# ABSTRACTS

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## PREFACE

The following section contains abstracts of papers/posters presented at the 36th Biennial Meeting of the American Society of Sugar Beet Technologists.

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## Section A – Agronomy
## Oral Presentations

BARTLETT, RYAN K., Monsanto Company, 800 North Lindbergh Blvd., St. Louis, MO 63167. **Weed management in Genuity® Roundup Ready® sugarbeet.**

In North America this year, 95% of the sugarbeet acreage was planted with Roundup Ready® varieties. The rapid adoption of Roundup Ready® sugarbeet in the U.S. is attributed to the benefits of broad spectrum weed control, proven crop safety, and simplicity and flexibility of use. Because of the severe impact weeds can have on sugarbeet production, weed control is considered by many growers to be their most serious production problem. Herbicide-resistant weeds are neither a new phenomena nor is resistance unique to glyphosate. Growers have been managing these herbicide-resistant weeds for decades with the use of alternative herbicides and/or cultural methods such as tillage or crop rotation. The development of weed populations resistant to glyphosate represents a challenge to farmers and Monsanto is committed to helping them address this challenge. Monsanto works closely with university weed scientists and others within industry to understand basic scientific principles, to develop the best recommendations to delay the development of resistant populations, and to develop best recommendations to manage glyphosate-resistant weeds when they occur. Monsanto has both, short- and long-term weed resistant management strategies. In the short-term, we provide farmers with recommendations to minimize the risk of weed resistance developing, including the use of other methods of weed management such as adding herbicides with other mechanisms of action and using cultural control methods in addition to herbicides. As part of our long-term commitment, Monsanto has funded long-term research projects to better understand the factors that can influence weed shifts and weed resistance. A review of the results from academic trials comparing the benefits of Roundup Ready® sugarbeet weed control to conventional alternatives, and new opportunities in Roundup Ready® sugarbeet systems will be included along with an overview of Monsanto's weed management strategy.

BREDEHOEFT, MARK* and CHRIS DUNSMORE, Southern Minnesota Beet Sugar Cooperative, 83550 County Road 21, Renville, MN 56284. **Evaluation of in-furrow products to enhance sugarbeet production.**

The application of products infurrow is not a new method of application. Dr. Albert Sims research indicating the advantage of infurrow application of pop-up fertilizer increased the interest in such applications. Research was initiated in 2007 with products applied infurrow. The products evaluated range from the tradition pop-up fertilizer to nontraditional iron chealate (Soygreen) and micronutrients. This research indicated that non-traditional products Soygreen and micronutrients applied infurrow increased sugar production with sugar beets. When considering product performance over time the effective non-traditional products were more consistent. However, when considering the mixtures of products tested, the most effective treatment included Soygreen and pop-up fertilizer.

DOWNARD, ROBERT W.[1]* and DAVID ELISON[2], [1]The Amalgamated Sugar Company, P.O. Box 127, Twin Falls, ID 83303-127 and [2]The Amalgamated Sugar Company, P.O. Box 700, Paul, ID 83347. **Nitrogen rate effect on sugar beet stands in strip tillage.**

Improper nitrogen fertilizer placement or high rates can reduce sugar beet stands. Strip tillage places fertilizer below the seed, which may reduce sugar beet stands. The objective of this study was to determine if high rates of liquid fertilizer placed directly below the seed would reduce sugar beet stands. Liquid fertilizer was placed at 6 inches directly below the seed at ½ (60 units N/acre), ¾ (90 units N/acre), and a full rate (120 units N/acre). In 2009 stand counts were taken 33, 41 and 50 days after planting and there was not any significantly difference between treatments. In 2010 stand counts were taken 9, 11, 15, 17, and 22 days after planting. The half rate treatment had lower stand counts at 11, 15, and 17 days after planting. This was due in part to poor soil conditions in that area.

DUSEK, LYNN D.*, CURTIS A. FUNK, JOE M. HASTINGS and ALLAN W. CATTANACH, American Crystal Sugar Company, 101 North 3rd Street, Moorhead, MN 56560. **The effect of variable rate seeding on sugar beet production.**

Establishing optimum plant populations is one of the most critical factors to maximize sugarbeet yield and quality. Equipment manufacturers are now selling planters capable of variable rate seeding to desired plant populations. Objective of the study conducted at 6 locations in 2008-2010 was to determine optimum plant populations for different management zones in commercial fields. All fields were

planted in 22 inch row widths. Cooperating growers used recommended agronomic and pest management practices. Productivity zones were established using previous crop yield maps, soil survey maps, satellite imagery or topographic maps. Yield and quality parameters measured included tons per acre, sugar percent, sugar loss to molasses, recoverable sugar per ton and per acre, and revenue per ton and per acre. Harvest loss assessments were completed after the 2008 and 2009 harvests. Yield and quality samples were taken by hand several times during the growing season to monitor crop growth. Final yields were taken with harvesters equipped with yield monitors. Optimum seed spacing determined for high, intermediate, and low productivity zones was 4.9-5.5 inches, 4.3 to 4.6 inches, and 3.5 to 3.9 inches respectively. Selecting the right seed spacing increased recoverable sugar per acre by 156 to 1415 lbs/acre for high productivity zones, 325 to 737 lbs/acre for intermediate zones and 103-1326 lbs/acre for low productivity zones depending on location and year. Harvests losses were greatest for higher plant populations required for maximizing yields in low productivity zones. Optimum ranges for plant populations based on this study were 35-42,000, 42-47,000 and 47-55,000 plants per acre for high, intermediate and low productivity zones respectively.

ELISON, DAVID M.[1]* and GREG DEAN[2], [1]The Amalgamated Sugar Co. LLC, P. O. Box 700, Paul, ID 83347 and [2]The Amalgamated Sugar Co. LLC, P. O. Box 8787, Nampa, ID 83653. **Nitrogen use management in sugar beet culture as related to soil type.**

For over three decades, Amalgamated production areas have used the constant that eight lbs. of N should be required for each ton of beets produced. With the improvements in seed in general, as well as the incidence of Roundup Ready culture it has become apparent that further refining of this approach was required. Mineralization of N is the forever unknown part of the N management equation. Because soil type has an inherent effect upon potential mineralization of N we determined to discover if the amount of N required could be closer refined to whatever varying amount the soil type might dictate. Over the past three years, plot studies have been conducted on silt loam, clay loam, and sandy loam soils to determine if tighter figures for N-use requirement could be discovered, basis of the potential varying nutrient holding and mineralization capacities of these soil types. Results from these studies show that use of lower constant rates for silt loam and clay loam soil types, as well as sometimes lowering the rate for sandy loam soils is advisable for further increasing sugar optimization without lowering tonnage production.

FISHER, JASON M., JEFF M. STACHLER* and JOHN L. LUECKE, Department of Plant Sciences, North Dakota State University and University of Minnesota, North Dakota State University, Dept. 7670, P. O. Box 6050, Fargo, ND 58108-6050. **Management of giant ragweed in glyphosate-resistant sugarbeet with clopyralid.**

Glyphosate-resistant giant ragweed was first confirmed in southern Minnesota in 2006 and continues to increase. Small-plot field research was conducted in 2009 and 2010 at two locations near Hutchinson, MN to determine the response of glyphosate-resistant sugarbeet and giant ragweed to clopyralid and glyphosate at various rates, timings, and number of applications. Factors in the study consisted of herbicide timing (giant ragweed heights of 2.5, 7.6, and 15.2 cm at initial application) and treatments. Treatments at each timing included glyphosate (840 g ae/ha) applied alone and in combination with clopyralid at 8.6, 17.2, and 34.5 g ae/ha in a single application. In addition, glyphosate (840 g/ha) plus clopyralid was applied twice at 8.6 and 17.2 g/ha and 17.2 followed by 34.5 g/ha and three times at 17.2 g/ha and 8.6 followed by 8.6, followed by 17.2 g/ha. Visual whole plot and individual plant evaluations were recorded 21 days after each application and at harvest. Sugarbeet was harvested in early September. Glyphosate applied in a single application ineffectively controlled giant ragweed confirming glyphosate resistance. Giant ragweed control was greater than 90% when clopyralid was applied twice totaling 51.7 g/ha or applied three times and mixed with glyphosate. Individual plant mortality at harvest was maximized when clopyralid was applied at > 17.2 g/ha to 2.5 cm giant ragweed and at > 34.5 g/ha to 7.6 cm giant ragweed. Clopyralid plus glyphosate applied in multiple applications to 2.5 or 7.6 cm giant ragweed maximized sugarbeet yield. Clopyralid must be applied two or more times in combination with glyphosate to 7.6 cm or smaller giant ragweed to maximize sugarbeet yield and giant ragweed control.

