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Nutrient Digest

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NUTRIENT BEST MANAGEMENT PRACTICES – ASSESSING ADOPTION BY COLORADO PRODUCERS

By Troy Bauder, Catherine M.H. Keske, and Erik Wardle — Colorado State University

Water quality impairments from Nitrogen (N) and Phosphorus (P) have been well-documented and researched in many environments and cropping systems. Thus, an enormous amount of research and outreach has been devoted to reducing off-field loss and transport of these nutrients. The state of Colorado is no exception in regards to potential and current nutrient impairment of water resources from agricultural sources. To mitigate these impacts, Colorado State University Extension (CSUE) along with agency and industry partners has promoted nutrient best management practices (BMPs) through applied research, demonstration and outreach, particularly in irrigated crop production. In an effort to understand current adoption of nutrient BMPs by Colorado agricultural producers, CSUE conducts periodic assessments of trends and costs of nutrient management practices. As follows is a summary of methodology and results from a 2011 study.

The 2011 BMP assessment consisted of a mail-back survey that queried 2,000 irrigating agricultural producers about BMP adoption rates and costs for the 2010 growing season and calendar year. The survey was pilot tested with 16 producers, extension specialists, agency personnel, and university faculty during development.

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IRRIGATION PRACTICE AFFECTS SOIL PHOSPHORUS AVAILABILITY

By Jim Ippolito and Dave Bjorneberg, USDA — ARS-Kimberly, Idaho

Water flowing in irrigation furrows detaches and transports soil particles and subsequently nutrients such as phosphorus (P). Converting from furrow to sprinkler irrigation, increases irrigation efficiency, saves labor, can increase crop yield, and reduces the risk of erosion and offsite P transport. Research was completed on soil P dynamics in furrow versus sprinkler irrigated soils from four paired-fields (i.e. four individual producers) in south-central Idaho. Surface soils (0-2 inches) were obtained from all fields in September following barley harvest. In furrow irrigated fields, soils were collected from the furrow, the shoulder, or planting bed at either the top (inflow end) or bottom of the field. In sprinkler irrigated fields, soils were collected from either the top or bottom of the field (i.e. where furrow irrigation historically used to begin and end). All soils were analyzed for Olsen-extractable P. No differences existed between in-field locations (e.g. top vs. bottom of field or bed/shoulder/furrow location). However, furrow irrigated soils contained 38 parts per million (on average) of plant-available P as compared to 20 parts per million under sprinkler irrigation (Figure 1). These results are important as greater than 20 parts per million extractable P can be construed as

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*WERA-103 is the Western Extension/Education Region Activites Nutrient Management and Water Quality committee, composed of representatives from land-grant universities, public agencies, and private industry.

Head Editor—Amber Moore, University of Idaho; Guest Editor—Troy Bauder, Colorado State University

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Survey questions focused on determining which BMPs producers were using to determine their nutrient rate, form, timing and placement. In addition, practices that are generally termed 'precision agriculture' were queried to better understand how producers are incorporating this new technology into their nutrient management. Producers were also asked about nutrient management practices that reduce off-field nutrient transport, recordkeeping and cost of BMP implementation.

The survey sample was drawn from farm operators utilizing 100 acres or more of irrigated land for production. The National Agricultural Statistics Service (NASS) stratified the sample of Colorado irrigators by county. Producer identities were anonymous to researchers at all times, as surveys were mailed directly to producers by NASS. In order to ensure a successful response rate, widely recognized survey design methodologies were followed. Surveys were initially mailed in February 2011, and later in March to those who did not respond to the first mailing. Producers who did not complete and return the second mailing were contacted by the NASS call center to increase response rate.

The final overall response rate was 44.8 percent. To control for the diversity of cropping practices in Colorado, survey responses were grouped into six geographic regions based upon county. This regionalization also allows for comparison to regional data presented in previous Colorado surveys conducted in 1997 and 2002. A few highlights of the survey are provided in the following table and figure.

Table 1. Percentage of respondents incorporating selected nutrient management practices.

