University of Idaho Extension

Nutrient Management Newsletter for Idaho

# Nutrient Digest

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## COMPARISON OF AUSTRIAN WINTER PEA AND WINTER TRITICALE FOR USE AS COVER CROPS

***By Derrick Reeves, Lydia Clayton, and Jodi Johnson-Maynard—UI***

Cover cropping, a once common management tool used to control weeds and enhance soil fertility and tilth, has largely been replaced with synthetic fertilizers and herbicides. Within low input and organic systems, however, cover crops remain a vital management tool. The goal of this research was to screen two potential cover crops for their ability to control weeds and restore nitrogen to the soil. A field study utilizing a replicated, randomized block design was established at the University of Idaho organic farm in Moscow, ID. Treatments included Austrian winter pea [*Pisum sativum spp. Avense var. Melrose* (L.) Poir], winter triticale (*X Triticosecale Wittmack* ) and an untreated control.

Despite the relatively late planting date (October 2), both crops emerged and grew well into fall

**Figure 1. Winter triticale (left) and Austrian winter pea (right) biomass production in late October 2008.**

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## RECONSIDERING FALL NITROGEN FERTILIZER APPLICATIONS FOR SPRING-PLANTED CROPS

***By Amber Moore—UI***

Ammonium, urea, and nitrate nitrogen fertilizers are often applied in the fall instead of the spring for spring-planted crops. Reasons for fall applications include: 1) fertilizers can be easily applied prior to fall bedding; 2) to minimize the number of practices that need to be performed in the spring; 3) to lengthen the growing season; 4) to take advantage of lower fertilizer prices; and 5) to spread out farming costs evenly throughout the year. While these justifications are understandable, the benefits of waiting until spring to apply nitrogen fertilizers outweigh the benefits of early fall applications.

The primary concern of fall applied nitrogen fertilizers is the loss of nitrogen through nitrate leaching, immobilization (conversion of ammonium to organic nitrogen), ammonium volatilization (conversion of ammonium to ammonia gas), and other pathways. Nitrates in the soil leach during freeze/thaw cycles over the winter and in the early spring as temperatures slowly rise above freezing. Also keep in mind that soil temperatures do not fluctuate as air temperature does, and will often be warm enough for leaching at lower soil depths when the air temperature is below freezing.

A common misconception is that ammonium and urea compounds will not contribute to winter leaching of nitrates, and therefore fertilizers that contain ammonium and urea are safe to apply in the fall. Urea, in fact, is highly soluble until it is hydrolyzed to ammonium. It is true that ammonium is a positively charged cation that can easily attach to negatively charged soil surfaces, which does limit leaching potential. However, ammonium from ammonium sulfate and other ammonium based fertilizers can be converted to nitrate through the microbial

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# FALL NITROGEN TO SUGAR BEETS?

***By Brad Brown—UI***

An effective single fall nitrogen (N) application, combined with other fertilizers fall applied for sugar beets, could reduce spring sidedress application costs. To evaluate fall broadcast urea N or slow release fertilizer N (Agrium, ESN®) relative to conventional spring split urea ammonium nitrate (URAN) sidedressings, a sugar beet trial was established at the Parma R& E Center for the 2008 season. All applied N was evaluated at both 100 and 200 lb N/A. Fall N treatments were broadcast then incorporated November 15 with a triple -K before fall bedding into 22" spaced beds. Split URAN sidedressings were made June 6 and June 23 (before row closure) 4-6" away from row centers on the furrow (wetted) side of the row. There were five replications of treatments. Individual plots were six 22" rows wide and 40' long. Soil testing indicated only N was likely limiting to sugar beet production.

Sugar beets were furrow irrigated twice (May 8 and June 7) between planting on April 8 and the first URAN sidedress. Yield was measured October 14-16 from the two center beds (4 rows) of each plot and eight beets collected from each plot for tare and beet quality determinations.

Urea in buried mesh bags was totally dissolved by April 8 when sugar beets were planted.

