INSIGHTS
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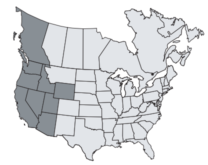
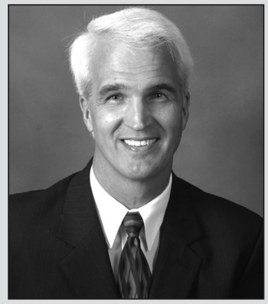


September 2008

Western Region Research Update

OUR TRANSITION from the well-known Potash & Phosphate Institute to the International Plant Nutrition Institute has gone extremely well and has provided new opportunities for education and research. With the increases in fertilizer prices and the keen interest in environmental impacts, our research efforts are more important than ever as we continue to identify opportunities for improved nutrient management.

This issue of *INSIGHTS* features the brief Interpretive Summaries related to research projects supported by IPNI in the Western North America Region. This information and even more detail on each project can be found at the research database at our website: >**www.ipni.net/research**<.



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British Columbia

Slow-Release Nitrogen and Phosphorus as an Alternate Delivery Method for Diverse Soil Types in British Columbia Cranberry Production: Decreasing Nutrient Losses to Riparian Systems

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Project Cooperators: Mike Wallis and Murray Isman

While recent overall cranberry production in North America has been impressive, production efficiency varies substantially within and among regions. For example, the average yields in the main cranberry producing areas in 2003 were 10 t/A for Wisconsin, 8.5 t/A for both British Columbia and Oregon, 7.5 t/A for New Jersey, 6 t/A for Washington, and 5 t/A for Massachusetts. Some well-managed farms in each of these main cranberry growing regions have fields that have consistently reached 15 to 17 t/A and occasionally 20 to 25 t/A. With the potential for such high yields, the barriers to these high yields need investigation. With the exception of N, the response of cranberry to the addition of various essential elements is not easily observable in the short-term. The addition of N quickly promotes shoot elongation and leaf development. Other nutrients will influence growth in a more subtle fashion (e.g. improved photosynthesis) and the benefits to yield may require several years of enhanced root surface area and rooting depth and a gradual canopy adjustment with more flowering buds and shoots and less vegetative growth, or runnering.

Plants were grown the first year with equal applications of nutrients. Last year, plants were given either one complete application of temperature responsive controlled-release diammonium phosphate and urea-N (DAP and UN), or a one-third rate of soluble, granular DAP and UN with two additional one-third applications in June and July. One set of the elemental N:P rates applied was at a level recommended currently for new plantings (25 lb N/A and 25 lb P/A) while the second rate had an enhanced rate of P (25 lb N/A and 50 lb P/A) to promote rooting and to take into account the low availability of P in the acidic soils used for cranberry. The influence of soil type on cranberry root and plant growth, nutrient uptake and mineral nutrition, and the plant's balance between vegetative vigor and flower bud set were considered.

The findings of this experiment demonstrate how various commercial cranberry soils differ in their capacity to hold nutrients for efficient capture by the cranberry root system. As the soils of commercial cranberry farms are variable, fertilizer strategies must be devised that will allow efficient nutrient absorption and prevent the loss of nutrients through leaching into nearby aquatic ecosystems. Our past findings demonstrated that temperature responsive controlled-release DAP plus urea were more effective at preventing such losses in comparison to the standard soluble granular nutrients – even when the latter were applied more frequently and at small doses. The use of controlled release DAP plus urea allowed for enhanced floral bud set (114% increase) and vegetative growth (23% increase) in various soils for young cranberry plants grown in a pot model system. Our early indications comparing the use of a 1:1 and 1:2 N:P ratio indicated a possible minor benefit to vegetative growth with a 1:2 ratio. However, further investigation is required to confirm this.

Four large farms (in close proximity to rivers) agreed to allow sampling of their reservoirs and to cooperate in this study. All farms had drainage systems in place. Two major reservoirs on each farm were also sampled in July and October (just before/at release of the harvest flood waters). It appears that movement of nitrate from the cranberry farms to their associated rivers is not a major concern. In the case of these and other nearby cranberry and blueberry farms, ammonium-N and urea-N are the primary forms of N fertilizer and may be contributing to the river ammonium concentrations via the ditch system. In the case of the cranberry farms that use extra river water for flooding the wet harvest operations, any soluble N should be managed carefully to avoid release to the nearby rivers. In the case of phosphate-P, the ditch system and the rivers sampled indicate a fairly low concentration of P.