Best Management Practice	Region of Colorado[1]					
	Arkansas Valley	Eastern Plains	Mountains	S. Platte	San Luis Valley	Western Slope
Soil Test Analysis	41.1%	86.2%	21.2%	75.4%	50.0%	44.7%
Deep Soil Test	12.5%	36.2%	0.0%	26.6%	18.6%	5.9%
Split Apply N[2]	46.3%	72.5%	2.5%	43.1%	38.7%	21.8%
Keep Written Records	32.1%	67.0%	26.3%	52.1%	49.1%	30.6%
Establish Yield Goals	30.4%	51.1%	14.1%	41.2%	30.6%	15.9%
Use Paid Crop Consultants for Advice	14.3%	47.9%	1.0%	22.8%	23.2%	1.9%
Plant Tissue Samples	5.4%	22.3%	4.0%	12.3%	20.4%	4.7%

[1] Respondents were asked to indicate multiple management practices incorporated therefore response estimates calculated across region will not sum to 100.

[2] Refers to using two or more N fertilizer applications with one of these during the growing season

Among the sampled producers, certain BMPs, such as soil testing in the E. Plains and S. Platte regions showed very high adoption rates (Table 1). Results indicate that this basic BMP is well accepted by irrigating producers in these areas to help determine the correct amount and type of nutrient required to achieve high crop yields. In contrast, plant tissue testing is adopted at a lower rate across all regions since the practice is typically limited to certain higher value crops. Record keeping, which is required to qualify in some USDA cost sharing programs, has been adopted at a rate of less than 50 percent in four of six regions. However, this is still a higher rate than reported in a previous survey. The percent of producers using paid crop consultants to determine fertilizer rates is highest in areas of higher value crops and where crop consultants are actively seeking clients.

Figure one shows expenses the respondents reported for costs to manage nutrients during the 2010 cropping

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Nutrient Best Management Practices, continued from page 2

season. These included nutrient management BMPs and other practices such as conservation tillage, filter strips, cover crops and other practices that prevent nutrient losses from fields. These costs varied among regions similar to patterns seen with BMP adoption, with the exception being the Arkansas Valley. It is important to point out that many of these costs also have benefits, such as improved yield or reduced fertilizer expenses, but others do not have net return for the producer. In many cases, cost-sharing programs from the USDA Natural Resources Conservation Service and other programs can help producers with these expenses and improve adoption.

A key result from this survey is that nutrient BMPs adoption and expenditures on BMPs varies widely by region of the state. These differences are expected as Colorado's irrigated farming regions are diverse in terms of crop and livestock systems utilized, irrigation systems and water sources, nutrient type and amount applied, input costs and management styles. Additionally, crop landscapes vary from high altitude mountain hay meadows to intensive vegetable row crops in some river valleys. In general, nutrient BMP adoption is highest within the regions where fertilizer and manure nutrients are utilized more and in areas with higher value crops.

Summary

Supplemental nutrients, particularly N and P are critical components of highly productive, profitable irrigated agriculture and to meet the food intake requirements of an increasing global population. This study found that most of the Colorado producers who responded to our survey are implementing some level of nutrient management practices to enhance nutrient use efficiency and prevent losses from irrigated fields. The BMPs with higher rates of adoption tend to be those with lower costs or are cost neutral to the producer, whiles others may require incentive programs to achieve higher levels of adoption. Ultimately, the decision on whether to implement a BMP or suite of BMPs can only be made at the local watershed scale, incorporating local knowledge of field conditions and cropping systems.

