University of Idaho Extension

Nutrient Management Newsletter for Idaho

Nutrient Digest

VOLUME 1, ISSUE 2 WINTER, 2009

SLOW RELEASE NITROGEN AND WINTER WHEAT

By Brad Brown

Late winter top-dressed urea N is more effective than early fall preplant incorporated urea for winter wheat in 2 out of 3 years, based on previous research in the Treasure Valley. This is due either to less leaching, denitrification, or immobilization with the late winter topdress. While early fall preplant urea is occasionally as effective as late winter top-dressed urea, it is seldom more effective. In part because of this, the current NRCS 590 Nutrient Management Standard discourages early fall preplant applied N unless the N can be maintained in the ammonium form going into winter.

Despite the relative effectiveness of winter top-dressed urea N, this N fertilizer is subject to volatile gaseous NH_3 losses under some conditions (warm, wet surfaces of high pH soils). Until the advantage of winter top

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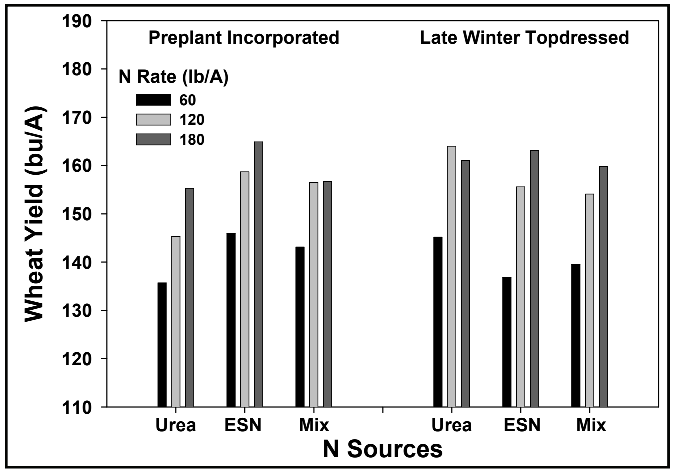


Figure 1. Three year average wheat yield as affected by fertilizer urea, ESN®, or a 50/50 mixture applied preplant or as a topdress in late winter at Parma.

COPPER SULFATE FOOT BATHS ON DAIRIES AND CROP TOXICITIES — WHAT ARE THE RISKS?

By Amber Moore and Jim Ippolito

A rising concern with the application of dairy wastes to agricultural fields is the accumulation of copper (Cu) in the soil. Copper sulfate ($CuSO_4$) from cattle foot baths are washed out of dairy barns and into wastewater lagoons. The addition of $CuSO_4$ baths has been reported to increase Cu concentration significantly in manure slurry from 4.8 g/1000 L to 88.6 g/1000 L (Miner Institute, New York). The Cu-enriched dairy waste is then applied to agricultural crops, thus raising concerns about how soils and plants are impacted by these Cu additions.

Once added to the soil, the Cu^{+2} from $CuSO_4$ can 1) remain in the soluble form of Cu^{+2}, which is available to plants, 2) adsorb to organic matter, 3) adsorb to clay particles, or 4) be converted to $Cu(OH)_2$.

The majority of Cu will be adsorbed strongly to organic matter and clay surfaces in the soil. In fact, Cu binds to organic matter more strongly than any other micronutrient. Dairy waste materials that are rich in organic matter, such as stockpiled manure, which will naturally have greater Cu adsorption than dairy lagoon water, which is low in organic matter. In soils with soil pH values greater than 7.0, which is common for Southern Idaho soils, soluble Cu^{+2} will react with water to form $Cu(OH)_2$.

With the strong binding of soluble Cu to soils, very little of the ap-

TOPDRESSING WINTER WHEAT WITH UREASE AND NITRIFICATION INHIBITORS — YEAR 1

By Brad Brown

Ammonia volatilization can occur with topdressed urea, in which case it is not available for use by plants. It occurs when urea is topdressed to high pH soils that are already wet on the surface or wetted with a light shower that is enough to solubilize the granules but not enough to move it into the soil. Urea granules are also wetted by furrow irrigation without providing effective incorporation. Relatively new N fertilizer products are available to address some of the issues with N volatilization.