The findings of this study indicated that with the current farming strategy, fertilizer N and P used by cranberry farms may potentially move via the ditch systems and contribute to the nutrient levels of the Fraser and Pitt Rivers associated with these farms. The actual impact on riparian systems was not investigated in this study specifically. Experiments with various fertilizers have shown that with controlled-release fertilizers, nutrient leaching was greatly slowed, while overall plant growth and development was improved. The benefits of these slow release fertilizers appeared more significant with soil types that were conducive to good root and plant growth. *BC-16F*

California

Evaluation of Improved Methods for Tissue Testing of Alfalfa

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Project Cooperator: Dan Putnam

Rising costs of fertilizer and the high value of hay make fertility management an especially critical issue for alfalfa producers. Many growers fertilize based on past practice with little idea of the actual nutrient status of the field, virtually guaranteeing improper application. The long-standing University of California (UC) recommendation has been to sample the standing crop at the 10% bloom stage, and fractionate the sample into three parts (tops, mid-stem, and mid-stem leaves). Because the grower must sample prior to harvest, and the special processing required, most growers currently do not tissue test alfalfa. In contrast, many growers routinely take cored samples of haystacks for forage quality analysis of Acid Detergent Fiber (ADF), Neutral Detergent Fiber (NDF), Crude Protein, and Dry Matter. Research was needed to determine whether these cored bale samples could be used to assess nutrient needs as well.

Trials were established in 2006 and 2007 to determine the effect of alfalfa fertilization rate on alfalfa yield and tissue P levels. Six different fertilizer rates were applied in 2006 in a trial in Butte Valley, California, including a zero fertilizer check, 30, 60, 90, 120, and 150 lb P_2O_5/A. Eight rates were used in 2007 to apply the same rates as in 2006, plus 180 and 210 lb P_2O_5/A at a site with higher yield potential in Scott Valley, California. The fields were sampled three to four times at various growth stages for the first and second cuttings. Whole tops and mid-stem samples were collected and analyzed. The intent was to monitor changes in P content with advancing alfalfa maturity. This allows us to assess the need for specific critical nutrient levels for different alfalfa maturities. Acid detergent fiber and NDF were analyzed to determine if these could be used to quantify alfalfa maturity and to adjust critical nutrient values. Yield was determined to help establish critical P concentrations at various growth stages for both whole plant and fractionated plant samples. Thirty-nine commercial alfalfa fields were sampled during the 2006 and 2007 growing seasons. Standing plant samples were collected from three locations in each field for in-field replication. One standing plant sample was used as a "whole plant" sample and another sample was fractionated according to the current UC recommendations for tissue analysis. Soil samples were collected from the same area that the standing plant samples were collected. After the fields were cut and baled, the bales were cored and sampled according to the protocol for forage quality analysis. If this alternative method for tissue sampling works well, the assumption is that growers will analyze other nutrients in addition to P. Therefore, the cored and standing crop samples from growers' fields were also analyzed for sulfur (S) and K.

Yield data has been collected over the 2 years and shows a significant yield increase with P fertilization. Tissue samples were collected and analyzed for available P, total P, available S, total S, K, ADF, and NDF. Soil samples were analyzed for pH and Olsen P. Data analysis has not yet been completed, but initial results look very promising and it appears at this point that bale samples could be used in lieu of the far more laborious mid-stem samples. Mid-stem P and cored-bale P were closely correlated. The results from grower fields showed considerable variation in the levels of all nutrients analyzed (P, K, and S). Averaged across all fields, the nutrient levels were adequate, however, individual fields varied from very deficient to high. This indicates that fertilizer practices for many growers could be improved significantly. The P rates applied in the fertilizer studies created very distinct plant tissue levels. The plant tissue levels for all fertilizer rates declined with advancing maturity, suggesting that the critical values used for plant tissue testing should be adjusted for plant maturity. *CA-26F*

Oregon

Fertigation of Fluid Nitrogen and Phosphate Fertilizers for Pears in the Pacific Northwest

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Project Cooperators: Clark Seavert and Jinhe Bai

The mid-Columbia region in Oregon produces 40% of the "winter" pears and 20% of the Bartlett "summer" pears in the U.S.A. Presently, N fertilizer is mostly broadcast-applied on the soil surface once (in March or April) per year at a rate of 80 to 100 lb N/A as a dry material followed by an intensive irrigation season. Nitrogen use efficiency is relatively low with this N management system because the tree root system cannot take up all the applied N fertilizer at such a high rate in a short time. Similarly, P fertilizer is currently broadcast-applied to the soil surface once per year (in March or April) at a rate of 100 to 125 lb P_2O_5/A as a dry material. Phosphorus use efficiency is relatively low with this P management system because P is highly immobile in the soil, and surface-applied P fertilizer does not positionally match up well with pear root system. Little research has been done to address the effects of split N and P fertigation on the growth, yield, quality, and storability of pears or other orchard trees in the Pacific Northwest. The objectives of this study were to: 1) evaluate the effects of fertigation of N and P fertilizers under drip irrigation and fertigation of N and P fertilizers under micro sprinkler as two integrated production systems on pear fruit yield, quality, and storability compared with the current pear production system, and 2) compare the costs of installing and maintaining fertigation plus drip irrigation system or fertigation plus micro sprinkler system with the costs of the current production system.