Percentages of ESN weight lost were 47.4% on April 8, 68.2% on May 7, 90.4% on June 9, and no more than 95.4% of weight was lost for the remainder of the season. Soil test $NO_3$-

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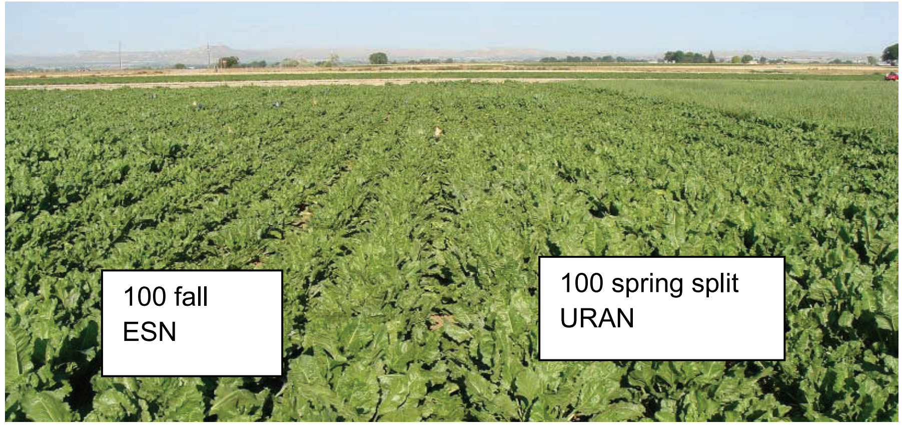


**Figure 1. August sugar beet growth response to fall applied slow release N (left) and conventional June split applied URAN (right) at the 100 lb N/A rate. Parma, 2008.**