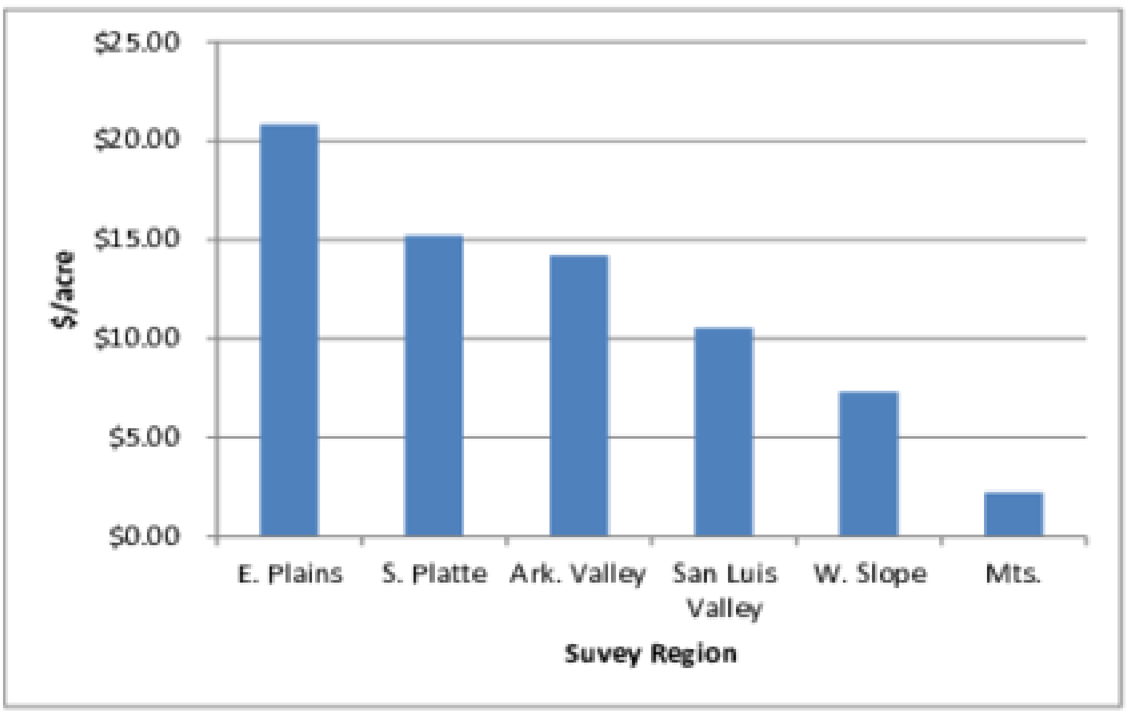

Figure 1. Average annual expenditures on nutrient management practices

A NEW PACIFIC NORTHWEST EXTENSION PUBLICATION: *ESTIMATING PLANT-AVAILABLE NITROGEN FROM COVER CROPS*

By Nick D. Andrews and Dan M. Sullivan — Oregon State University

We have been working with vegetable farmers in the Willamette Valley to find ways to estimate plant-available nitrate-N (PAN) released by cover crops, and understand the relative costs of cover crops and organic fertilizers. The new Extension publication (PNW 636; scheduled for Oct 2012 online release by OSU, WSU and U of I Extension) highlights recent Willamette Valley research and features a worksheet to assist in fine-tuning cover crop N credits. Our estimates for cover crop PAN were validated in the context of winter cover crops grown prior to summer mixed vegetable crops. In this cropping system, the cover crops are typically seeded in September and killed and incorporated by tillage the following April. In field trials, we found that PAN release by the cover crop occurred rapidly (by mid-June) and was linearly related to the %N in the above-ground cover crop biomass.

Research to validate a prediction equation for PAN in the Willamette Valley (OR)

We conducted laboratory incubations to measure the amount of PAN released from different cover crop residues. About 50 cover crop samples were collected each spring (2008-10) from field plots in the Willamette Valley, and then chopped and mixed with moist soil. PAN accumulation was measured after 4 and 10 weeks of incubation at 72°F. Incubations showed that PAN was linearly related to cover crop total N%, as had been reported by Vigil and Kissel (1991) in Kansas. Their research included a prediction equation relating cover crop total N% to PAN ("Calculator" line in Figure 1). We incorporated the Kansas regression equation ("Calculator" line in Figure 1) into our software (OSU Calculator; Andrews et al., 2010) that was developed for farmers that use organic amendments.

