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Managing Fertilizer Nitrogen Applications for Spring Barley & Wheat

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Soil-nitrogen (N) is often insufficient to maximize agronomic yield and economic return in cereal production systems. Fertilizer-nitrogen (N) applications play an important role in obtaining optimal yield and quality for Idaho growers.

Available soil N and crop yield potential determine a crop's N requirements, where both are key factors for prescribing optimum N applications rates. As such, N fertilizer should be managed in a way that improves plant availability and minimizes losses to the environment.

Nitrogen fertilizer is primarily composed of ammonium, nitrate, and urea or their combination. However, plants take up N from the soil as inorganic-N (i.e., ammonium and nitrate); thus, applied fertilizer N must undergo chemical and biological transformations in the soil to convert it into plant-available forms.

Fertilizer N use efficiency (FNUE, amount of grain per unit of applied N fertilizer) for cereal crops is typically around 50% where fertilizer management play a key role in the system's efficiency. The FNUE of a crop is decreased due to N losses via various pathways (Fig. 1).

Major mechanisms of N loss include denitrification of nitrate, leaching of nitrate, and ammonia volatilization. Denitrification occurs when oxygen is reduced in soils; preventing waterlogged conditions in the field is key to reducing this process.

Leaching occurs when nitrate moves with water deeper in the profile where the plant roots are unable to reach and take up N, and thus, avoiding excessive irrigation is key to minimizing leaching losses.

Finally, ammonia volatilization occurs when ammonia is lost as a gas either directly, or through the conversion of ammonium to ammonia and moves into the

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Figure 1 - Nitrogen Pathways in the soil-plant-atmosphere