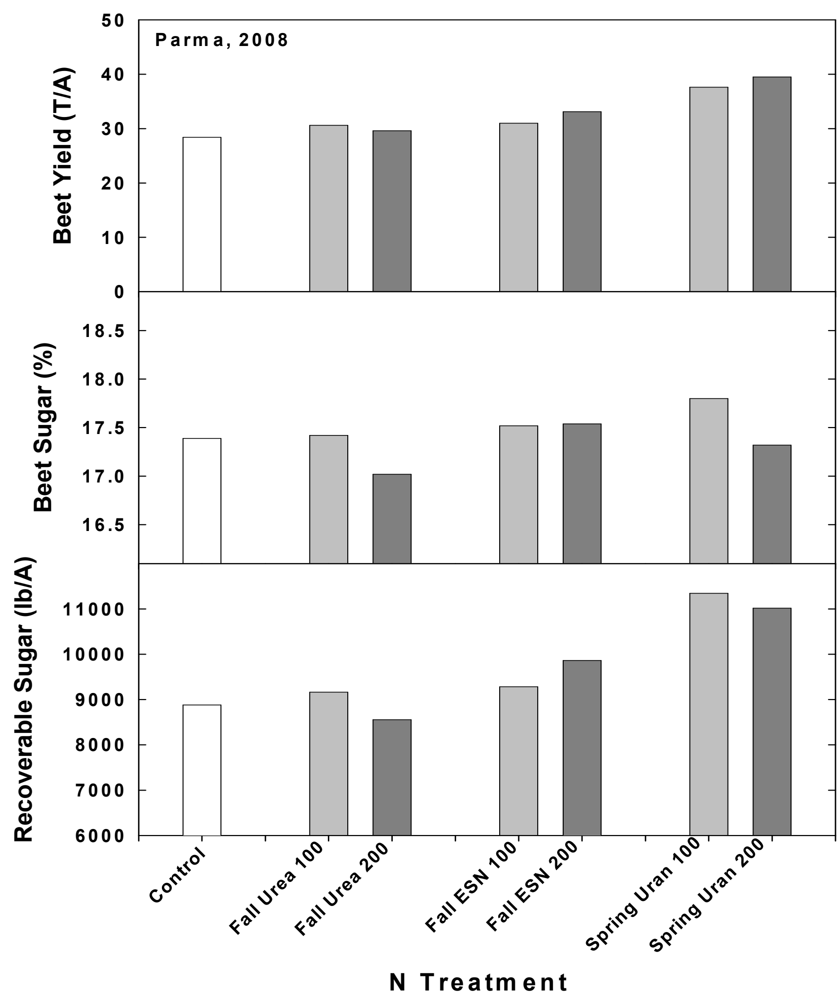


**Figure 2. Sugarbeet yield, percent sugar, and recoverable sugar as affected by fall preplant urea or preplant ESN N relative to conventional spring side-dressed URAN N.**

# CLINOPTILOLITE ZEOLITE INFLUENCE ON INORGANIC NITROGEN IN SILT LOAM AND SANDY SOILS

***By David Tarkalson and Jim Ippolito—USDA ARS***

Development of best management practices can help improve inorganic nitrogen (N) availability to plants and reduce nitrate-nitrogen ($NO_3$-N) leaching in soils. This study was conducted to determine the influence of the zeolite mineral Clinoptilolite (CL) additions on $NO_3$-N and ammonium-nitrogen ($NH_4$-N) in the soil/leachate system of two common Pacific Northwest soils (Portneuf silt loam and Wolverine sand).

Clinoptilolite was obtained from the Zeocorp LLC owned mine located in Hines, OR. Treatments for the Portneuf soil consisted of four CL rates (0, 6.7, 13.4, and 20.1 Mg $ha^{-1}$) and two application methods (incorporated and band). Treatments for the Wolverine soil consisted of four CL rates (0, 6.7, 13.4, 20.2, and 26.9 Mg $ha^{-1}$) and the two application methods. For each soil type, all CL rate treatments received a nitrogen fertilizer application rate of 224 kg N $ha^{-1}$ as urea (46% N) on an area basis. Water was applied to all columns on a weekly basis. The total water applied over the duration of the study for both soil types was 11.3 inches. Leachate from each event was collected and analyzed for $NO_3$-N and $NH_4$-N. At the end of the study, soil from each column was analyzed for $NO_3$-N and $NH_4$-N.

In both soils, the band N application retained available inorganic N ($NO_3$-N and $NH_4$-N) in the soil/leachate system compared to incorporation. In the Portneuf soil, there was no effect of CL application rate (including the control) on the $NO_3$-N and $NH_4$-N in the leachate and soil; band N application resulted in 48% greater inorganic N in the soil/leachate system compared to when it was incorporated.

In the Wolverine soil, band CL application at all rates conserved available inorganic N in the soil/leachate system compared to the control. For the band treatment, inorganic N in the soil/leachate system was 26% greater when CL was banded at all rates compared to the control; this was not the case when CL and N were incorporated. Band applying N fertilizer appears to conserve available inorganic N in the soil compared to incorporation possibly due to decreased rates of microbial immobilization, nitrification and denitrification. In sandy soils, application of CL at a rate as low as 6.7 Mg $ha^{-1}$ can help retain available inorganic N in the soil system.

*For more information, contact David Tarkalson at 208-423-6503, or david.tarkalson@ars.usda.gov.*

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*"In sandy soils, application of CL at a rate as low as 6.7 Mg $ha^{-1}$ can help retain available inorganic N in the soil system."*

# Back to Basics—Cover Crops

**By Marlon Winger—USDA NRCS**

*A cover crop is a crop that is not harvested or generally grazed, but is grown to benefit the soil and/or other crops in numerous ways.* Cover crops function by: reducing erosion from wind and water; sequestering carbon in plant biomass and soils to increase soil organic matter content; capturing and recycling excess nutrients in the soil profile; promoting biological nitrogen fixation; increasing soil biodiversity; weed and pest suppression; providing supplemental forage; soil moisture management; reducing particulate emissions into the atmosphere; minimizing and reducing soil compaction.