Field studies have confirmed that we reach the Calculator-estimated PAN at about 6 weeks following mid-April cover crop incorporation. Our system for predicting PAN has not been extensively tested across the PNW, so we recommend caution when extrapolating it to other cropping systems or to regions dissimilar to western Oregon.

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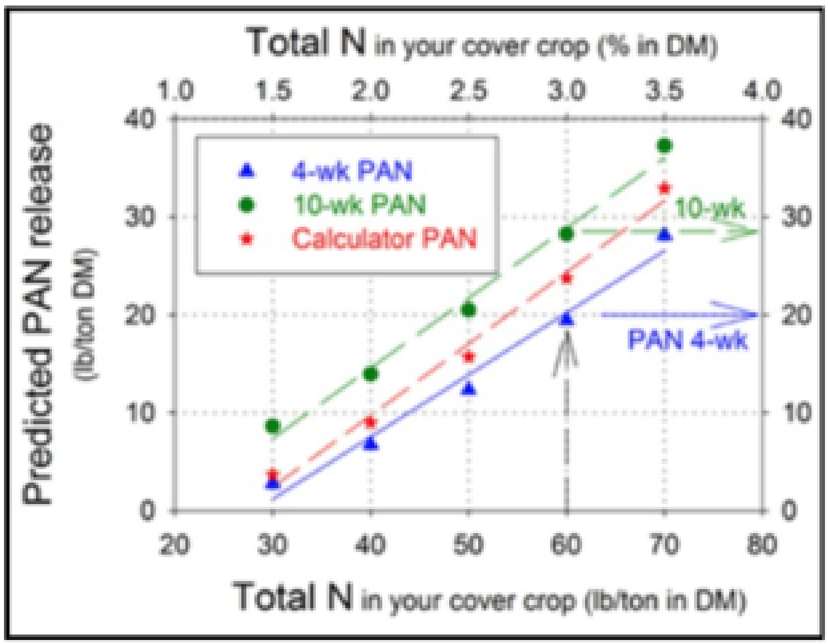

Figure 1. Predicted PAN release from cover crops. *Instructions:* (1) Find the total N analysis of your cover crop, using either the top (%N) or bottom (lb. N/ton) x-axis (using a commercial laboratory analysis). (2) PAN release predictions are made on the y-axis. Four- and 10-week predictions were estimated by incubation of cover crop residue in moist soil at 72°F. "Calculator PAN" predictions are estimated by the OSU Organic Fertilizer and Cover Crop Calculator.

A New Pacific Northwest Extension Publication, continued from page 4

Site-specific method for estimating PAN

The primary advantage of this approach is improved accuracy of cover crop N "credits", especially for mixed cereal/legume cover crops. Our recommended field sampling method (PNW 636) is similar to methods used to harvest and determine N uptake for forages. Foliage is collected from a known area and wet weight is determined. Crop N uptake is calculated using measurements of dry matter % and N% from lab analysis of a subsample. The Extension publication (PNW 636; Sullivan and Andrews 2012) includes sampling instructions and a step by step worksheet to estimate biomass, crop N uptake, and PAN from field samples.

When to kill cover crops to get maximum PAN benefit?

We have also developed general guidance for use with growers that do not want to collect cover crop samples to determine PAN (Figure 2). General guidelines: 1) To maximize PAN, kill cereal cover crops early, but wait until bud stage to kill legumes. 2) A cover crop with at least 25% legume can be allowed to grow until early May (boot stage for cereal) without danger of N immobilization (negative PAN). 3) Seeding legume and cereal mixes instead of a solo cereal crop allows greater flexibility in timing of cover crop incorporation without the consequences of negative PAN.

Integrating cover crop PAN estimates into an overall N budget

Complementary software (OSU Calculator: Andrews et al., 2010) is an Excel spreadsheet that contains the same cover crop equation explained here (Figure 1) plus other features. The Calculator can be used to compare a range of PAN sources (manure, compost, cover crops) in terms of cost per unit PAN. The Calculator can also be used to evaluate nutrient balance (NPK) outcomes of supplying N from cover crops, manure, or compost.

