

GSCSSA PROGRESS REPORT

2006

Title: Alternative nitrogen sources for grass seed production in the post-ammonium nitrate era.

Objectives(s)/Sub-Objectives

1. Assess the relative effectiveness of dry urea and fluid urea ammonium nitrate compared to dry ammonium nitrate on plant nitrogen recovery and grass seed yield in burned and baled residue management systems;
2. For dry urea and fluid urea ammonium nitrate, evaluate subsurface placement as an alternative to surface applications for grass seed production;
3. Evaluate the effect of timing of nitrogen application on plant nitrogen recovery and grass seed yield in burned and baled residue management systems;
4. Evaluate the potential for ammonia volatilization from ammonium nitrate and urea-based nitrogen sources under burned and unburned residue management practices;
5. Evaluate the economics of the alternative practices in objectives 1-3;
6. Disseminate the research results to Pacific Northwest grass seed producers in written publications and oral presentations.

Investigators

Dr. Richard T. Koenig, Soil Scientist (richk@wsu.edu), WSU Crop and Soil Sciences Department coordinate fertilizer application and measurements of N recovery.

Dr. William J. Johnston, Agronomist (wjohnston@wsu.edu), WSU Crop and Soil Sciences Department, coordinates yield and agronomic seed measurements.

Dr. C. Richard Shumway, Economist (shumway@wsu.edu), WSU School of Economic Sciences, conducts economic analysis of on-farm research.

Mr. Chris Proctor, Crop and Soil Sciences Undergraduate Research Assistant working in Dr. Koenig's lab to conduct analyses; potential future graduate student.

Cooperators: John Cornwall (2005-06 preliminary study); Art Schultheis, John Sawyer, and David and Larry Gady (2006-07 study sites), grass seed growers in WA and ID.

Abstract of 2005-06 Progress: A preliminary study was completed in 2006 showing that, on average, subsurface banding of dry urea or fluid urea ammonium nitrate (UAN), or surface banding of UAN, resulted in 19% lower seed yield than broadcasting dry ammonium nitrate or urea. Laboratory and field measurements indicate that burning residue increases pH at the surface, which increases the potential for ammonia volatilization. However, burning also significantly lowers urease enzyme activity, which reduces the potential for urea hydrolysis to form ammonia. This reduction in enzyme activity is temporary, as lab studies indicate that ammonia volatilization (and therefore urea hydrolysis) increases over time after burning. Field and lab studies were expanded beginning fall 2006.

Justification: With the recent loss of ammonium nitrate as a fertilizer option, there is an urgent need to develop management recommendations for urea-based fertilizers, the

main alternative nitrogen sources for grass seed production. Ammonia volatilization from urea can result in economic losses for grass seed producers in the form of wasted money on nitrogen fertilizer and/or lower seed yields. Ammonia volatilization is also an emerging air quality concern that is being regulated in livestock systems, and may be regulated in the future inorganic fertilizers. Research is needed to determine how to manage urea-based nitrogen sources for maximum retention and utilization in Pacific Northwest grass seed production systems.

Progress: A preliminary nitrogen source field study was initiated in October 2005 and harvested in 2006. On average, subsurface banding of dry urea or fluid urea ammonium nitrate (UAN), or surface banding of UAN, resulted in 19% lower seed yield than broadcasting dry ammonium nitrate or urea (Figure 1). There was no statistical difference in yield between broadcast dry urea and dry ammonium nitrate, indicating that it is possible to achieve equal performance between dry ammonium nitrate and urea. Stand disturbance may explain the lower yields observed with the subsurface band placement. The reason for lower yields with the surface band UAN treatment are not clear although there was some evidence of leaf tissue burning with fluid UAN applications. Interpretation of the 2006 grass seed study yields is preliminary since, based on the high yield of the unfertilized control (Figure 1), we believe that this site had substantial residual nitrogen prior to application of the fertilizer treatments. We did not sample this preliminary study site so cannot confirm this. Laboratory and field measurements indicate that urea fertilizer, bluegrass residue, and burned residue all increase pH at the surface, which increases the potential for ammonia volatilization (Figure 2). Burning also significantly lowers urease enzyme activity in the residue compared to unburned residue (Figure 3), which reduces the potential for urea hydrolysis to form ammonia. This decline in enzyme activity is apparently temporary, as lab studies indicate that ammonia volatilization increases over time after burning (Figure 4).