Cover crops are grown during or between primary cropping seasons. Legume cover crops fix atmospheric nitrogen into a form plants and microorganisms can use (table 1), while non-legume cover crops recycle existing soil nitrogen and can reduce the risk of excess nitrogen leaching into ground water (table 2). Specific strains of rhizobium provide optimum nitrogen production for each group of leguminous cover crops. As recommended by Stephen Guy, WSU extension agronomist, if a field has not had a similar crop within 4 years, it could pay to inoculate with Rhizobium. Rhizobium is purchased by type or legume group. If seed is not inoculated when purchased, coat the seed with condensed milk, weak sugar water or a commercial sticking agent to help the Rhizobium bacteria to stick to the seeds. Table 1 lists several legume cover crops and associated agronomic data including Rhizobium Inoculant type.

Researchers in Michigan have adopted an over-seeding cover cropping system with corn that includes a 10-inch band herbicide treatment followed by two cultivations. Cover crops are over-seeded during the second corn cultivation. Several cover crop species have been successfully established this way, including crimson clover, mammoth red clover, annual ryegrass, hairy vetch and a 60 percent red clover/40 percent sweet clover mixture. Timing is critical to successfully establish a cover crop by overseeding. It is extremely important to seed when there is enough light to germinate and establish the cover crop, yet late enough so it will not compete with the corn crop for water, nutrients or light. Other methods use cover crops by seeding cover crops aerially or with highboys applicators. These seedlings can begin when the corn crop begins drying. As the plant dies, sunlight penetrates to the soil, allowing cover crops to germinate and establish. Generally the nitrogen will not be available to the crop until it is killed and the residue starts to decompose or it is incorporated into the soil.

The effectiveness of cover cropping hinges on a few key factors. First, the cover must be seeded as soon as possible after the preceding crop because growing degree days are the most limiting factor for fall cover crop growth. This is especially important for Sudan grass. Ce-

**Table 1. Legume cover crop species with associated agronomic data.**

| Cover Crop Species | Life Cycle | Potential Fixed Nitrogen | Seeding Rate | Seeding Depth | Rhizobium Inoculant Type |
|---|---|---|---|---|---|
| **Legumes** | | **(lbs/A)** | **(lbs/A)** | **(inches)** | |
| Annual medic* | SA | 40-100 | 10-40 | 1/4 to1/2 | A |
| Berseem clover* | SA | 60-90 | 9-20 | 1/4 to1/2 | R |
| Crimson clover* | SA | 50-60 | 12-20 | 1/4 to1/2 | R |
| Austrian peas | SA / WA | 30-100 | 70-150 | 1 to 2 | C |
| Hairy vetch | WA | 60-180 | 25-40 | 1/4 to1/2 | C |
| Mammoth red clover | B | 60-70 | 8-15 | 1/4 to1/2 | B |
| Sweetclover (yellow) | B | 70-90 | 8-15 | 1/4 to1/2 | A |
| Alfalfa | P | 50-150 | 9-25 | 1/4 to1/2 | A |
| White clover | P | 60-100 | 5-7 | 1/4 to1/2 | B |
| Medium red clover | P | 60-70 | 10-15 | 1/4 to1/2 | B |
| Alsike clover | P | 60-70 | 4-10 | 1/4 to1/2 | B |

*Cover crops currently not commonly used in Idaho
Life cycles: P = perennial, WA = winter annual, SA = summer annual, B = biennial
Nitrogen values vary depending on cover crop densities (biomass produced) and date of planting

***Continued on page 7***

## *Fall nitrogen applications, continued from pg. 1*

process of nitrification, creating negatively charged nitrate anions that will freely leach through the soil system. While nitrification does occur at a slower pace during the winter compared to warmer months, it does still occur.

One factor that is overlooked is the immobilization of nitrogen fertilizers that are applied in early fall following crops such as wheat and barley that leave behind residues with high carbon to nitrogen ratios (C:N). Delaying nitrogen applications until spring will decrease the amount of N lost to immobilization.