Urease inhibitors are compounds that prevent the hydrolysis of urea to ammonia gas that escapes into the atmosphere. Nitrification inhibitors block the microbial conversion of soil NH_4-N to the more mobile form of NO_3-N. Both inhibitors can improve the availability of N to plants if conditions are right.

SuperU® (Agrotain) is an alternative N fertilizer containing both a urease and nitrification inhibitor. Two trials were conducted at Parma on March 5th and 27th of 2008 to evaluate the relative effectiveness of urea and SuperU® fertilizers topdressed at different N rates.

The soil surface was dry when the topdressings occurred in both trials. Rainfall after the March 5 topdressing included 0.03, 0.10, 0.02, and 0.18 inches on March 7, 12, 13, and 14 respectively. Rainfall after the March 27 topdressing included 0.18 inch the following day on March 28. The wheat was furrow irrigated the first time on April 16 in both trials.

The results for topdressings applied to furrow irrigated soft white winter wheat in 2008 trials are shown in table 1. Topdressed N increased yield, plant height, test weight, and the chlorophyll meter reading (SPAD) in both trials. Statistically, urea and SuperU® did not differ significantly in any of the parameters in 2008 in either of the trials. Despite a light shower two days following the March 5 topdressing, conditions were apparently not conducive for significant urea N loss. Significant rainfall a day after the March 27 topdressing likely provided sufficient incorporation of topdressed fertilizers. In 2008 trials, we found no advantage to using SuperU® over urea for improving winter wheat yields.

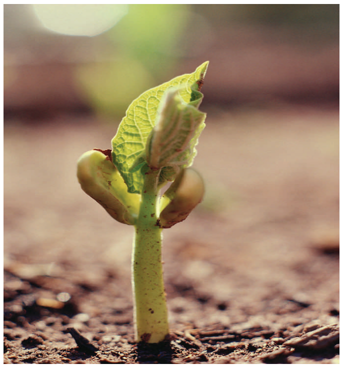
> "In 2008 trials, we found no advantage to using Super U® over urea for improving winter wheat yields."

Table 1. Comparison of spring topdressed dry N sources for furrow irrigated winter wheat in two separate trials. Parma, 2008.

N rate	N Source	Yield	Test weight	Height	SPAD
lb/A		bu/A	lb/bu	in	
Topdressed March 5, 2008					
0	none	81	57.2	31.8	33.9
60	Urea	128	57.7	34.6	40.8
60	SuperU	123	57.7	35.2	42.5
60	ESN	122	58.4	33.7	44.2
120	Urea	155	58.6	37.7	46.1
120	SuperU	147	58.6	36.8	44.8
120	ESN	143	59.5	35.4	45.2
$LSD_{.10}$		14	0.4	1.5	3.0
CV		8	0.5	0.4	5.8
Topdressed March 27, 2008					
0	none	110	56.9	33.3	47.8
50	Urea	135	58.5	34.6	50.4
50	SuperU	138	58.5	35.5	50.1
100	Urea	152	58.1	36.5	51.7
100	SuperU	143	58.3	35.9	50.8
150	Urea	149	57.9	36.3	52.5
150	SuperU	153	57.7	35.9	51.3
$LSD_{.10}$		16	0.6	1.2	2.6
CV		9	0.9	2.9	4.2

The results for 2008 are tentative. Evaluations of alternative late winter/early spring topdressed N sources will continue in 2009 thanks to support from the Idaho Wheat Commission.

For more information, contact Brad Brown at 208-722-6701, or bradb@uidaho.edu.



