Utilizing Soybean Hulls as a Supplemental Slow-release Nitrogen Source in Crop Production

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In the growing season of 2023, a study was conducted to test the potential use of soybean hulls as a source of nitrogen fertilizer at the Carrington Research Extension Center on three sites: a dryland site that is managed with conventional tillage, a dryland long-term no-till site, and an irrigated site with conventional tillage. The same treatments were applied on each site. Spring wheat was used for this evaluation.

The objective was to evaluate the potential of utilizing soybean hulls as a supplemental slow-release nitrogen source in crop production by measuring yield impact and soil residual nitrogen after harvest. To achieve this objective, the following treatments were applied on a dryland site with conventional tillage, an irrigated site with conventional tillage and a dryland no-till site:

- Check, no N
- 40 lbs. N applied as urea
- 40 lbs. N from soybean hulls
- 90 lbs. N rate from a mix of 40 lbs. N from hulls + urea
- 90 lbs. N applied as urea

Treatments were replicated four times.

To determine soybean hulls application rates, a sample of the hulls was sent to Agvise Laboratories for chemical analysis (Table 1).

Table 1. Soybean hulls nutrient analysis.

N	P	K	S	Mg	Zn	Mn	Na	Cu	Ca	B	Fe	Carbon	C/N ratio
%					ppm							%	
2.3	0.13	1.4	0.12	0.23	33	36	0.01	6	0.46	24	416	44.4	19.3

Results

There were no significant differences observed at the irrigated site for any variables. The treatments where soybean hulls were applied at the 40 lb./a nitrogen rate did not yield significantly different from the untreated check at any of the sites. Urea at the 40 lb. N rate produced a significant yield increase compared to both the check and the soybean hulls treatment at both dryland sites (Figures 1,2,3). This shows that there was a nitrogen response at those sites, but the nitrogen from the soybean hulls was not available to the plants when they needed it. Similarly, the treatments where soybean hulls were applied in combination with urea yielded significantly worse than where only urea was applied at the same rate. The grain protein results followed a similar pattern, as well. The application of urea increased protein content, but the soybean hulls had no effect (Figures 4,5,6). Unsurprisingly, grain nitrogen uptake, which was calculated from grain yield and grain crude protein, also followed this same trend. Post-harvest soil nitrates were highest in the check and the 90 lb. urea-nitrogen treatments. The rest of the treatments were not significantly different from each other (Figures 10,11,12).

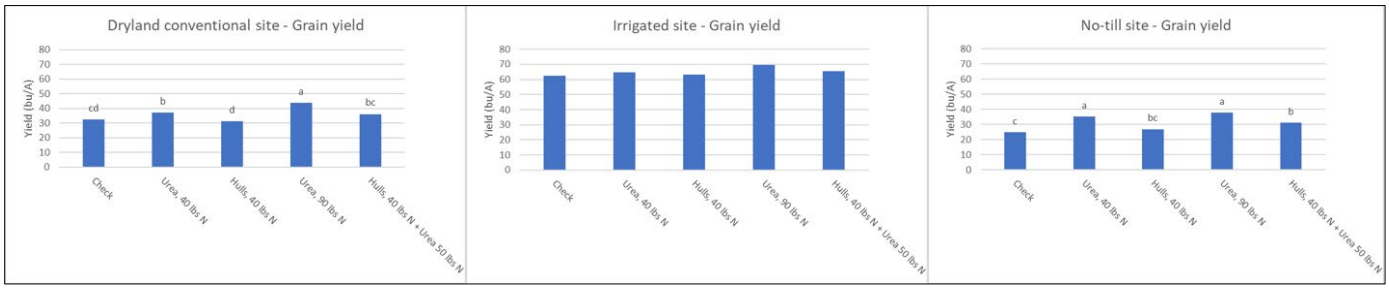

Figure 1,2,3. Grain yield by treatment from the conventional dryland, the conventional irrigated and the no-till dryland sites.