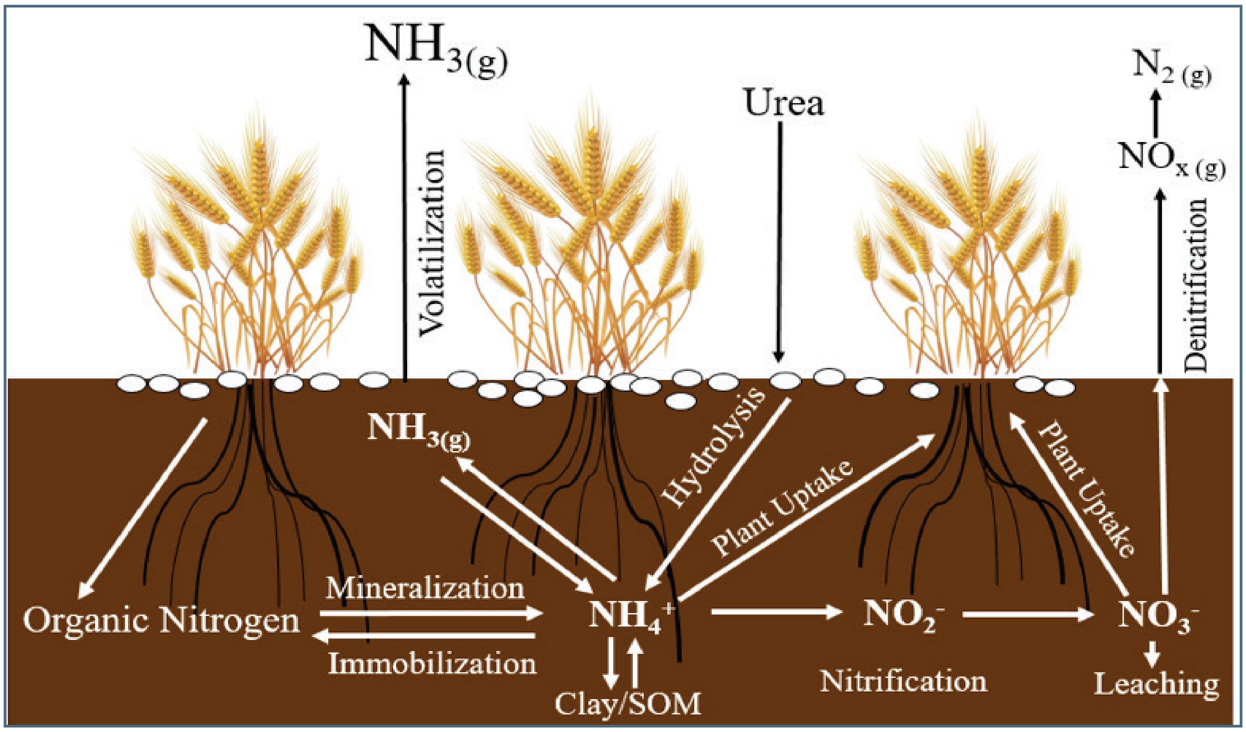

Table 1 - Best Management Practices for Fertilizer Nitrogen Application

Avoid over-application of irrigation water, as waterlogged conditions are conducive to denitrification and leaching of nitrate through the soil can occur
Delay appplication under high-risk conditions (i.e., moist soil, high-soil tempurature or frozen soil, as loss can still be substantial at low tempuratures
For surface applications incorporate within one to two days following application: • Tillage (> 2 in) • Irrigation (>0.5 in) • Rainfall (>0.5 in single event)
Subsurface band (>2 in)
For urea, consider a urease inhibitor (i.e., NBPT) for surface applications particularily when conditions are sub-optimal
Consider an alternate N source to urea, particularily when conditions are sub-optimal

Adapted from Jones et al. 2013 Montana State University Ext. EB0209

atmosphere. Under sub-optimal conditions, losses due to ammonia volatilization from urea can approach 50% of applied N.

Fertilizers should be managed based on the 4Rs approach of nutrient management: Right Source, Right Rate, Right Timing, and Right Placement.

Fertilizer-N sources have different potential for loss. For example, surface-applied urea is the most susceptible to ammonia volatilization. Table 1 summarizes practices that can help minimize N losses from urea and other ammonium-forming fertilizers.

To determine the right fertilizer N application rate, growers should test their soils annually and consult University of Idaho Extension guides (i.e., Southern Idaho Spring Barley – UI BUL742; North Idaho Spring Barley – UI CIS 920, Southern Idaho Spring Wheat – UI CIS 828, and North Idaho Soft Spring Wheat – UI CIS 1101). Fertilizer guides have been developed based on Idaho growing conditions and typical response of Idaho varieties to applied N.

Fertilizer recommendations rely on accurate inorganic-N values determined by soil testing and specific factors for N mineralization based on the individual fertilizer guide. Soil sampling should be conducted as close to fertilization timing as possible where proper sampling protocols (UI BUL 915) must be followed to ensure sample accuracy.

Right timing is crop specific where fertilizer N for malt barley is not recommended after tillering as grain protein can increase above contract specifications. Similarly, application of N close to harvest time in wheat can result in deceivingly high grain protein measurements.

Right placement for fertilizer N should facilitate maximium movement of the applied N into the soil. For example, broadcast urea or ammonium-forming fertilizers should be followed by incorporation either through tillage (> 2 in), irrigation (> 0.5 in), or sufficient rainfall (> 0.5 in) shortly after application. Additionally, urea and ammonium forming fertilizers should not be applied under high-risk conditions (i.e., moist soil, high-soil temperature, or onto frozen soils).

If fertilizer N is banded at seeding, it should be done to a depth of 2 in or greater where a 2 in offset is common in many areas in Idaho as fertilizer N applied in the seed row can damage seeds/seedlings, particularly at higher N-application rates.

Two new University of Idaho Extension Bulletins that specifically address issues associated with ammonia volatilization from Idaho soils will be available at http://ww.uidaho/extension/publications in the near future.

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2017 Comparison of LESA and Conventional Irrigation Systems

BY DR. HOWARD NEIBLING, UNIVERSITY OF IDAHO EXTENSION IRRIGATION ENGINEER

A full-pivot LESA – conventional center pivot sprinkler package comparison was conducted on adjacent 180 acre center pivots of Voyager malting barley south of Dubois, ID this summer. Soil water content was monitored using watermark sensors and AgSense data loggers on both pivots. The soil was shallow and rocky, with sensors unable to be installed below 24 inches. Applied water was measured using rain gages.

Results: Crop yield and quality were essentially the same (135 control vs 130 LESA) with plumps and test weight the same. However, 2.5 inches less water from 3 fewer irrigations was applied to the LESA pivot.