OLSEN PHOSPHORUS

by Brad Brown

The most commonly used soil test for indicating available soil phosphorus (P) in the western US is the extraction using 0.05M sodium bicarbonate ($NaHCO_3$) buffered at pH 8.5. The test was originally developed in the early 1950s for identifying the P fertilizer needs for corn in calcareous soils. Since then the test has been widely calibrated for several commodities and soils throughout the world. It turns out to be a robust test that indicates reasonably well the P shortages in a wide variety of soils. While some P soil test extractants are designed specifically for acid or strongly acid soils, and work best in those soils, few if any tests work better in soils ranging widely in pH from strongly acid to highly alkaline. It is commonly referred to as simply the Olsen test, after the USDA-ARS researcher who developed it.

> "The Olsen soil test P value is an index of available P much the same as a car's fuel gauge roughly estimates the availability of gas left in the tank".

Occasionally Olsen test results are reported as actual pounds of available P per acre, much the same as is done with the soil test for extractable nitrate nitrogen. The Olsen test was never designed to be used in this way. The Olsen soil test P value is an index of available P much the same as a car's fuel gauge roughly estimates the availability of gas left in the tank. When the gauge is on the quarter mark, you don't know how much gas is actually remaining unless you know the size of the tank. Furthermore, gas gauges in some cars are not very accurate, and may read empty but still have enough gas remaining for another 50 miles.

The Olsen test was developed originally to identify available P shortages that limit crop production. But the test can and has been used to identify soils that have been enriched with P from manures, composts, or other by-products. The soil P available for plant uptake is also the soil P most easily solubilized and carried by surface runoff or percolating waters. Olsen test P concentrations are directly related to the soluble P in runoff from fields. It is the accepted test for monitoring soil P enrichment in Idaho's fields receiving animal wastes. Few if any southern Idaho laboratories use any other extractant for P other than Olsen, unless it's the occasional water extraction.

Since phosphorus is normally considered to be immobile and does not move as readily with the wetting front as nitrates, chlorides and sulfates, available soil P is typically measured from soil sampled to the tillage depth. We've learned that P is more mobile than we once thought, particularly in soils highly enriched with P. The extractable P is moved deeper in soil by mixing (plowing and ripping) but also by preferential flow of soil water down old root channels or worm holes. Normally, P at depths below 12" or the plow depth would be near background levels of 2-5 ppm. In highly P enriched soil, Olsen P below the tillage layer can measure well above those found in some surface soils. Movement of P to deeper depths would not be a concern were it not for the potential for soluble P to move into shallow waters that reach the surface in springs that then contribute to the P loading of surface waters. Where there is potential for this to occur, regulatory sampling is done in the 18 to 24 inch depth.

> "We've learned that P is more mobile than we once thought, particularly in soils highly enriched with P. "

It is not clear if the original developer of the $NaHCO_3$ extraction envisioned his test being so widely used or used so extensively for regulatory/environmental monitoring. He certainly lived to see it all come about. Sterling Robertson Olsen died August 20, 2008 at his home in Spanish Fork, UT at the age of 91.

BALANCING BIOSOLID NUTRIENTS WITH FERTILIZERS

By Dick Johnson

Table 2. Guidelines for safe use of starter fertilizer	
No more than:	30 lbs/acre of actual N from urea (46-0-0),
	30 lbs/acre of actual P_2O_5 from DAP, or
	30 lb/acre combination from urea and DAP blend
	80-100 lbs/acre any combination of N + Potassium (K_2O) in band to avoid salt injury to the emerging plant.

Fertilizers can play an important role in balancing crop nutrient needs, even with bio-solid (compost/manure) applications. Determine the nutrient requirement for each field based on the crop, soil test, soil type, and fertilizer history. Refer to the University of Idaho Fertilizer Guides to assist in making your fertilizer decisions. Use the lowest cost fertilizer materials and consider the following.

Biosolids are excellent sources of nutrients and should provide most of the nutrients needed for crops, depending on the nutrient, biosolid application rates, and nutrient requirements of crops. Where biosolid applications are limited, there is greater reliance on fertilizers to provide the rest or balance of the needed nutrients. Nitrogen (N) is the fertilizer most likely needed when biosolids are not used, or used only to replace phosphorus removed in harvested crops.