For More Information:

Andrews N., D. Sullivan, J. Julian and K. Pool (2010). Organic Fertilizer and Cover Crop Calculator. Online at: http://smallfarms.oregonstate.edu/calculator.

Sullivan D. M. and N. D. Andrews (in press). Estimating plant-available nitrogen release from cover crops. PNW Extension Publication 636.

Vigil, M. F. and D. E. Kissel (1991). Equations for Estimating the Amount of Nitrogen Mineralized from Crop Residues. *Soil Science Society of America Journal*, 55:757-761.

Acknowledgements:

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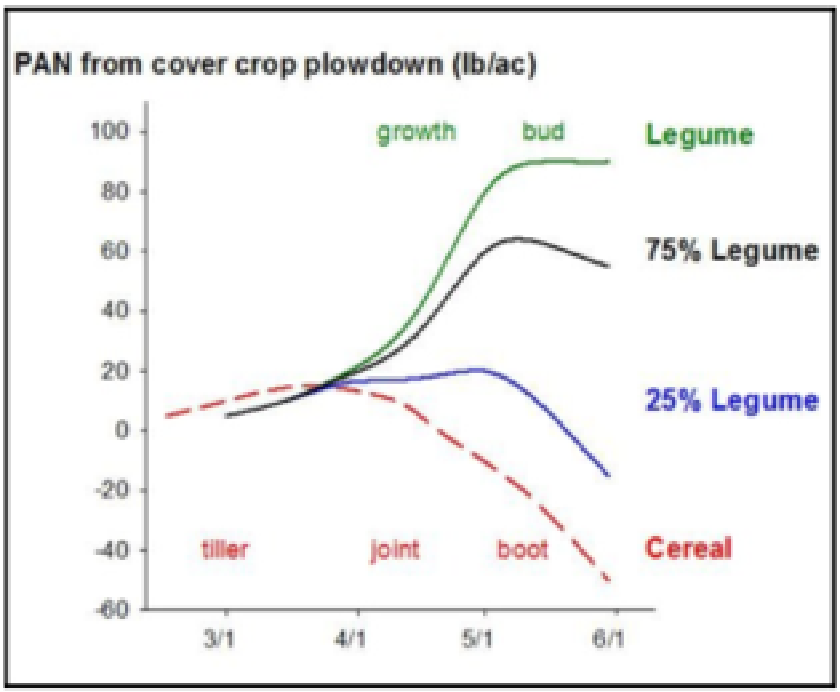

Figure 2. Effect of kill date on typical plant-available N (PAN) release from cereal, legume, or mixed stands. Based on compilation of field data from Willamette Valley cover crop trials. D. Sullivan.

PARTNERSHIP WITH UNIVERSITY OF IDAHO PARMA CENTER AND THE J.R.SIMPLOT COMPANY

By Terry A. Tindall and Galen Mooso — J.R. Simplot Company

The University of Idaho has developed over the past 100 years and more a series of Research and Extension Education Centers that focus on field research of irrigated crop land through-out Idaho. Parma was established in 1925 with the following goals: "from the need for research and extension efforts to sustain and improve the productivity of the crops in grown in SW Idaho". The Parma research station includes 200 acres and houses University Faculty offices as well as farm ground where intense research is conducted for seed, potatoes, onions, corn, cereals, hops and other local crops.

The current superintendent and professor of plant science is Dr. Mike Thornton. Dr. Thornton indicates that "Parma is a special facility due to, among other reasons, is its location in the heart of the Treasure Valley region. This location serves a unique role in that we are the only one in Idaho working many of the high value crops grown in what is known as the Treasure Valley regions of Southwestern Idaho and eastern Oregon" says Thornton. "For example, we conduct research on crops like alfalfa seed, sweet corn seed, hops, mint, onions, potatoes, apples, sugar beets and table grapes to name a few."

What sets Parma apart from the other land-grant University research centers is also the close relationship with the J.R. Simplot Company, which is the 5th ranked U.S. fertilizer retailer out of the top 100 for North America. Simplot became involved in the center in 2008 as a cooperative partner after funding

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Irrigation Practice Affects Soil Phosphorus Availability, continued from page 1

the point where soil P is considered to change from low to medium in terms of soil concentration and soil testing. These findings suggest that P use efficiency may potentially be greater under sprinkler versus furrow irrigation. Scientists at the USDA-ARS in Kimberly Idaho are currently performing research to help answer this question.