Field and lab studies are ongoing and were expanded when funding for this project was received in 2006. (Objectives 1-3) Field studies were initiated at three locations: near Colton, WA; east of Palouse, WA (in Idaho, burned site); and near Rockford, WA. Preliminary soil samples verified that these sites were relatively low in residual nitrogen (27 to 78 lb $\text{NO}_3\text{-N/ac}$ to a 3-foot depth). At each location, seven nitrogen source-placement treatments were applied October 5-6 and again to separate plots in late October: 1) unfertilized control; 2) broadcast dry ammonium nitrate; 3) broadcast dry urea; 4) surface banding of fluid urea ammonium nitrate (UAN, 7½-inch between bands); 5) subsurface banding dry urea (7½-inch spacing between bands and 2 inch band depth using a double disk no-till drill); 6) subsurface banding fluid UAN at the same depth and spacing treatment as #5; 7) broadcast dry controlled release urea fertilizer. Each plot is 7 feet wide by 30 feet long. Rate of N was set by the grower standard for the site (100 or 150 lb N/acre). Plots will be harvested for total biomass and seed yield, total nitrogen uptake, and apparent nitrogen recovery in 2007. (Objective 4) For a 10-day period after application of the fertilizer field measurements of ammonia volatilization from the surface-applied ammonium nitrate, urea and fluid UAN treatments will be made using procedures outlined in the proposal. Surface pH and urease enzyme activity will also be measured from field plots at each application time.

Lab studies described in the proposal will also continue (Objectives 1-4). Progress on objectives 5 (economic evaluation) and 6 (dissemination of results) is awaiting more comprehensive grass seed yield results from the field studies.

Figure 1. The effect of nitrogen source and placement applied October 17, 2005 on grass seed yield in 2006. Bars capped with the same letter are not significantly different at the 5% level.

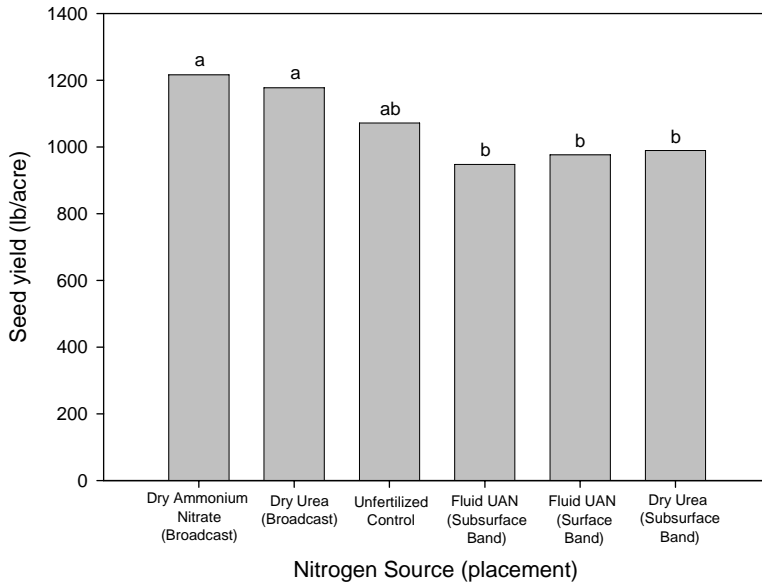
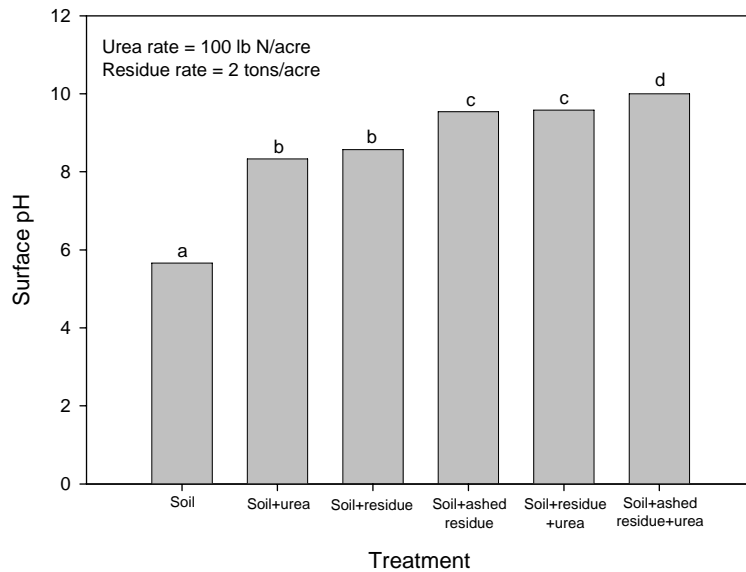