For manured systems, develop a Nutrient Management Plan (NMP) that is Phosphorus (P) based. In a P based system, biosolids are applied at rates that provide no more P than is removed in harvested crops. This may not satisfy the N required for the crop but fertilizer can provide the additional N if needed. Phosphorus based manuring avoids the excessive P enrichment of soil. Applying manures to satisfy all the N required for production will lead to (1) P enrichment, soil test P exceeding 40 ppm, and (2) greater risk of P entering surface waters.

Where biosolids do not provide enough phosphorus to meet crop requirements, consider a starter band application of fertilizer P to increase P efficiency. For row crops, band 2 inches below and 2 inches to the side of the seed furrow for maximum effectiveness. Starter fertilizers can injure developing plants at rates exceeding those in Table 2.

For more information, contact Dick Johnson at 208-685-6992, or dick.johnson@id.usda.gov

"Applying manures to satisfy all the N required for production will lead to (1) P enrichment, soil test P exceeding 40 ppm, and (2) greater risk of P entering surface waters."

Copper, dairies, and crop toxicities, continued from pg. 1

plied Cu is plant available. Overall, the potential for Cu toxicities in

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plants is relatively small given the amount of Cu that is applied through dairy waste. Preliminary results from the USDA ARS in Kimberly, Idaho, showed that DTPA extractable Cu concentrations ranging from 1 to 154 ppm in a calcareous soil had no effect on alfalfa or corn silage biomass yields, with plant survival drastically impeded at concentrations of 323 ppm and greater (Ippolito and Tarkalson). It should be mentioned that Cu application rates used in this study to achieve reductions in yields and plant survival greatly exceeded rates typically seen for dairy manure applications. In a similar study in New York, Flis et al. (2006) applied $CuSO_4$ 0, 6.3, and 12.6 lbs Cu/acre to corn silage and orchardgrass, and timothy grass, using Cu rates equivalent to those typical to dairy waste applications. Corresponding soil Cu concentrations were 11, 13, and 18 ppm, respectively. The varying Cu application rates had no effect on grass or corn silage yields, although tillering and regrowth rates were significantly reduced for the grasses.

While these results are encouraging on the short-term, repeated applications of dairy manures could potentially raise Cu concentrations to levels toxic to plants, with very limited possibilities for remediation. A few fields in Idaho that have received frequent applications of lagoon water have shown evidence of copper toxicity. Because Cu is so tightly bound by the soil, it is very difficult to remove. Succeeding crops can only remove 0.1 lb Cu/acre/year. As it stands now, if a grower waits until Cu plant toxicity symptoms occur (including plant death), they will continue to see Cu toxicities on that field for an indefinite period of time.

In terms of regulation, there is an existing EPA 503 “worst case scenario” standard that limits annual loading of Cu from biosolids to 66 lbs Cu/acre, and lifetime loading to 1,339 lbs Cu/acre. Reaching these limits is almost impossible with dairy waste applications, and would devastate most agricultural crops long before the lifetime loading limits were met. New York and Illinois have set lower lifetime loading limits for Cu at 75 and 250 lb/acre, respectively, to avoid the potential of irreversible toxic accumulations of Cu in the soil.

While more studies are needed to develop an official threshold for Cu in Idaho soils, based on what we know thus far it would be advisable to cease Cu additions to soils with greater than 100 ppm extractable Cu. To determine if you currently have a Cu accumulation problem in your soil, or to identify a developing accumulation, request an analysis for DTPA extractable Cu every 2-3 years from a soil testing laboratory accredited by the Idaho State Department of Agriculture.