HOLTSCHULTE, BERND[1]*, GARY KORBEL[2] and JAY MILLER[2], [1]KWS SAAT AG, 37555 Einbeck, Germany and [2]Betaseed, Inc., P. O. Box 195, Shakopee, MN 55379. **Nutrient deficiencies in glyphosate-resistant sugar beets?**

In the US Roundup-tolerant sugar beets are planted on 95 percent of the farmland (over one million acres), enabling the farmers to weed their crops chemically at low production costs with a high efficiency and without harming the beets. Observations during recent years in Roundup Ready soybeans suggest that the use of glyphosate complicates the uptake of micronutrients, in particular manganese (causing "yellow flash" symptoms in beans). The application of micronutrients has been recommended to overcome manganese deficiencies in soybean production. Nothing is known regarding such possible compli-

cations in Roundup Ready sugar beets. Trials were conducted over a three year period to determine if spray application of manganese fertilizer affects the micronutrient content in the leaves, or yield at harvest in Roundup Ready sugar beets. Roundup Ready sugar beet cultivar Beta 5501RR was planted in strip trials (12 rows) at Rosemount; MN and Hampton, MN location in 2008, and Randolph, MN (2009 and 2010). All plots were 11 x 40 encompassing 12/22" rows. The six treatment rows were sprayed "down the row" with manganese fertilizer approx. 14 days after Roundup application, the check rows receiving no manganese. Treatments "across the row" were 3 replications of Roundup herbicide (32 fl oz/acre, one application in 2008, two applications in 2009 and 2010). All three check plots were hand weeded. Leaf samples were collected prior to and 5 to 6 weeks after Roundup application. At least 24 beets were harvested from the center two rows of each plot for yield and quality data. There was no evidence that applications of Roundup lead to yellowing symptoms or to a lower content of micronutrients in leaf samples. When comparing plots with and without manganese application no response in yield and quality of the sugar beets could be determined.

HUBBELL, LEE A.[1]*, JAMES F. STEWART[1], BRIAN J. GROULX[1] and RALPH FOGG[2], [1]Michigan Sugar Company, Agricultural Research Center, 1459 S. Valley Center Drive, Bay City, MI 48706 and [2]Michigan Sugar Company, 2600 S. Euclid Avenue, Bay City, MI 48706. **Rhizoctonia solani; the extent of the problem and control measures in Michigan.**

Rhizoctonia solani root and crown disease is a significant problem in the Michigan Sugar Company growing area. The severity of the problem has increased in some areas and has expanded into new parts of the growing region. Rhizoctonia solani has traditionally infected the root crown but infection of the lower root area has increased in recent years. The more virulent strain AG 2-2 IIIB is being found in increasing levels. Quadris and tolerant varieties are being used to help reduce the disease level in problem fields. Other fungicides have also been found to have some control but Quadris is the most consistent. Foliar application of Quadris has been the most common application timing but application in a T-band at planting is increasing. Limited testing of the T-band application of Quadris using reduced band widths with reduced rates has produced good results.

KNISS, ANDREW R.[1]* and DENNIS C. ODERO[2], [1]University of Wyoming, 1000 E. University Avenue, Laramie, WY 82071 and [2]University of Florida EREC, 3200 E. Palm Beach Road, Belle Glade, FL 33430. **Preemergence ethofumesate increases postemergence spray retention on common lambsquarters.**

Greenhouse experiments were conducted to determine whether sublethal rates of ethofumesate applied preemergence (PRE) increased postemergence (POST) spray retention on common lambsquarters. Ethofumesate was applied PRE at rates from 0 to 224 g/ha, followed by POST treatment with either water or glyphosate (at 840 g ae/ha) to which a red dye had been added. Plants were immediately washed and spray retention determined spectrophotometrically. POST spray retention was influenced by the interaction of PRE ethofumesate rate and POST spray material. Common lambsquarters retained more glyphosate compared to water, regardless of PRE ethofumesate rate. Increasing the rate of PRE ethofumesate increased the POST spray retention of both water and glyphosate. PRE application of ethofumesate increased POST spray retention of water by 114% and glyphosate by 18% compared to no ethofumesate treatment as determined by non-linear regression. Ethofumesate rates of less than 90 g/ha increased POST spray retention to 95% of the total observed response.

LAMB, JOHN A.[1]*, MARK W. BREDEHOEFT[2] and CHRIS DUNSMORE[2], [1]Department of Soil, Water, and Climate, University of Minnesota, 439 Borlaug Hall, 1991 Upper Buford Circle, St. Paul, MN 55108 and [2]Southern Minnesota Beet Sugar Cooperative, P.O. Box 500, 83550 County Road 21, Renville, MN 56284. **Where does turkey litter fit with sugarbeet production?**

Livestock operations, mainly poultry and swine, are increasing in size and impact in the Southern Minnesota sugar beet growing area. Many sugar beet producers own or have interest in these operations; thus have manure available to use on their fields. A concern has been raised about the effect of late season nitrogen mineralized from the manure on sugar beet quality. The question is when in the sugar beet crop rotation should manure be applied to minimize quality concerns and realize benefits? This research project has been designed to: 1) determine when in a three-year rotation, should turkey litter be applied and 2) determine nitrogen fertilizer equivalent of turkey litter applied in advance of sugar beet production.

Three sites were established over a period of three years. At each site, a soybean/corn/sugar beet rotation was used. This study had five replications of the treatments. The treatments included two rates of turkey litter applied at 3 and 6 tons per acre, one, two, and three years before sugar beet production plus fertilizer N rate appli-

cations for comparison. Grain yields, sugar beet root yield and quality were measured.

At the time of this presentation, the results for two locations are available. There was a significant response to nitrogen application at the first location or root yield, extractable sucrose per acre, and revenue. Sugar beet quality was not affect by N fertilizer application. The optimum nitrogen rate was 90 pounds per acre. The residual nitrate-N in the surface 4 feet was 40 pounds per acre. The optimum fertilizer application was similar statistically to the best litter application for revenue.

LAMB, JOHN A.[1]*, MARK W. BREDEHOEFT[2] and CHRIS DUNSMORE[2], [1]Department of Soil, Water and Climate, University of Minnesota, 439 Borlaug Hall, 1991 Upper Buford Circle, St. Paul, MN 55108 and [2]Southern Minnesota Beet Sugar Cooperative, P. O. Box 500, 83550 County Road 21, Renville, MN 56284. **Influence of starter fertilizer on optimum nitrogen rate.**

Nitrogen management for optimum sucrose production is the goal of the nutrient management research in the Southern Minnesota Beet Sugar Cooperative growing area. Recent research results have caused growers to adopt the use of seed placed fertilizer on their sugar beet crop as a phosphorus source. The question growers have, will this use of starter affect the nitrogen rate needed for optimum sucrose? This research project was design to determine if the use of seed placed liquid fertilizer (10-34-0) affects sugar beet yield or quality and if the use of this practice affects revenue.

Eight sites were established over a period of three years. The treatments included a factorial arrangement of the use of seed placed liquid fertilizer (28 L ha-1, 10-34-0) and nitrogen rates of 0, 22, 45, 67, and 90 kg N ha-1 with 4 to 6 replication depending on the location. The N was applied broadcast as urea (45-0-0). Sugar beet root yield and quality were measured.