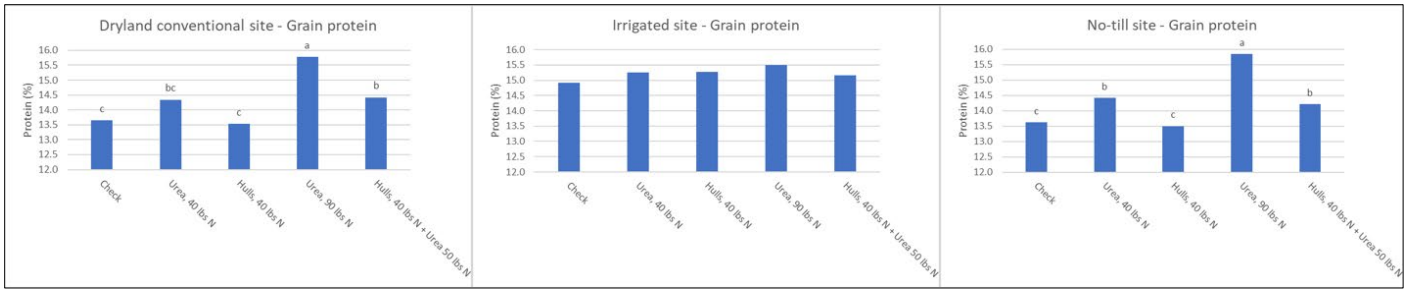

Figure 4,5,6. Grain protein by treatment from the conventional dryland, the conventional irrigated and the no-till dryland sites.

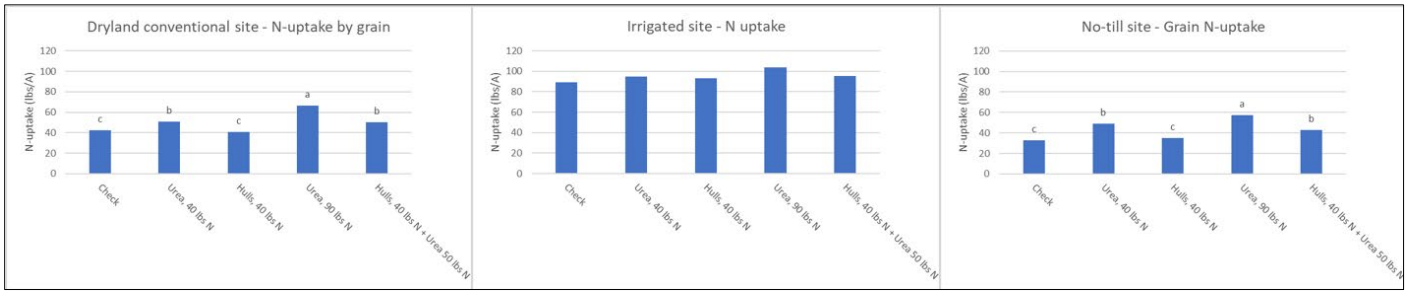

Figure 7,8,9. Grain N-uptake by treatment from the conventional dryland, the conventional irrigated and the no-till dryland sites.

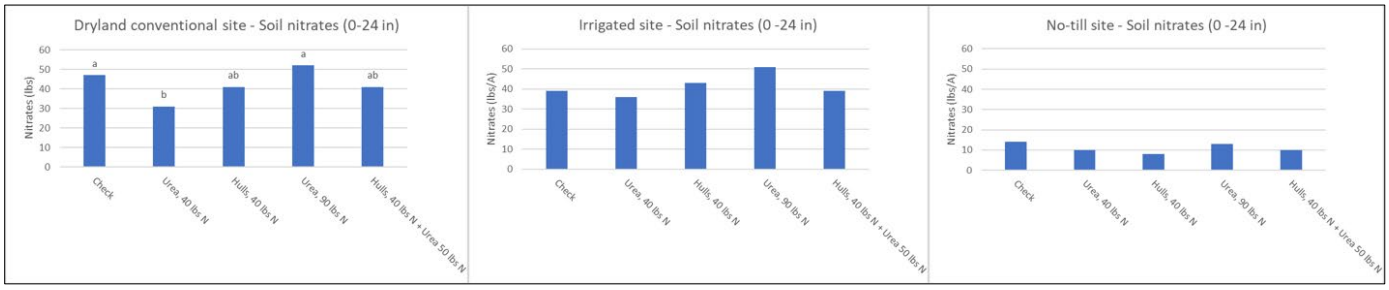

Figure 10,11,12. Post-harvest soil nitrate content by treatment from the conventional dryland, the conventional irrigated and the no-till dryland sites.

Discussion

Based on the results, it seems that nitrogen release from soybean hulls was slow to non-existent in the year it was applied under all three management practices. This is could be caused by a carbon to nitrogen ratio that is too high for quick breakdown under the climatic conditions of the trial year. The no-till trial area will be planted back to spring wheat, to observe the soybean hulls' nitrogen contribution to the next year's crop.

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