Although the control yield was 5 bu/ac more, the farmer said that the LESA pivot suffered more stand loss due to wind, so the two field yields were essentially equal. Nozzle height on the conventional pivot was 72 inches above the ground, and 42 inches above the ground on the LESA pivot.

Soil moisture measurements over the course of the summer (Figure 1) showed that the crop root zone water content under the LESA pivot was consistently higher water than under the conventional pivot. LESA water content at 18 inches increased over the season while the control decreased.

The greater soil water content in LESA allowed irrigation to be cut off earlier than on the conventional (7/12 vs 7/15).

The irrigation energy savings due to 3 less irrigations for a 150 foot pumping lift is about $2000 on this 180 acre pivot, or $11/ac. Until June 1, applied irrigation was the same for the two pivots.

Irrigation management after June 1 resulted in 3 less irrigations on the LESA pivot, or a water application reduction of 17%.

17 percent water savings achieved under LESA center pivot in 2017

Previous Idaho research has shown that irrigation could be reduced by 15% or more with nozzles 12-18 inches above the soil. This height put the nozzles in-canopy by early June on malting barley.

However, no direct comparisons had been done with nozzles as high as 42 inches. This height was used to clear potato vines last year and was then used on the barley this year.

One of the previously uncertain factors in LESA design was the height above which evaporation and wind drift loss reduction dropped to near zero.

This comparison fills in some missing information and is essential in designing pivots that will have potatoes in the rotation.

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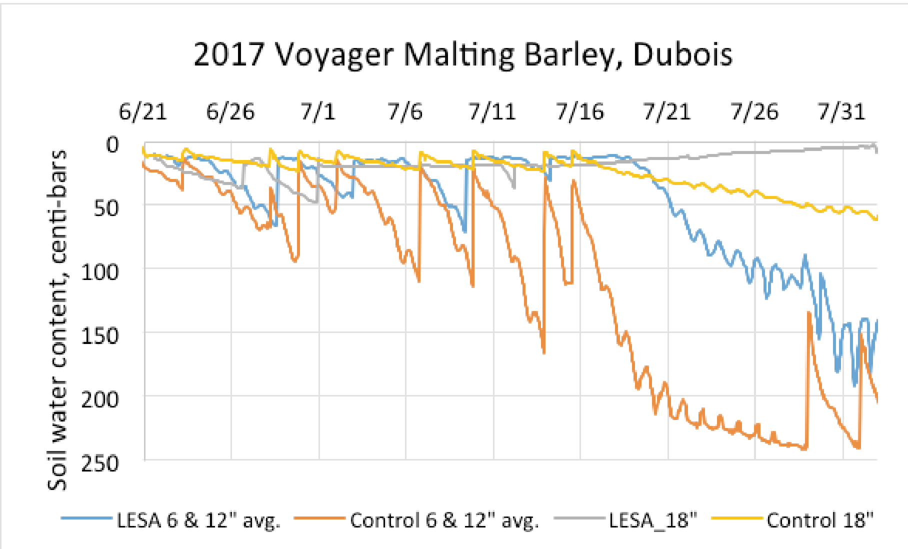

Figure 1. Change in soil water content over time and soil depth as indicated by watermark soil moisture sensors and AgSense data loggers. Centi-bar values are zero at saturation and rise as the soil dries. The two upward rises in water content in late July are from precipitation events and show in 6 and 12 inch readings in control and 6 inch readings in LESA.

Several other locations had LESA sprinklers in the potato canopy this year with statistically equal LESA and conventional yield and quality. However, nozzle height may need to be higher under certain conditions: 1) more rolling topography where nozzle height needs to be higher to avoid dragging (although this does not seem to be a problem in other crops), and 2) if growers are concerned about potential spread of disease by sprinkler heads dragging in canopy.

Results of this comparison indicate that significant water savings can occur with the 42 inch height because during the high water use period, the sprinklers are within a foot of the canopy, or were in canopy during the last part of the growing season.

The UI greatly appreciates funding support from Anheuser Busch InBev for the ongoing LESA irrigation studies.

US Barley Stats