The soil nitrate-N to a depth of 120 cm before the trials were established ranged from 32 to 109 kg ha-1. The root yield, extractable sucrose ha-1, and revenue ha-1 responded to the seed placed fertilizer and nitrogen applications differently at each location. In most cases, the response was to seed placed fertilizer was either none or a positive increase to root yield. The change in root yield expressed itself in the extractable sucrose ha-1 and the revenue ha-1. The extractable sucrose Mg-1 of root was increased by the use of seed placed fertilizer and the use of nitrogen fertilizer did not affect the use of starter. This information indicates that the use of seed placed liquid fertilizer does not affect the nitrogen management of sugar beet for yield and quality.

MORISHITA, DON W.*, J. DANIEL HENNINGSEN and DONALD L. SHOUSE, University of Idaho, Twin Falls R&E Center, P. O. Box 1827, Twin Falls, ID 83301. **Comparison of adjuvants used with glyphosate for weed control in sugar beets.**

Many different adjuvants are recommended for use with glyphosate. Some studies have shown differences in weed control between adjuvants used in combination with glyphosate when applied at low rates less. A study was conducted to compare weed control efficacy with different adjuvants used in combination with glyphosate in sugar beets. Glyphosate was applied at 0.35 lb ae/A (low rate) and 0.75 lb ae/A (normal rate) with varying ammonium sulfate (AMS) rates and various adjuvants. Kochia control with glyphosate at 0.35 lb ae/A used in combination with Bronc Max + R-11 + Coverage G-20 was better than Bronc Plus Dry EDT (91 vs 85%) 8 days after the last treatment was applied (DALT). At 23 and 86 DALT evaluations, there were no differences among the adjuvants with either glyphosate rate. At the normal glyphosate rate, kochia control ranged from 89 to 96% with all adjuvants. Common lambsquarters control with the low rate at 8 DALT ranged from 64 to 90% with the different adjuvants. Bronc Max + R-11 + Coverage G-20 had the lowest common lambsquarters control. Alliance used with glyphosate had the highest lambsquarters control. This same trend was observed at 23 and 86 DALT evaluations, although the difference was not as great. Differences in Russian thistle control were similar to common lambsquarters control with the low glyphosate rate and the different adjuvants compared, where control ranged from 65 to 84% 8 DALT. There was a difference in Russian thistle control between the low and the normal glyphosate rates and some adjuvants. This was particularly true with different AMS rates, indicating the importance of using AMS with glyphosate for Russian thistle control. With the normal rate, no differences in yield were observed among the different adjuvants compared. These studies indicate that there are no differences in the adjuvants compared when using glyphosate at the recommended minimum use rate of 0.75 lb ae/A.

REGITNIG, PETER J.[1]*, BRYAN R. AVISON[1] and JENNIFER NITSCHEL M.[2], [1]Lantic Inc., 5405 – 64th Street, Taber, Alberta, Canada T1G 2C4 and [2]Alberta Agriculture and Rural Development, 100, 5401 – 1st Avenue South, Lethbridge, Alberta, Canada T1J 4V6. **Agronomic research experiences with emergence enhancement treatments in Alberta.**

Experiments in different sugar beet production regions in North America have reported increased speed of emergence, established stand and root yield as a result of emergence enhancement treatments. A total of 17 replicated trials evaluating some of these treat-

ments have been conducted in Alberta since 1996. In experiments conducted between 1996 and 1999, PAT (Primed Advancement Treatment) developed by Seed Systems Inc. (now Germains Seed Technology) was evaluated. Recent trials conducted between 2006 and 2010 evaluated UltiPro® developed by Betaseed and XBEET® developed by Germains Seed Technology. In all experiments, varieties were tested with and without emergence enhancement treatments. Direct comparisons were not made between enhancement processes in individual trials. Speed of emergence was significantly increased in 1 of 4 trials where PAT treated seed was compared to regular and pelleted seed without PAT treatment. Conversely, in 1 trial pelleted seed had significantly faster emergence than PAT treated seed. Speed of emergence was significantly increased in 2 of 6 trials where a commercial Alberta variety was tested with and without UltiPro in 2006 and 2007. Between 2008 and 2010, speed of emergence was significantly increased in 3 of 7 trials where XBEET treated seed was compared to untreated seed. The most conspicuous speed of emergence increases with XBEET occurred in a spring with abnormally cool and wet environmental conditions. Final established stand was only increased significantly in 2 of 17 trials when emergence enhancement treatments were applied and in one case final established stand was significantly reduced. Treatment with PAT, UltiPro or XBEET did not significantly increase sugar beet root yield or extractable sugar per acre in any trials.

SMITH, JOHN A., University of Nebraska, 4502 Avenue I, Scottsbluff, NE 69361. **Shank Operating Depth for Zone Tillage.**

Zone tillage began use in sugarbeet production in Nebraska during the mid-1990's. Sugarbeet growers modified and adapted the system as a means to provide soil conservation, improve sugarbeet plant population, reduce production costs and improve crop yields. Equipment manufacturers responded by designing zone tillage machines that would accommodate high quantities of surface residue, apply fertilizer, and prepare a good seedbed for planting. By 2010, zone tillage had become the most popular production system for sugarbeets in Nebraska, used on an estimated 60% of the Nebraska sugarbeet crop. The zone tillage machine shank depth is typically adjusted to operate between 9 and 12 in. deep. But what is the best or most appropriate shank operating depth? Machine draft increases dramatically with increased shank depth. Increasing the shank depth from 9 in. to 12 in. will often increase machine draft by a factor of at least two. Increasing shank depth complicates closure of the shank track and formation of a good seedbed. If the shank is not deep enough, alleviation of soil compaction may not be achieved if soil compaction exists. The objective of this study was to determine if shank

depth influenced sugarbeet yield. Treatments included three levels of surface applied soil compaction (none applied, moderate, severe) and four shank depths (0, 5, 10, 15 in.). Results from the first two years of the project include that in the absence of soil compaction; there was no difference in sugarbeet yield between the four shank depths. Severe and even moderate soil compaction reduced sugarbeet yield. In severe and moderate soil compaction, shank depths of 5 and 10 in. improved sugarbeet yield compared to zero shank depth. Shank depth of 15 in. did not increase sugarbeet yield compared to 10 in. depth.

STACHLER, JEFF M.* and JOHN L. LUECKE, Department of Plant Sciences, North Dakota State University and University of Minnesota, North Dakota State University, Dept. 7670, P. O. Box 6050, Fargo, ND 58108-6050. **Effect of late-season glyphosate on glyphosate-resistant common ragweed.**

Plant mortality and fecundity was observed in previous research to increase and decrease, respectively, when glyphosate was applied during reproduction of glyphosate-resistant common ragweed. The objective of this research was to determine the effect of glyphosate applied to glyphosate-resistant common ragweed at three stages of reproduction on plant mortality and fecundity. Glyphosate was applied twice starting at 5 cm common ragweed to select surviving plants for the reproductive stage treatments. Glyphosate (840 g ae/ha) plus ammonium sulfate (6.7 kg/378 L of spray solution) was applied to common ragweed when the terminal male inflorescence spike began to elongate in approximately 50% of the plants, 10 days later, and 20 days later. Plant mortality was determined 21 days after each in-season glyphosate application, prior to reproductive stage treatments, and near common ragweed maturity. Plants with seeds were harvested and seeds enumerated. Plant mortality increased over time and was maximized when glyphosate was applied 10 days after terminal spike elongation. Glyphosate applied 10 days after terminal spike elongation reduced glyphosate-resistant common ragweed fecundity greater than when applied at spike elongation and the untreated check.

