University of Idaho Extension

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CASE STUDY—PIVOT IRRIGATION EFFECTS ON NITROGEN MINERALIZAION IN A LOW-NUTRIENT SOIL

By Brad Brown

On the right is a photo of pivot irrigated winter wheat grown in the Treasure Valley region of Idaho in May 2009. At first glance, one may assume the alternating pattern of dark and light green wheat leaves to be caused by poorly overlapping fertilizer fan spreader strips. Not so. No application of fertilizers, lagoon waters, pesticides, or anything but groundwater were applied through the pivot or through any other method for the last three years. Excluding watering, all cultivation, planting, harvesting, and other operations were conducted in a straight lines across the field.

Concentric streaks or rings in this field likely reflect systemic differences in water application between each

Pivot irrigated winter wheat field in May, 2009. This field has not received an application of nutrients since biosolids were applied in 2005.

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CHALLENGES IN PROVIDING SUFFICIENT NITROGEN TO ORGANIC POTATOES

By Amber Moore and Nora Olsen

A major challenge for Idaho organic potato growers is finding sources of effective local sources of plant available nitrogen (N). Dairy manure is by far the most accessible nutrient source in Idaho, and is commonly used by organic growers in its composted form. In 2008, Amber Moore and Nora Olsen of the University of Idaho evaluated dairy manure applications and other nutrient management methods used by established organic potato growers in Southern Idaho. For the third year of transition to organic production, fresh dairy manure (2.7 %N) and composted dairy manure (0.8 %N) were spring-applied preplant to Russet Burbanks at rates of 50 and 100 lb total N/acre (2 and 4 ton manure / acre; 3 and 6 ton compost /acre) following alfalfa in Kimberly, Idaho. Selected plots also received Agrolizer (6-2-0), an enzymatically digested fish emulsion, at a rate of 10 lb N/acre per application for three application events over the growing season. The fish emulsion was selected as a potential source of in-season N to support tuber initiation and bulking.

Additions of manure, compost, and fish emulsion had no significant impact on tuber yield, grade, size, quality, or petiole nitrate concentrations over control plots receiving no applications of nutrient amendments, suggesting that the nutrient sources and rates used in the study did not increase concentrations of plant available nitrogen in the soil enough to improve tuber growth. Average yield

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UNIVERSITY FERTILIZER RECOMMENDATIONS MADE SIMPLE

By Amber Moore and Anna Carey

There are several entities that provide recommendations for nutrient applications based on soil and/or tissue test results, including land-grant universities, private soil and tissue testing labs, commodity agronomists, fertilizer companies, and field consultants. There are advantages to each of these recommendation sources. Some of the benefits of land-grant university recommendations include:

1) Government sponsored programs, such as the EQIP conservation program, require growers to use university fertilizer recommendations based on soil test results in order to receive continued funding.
2) University fertilizer guides are required to go through an extensive peer-review process before they can be published and released to the public. Reviewers are considered experts in their field, and include colleagues from within the university, neighboring universities, and government agencies.
3) Information included in university fertilizer guides is generally based on replicated research trials conducted under varying environmental and management conditions.
4) In addition to recommendation rates based on soil test values, university fertilizer guides also typically include information on application timing, fertilizer incorporation, environmental risks, human and animal health risks, role of the nutrient in the plant, non-limiting nutrient status in the soil, preferred nutrient sources, manure nutrient release potential, crop rotations, conservation tillage, organic production, and plant tissue analysis, allowing the grower to make independent and informed decisions about nutrient management for their crop.
5) Specialists from universities are obligated to serve an audience that includes growers, producers,

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PHOSPHORUS LEACHING DIFFERS IN DAIRY MANURES

Reprint from ARS News Service article, authored by Ann Perry

Agricultural Research Service (ARS) scientists have found that solid dairy manure is better than commercial fertilizer in mitigating the amount of phosphorus that can accumulate in water percolating through the soil. But using liquid dairy manure can make it worse.

These findings could help farmers in the semiarid western United States protect local watersheds from agricultural pollutants. Idaho is now the second-largest milk producer in the western United States, and farmers there are using substantial amounts of dairy manure for fertilizing irrigated crop fields. Phosphorus can fuel the excessive growth of algae and other plant matter in freshwater ecosystems.

ARS soil scientists David Tarkalson and April Leytem used manure they obtained from two dairy farms in Idaho to study phosphorus leaching in the fine sandy loam soils typically found in the region. In laboratory tests they amended 24 soil columns with either liquid dairy manure, solid dairy manure or monoammonium phosphate (MAP), a commercial fertilizer.