For more information, contact Amber Moore at 208-736-3629, or amberm@uidaho.edu. Contact Jim Ippolito at 208 423-6524, or

Slow release nitrogen and winter wheat, continued from pg. 1

In contrast to preplant incorporated N, late winter topdressed ESN tended to be lower yielding than topdressed conventional urea (Fig. 1). The mixture of fertilizers was typically no better than ESN® when late winter topdressed. Top dressed ESN® at low N rates may not release sufficient N to promote adequate vegetative growth. The reduced effectiveness of topdressed ESN® in furrow irrigated wheat may be related to rapidly drying soil surfaces that reduce the diffusion of urea from the ESN® granule.

The cost of ESN® one to three years ago was only 12 cents more a pound for ESN® N than for urea N. At that price difference, preplant ESN® was more cost effective than preplant urea. The price difference increased in some locations to almost 50 cents a pound this last fall, and the economics at those prices are not favorable. The additional $30 to $90 for ESN® per acre for 60 to 180 lb N/A rates would not be justified when growers have the proven option of topdressing conventional urea in late winter. Early fall preplant ESN® was no more effective for soft white winter wheat yield than late winter topdressed urea. Prices may differ depending on location and producers will need to weigh the higher costs of ESN® with the costs of an extra application in winter.

For more information, contact Brad Brown at 208-722-6701, or bradb@uidaho.edu.

Questions from the field

If I am growing Round-up Ready sugar beets, do I need to be concerned about manganese deficiencies? Manganese deficiencies in Round-up Ready soybeans have been documented in the Midwestern United States. Suspected causes of the deficiencies include the binding of glyphosate to manganese in the soil, and gene-alterations that reduce manganese adsorption in the roots. While manganese deficiencies in Round-up Ready sugar beet cropping systems have not been identified, growers should still be aware of this phenomena. If you notice interveinal chlorosis in the leaves, a visible sign of manganese deficiency, send chlorotic leaf blades to a plant tissue-testing lab to be analyzed for manganese concentrations. Leaf blade manganese deficiency symptoms have been observed with leaf blade concentrations within the 4 and 20 ppm range, while sufficiency levels range from 25 to 360 ppm.

Will field applications of dairy manure increase salt concentrations on my field to hazardous levels? Because dairy feed is supplemented with minerals and salts as buffering agents, dairy waste materials will inevitably contain salts as well. Field applications of dairy waste can potentially increase salt concentrations in the soil, as can fertilizers, hard water, and other agricultural products. A proportion of added salts are removed with the harvested portions of crops. Salts can also combine with anions in the soil to form soluble minerals that do not contribute to the total salt load. The relative salt balance in soil depends on the total salts applied in manure/compost and other additions, and the fate of those salts. If you frequently apply manures and/or other salt sources to your fields, we recommend analyzing your soil for electrical conductivity, sodium, potassium, magnesium, and calcium concentrations on a yearly basis to prevent salt-induced water stress, soil sealing, and crop toxicities. Guidelines for soil analysis, interpretation, and reclamation of salt affected soil are listed in the publication *Managing Salt-affected Soils for Crop Production* (PNW 601-E), which can be found at: http://extension.oregonstate.edu/catalog/pdf/pnw/pnw601-e.pdf.

If you have a nutrient management question from the field, please email your question to amberm@uidaho.edu. Names will not be used.

Upcoming Events and Contact Information

University of Idaho

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UPCOMING EVENTS

- Jan. 5-7: FarWest Fertilizer & Chemical Conference—Jackpot
- Jan. 8-9: Snake River Sugar beet Conference—Twin Falls
- Jan. 20-22: U of I Potato Conference—Pocatello
- Feb. 3: U of I Magic Valley Cereal School—Burley
- Feb. 3-4: Idaho Alfalfa & Forage Conference—Burley
- March 4-5: Western Nutrient Management Conference—Salt Lake City

- NRCS CMNP Training and Update Sessions TBA for January, February, and March. Call 208 685-6992 for more info.
- SW Idaho Organic Producer's School in Caldwell. TBA for March. Call 208 459-6003 for more info.
- EPA Region 10—Presentation on updated CAFO regulations. TBA for spring. Call 208 378-5765 for more info.