STEWART, JAMES F.*, LEE A. HUBBELL, RALPH FOGG and BRIAN GROULX, Michigan Sugar Company, 2600 S. Euclid Avenue, Bay City, MI 48706. **Variety approval "points" system based upon yield, quality, emergence and resistance traits.**

Michigan Sugar Company has traditionally approved sugarbeet varieties based upon yield, quality, storage and Cercospora tolerance

levels. Yield levels have improved significantly in Michigan over the past 10 years but quality levels have remained fairly constant. A new approval system has been introduced in Michigan to facilitate improvements in sugarbeet quality. This "points" system also considers disease and insect tolerance and emergence in the approval process. Storage RWST is not a part of the new approval system but may be re-introduced as we improve our storage test protocol. The "old" approval standards used in 2009 approved varieties based upon their RWSA, RWST, Storage RWST and Cercospora levels. The new approval system approves varieties based upon RWSA, RWST and Cercospora minimum levels and also considers other factors including Rhizoctonia, Rhizomania and root aphid tolerance and emergence. The minimum levels for RWSA and RWST have been raised significantly while the Cercospora resistance level has been relaxed. Rhizoctonia, Rhizomania, root aphid and emergence do not have minimum approval levels but influence the approval process by contributing to a variety's total points score. The approval process works as follows: RWSA (% of check) is the starting point. Other parameters are added to or subtracted from RWSA. For RWST, the variance above or below 100% is multiplied by 3 (i.e. a variety with an RWST level of 102% would receive 6 points). Cercospora has a wide points range, from 10 for very good tolerance to -18 for poor tolerance. Rhizoctonia values range from 0 to 10, root aphid ranges from 0 to 5, Rhizomania ranges from 0 to 3 and emergence has a 10 point spread. The points are totaled and a minimum level (based on % of check) must be reached for full approval. Varieties not making approval that have desirable qualities such as nematode or Rhizoctonia tolerance will be considered for specialty approval.

TARKALSON, DAVID D.* and DAVE L. BJORNEBERG, USDA Agricultural Research Service, 3793 N 3600 E, Kimberly, ID 83341. **Effect of tillage and nitrogen fertilizer rate on sugarbeet production.**

The sugarbeet industry in Idaho is interested in strip tillage due to the potential savings in tillage costs and other production advantages. This study was conducted to evaluate the use of strip tillage in Idaho compared to conventional tillage practices. The effect of tillage method (strip tillage, moldboard plow system, and chisel plow system) and N application rate (0, 50, 100, 150, 200 lbs applied N/acre) on sugarbeet production factors were investigated in Kimberly, ID over a 3 year period (2008 – 2010) on a Portneuf silt loam. Preliminary data indicates that root yield and ERS are the same for strip tillage and moldboard plow treatments and the N requirement per ton of beets were approximately 1 to 3 lbs N/ton less than the previously recommended 7 to 8 lbs N/ton. When 2010 data has been collected and analyzed a complete short abstract will be provided.

TARKALSON, DAVID D.[1]*, IMAD EUJAYL[1], BRAD KING[1] and WERNER BEYER[2], [1]USDA Agricultural Research Service, 3793 N 3600 E, Kimberly, ID 83341 and [2]KWS SAAT AG, Einbeck, Germany. **Production response of sugarbeet breeding lines to deficit irrigation.**

Sugarbeet varieties can potentially vary in production response to deficit evapo-tranpiration (ET) water inputs. Research is needed to determine production and water input functions of genetically diverse sugarbeet breeding materials. This research will help public germplasm enhancement programs to develop selection criteria for drought tolerance as well as the industry community to environmentally and economically fine tune irrigation input practices. This study was conducted in Kimberly, ID over a 3 year period (2008 – 2010) on a Portneuf silt loam soil. Six sugarbeet hybrids and one commercial variety were grown under six water levels ranging from approximately 8% to 125% of required crop ET. Preliminary research suggests that some lines have higher production under deficit ET conductions. Complete analysis of production data and proline accumulation results will be presented after the 2010 plots are harvested.

WILSON, ROBERT G.[1]*, GUSTAVO M. SBATELLA[1] and ANDREW R. KNISS[2], [1]University of Nebraska, 4502 Avenue I, Scottsbluff, NE 69361 and [2]University of Wyoming, 1000 E. University Avenue, Laramie, WY 82071. **Volunteer glyphosate-resistant corn control and interference in glyphosate-resistant sugarbeet.**

Field experiments were conducted in 2009 and 2010 to measure the efficacy of clethodim and quizalofop applied at different rates and timings for glyphosate-resistant corn control in glyphosate-resistant sugarbeets. In addition, the competitive effect of different densities of volunteer corn on sugarbeet root yield was measured at Scottsbluff and Lingle in 2009 and 2010.

WILSON, ROBERT G.[1]*, STEPHEN C. WELLER[2], DAVID R. SHAW[3], MICHEAL D. K. OWEN[4], BRYAN G. YOUNG[5] and DAVID L. JORDAN[6], [1]University of Nebraska, 4502 Avenue I, Scottsbluff, NE 69361; [2]Purdue University, West Lafayette, IN 47907; [3]Mississippi State University, Mississippi State, MS 39762; [4]Iowa State University, Ames, IA 50011; [5]Southern Illinois University, Carbondale, IL 62901 and [6]North Carolina State University, Raleigh, NC 27695. **Benchmark study: impact of glyphosate-resistant crops on weed populations, weed management tactics, and farm profitability B can this study provide insight into the future of glyphosate-resistant sugarbeets?**

The Benchmark Study was initiated in 2006 and involves 156 producers in the states of Iowa, Illinois, Indiana, Mississippi, Nebraska, and North Carolina. Producers were randomly selected and provided a 16 ha field which was divided in half, the producer continued their weed management program on half of the field and a scientist at each university used their expertise to recommend herbicide resistance management practices. Fields selected for the study in 2006 had a minimum of a three-year field history in glyphosate-resistant (GR) cropping systems. Fields were divided into three categories: 1) a single continuous GR crop, 2) a rotation of two GR crops, and 3) a GR crop rotated with a non-GR crop. This presentation will discuss the results observed after four years and how these results can be used to develop weed resistance management practices in glyphosate-resistant sugarbeet.

YONTS, C. D., University of Nebraska, Panhandle Research and Extension Center, 4502 Avenue I, Scottsbluff, NE 69361. **Development of season long deficit irrigation strategies for sugarbeets.**

Irrigating crops to produce food is the greatest use of freshwater in the world. As population on earth increases, demand for food requires even greater amounts of water to be used for food production. At the same time, the demand for water resources is increasing from all sectors of our society. The result is that groundwater levels in many areas are declining due to overuse and surface water shortages occur during drought. The objective of this experiment was to evaluate the yield potential of sugarbeets when water resources are limited and changes in water management are required. The study was conducted from 2007 to 2010. Sprinkler irrigation was used to establish nine irrigation water treatment levels ranging from full irrigation to no irrigation during the growing season. The full irrigation treatment was based on meeting full season crop water needs of the sugarbeet. Other irrigation treatments were based on the sugarbeet receiving different fractions of the full irrigation amount being applied. Results through 2009 indicate that a significant reduction in root yield did not occur until the amount of irrigation water applied was 25% or less of the full irrigation amount. Percent sucrose on the other hand was significantly greater for the no irrigation treatment compared to all other irrigation treatments. As the amount of water being applied was reduced, only a slight decline in sucrose production resulted until the amount of irrigation water applied was 25% or less of the full irrigation treatment. Results will be given for the 2007 through 2010 growing seasons.

## Section A – Agronomy
## Poster Presentations

AVISON, BRYAN R.* and PETER J. REGITNIG, Lantic Inc., 5405 – 64th Street, Taber, Alberta, Canada T1G 2C4. **Management of unharvested sugar beet in Alberta.**

During the 2009 sugar beet harvest, extremely low temperatures persisted from the 8th to the 14th of October with temperatures dropping as low as -13.9°C (7.0ºF). Day time highs did not rise above freezing for 5 days during this period resulting in extensive root injury. Long term storage of these sugar beets was not an option, since damaged root tissue did not exhibit healing from the frost injury. Beets were harvested on a controlled basis and processed within a few days of delivery. The end result of this frost event was that significant sugar beet acreage remained unharvested in Southern Alberta in 2009. Seed bed management of these unharvested sugar beet fields was a concern for many growers. A strip trial with 3 treatments and 4 replications was conducted at the Lethbridge Irrigation Demonstration Farm on November 26, 2009 to assess different tillage options for unharvested sugar beets. Beets were not defoliated prior to tillage being conducted. Tillage treatments included fall ploughing, fall and spring disking and leaving sugar beets untilled overwinter with direct seeding of grain in the spring. Strips were randomized within each replication. Wheat was planted on May 26th, 2010 on all treatments using a Conserva–Pak air seeder with a low disturbance hoe opener on 9" shank spacing. For no tillage direct seeded strips the wheat was planted parallel to sugar beet rows. Fertilizer applied was 124 lbs N/acre and 40 lbs P2O5/acre. Wheat samples were harvested on October 15th, 2010 and yields were adjusted to 13.5% moisture. Average irrigated grain yields were 94.4 bushels/acre for fall ploughed strips, 99.8 bushels/acre for fall/spring disked strips and 98.1 bushels/acre for strips with no tillage and direct seeding. The absence of tillage when sugar beets were left unharvested did not appear to result in any detrimental effects to wheat yield the following year.