Losses of nitrogen are costly, both financially and environmentally. Preplant nitrogen rates have a major impact on crop yield and quality. Nitrogen losses can significantly lower yields, thus lowering a grower's financial return from that field. Growers can easily apply the same amount of nitrogen fertilizer in the spring and achieve greater yields than from fall applications.

In addition to yield losses, practices such as fall applications of nitrogen fertilizers may be contributing to degradation of water quality in agricultural regions in southern Idaho. Urban areas that rely heavily on groundwater wells and are surrounded by agricultural areas are at the highest risk. In fact, Twin Falls and Ada/Canyon areas are at the top of the Idaho Department of Environmental Quality (DEQ) 2008 nitrate priority area list. For more information on nitrates and Idaho water quality, refer to the Idaho DEQ web link "Ground Water in Idaho: Degraded Water: Nitrate" at http://www.deq.state.id.us/water/prog_issues/ground_water/nitrate.cfm If you have no choice but to apply N fertilizers in the fall, apply in November instead of September or October, as the warm early fall temperatures will significantly increase nitrate losses compared to late fall. However, your best option is still to take a closer look at your nutrient management program and determine how to eliminate he winter time lag between nitrogen fertilizer applications and planting. *For more information contact Amber Moore: (208) 736-3629, or amberm@uidaho.edu*

## *Fall nitrogen and sugar beets, continued from pg. 2*

N (first foot) on April 10 was higher for fall applied urea than for fall applied ESN (54.4 ppm vs 38.2 ppm) but fall N sources did not differ appreciably in soil test $NH_4$–N (36.2 vs 34.6 ppm).

Beet stands were reduced 28% with fall applied urea at the 200 lb rate. Petiole nitrates from mid-July to late August were higher for the spring split applied URAN than for either of the fall applied N sources. For both fall applied ESN and spring split applied URAN, yields were highest at the 200 lb rate. For fall applied urea N, the 100 and 200 lb N rates yield did not differ significantly, presumably because the 200 rate significantly reduced the stand. Spring split applied URAN was clearly the most productive of all N sources.

Percent sugar was relatively high for western Idaho and was lower at the 200 than the 100 lb N rate for both fall applied urea and spring sidedressed URAN, but not for ESN. Brei nitrates were highest and percent sugar was lowest for fall applied urea compared to other N treatments. *Total recoverable sugar was greatest for spring sidedressed URAN primarily due to higher yields.*

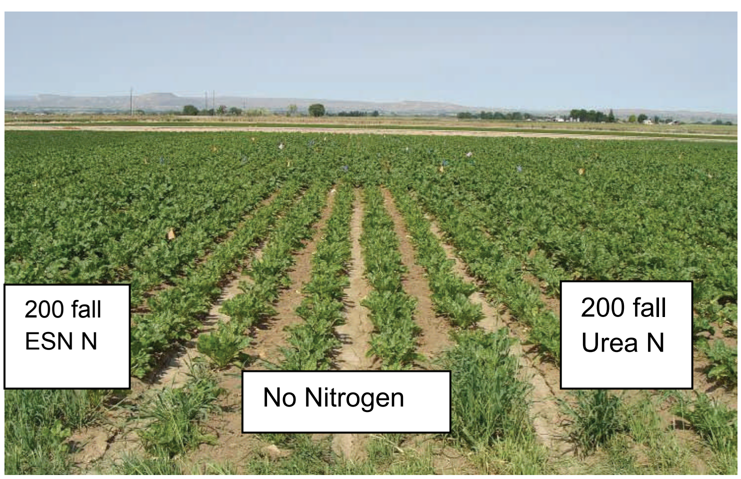


**Figure 1. Sugarbeets without N (forecenter) flanked by 200 lb N/A as either fall applied ESN (left) or urea (right).**

In summary, fall broadcast urea N or slow release N did not compare favorably to conventional split spring URAN sidedressings. Growth of sugar beet tops (leaves) was consistently better, from early July to the end of the season, with the sidedressings.
*For more information, contact Brad Brown at 208-722-6701, or bradb@uidaho.edu.*