Then the researchers "irrigated" the soil columns 13 times over nine weeks and collected the leachate-the liquid that drained out of the soil, carrying substances picked up along the way-from each irrigation event. The leachate was analyzed for total organic carbon and total phosphorus. After the irrigation testing, they also analyzed the soil in each column for phosphorus, carbon, calcium, iron and manganese.

Tarkalson and Leytem found that the largest quantities of phosphorus moved through soils that had been amended with liquid manure. They also found that the phosphorus in MAP was more mobile in the soil than phosphorus in the solid manures.

The scientists also observed that liquid manure and solid manure differed significantly in their carbon compound makeup, which may contribute to the resulting variations in the manure leachates. Other factors may also play a part in the dynamics of phosphorus leaching, including microbial activity and metal content in the soil and the ability of clay particles in the soil to attract and hold onto phosphorus.

Fertilizer recommendations, continued from pg. 2

environmental agencies, health organizations, and the Idaho community as a whole.

Unfortunately, people often do not know where to find university recommendations, and admittedly, such information is not always easily accessible. To help with this issue, we have compiled a list of fertilizer recommendations from the University of Idaho and surrounding universities, addressing crops commonly grown in Southern Idaho.

For more information contact Amber Moore: (208) 736-3629, or amberm@uidaho.edu

Sources for university fertilizer recommendation guides, addressing crops grown in Southern Idaho.

Crop	Publisher	Publication title	Website
Alfalfa	University of Idaho	Southern Idaho Fertilizer: Irrigated Alfalfa- CIS1102	http://info.ag.uidaho.edu/pdf/CIS/CIS1102.pdf
	University of Idaho, Oregon & Washington	Nutrient Management Guide for Dryland and Irrigated Alfalfa in the Inland Northwest- PNW0611	http://cru.cahe.wsu.edu/CEPublications/PNW0611/PNW0611.pdf
Barley (winter)	University of Idaho	Southern Idaho Fertilizer Guide: Irrigated Winter Barley-CIS1082	http://info.ag.uidaho.edu/Resources/PDFs/CIS1082.pdf
Corn (grain and silage)	Oregon State University	Field corn eastern Oregon—east of Cascades	http://extension.oregonstate.edu/catalog/html/fg/fg71-e/
	University of Idaho	Idaho Fertilizer Guide: Irrigated Field Corn for Silage or Grain- CIS 372	Not available electronically, Call University of Idaho CALS publications at (208) 885-7982 or email: calspubs@uidaho.edu to order
Mint	Oregon State University	Peppermint and Spearmint -East of Cascades Fertilizer Guide	http://extension.oregonstate.edu/catalog/pdf/fg/fg69-e.pdf
Onions	University of Idaho	Southern Idaho Fertilizer Guide: Onions-CIS 1081	http://info.ag.uidaho.edu/resources/PDFs/CIS1081.pdf
Pasture	University of Idaho	Irrigated Pastures- CIS0392	http://info.ag.uidaho.edu/pdf/CIS/CIS0392.pdf
Potato	University of Idaho	Nutrient management guidelines for Russet Burbank potatoes - BUL 840	http://info.ag.uidaho.edu/pdf/BUL/BUL0840.pdf
	University of Idaho	Western Regional & Tri-State Potato Variety Trial Reports	http://www.ag.uidaho.edu/potato/VarietyInfo.htm - then click on Agronomy Notes for each variety
Sugarbeet	University of Idaho	Revised University Of Idaho Fertility Guidelines For Sugarbeets	http://www.uiweb.uidaho.edu/sugarbeet/slsfrt/gallian1.htm
Wheat (spring)	University of Idaho	Southern Idaho Fertilizer Guide: Irrigated Spring Wheat- CIS 0828	http://info.ag.uidaho.edu/pdf/CIS/CIS0828.pdf
Wheat (winter)	University of Idaho	Southern Idaho Fertilizer Guide: Irrigated Winter Wheat- CIS 0373	http://info.ag.uidaho.edu/pdf/CIS/CIS0373.pdf

BACK TO BASICS—NITROGEN AND PHOSPHORUS DEFICIENCIES IN CORN

By Steve Hines

With the dairy industry in the Magic Valley, corn grown for silage has become a major crop. Corn is one of the most nutrient requiring crops we grow in this area. High amounts of nitrogen (N) are needed for maximum yield. Nitrogen deficiencies can be seen as a light green (chlorotic) young plants, and light green larger plants with yellow color in lower leaves that extends from the tips down and along the leaf midrib, as well as firing, dropping the lower leaves, as the plant translocates nitrogen to newer tissue. Corn uses nitrogen rapidly from about 25 days after emergence until grain fill.