BEAUDRY, RANDOLPH[1]*, RON GEHL[2], JAMES STEWART[3] and LEE HUBBELL[3], [1]Department of Horticulture, Michigan State University, East Lansing, MI 48824, [2]Department of Soil Science, North Carolina State University, 455 Research Dr., Mills River, NC 28759 and [3]Michigan Sugar Company, 2600 South Euclid Avenue, Bay City, MI 48706. **Respiratory losses in sugar beets as a function of storage temperature, field nitrogen application, sprouting incidence and handling severity.**

The trend toward warmer temperatures in Michigan has lead to an increased risk of excessive temperatures in field piles of sugarbeets. In the 2004-2005 season, the Michigan industry is estimated to have lost approximately $25,000,000 to pile breakdown following an unusually warm winter and spring. Determination of optimal storage strategies requires knowing the effects of the major factors influencing respiratory activity. From 2005 to 2009, we evaluated the impact of storage temperature, nitrogen applied during the growing season, and handling severity on respiration after one and four months holding. In addition, the contribution of sprouts formed during storage to respiratory activity was estimated by harvesting sprouts and measuring their respiratory activity relative to the root. Field nitrogen application between 0 and 160 lb/acre did not influence respiratory activity. Commercial machine harvesting increased respiratory activity between 10 and 25% relative to hand-harvested controls and the impact of machine harvesting increased with storage duration. Beets collected after dropping into full, half-full and empty trailers all experienced enhanced respiration, with the greater respiratory activity induced by the most damaging treatment. The data collected will be used to model respiratory activity and pile temperature profiles for field-stored sugarbeets in Michigan.

CATTANACH, NORMAN R.[1]* and LAURA F. OVERSTREET[2], [1]Soil Science, North Dakota State University, Department 7680, P. O. Box 6050, Fargo, ND 58108-6050 and [2]Department of Crop Sciences, University of Illinois, 314 ERML MC-051, 1201 W. Gregory Drive, Urbana, IL 61801. **Four years of strip tillage in a wheat-beet-soybean-corn rotation in ND and MN.**

This is the longest-running project examining effects of strip tillage on three major row crops at multiple locations in the Red River Valley region. The study was replicated at two locations: the Prosper research station in ND and a grower-cooperator's farm near Moorhead, MN. Both sites are relatively well-drained and located on regionally representative soil types with no history of major disease. The study was designed as a randomized complete split plot with two whole plot treatment factors: strip tillage vs. conventional chisel plow tillage. Split plot treatment factors are each of the four crops used in the rotation (i.e. wheat, sugarbeet, soybean, and corn); each crop is present in each year of the study. The data produced from this study proves that strip-tillage can produce sugarbeet, soybean, and corn yields that equal or exceed those obtained using conventional tillage. Although sugarbeet root yield was the same for both tillage treatments, reduced sugar and greater loss to molasses was consistently observed in strip tillage systems. These issues can be largely overcome with appropriate management practices. During the 4 years of this study, corn consistently (6 out of 8 site-years) produced

higher yields with strip tillage than conventional tillage. Averaged over all site-years, soybean produced statistically equal yields under the two tillage systems. Based on results of this study, we do not recommend spring strip tillage for sugarbeet production on moderate- to poorly-drained soils in the Red River Valley. Otherwise, strip tillage is an effective, productive, and cost-saving tillage alternative to conventional full-width tillage for sugarbeet, corn, and soybean production in the Red River Valley.

CLARK, GREG M.[1]*, JAMES F. STEWART[2], LEE A. HUBBELL[2], RALPH FOGG[1] and BRIAN GROULX[2], [1]Michigan Sugar Company, 2600 S. Euclid Avenue, Bay City, MI 48706 and [2]Michigan Sugar Company, 1459 S. Valley Center Drive, Bay City MI 48706. **Influence of nitrogen application timings and methods on sugarbeet yield and quality.**

Sugarbeet yields have increased significantly in Michigan in the past decade; however, sugarbeet quality has remained relatively constant. Improving sugarbeet quality over the next five years is a principal goal of the sugarbeet cooperative in Michigan. The proper use of nitrogen fertilizer plays an important role in both the yield and quality of sugarbeets. Many growers in Michigan effectively manage their fertility programs in sugarbeets, however, some growers apply too much nitrogen or apply nitrogen too late in the season. Both of these practices significantly lower sugarbeet quality. Trials were conducted in 2008, 2009 and 2010 to determine the best application method and timing for nitrogen in sugarbeets. Overall, sugarbeet quality and yield increased in treatments which included 2X2 placement of nitrogen compared to treatments where all of the nitrogen was applied preplant incorporated or side dressed at the 4 to 6 leaf stage. Yields and quality were significantly lower when the side dress application was delayed until the 12 leaf stage. The 2X2 treatments reached row closure earlier, had a lighter green canopy and lower amino levels than preplant incorporated or side dress treatments. There was not a significant yield or quality difference between preplant incorporated and side dressed nitrogen applications. None of the treatments reduced sugarbeet stand.

DEAN, GREG A.[1]* and DAVID M. ELISON[2], [1]The Amalgamated Sugar Co. LLC, P. O. Box 8787, Nampa, ID 83653 and [2]The Amalgamated Sugar Co. LLC, P. O. Box 700, Paul, ID 83347. **Managing nitrogen fertilizer for maximum returns of the sugar beet crop as related to soil type.**

The Amalgamated Sugar Company's sugar beet production area

is large and has many different types of soil. Previously Company Crop Consultants have used a constant of eight lbs. of N be required for each ton of beets produced across all soil types. This N constant was generated thirty years ago with different sugar beet varieties and without Roundup Ready® sugar beet seed, across all soil types. The amount of mineralized N coming from each soil type is still unknown, but it is accepted that it differs by soil type. Because soil type has an effect upon the mineralization of N, and sugar beet varieties have changed, we decided to take another look to see if we could further refine, by soil type, the N constant used for making fertilizer recommendations in our sugar beet growing area. Over the past three years, replicated small plot studies have been conducted across our growing area on silt loam, clay loam, and sandy loam, type soils. Results from these studies show that use of lower N constant rates for silt loam and clay loam soil types, as well as sometimes lowering the rate for sandy loam soils is advisable for further increasing sugar optimization without lowering tonnage production.

ECKHOFF, J. L. A.*, J. W. BERGMAN and C. R. FLYNN, Montana State University, Eastern Agricultural Research Center, 1501 N. Central Avenue, Sidney, MT 59270. **Scalped vs. non-scalped sugarbeets.**

Defoliating sugarbeets without removing the crown can increase storage quality. Because the crown has lower sucrose and more impurities than the body of the sugarbeet, removing the crown with knives (scalping) can result in higher sucrose per delivered ton for the producer, but can increase spoilage in the pile. The objective of this study was to compare scalped and non-scalped sugarbeets for yield and quality. In this four year study, sugarbeets were defoliated using flails but not knives. Sugarbeets were dug from the field and each beet was split in half with a saw. One half was scalped to the last leaf scar using a machete, and the other half was not scalped. The two halves were put into paired bags, with one bag having all the scalped halves and the other having all the non-scalped halves. Fifteen to eighteen sugarbeets were used for each pair of bags. Twelve pairs of bags were evaluated each year. Sugarbeet weight, sucrose and impurities were compared using a paired-t test. Across years, scalped beets had a 7.7% yield loss to scalping and had 0.14% increase in sucrose content. Non-scalped sugarbeets had significantly greater sodium and amino-N contents, resulting in greater sucrose loss to molasses.