Quiz answers—1.d, 2.c, 3.d, 4.d, 5.d, 6.a, 7.F

## *Peas, triticale, and cover crops, continued from pg. 1*

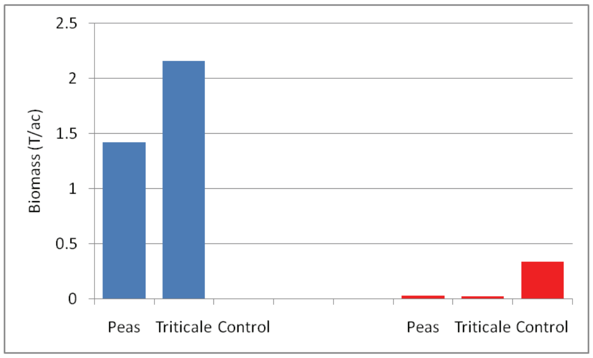


**Figure 2. Crop biomass (blue) and weed biomass (red) sampled prior to plow down. Different letters within a crop type indicate statistically significant differences.**

(Figure 1). Mean crop biomass production, measured just before plow down, was significantly greater for triticale (2.16 T/ac) than for pea (1.42 T/ac) (Figure 2). Greater biomass production by triticale suggests that this crop would be better at protecting the soil against erosion. Weed biomass in the pea and triticale treatments was similar at 0.032 and 0.021 T/ac, respectively (Figure 2). Weed biomass in the untreated control was approximately ten times greater than that measured in the pea and triticale treatments (Figure 1). In the eight replications, three of the pea plots and five of the triticale plots sampled had no weeds (Figure 3).

Although the pea treatments did not produce as much biomass as did triticale, the total amount of nitrogen in the biomass was greater. Prior to plow down, biomass nitrogen in the pea treatments was 91.9 lbs N/ac compared to 66.2 lbs N/ac for triticale. Historically, when peas are incorporated as green manure, they are plowed in soon after they bloom. Due to time constraints and the need to plant spring vegetable crops in the field, peas in this study were incorporated before bloom. Our estimate of biomass nitrogen for the peas, therefore, is likely lower than the typical value.

The ratio of carbon to nitrogen (C:N) in plant biomass is often used to predict the rate of nitrogen mineralization from crop residues. The mean C:N ratio of triticale biomass as measured in early summer was higher than that of pea biomass (13:1) indicating that nitrogen tied up in the plowed down triticale residue would likely take longer to mineralize and may result in short-term nitrogen immobilization. Immobilization could result in nitrogen deficiency in spring crops that are seeded immediately following incorporation of the cover crop.

Furthermore, it should be kept in mind that the peas are introducing new nitrogen from the atmosphere into the soil through nitrogen fixation while the triticale is recycling nitrogen from deeper layers in the soil. Triticale, therefore, may be a useful crop for trapping excess nitrogen that would normally be lost through leaching, while peas can be used to actually increase the total amount of nitrogen in a soil. Soil test data taken a week after plow down showed that plant available nitrogen (ammonium + nitrate) was significantly greater in the pea (9.1 ppm) and untreated control (9.4 ppm) treatments compared to triticale (5.1ppm). The data indicate that triticale depleted the soil of nitrogen through plant uptake and/or that nitrogen immobilization was occurring immediately after plow down.

Overall, Austrian winter peas and winter triticale both show promise as cover crops. Both grew well and effectively suppressed weeds despite cold conditions and a late planting date. Although triticale produced the most biomass, the pea treatments resulted in more biomass nitrogen being returned to the soil. While our study suggests that Austrian winter pea is the better crop in terms of enhancing soil fertility, triticale may be useful as a catch crop to remove and recycle nitrogen that would otherwise be leached out of the soil profile.