Figure 2. The effect of urea, and bluegrass residue and burned residue with and without urea on soil surface pH measured with a microelectrode. Bars capped with the same letter are not significantly different at the 5% level.



Interaction: This is a new project. Interaction and cooperation with other scientists conducting related grass seed research has not occurred but will commence in 2006.

Timeline

June 2006: The preliminary grass seed study on John Cornwall farm was harvested.

October 2006: Three grass seed fertility studies were initiated at the farms of Art Schultheis near Colton, John Sawyer (burned site in Idaho) east of Palouse, and David

and Larry Gady near Rockford. Details are described above. Sites will be harvested to measure seed and biomass yield and nitrogen recovery in June 2007.

January 2006-present: Preliminary laboratory studies were completed to assess the influence of soil properties and nitrogen management in grass seed systems on urease activity and potential ammonia volatilization.

Publications, Reports, and Presentations for Current Year

This is a new project and no publications or reports have been prepared from it yet.

Figure 3. Urease enzyme activity measured in soil, bluegrass residue and residue after burning. Bars capped with the same letter are not significantly different at the 5% level.

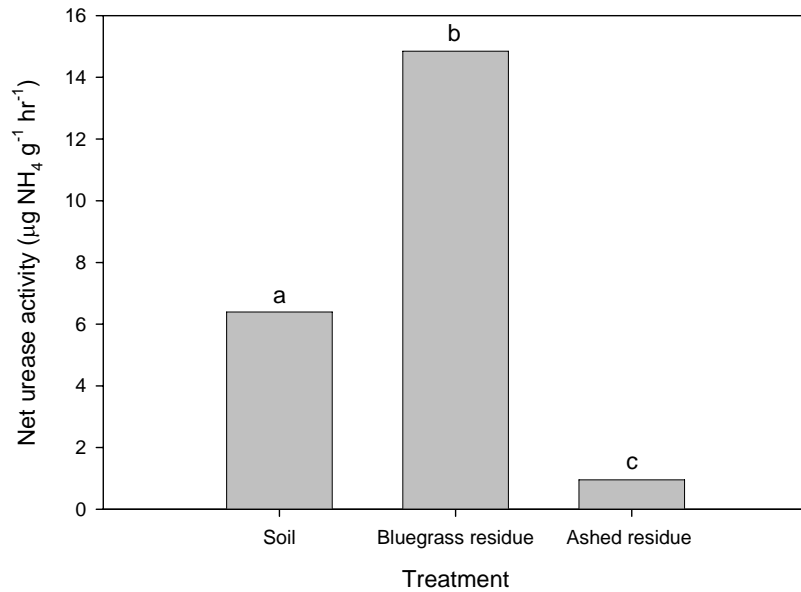


Figure 4. Ammonia volatilized and captured in boric acid solution from select nitrogen source and surface bluegrass residue state (burned or not) treatments incubated in the laboratory. The vertical bars represent least significant difference values at the 10% level ($\text{LSD}_{0.10}$). If the distance between two symbols at the same interval is larger than the length of the bar then the difference is statistically significant.