GROULX, BRIAN J.[1]*, LEE A. HUBBELL[1], JAMES F. STEWART[1] and RALPH FOGG[2], [1]Michigan Sugar Company, Agricultural Research Center, 1459 S. Valley Center Drive, Bay City, MI 48706 and [2]Michigan Sugar Company, 2600 S. Euclid Avenue, Bay City, MI 48706. **Effect of row width and population on sugar beet yield and quality.**

In the effort to improve beet yield and quality in Michigan, row width has become an important topic. Approximately 20% of Michigan Sugar Company growers are growing beets in narrow rows. For the planting season of 2009, Michigan Sugar Company's Agricultural Research made the change from 30 inch row width to 22 inch row width for all research trials. In 2009, one trial was completed comparing 30 inch to 22 in row widths at seven populations (75, 100, 125, 150, 200, 225, and 250 beets/100ft. of row). The trial was planted at a high population and then thinned at the four leaf stage to the respective amount of beets/100ft of row. When populations were averaged, beets planted in 22 inch rows had an increased yield of 2.97 tons/acre compared to 30 inch rows. In general, yields increased as populations increased for both row widths. In 30 inch rows, the yield declined at the highest populations. There was no difference in sugar content between the two row widths. In 2010, two trials were completed comparing 30 inch to 22 inch row widths at six populations (15000, 20,000, 25,000, 30,000, 40,000, and 50,000 beets/acre). The trials were planted at a high population and then thinned at the four leaf stage to the respective amount per acre. When populations were averaged, beets planted in 22 inch rows had an increased yield of 3.4 tons/acre and an increase in sucrose by .4 percentage points over beets planted in 30 inch rows. Yields tended to increase in 22 inch rows as the population increased. Beets planted in 30 inch rows had their highest yield at the 40,000 beets/acre population. When both row widths were combined to compare populations, both yield and quality increased as populations increased.

HERGERT, GARY W.* and REX A. NIELSEN, University of Nebraska Panhandle Research and Extension Center, 4502 Avenue I, Scottsbluff, NE 69361. **Effect of manure compost on sugar beet yield and quality.**

Before the advent of commercial fertilizer, manure application was the only means of supplying additional N other than plowing down previous legume crops for sugar beets. Manure mineralizes slowly over the summer and into the fall which can affect sugar content and impurities. Composted manure is lower in total N content than feedlot manure and composting reduces the mineralization rate of the N. Due to significant fertilizer cost increases in 2008, producers were interested in using low rates of compost to supply both P and N

for sugar beets. Compost and commercial N fertilizer were compared during 2009 and 2010 near Scottsbluff, NE. Effects on sugar beet stand, yield, sugar content and sucrose production and sugar loss to molasses (SLM) were evaluated. N rates of 0, 60 and 120 lbs N/acre were compared to composted manure rates of 4, 8 or 16 tons per acre. The composted manure contained 15 to 18 lbs total N per ton. Data showed no significant N source effects were shown on late June stand counts. In 2009, N application significantly increased tonnage. Yields of commercial N treatments or the 8 or 16 ton compost averaged 28.5 tons per acre. There was no effect on sugar content. SLM has higher for all manure treatments (SLM = 1.44 versus 1.34 for commercial N). 2009 sugar content was low (average 14.5%). Data from 2010 will be included when available as harvest just concluded. The first year results, however, show that even the highest compost rate did not produce a disaster. The rates farmers are currently using (4 to 6 T/acre at $18-$22/T) will probably provide good yields plus acceptable sugar and SLM.

POWELL, GARY E.* and CHRISTY L. SPRAGUE, Department of Crop and Soil Sciences, Michigan State University, Plant and Soil Sciences Building, East Lansing, MI 48824. **Volunteer glyphosate-resistant soybean management in glyphosate-resistant sugarbeet.**

One of the greater weed challenges in glyphosate-resistant sugarbeet is management of other glyphosate-resistant crops. Glyphosate-resistant corn, canola, and even soybean can be found in glyphosate-resistant sugarbeet fields. A field trial was conducted in 2009 and 2010 to examine different management strategies for volunteer glyphosate-resistant soybean and what effect volunteer soybean may have on glyphosate-resistant sugarbeet yield. Fifteen different treatments examining application timing, clopyralid and triflusulfuron application rates, and adjuvant systems were studied. The control treatment was two applications of glyphosate at 0.84 kg ae/ha plus ammonium sulfate (2% w/w) applied at 5-cm followed by 10-cm weeds. These application timings corresponded with V2 and V4 volunteer glyphosate-resistant soybean. Glyphosate was applied alone and in combination with the various treatments described above in either the first or second application timing. Results indicated that the greatest volunteer glyphosate-resistant soybean control that triflusulfuron provided was less than 70%. This treatment included methylated seed oil (MSO) at 1% v/v. All treatments that contained clopyralid provided greater than 80% control of volunteer glyphosate-resistant soybean.

SPANGLER, ALICIA J.*, CHRISTY L. SPRAGUE and DARRYL D. WARNCKE, Department of Crop and Soil Sciences, Michigan State University, Plant and Soil Sciences Building, East Lansing, MI 48824. **The effect of nitrogen and time of weed removal on sugarbeet yield and quality in glyphosate-resistant sugarbeet.**

Effective weed control is a key component for achieving high quality yields in sugarbeet. A field experiment was conducted at two locations in Michigan during the 2010 growing season. The objectives of this experiment were to: 1) determine if early-season weed growth affected the amount of nitrogen available to sugarbeet, and 2) determine if nitrogen is a limiting factor for early-season weed competition for sugarbeet yield and quality. Nitrogen was applied preplant at 0, 67, 100, and 135 kg/ha. An additional treatment included a split-application of 135 kg/ha of nitrogen applied preplant and when sugarbeet was at the 4 to 6-leaf stage. Glyphosate at 0.84 kg ae/ha plus 2% w/w of ammonium sulfate was used to remove weeds <2, 8, 15, and 30 cm tall. A non-treated control was also present. Plots were maintained weed-free after the initial glyphosate application. Sugarbeet were analyzed for total nitrogen at each weed removal timing and at the end of the growing season. At one location, across all nitrogen rates weeds that were not removed until they were 8 cm tall reduced sugarbeet yield and recoverable white sugar per hectare.

SPRAGUE, CHRISTY L.*, GARY E. POWELL and ERIN C. TAYLOR, Department of Crop and Soil Sciences, Michigan State University, Plant and Soil Sciences Building, East Lansing, MI 48824. **Cover crops and reduced tillage in glyphosate-resistant sugarbeet.**

Cover crops and reduced tillage systems may have a fit in sugarbeet production with the use of glyphosate-resistant sugarbeet. Over the last three years we have conducted research to evaluate strategies utilizing the cover crops; oat, winter wheat, oriental mustard, and oilseed radish and the reduced tillage systems; no-till and spring strip-tillage in glyphosate-resistant sugarbeet. The objective of this experiment was to evaluate weed control, sugarbeet stand establishment, yield and quality in these different systems. Cover crops were planted in the early fall following dry bean or soybean harvest. Tillage-strips were established in the spring with a four-row strip-tillage implement, two more weeks prior to planting. A third factor in this experiment examined the time of early-season glyphosate application. Glyphosate at 0.84 kg ae/ha plus ammonium sulfate at 2% w/w was applied two weeks prior, at planting, or two weeks after planting. Results varied between the different years of this research. In at least one of the years, cover crop type had a significant effect on weed control. We have also observed tillage, glyphosate application timing, and cover crop effects and interactions on sugarbeet yield.

TARKALSON, DAVID D.* and DAVE L. BJORNEBERG, USDA, Agricultural Research Service, 3793 N. 3600 E., Kimberly, ID 83341. **Effects of phosphorus placement and rate on sugarbeet production.**

The sugarbeet industry in Idaho is interested in strip tillage due to the potential savings in tillage costs and other production advantages. The effect of phosphorus (P) placement and rate on sugarbeet production factors were investigated in Kimberly, ID over a 2 year period (2009 – 2010) on a Portneuf silt loam. Treatments included eight P rates ranging from 0 to 205 lbs $P_2O_5$/acre and two placements (banded with strip tillage shank 6 inches below seed and broadcast). All P fertilizer was applied prior to planting. Nitrogen fertilizer was applied at the same rate over the entire study with placement treatments received equal proportions of N both surface applied and banded. In 2009, average initial Olsen soil test P in 2009 was 3.7 mg/kg over the study area. In 2009 band placement of P increased root yields by 1 ton/acre compared to broadcast averaged over all P application rates. Yield increases were realized at the lowest P application rate of 50 lbs $P_2O_5$/acre. When 2010 data has been collected and analyzed a complete short abstract will be provided.