*For more information, contact Jodi Johnson-Maynard at (208) 885-9590, or jmaynard@uidaho.edu.*

**Figure 3. Plots planted to Austrian winter pea (left), triticale (far, back right) and the untreated control (front right) prior to plow down. Biomass in the untreated control is from weed growth.**

Test your knowledge

# Nutrient Management Quiz

1. Assume a ton of poultry litter contains ten pounds of nitrogen. How much litter is needed to contain the total nitrogen in 200 pounds of a 20-0-0 fertilizer?
a. One ton
b. Two tons
c. Three tons
d. Four tons

2. One ton of 16-8-8 fertilizer contains
a. 160 pounds N, 80 pounds P, 80 pounds K.
b. 16 pounds N, 8 pounds P, 8 pounds K.
c. 320 pounds N, 160 pounds P as phosphoric acid, 160 pounds K as potash.
d. 320 pounds N as nitrates, 160 pounds P as phosphoric acid, 160 pounds K as potash.

3. One of the following is a description of a soil that may not be able to supply enough phosphorus to a young plant. Which soil is it?
a. A soil with a pH of 6.5
b. A soil with a low cation exchange capacity
c. A soil with many mycorrhizae
d. A cold, wet soil

4. Which cropping system causes the most rapid loss of organic matter?
a. Corn-oats-alfalfa-alfalfa rotation
b. Double crop winter wheat-beans
c. Pasture
d. Annual corn

5. The opposite of immobilization is
a. nitrification.
b. fixation.
c. mobilization.
d. mineralization.

6. Which form of nitrogen is absorbed by plant roots?
a. Nitrate nitrogen – $NO_3$
b. Nitrogen gas – $N_2$
c. Protein molecules containing nitrogen
d. Nitrogen in organic matter

7. True or False— Trace elements are less necessary for plant growth than primary elements.

ANSWERS, PAGE 5

## *Cover crop basics, continued from pg. 4*

**Table 2. Non Legume cover crop species with associated agronomic data.**

| Species | Life Cycle | Seeding Rate (lbs/A) | Seeding Depth (inches) |
|---|---|---|---|
| Buckwheat* | SA | 35-60 | 1/4 to1/2 |
| Forage turnips | SA | 3-5 | 1/4 to1/2 |
| Forage radish | SA | 10-15 | 1/4 to1/2 |
| Oilseed radish | SA | 25 | 1/4 to1/2 |
| Mustards (White) | SA | 15 | 1/4 to1/2 |
| Mustards (Oriental) | SA | 10 | 1/4 to1/2 |
| Canola / Rape | SA/WA | 15 | 1/4 to1/2 |
| Annual ryegrass | SA | 15-25 | 1/4 to1/2 |
| Barley | SA / WA | 50-100 | 1 to 2 |
| Rye | SA / WA | 50-100 | 1 to 2 |
| Triticale | SA / WA | 50-100 | 1 to 2 |
| Wheat | SA / WA | 50-100 | 1 to 2 |
| Oats | SA | 35-70 | 1 to 2 |
| Sudangrass | SA | 20-60 | 1 to 2 |

*Cover crops currently not commonly used in Idaho
Life cycles: WA = winter annual, SA = summer annual

real rye, triticale and turnips are among the most tolerant and fast growing in the cool fall temperatures. For example, turnips will continue to grow below freezing down to 10 degrees Fahrenheit. Second, incorporation of the cover crop should be delayed until spring. Spring incorporation allows overwintered cover to continue nitrogen capture up until incorporation and prevents loss of nitrogen caused by fall-winter decomposition of the cover crop. Lastly, producers should be aware of the economic benefit of fall cover cropping. The ability to capture as much as 100 lbs N/acre can translate into a fertilizer savings worth roughly $50/acre for the following cash crop. *For more information, contact Marlon Winger at (208) 378-5730, or marlon.winger@id.usda.gov*

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## Upcoming Events and Contact Information

### Nutrient Digest Newsletter Contact Information:

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### UPCOMING EVENTS

**Sept. 15-18—"Lost Rivers Grazing Academy"** Salmon, Idaho. Call Chad Cheyney at 527-8587 for more info.