To prevent N deficiencies, apply N both as preplant and during the growing, season N uptake by corn is the greatest. Nitrogen can be applied in-season by side dress or through fertigation. Side dressing must be timed to prevent plant damage and root pruning. All of the required nitrogen can be broadcasted at pre-plant, but there is likely to be some loss through leaching or volatilization depending on field management, water management, and soil conditions. Soil tests for N should be taken every year and N applications should be based on the soil test and yield goals. Other considerations include previous crop and residue management. Also, fresh and composted dairy manure will not meet N requirements without applying excess phosphorus.

Phosphorus (P) is also a nutrient essential for plant growth and development in corn. Non-manured soils in the Magic Valley typically do not have adequate P to support optimal growth potential. Phosphorus supports strong root and shoot development and is necessary for energy storage and transfer within the plant. Phosphorus also promotes early maturity. A P deficiency will appear usually in young corn plants from May through early June. The lower leaves of the plant will appear purple at the tips and the purple color will follow the margins until the entire leaf is purple. Eventually, the lower leaves may die if the deficiency is severe. The upper (newer) leaves appear green and healthy as the plant translocates the P from older to newer tissue. Stunting also occurs and may be evident throughout the season.

Left photo—P deficient corn.
Right photo—Corn stressed by cold temperatures

Many studies have been conducted across the country and corn will show response to P applications more frequently if the soil is below 12 ppm (Olsen P). As P concentration increases beyond 12 ppm, yield response is less likely. If needed, P should be applied before or during planting. Banded applications near seed can be more effective than broadcast P. Starter placement with seed is also an option as long as other fertilizers are not phytotoxic.

In addition to low concentrations of P in the soil, P deficiency symptoms can also be caused by any condition that inhibits plant growth. For example, P deficiency symptoms can also be caused by some damage to the plant or root, such as root pruning due to a poor side dressing application. Since P is relatively immobile in the soil, the roots must either grow to reach new P sources in the soil or take up P that slowly diffuses through soil water to the root surface. Colder soil temperatures also slow P diffusion. In the Magic Valley, one of the major triggers is a cold snap followed by a warming trend. The upper plant grows faster than the roots can absorb P, and the tell-tale purple leaves appear. I have seen entire fields of corn turn purple after a cold snap, although the plants were eventually able to recover. Generally, when this cold condition happens, it has more to do with sugar accumulation disruption in the plant than with an actual deficiency. The message here is, just because the plant has purple leaves, doesn't mean the soil is P deficient. Also, some corn variety genetics will exhibit more purpling than others.

For more information on corn and nutrient deficiencies, contact Steve Hines: (208) 734-9590, or shines@uidaho.edu

2009 WESTERN ODOR AND AIR QUALITY EDUCATION PROGRAM, AVAILABLE ON THE INTERNET

By Mario de Haro Marti and Mireille Chahine

On May 19 to 21, 2009 the Western Odor and Air Quality Education Program was offered in Idaho. This program was developed by researchers and educators from USA universities and funded by a Western Sustainable Agriculture, Research and Education (WSARE) grant. The education program consists of a series of workshops to be offered in western states plus a web page that includes all presented lessons and will contain future webinars on related topics.

The objective of the program was to educate the target audience on pertinent air quality issues in the region and the Best Management Practices (BMP) available to livestock producers to mitigate the impact of their operations and to offer science-based information regarding applicable air quality measurement techniques and educate the audience regarding applicable laws nationally and in Idaho.

Mario E. de Haro Marti, University of Idaho Gooding County Extension Educator hosted the program in Idaho. In addition to the 1.5 days SARE program another 1.5 days were added that included local presenters from US Environmental Protection Agency (EPA), Idaho Department of Agriculture (ISDA) and Department of Environmental Quality (IDEQ), plus visits to a local dairy farm and manure composting facility. The program brought together some of the best specialists in agricultural air quality around USA universities and local presenters specialized in agricultural topics.

