill	41.4 a	36.9 a	147	22.0 c	2709 c
100 N Emerg	31.5				

- Soybean yield did not respond to early applied N but yield increased 24% and 32% with late applied nitrogen at 50 and 100 lb N/ac, respectively.
- Higher N rates increased protein, decreased oil content and increased seed size (ie a lower number of seeds/lb).
- Nitrogen removal generally exceeded 100 lb N/ac.
- Even with 100 lb N/ac, seed protein was less than that commonly achieved with good nodulation (40%).

Discussion:

1. A combination of soil factors (salinity, carbonates and soil nitrate) contributed to IDC in soybeans.
2. The combination of soil nitrate and mineralization from soil organic matter provided sufficient nitrogen for a modest check yield (31.4 bu/ac).
3. Soybeans responded favourably to late N applications even though yellowing was not severe and leaf N rated sufficient.. Both N rates were highly profitable at current crop and fertilizer prices.
4. N application is not a substitute for effective nodulation.

Growers should be prepared to make N applications to non-nodulated soybeans during pod filling.

References:

[1]Ontario Ministry of Agriculture, Food and Rural Affairs. 2009. Agronomy Guide for Field crops. Pub. 811. .http://www.omafra.gov.on.ca/english/crops/pub811/2fertility.htm

[2]AgVise Laboratories. Iron Chlorosis: Soybeans http://www.agvise.com/tech_art/iron_chlorosis_soybeans_2003.php

[3]Bloom, P.R.,G.W. Rehm, J. A. Lamb and A.J. Scobbie. 2011. Soil nitrate is a causal factor in iron deficiency chlorosis in soybeans. SSSA Jr.75(6):2233-2241

Acknowledgements:

AgVise Laboratories