Next, these soils were then analyzed using a sequential extraction technique to identify different soil P pools. It was found that soils under furrow irrigation contained greater concentrations of inorganic P in several different soil pools, including P associated with amorphous iron-oxides. This suggests that with furrow irrigation, P forms that are more stable under sprinkler irrigation are not stable under furrow irrigation. In fact, it appears that furrow irrigation promotes short-term changes in soil oxidation/reduction processes (due to saturated soil conditions) which appears to release P to the environment more readily than under sprinkler irrigation. This release of P under furrow irrigation likely caused the observed increase in Olsen-extractable P content. Besides reducing offsite sediment transport, overall findings from this project further support the various reasons why producers should (if possible) convert from furrow to sprinkler irrigation.

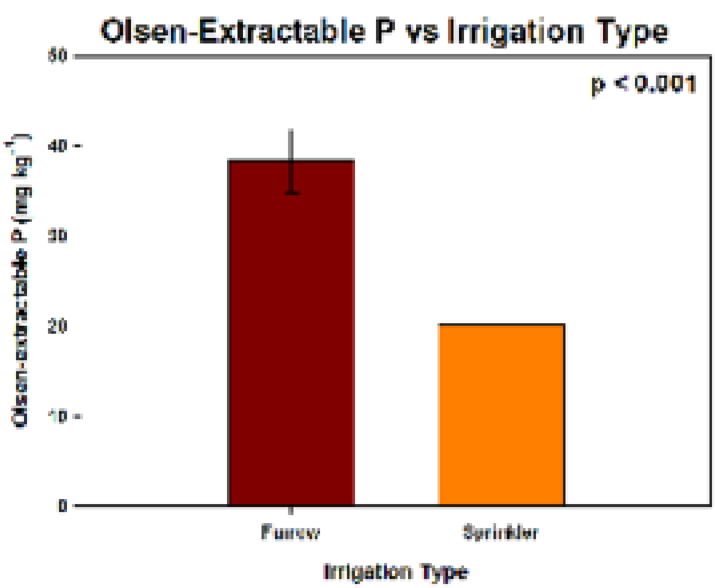

Figure 1. Olsen-extractable soil phosphorus content versus irrigation type from four paired producer fields in south-central Idaho.

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Parma Center and J.R. Simplot Partnership, continued from page 6

shortfalls had this important R/E center on the brink of being shut-down.

A creative arrangement was initiated between the University of Idaho and the J.R. Simplot Company. "At the time these changes were being discussed the Simplot Company was having internal discussions regarding the creation of a research farm mainly for potato production" says Terry A. Tindall, Senior Agronomist for the J.R. Simplot Company. "One of our many goals was to partner with existing University or third party independent research groups to allow our developing technologies for improving fertilizer practices to move forward with a better understanding of responses to various crops or environments. We have always relied heavily on various Universities to conduct our directed research. We asked ourselves why not create a 'Partnership with Parma' that would meet both our internal company needs as well as providing a vehicle for the University of Idaho to keep the research station open and serving the unique agriculture community within the Treasure Valley."

"Nothing replaces research in providing a foundation for agronomic understanding," according to Dr. Galen Mooso, Agronomy Manager with the J.R. Simplot Company. "With the close working relationship that is being developed at Parma we can not only direct small scale research trials, but also have a local resource where agronomic educational tours can be conducted that would allow a better understanding of our research efforts." "This experience is also a great opportunity to showcase our new fertilizer technologies that can improve efficiencies and better relate the fertilizer industry to nutrient management stewardship."

U of I President Nellis and Debbie Simplot McDonald participate with at the U of I/Simplot International Field day made possible by the recently formed partnership between the U of I and J.R Simplot Company.

Simplot International Field Day held at the Parma Research Center in 2010.