A field experiment initiated in 2005 was continued in 2007 on a mature green d'Anjou pear orchard near Parkdale, Oregon, with five treatments: 1) Broadcast application of N and P fertilizers to the soil surface under drip irrigation, 2) Band application of N and P (12 in. deep) under drip irrigation, 3) Broadcast application of N and P to the soil surface under drip irrigation along with soil disturbance caused by banding (no fertilizer was banded), 4) Fertigation of N and P under drip irrigation, and 5) Fertigation of N and P under micro sprinkler irrigation.

In the 2007 season, fertigation of N and P fertilizers under drip irrigation resulted in similar leaf N concentration as surface broadcasting of N and P fertilizers. The two N and P fertigation treatments had equal or significantly higher leaf P concentration than surface broadcasting. The results indicate that split fertigation could supply adequate mineral nutrition to fruit trees, even at a reduced application rate, relative to broadcast application. Our results show a tendency for P fertigation to have significantly increased leaf P concentration relative to broadcast application. Enhanced mobility of P in soil under fertigation may be responsible for improved tree P nutrition. The differences in fruit yield were statistically insignificant among the five treatments in 2007. Numerically, pear yield with broadcasting application of N and P fertilizers to the soil surface was 208 kg/tree. Fruit sugar, firmness, or titratable acidity was not statistically different among the five treatments. Fruit size or color did not differ among the five treatments. On average, the two fertigation treatments reduced both N and P fertilizer use by 20% compared with broadcast application of N and P fertilizer to the soil surface.

Visual evaluation of fruit surface scald was conducted after the fruits had been stored in a cold storage room for three months in 2007. The two split N and P fertigation treatments reduced the total of slightly scalded, moderately scalded, and severely scalded fruits by 9 to 14% (absolute value) compared with surface broadcasting. The increase in marketable fruit, which resulted from the reduction in slight, moderate, and severe scald incidence, could significantly enhance grower profitability. Our results show that reduction in fruit superficial scald during cold storage is another notable benefit with split fertigation. OR-15F

Washington

Spatial Variability in Soil Phosphorus

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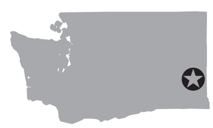

Wheat growers in eastern Washington are in a below-maintenance P fertility program. In low (<12 in. annual) precipitation, winter wheat-fallow environments, few use P fertilizer due to low yield potential and need to minimize input costs. In high (>18-in. annual) precipitation annual cropping environments, most growers use P fertilizer, but at rates far below removal. At standard removal rates of approximately 0.5 lb P_2O_5/bu, more P is being removed than is added in most fertilizer programs. At the same time, many growers report stable or increasing soil test P concentrations. The majority of growers in eastern Washington place P in a band beneath the surface with N, or directly with the seed. Clearly, this placement method is leading to high P use efficiency. However, the sustainability of this P management program is questionable. This work is examining the apparent contradiction between below-maintenance P applications and the apparent increase in soil test P concentrations. Based on the results of earlier research, we conducted experiments to evaluate dryland winter wheat responses to fluid and dry P fertilizer in low and high rainfall zones of eastern Washington State. The intent was to compare wheat responses to dry and fluid P in common crop-tillage fallow and annual cropping systems.

Studies were conducted at two locations in the low rainfall zone of eastern Washington and in the high rainfall zone. Each study included four rates of fluid ammonium polyphosphate P (0, 10, 20, and 40 lb P_2O_5/A) placed in a deep band with N (32-0-0) and one rate of dry monoammonium phosphate (MAP, 20 lb P_2O_5/A). Phosphorus was placed 2 weeks before seeding at the crop-fallow sites and at seeding with a one-pass, no-till drill at the annual cropping locations.

Positive grain yield responses to fluid P at summer fallow locations were obtained when soil test levels were near or above historical critical values. This suggests current soil test-based fertilizer recommendations may be outdated and critical levels do not accurately predict a response to P in these situations. Grain yield responses to dry P were lower than to fluid P at 3 of the 4 site-years. This is similar to results from Australian research, showing better responses to fluid P than to dry P. Interestingly, responses to fluid P rate were quadratic in 3 of the 4 site-years. At the highest rate of P, both anthesis whole-plant dry matter and final grain yields were reduced slightly over the intermediate rate. Moisture is a main limiting factor in the summer fallow cropping systems at these locations. Higher rates of P apparently stimulated excessive vegetative growth that depleted stored soil moisture and reduced late-season vegetative and grain yields. Responses to P were not obtained at annual cropping sites even though yields were high and soil test P levels were as low as in the summer fallow locations. We are unable to explain why there was no response to P at the annual cropped sites.

Early results of this study indicate a good potential for dryland wheat to respond to fluid P in the low rainfall, crop-fallow areas of eastern Washington. Intermediate rates of fluid P should be applied to optimize yields and prevent grain yield reductions in this moisture limited environment. While responses to applied P were not obtained in the high rainfall zone, given the high yields in these areas, regular P applications are still necessary. *WA-13F* ■

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