WAHLERT, BILL[1]*, GREG DEAN[1] and DAVID M. ELISON[2], [1]The Amalgamated Sugar Company, LLC, P. O. Box 8787, Nampa, ID 83653 and [2]The Amalgamated Sugar Company, LLC, P. O. Box 700, Paul, ID 83347. **Nitrogen use management in sugar beet culture as related to silt loam soils in the Grande Ronde Valley of Eastern Oregon.**

In recent years, The Amalgamated Sugar Company has used eight pounds of nitrogen per ton of beets as its base. The Grande Ronde Valley of Eastern Oregon has a soil organic matter of two to three percent which can be two percent more than the typical sugar beet fields in the Amalgamated growing area. Mineralization of N in these higher organic loam soils is an inherent unknown factor of nitrogen management. While the mineralization rate is unknown, it is believed that higher organic soils will have a higher mineralization of N. This difference in N mineralization, when combined with changes in seed varieties and the advent of roundup ready sugar beet seed, leads me, as a crop consultant in this growing area, to think that this N rate of eight pounds is too high. This past year, with the help of the company area agronomists on a silt loam type soil, I conducted a study to see if I was correct. The results of this study suggest that lower N rates can be used when recommending N rates to attain maximum sugar per acre.

WILSON, ROBERT G.* and GUSTAVO M. SBATELLA, University of Nebraska, 4502 Avenue I, Scottsbluff, NE 69361. **Influence of different brands of glyphosate and spray adjuvants on weed control and sugarbeet performance.**

Nine brands of glyphosate and nine water conditioning agents were compared over a two year period for weed efficacy and sugarbeet selectivity. Not all glyphosate brands or water conditioning agents were equal in efficacy.

## Sections B & E
## Physiology, Biotechnology, Genetics and Germplasm
## Oral Presentations

EUJAYL, IMAD A.[1]*, CARL A. STRAUSBAUGH[1], WOLFGANG MICHELKE[2] and ANDRZE J. KILIAN[3], [1]USDA-ARS, Northwest Irrigation and Soils Research Laboratory, 3793 N. 3600 E., Kimberly, ID 83341, USA, [2]KWS-SAAT AG, Grimsehlstr. 31, 37555 Einbeck, Germany and [3]Diversity Array Technology PL, 1 Wilf Crane Crescent, Yarralumla, ACT 2600, Australia. **DArT based genetic linkage map of sugarbeet and mapping of beet curly top.**

Determining mode of inheritance and identification of markers linked to B*eet curly top virus* (BCTV) are critical to developing BCTV resistant germplasm. The objectives of this study were to construct a high-density genetic linkage map so as to identify DNA markers closely linked to BCTV resistance genes. Diversity Arrays Technology (DArT) markers were developed for sugar beet providing 2,300 publically available markers for genotyping. These markers were produced from genomic representations from genetically diverse panel of commercial varieties, germplasm accessions, and wild relatives. A genetic linkage map was constructed from 598 DArT, 39 SNP and 27 SSR markers on 182 individuals of an $F_2$ population that is segregating for BCTV. The parents and the F2 population were phenotyped in the greenhouse using viruliferus hoppers that were clip-caged on each plant. The female parent (P1) showed no visible symptoms in reaction to BCTV and the male parent (P2) was completely susceptible. Additionally, the population was evaluated for virus accumulation using ELISA, and parents showed 0.2 and 3.8 OD values at 405 nm for P1 and P2 respectively. The BCTV resistance in this $F_2$ population is controlled by few major genes and several markers were identified linked to resistance genes in three linkage groups.

FUGATE, KAREN KLOTZ[1]*, JOCLEITA P. FERRAREZE[2] and MELVIN D. BOLTON[1], [1]USDA-ARS, Northern Crop Science Laboratory, 1605 Albrecht Blvd. N., Fargo, ND 58102-2765 and [2]Federal University of Viçosa, Viçosa, MG, Brazil 36571-000. **Jasmonic acid and salicylic acid inhibit growth of three sugarbeet storage rot pathogens.**

Storage rots contribute to postharvest losses by consuming sucrose and increasing carbohydrate impurities that increase sugar loss to molasses during processing. They also increase root respiration rate, which causes additional sucrose loss and contributes to pile warming. Currently, storage rots are controlled by cooling piles and removing pile 'hotspots' as they develop, since low temperatures reduce the growth rate of many rot-causing organisms. Such control methods, however, require favorable weather conditions and continuous monitoring of piles, and they are limitedly effective in controlling those rot-causing fungi that are capable of growth at low temperatures. Jasmonic acid and salicyclic acid are endogenous plant hormones that have been shown to induce plant defense responses and reduce storage diseases in several crops when applied exogenously. The ability of these compounds to reduce the incidence and severity of storage diseases of sugarbeet, however, has not been previously reported. Pretreatment of sugarbeet roots with jasmonic acid or salicyclic acid reduced the severity of disease symptoms after inoculation with *Botrytis cinerea*, *Penicillium claviforme*, and *Phoma betae*, three common storage rot-causal organisms. Both jasmonic acid and salicyclic acid were more effective in limiting infections due to *B. cinerea* and P. betae, than those caused by *P. claviforme*. The effect of jasmonic acid and salicyclic acid on the expression of defense-related genes and the activity of defense-related enzymes is currently under investigation. Results from these ongoing investigations will be presented.

HOFFMAN, CHRISTA M., JENS LOEL, CHRISTINE KENTER and BERNWARD MAERLAENDER*, Institute of Sugar Beet Research, Holtenser Landstr. 77, 37079 Goettingen, Germany. **Analysis of the breeding progress of sugar beet.**

Breeding of new sugar beet varieties allows a steady increase of yield and thereby contributes to the increasing demand for plant biomass. The aim of this study was to analyze the extent of the breeding progress of sugar beet varieties and to show which characteristics were modified by breeding. Sugar beets approved as varieties during the years 1964 to 2003 were cultivated under equal environmental conditions in field and greenhouse experiments, to exclude effects from alterations in production technique and climatic conditions. Differences in beet yield therefore regarded as breeding progress. Re-

sults show that breeding caused an increase in the white sugar yield of about 0.6 to 0.9 % a-1. This progress was realized by an increased harvest-index (higher root/leave ratio and higher sugar/marc ratio), an improved technical quality (decreased standard molasses loss) and an improved assimilation (higher chlorophyll content, improved efficiency of the photosynthesis) of the sugar beets. To continue the increase of breeding progress in future it is essential to work on parameters like disease and pest resistance and stress tolerance. A sustainable improvement of sugar beet yield by breeding can be achieved by modifying several traits.

McGRATH, J. MITCHELL* and LINDA E. HANSON, USDA-ARS, SBRU, 494 PSSB, Michigan State University, East Lansing, MI 48824-1325. **Overview of breeding and enhancement activities at East Lansing, Michigan.**

The ARS breeding and germplasm enhancement program at East Lansing, Michigan has been active for over 50 years, and was instrumental in breeding for resistance to Aphanomyces seedling disease, germplasm conversion for hybrid seed production, and developing smooth-root germplasm to reduce soil tare. Throughout this process, the focus has been on practical agronomic conversion to useful varieties and germplasm for the humid, rain-fed, sugar beet growing regions as typified by the Great Lakes region. For many reasons, our understanding of the genetic basis of these traits, and perhaps the majority of traits in sugar beet, has lagged behind our ability to recombine different disease resistances with sucrose yield, as well as application of technologies that would be useful to dissect the genetic basis of useful heritable variation for sugar growers. Three requisites to dissect the genetics of any trait are a (1) a population in which the trait(s) of interest segregates, (2) one or more measurable characteristics, e.g. traits, and (3) a context that allows clarification of the underlying genetic processes (e.g. markers and methods). Sugar beet suffers in the first instance by its complex self-incompatibility system, a trait that precludes self-fertilization for traditional, powerful, Mendelian genetic approaches to trait dissection. Over 10 years of deploying the self-fertility ($S^f$) allele has allowed developing a number of very interesting populations for genetic analyses. The process of inbreeding has not been as detrimental for fecundity as expected although it is unlikely inbreds would ever supplant hybrids for sucrose production. Traditional germplasm enhancement activities are still a strong component of the program, however stacking traits and resistances in such populations will eventually require marker-assisted approaches. The combination of population and marker development, ongoing, with existing expertise in measuring phenotypic variation is expected to facilitate introgression of novel alleles from wild

germplasm as part of a more directed approach to sugar beet germplasm enhancement.