A total of ***Continued on page 7***

Organic potatoes, continued from pg. 1

over all treatments was 276 cwt./acre, much lower than the 400-500 cwt./acre tuber yields that are typically seen at this location for conventional potatoes. Tuber quality was also compromised for the organic potatoes, with an average of 27% of tubers harvested falling into the U.S. #2 category. While modest applications of dairy compost and fish emulsion may provide enough nutrients for Russet Burbanks grown on established organic fields that have had several years to build up nutrient reserves in the soil, growers who are transitioning from conventional to organic will need to work with larger quantities of materials rich in nitrogen to improve yield and quality of the crop while continuing to build nutrient reserves with compost applications and alfalfa crop rotations.

To address nitrogen deficiencies issues from 2008, Olsen and Moore will fertilize Russet Burbanks in 2009 with dried distillers grains (an organically approved waste product from ethanol production with 4.3 %N), Chilean nitrate (16 %N), and fresh manure applied at twice the rate that was used in 2008. These 2009 trials will be part of a systems approach evaluating organic potato production at the UI Kimberly R & E Center.

For more information contact Amber Moore: (208) 736-3629, or amberm@uidaho.edu or Nora Olsen: (208) 736-3621 or norao@uidaho,edu

Above: **Russet Burbank from a typical plot in our organic transition research study on August 26, 2008.**

Below: **Conventional Russet Burbanks on August 26, 2008, planted at the same time as the organic potatoes, under same irrigation, same soil type, same climate, same watering schedule, and same planting method.**

Pivot irrigation case study , continued from pg. 1

nozzle. Soil below the nozzle is wetter than between the nozzles. The lighter colored ring of winter wheat is centered below the nozzle. Variable water applied along the pivot has apparently resulted in considerable difference in nutrient removal and residual fertility.

The field has not received any fertilizer for several years since receiving an application of biosolids four years prior. The symptoms of variable nutrient deficiencies were not evident in corn grown for silage the last three years. What has caused the lighter colored and stunted wheat below the nozzles? Why are the rings evident now but not in the previous corn crop?

It is possible that the higher moisture content beneath the nozzles stimulated the nitrogen mineralization process at a higher rate than between the nozzles for the first three years after the application of biosolids, leaving little N available in the fourth year in comparison the dryer areas between the nozzles. Or, the majority of the water landed between the nozzles instead of beneath them, increasing the N mineralization rates between the nozzle in the spring of the fourth year after application. Unlike corn, wheat develops during the coolest part of the year, when soil biological activity is lowest and nutrient cycling is greatly reduced. Crops depending exclusively on nutrient cycling from biosolids (or other organic amendments) will be more sensitive to marginal nutrient conditions when growing under colder soil conditions.

Soil test available N in composite samples of the field collected to two feet across the pivot measured well over 200 lb N per acre in December, with most of it located below the first 8 inches. Composite soil test phosphorus (P) in December measured a relatively high 77 ppm in the first 8 inches of the composite sample, but potassium (K) was only 95 ppm, relatively low. The soil test results for the composite sampling would not reflect any differences within the field due to previous variable water application between nozzles. Since the rings were not evident until much later, there was no reason to sample differently.

Also, this growers were relying on N mineralization estimates for the fourth year after applied biosolids were for the whole growing season. However, winter wheat maturing in June would utilize only a fraction of the predicted annual release of N (and other nutrients) from these biosolids, which could mislead a grower as to how much N would be available when it was needed most by the crop.

Whole plant tissue N measured 4.8% in the good and 4.1% in the lighter area. A substantial difference, but both N concentrations are within adequacy levels for the growth stage. Total sulfur (S) in the tissue measured 0.31% in the greener wheat and 0.20% in the lighter colored wheat, again a substantial difference, reflecting different residual S from the watering pattern. The ratio of N to S has been useful for diagnosing shortages of S. The ratios were 15.5 in the greener wheat and 20.1 in the lighter wheat. Values above 19 may indicate too little S for the N present. Phosphorus was adequate in the tissue. The tissue K was low in both wheat strips, but K was lowest in the greener wheat (1.19% vs 1.73%) possibly due to greater biomass dilution with higher N, S, or both. The lower concentrations of N and S and the higher concentrations of K in the lighter green areas of the field may be due to one or a number of combinations of factors. In fact, the concentric rings occur to varying degrees in several pivot irrigated wheat fields at this operation, and the cause may differ for each field.

Several lessons are provided by this example.

- Composite soil samples can mask huge systematic differences in available nutrients within fields.
- Sprinkler systems do not guarantee uniform water applications, check nozzles and water application uniformity between nozzles.
- Variable water applications over time affect nutrient removal and residual fertility
- Soil moisture appreciably affect nutrient cycling and availability to plants.
- N mineralization estimates should consider the growing conditions for specific crops.

For more information and speculation on this case, contact Brad Brown at 208-722-6701, or bradb@uidaho.edu.

Reader's Corner

Introducing new extension publications in nutrient management

University of Idaho

- **Southern Idaho Fertilizer Guide: Irrigated Pastures** 2009 CIS 392 http://info.ag.uidaho.edu/pdf/CIS/CIS0392.pdf
- **Dairy Manure Field Applications: How Much is Too Much?** 2009 CIS 1156 http://info.ag.uidaho.edu/pdf/CIS/CIS1156.pdf
- **Mitigating High-Phosphorus Soils** 2008 BUL 85.1 http://info.ag.uidaho.edu/pdf/BUL/BUL0851.pdf

Oregon State University

- **Estimating Plant-available Nitrogen from Manure** 2008 EM 8954-E http://extension.oregonstate.edu/catalog/pdf/em/em8954-e.pdf

Washington State University

- **Organic Alfalfa Management Guide** 2009 EB 2039E http://csanr.wsu.edu/Publications/FarmMgmtEconomics.htm
- **Irrigated Spring and Winter Canola Production in Washington** 2009 EM006E http://cru.cahe.wsu.edu/CEPublications/EM006e/em006e.pdf

Pacific Northwest Joint Publications (Washington, Oregon, and Idaho)

- **Nutrient Management Guide: Dryland and Irrigated Alfalfa in Inland Washington-Oregon-Idaho** 2009 PNW 611 http://cru.cahe.wsu.edu/CEPublications/PNW0611/PNW0611.pdf

Montana State University

- **From Conventional to Organic Cropping: What to Expect During the Transition Years** 2009 MT200901AG http://msuextension.org/publications/AgandNaturalResources/MT200901AG.pdf
- **Nutrient Management in No-till and Minimum Till Systems** 2008 EB0182 http://msuextension.org/publications/AgandNaturalResources/EB0182.pdf
- **Camelina Production in Montana** 2008 MT200701AG http://msuextension.org/publications/AgandNaturalResources/MT200701AG.pdf
- **Soil Sampling Strategies** 2008 MT200803AG http://msuextension.org/publications/AgandNaturalResources/

Air quality education, continued from pg. 5

38 participants attended these three days educational event. Dairy producers, educators, county commissioners, county Planning & Zoning officials, ISDA, IDEQ, NRCS officials, nutrient management planners, and dairy service companies were among the attendees.

The SARE program addressed the following topics: Odor Measurement Techniques - Odor Mitigation Strategies (BMPs) - Ammonia Measurement Techniques - Ammonia Mitigation Strategies (BMPs) - Particulate Measurement Techniques - Particulate Mitigation Strategies (BMPs) - Hydrogen Sulfide Measurements and BMPs - Federal and Regional Air Quality Legislations - Volatile Organic Compounds (VOCs) Measurements - VOCs Mitigation Strategies (BMPs) - Dietary changes for air quality: Overview - Greenhouse Gases and Carbon Credits.

Local presentations included: IDEQ Odor rule and ID rules on air Quality &CAFO - ISDA Air Quality and CAFO regulations in ID and CAFO permits - USEPA NPDES appOlication to agriculture and other air quality federal rules applicable to CAFO in Idaho - ISDA Comprehensive Nutrient Management Planning.

All the SARE Western Odor and Air Quality Education Program presentations can be accessed on the internet at: http://bsyse.wsu.edu/ndegwa/main/WOAQ/WOAQhome.html

For more information contact Mario de Haro Marti at 208-934-4417, or mdeharo@uidaho.edu

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Upcoming Events and Contact Information

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University of Idaho

UPCOMING EVENTS

June 10th-Native Plant, Hardy Rose, and Turf Field Day. Aberdeen UI R&E Center. Call 397-4181 for more info.

June 10th-"4R Nutrient Stewardship" ASA online seminar, CCA credits offered. https://www.agronomy.org/certifications/webinars

July 8th-"Cover Crops" ASA online seminar, CCA credits offered. https://www.agronomy.org/certifications/webinars

July 21st-U of I Organic Cropping Systems Field Day. Kimberly, Idaho. Call 208 237-4628 ext. 104 for more info.

August 12th-"Climate Change—Part I" ASA online seminar, CCA credits offered. https://www.agronomy.org/certifications/webinars

September 9th-"Climate Change-Part II" ASA online seminar, CCA credits offered. https://www.agronomy.org/certifications/webinars