MARCINEK, RAFAL, CHRIS MARROW and STEPHEN HARPER*, Germains Seed Technology, Hansa Road, King's Lynn, Norfolk, PE30 4LG, UK. **Changes in viability and germination speed of primed sugar beet seed during storage**

It is accepted knowledge for many species that while priming results in both faster and more uniform germination it causes some degree of loss of shelf life. Priming protocol development must take account of the shelf life requirement for each individual product. Shelf life is often determined simply as loss of viability, but there is also a progressive slowing of germination speed with increasing period of storage. This is of particular significance for primed seed where speed gained through priming is potentially at risk

Storage characteristics of sugar beet seed have not been reported in detail, but appear to follow common rules that can be applied to all species. Shelf life is reduced by half for (1) every 1% increase in moisture and (2) every 5.6°C (10°F) increase in temperature. Hence, to fully characterize changes in sugar beet seed during storage, it is essential to control both temperature and moisture content. We have stored seed under a variety of controlled conditions. At 20°C and 50% relative humidity, which we believe represents typical storage conditions for commercial sugar beet seed coated products, the viability determined by laboratory germination tests does not deteriorate over a period of 18 months. This applies equally to unprimed and primed seed. The story is different for speed of germination. There is a progressive loss of germination speed with time of storage. After 18 months, the increase in speed gained through priming is generally reduced though to a degree that differs greatly between seedlots. But unprimed seed also becomes slower in storage, such that the margin between unprimed and primed seed is preserved.

PANELLA, LEE, USDA, Agricultural Research Service, 1701 Center Avenue, Fort Collins, CO 80526. **Screening sugar beet germplasm for resistance to *Rhizoctonia solani* in artificially induced field epiphytotics: Examining 25 years of data.**

Rhizoctonia root rot (caused by the fungus *Rhizoctonia solani* Kühn, AG2-2) continues to be a problem in most sugar beet-growing areas in the United States, and is a growing problem worldwide. The USDA-ARS at Fort Collins has screened germplasm in artificially induced epiphytotics to provide uniform, heavy disease pressure for over 50 years. One of the major concerns with an artificially created

epiphytotic event is that the disease pressure is uniform and consistent. Also of concern, is the potential for "cryptic variation" or "interplot interference" – i.e., the influence of including many susceptible lines in the same trial. If inoculum load is a limiting factor, and resistance is partial (as is the case with sugar beet and Rhizoctonia root rot), a large number of susceptible lines might cause a trial to be more severe than a trial with many resistant lines. The same check lines have been used in the Fort Collins nursery since 1985. In each year, there are from 6 to 10 experiments within the disease nursery, each of which contains the check lines. This allows us to monitor variation in results from within each year as well as from one year to another. Consistency of disease pressure seen within a single year is not necessarily seen over all years. For example in 1992 the mean value of the Disease Index (DI) of the susceptible check was 1.3 and in 1997 it was 6.5, rated on a scale of 0 (no damage) to 7 (dead plant with root completely rotted). For 1992 and 1997, the highly resistant check had a DI of 0.7 and 3.8, respectively. This environmental variation underscores the necessity of using consistent checks across years to compare results across years.

SAVARY, BRETT J.[1,2]*, PRASANNA VASU[1] and JOSE C. TOVAR[1], [1]Arkansas Bioscience Institute and [2]College of Agriculture, Arkansas State University, Jonesboro, AR 72467. **Development of an enzyme for beet pulp processing.**

Processing sugar beet pulp for animal feed is an energy intensive process with the result being a low-value co-product. We are investigating a naturally thermostable pectinesterase for innovative applications in processing sugar beet pulp. Envisioned applications include reducing pulp drying energy costs, promoting biochemical treatment for biomass fermentation, and modifying polysaccharide structure and function in pulp for feed and new biobased products. The enzyme tolerates sustained heating at 75 deg C with little loss of activity. We have developed an efficient process for purifying the enzyme from a GRAS source and have obtained its complete gene sequence (Savary *et al.*, 2010, US Patent No. 7,803,597 B2). We present details of the enzyme and outline experimental objectives to over-express it, determine fundamental structure-function relationships, and develop bench-scale application assays with it.

## Physiology, Biotechnology, Genetics and Germplasm Poster Presentations

BULLOCK, MURRAY S., Holly Hybrids, 220 East 200 South, Burley, ID 83318. **Storage comparison for beets on and in a storage building beet pile.**

Sugar losses in stored beets are a concern for sugar companies. In order to develop varieties that may store long term, the boundary conditions for storage must be defined. If beets could just be placed on the pile instead of in the pile and provide similar storage information as a variety in the pile then there would be less effort needed to obtain data. This study was set up to determine if surface rot and sugar losses on top of a storage building pile were comparable to storage within the same pile. The study took place in an 80,000 ton storage building owned by The Amalgamated Sugar Company (TASCO) at Paul, Idaho. Samples from 18 experimental varieties were taken during harvest in September 2009 from Holly Hybrid proprietary trials and placed in tare bags. The samples were then transferred into onion bags for the duration of the storage. The samples were split with one set placed on top of the pile and the other set hung with ropes in the pile. Visual beet surface rot estimates and sugar losses were measured and rankings of the varieties made with differences noted. Sugar reduction ranged from 22 to 83% for individual samples stored in the pile and from 21 to 73% for samples stored on the pile in the storage building. This could be useful information for breeding storage characteristics into future varieties.

HELLIER, BARBARA C.[1]*, LEE PANELLA[2], YASMINA EL BAHLOUL[3] and NAIMA QARIOUH[4], [1]USDA-ARS, Western Regional Plant Introduction Station, 59 Johnson Hall, Pullman, WA 99164; [2]USDA-ARS, Sugar Beet Breeding Unit, Fort Collins, CO 80526; [3]National Institute of Agronomy Research, Genetic Resources and Plant Breeding Unit, Rabat, Morocco, and [4]National Institute of Agronomy Research, Setatt, Morocco. **New additions to the National Plant Germplasm System's Beta collection: Southern Morocco expedition.**

The USDA Agricultural Research Service's National Plant Germplasm System's (NPGS) *Beta* collection is comprised of 2,541 accessions from 14 species. The largest number of accessions is from *Beta vulgaris* ssp. *vulgaris*, (domesticated beet crops – table, leaf (Swiss chard), fodder and, primarily, sugar beets) and *Beta vulgaris* ssp. *maritima* (sea beet, the progenitor and wild relative of domesticated beet). Beta accessions in this collection originate from 54 countries worldwide. Accessions of wild sea beet, *Beta vulgaris* ssp.

maritima, a source of resistance genes for cultivated beet, are well represented from locations along the northern Mediterranean coast and up the Atlantic coast into Norway. Collections from wild populations along the southern Mediterranean coast and down the northern African Atlantic coast are not well represented, and were completely lacking from Morocco. The 2010 NPGS funded expedition to the southern Atlantic coast of Morocco yielded 16 new accessions of *Beta vulgari*s ssp *maritima* and 15 of *Patellifolia patellaris* (previously *Beta patellaris*), which is part of the tertiary gene pool for sugar beet. These accessions represent the southernmost locations from which *Beta* germplasm in gene banks has been collected to date. In addition to seed, habitat data, geographic coordinates, images, and herbarium samples were collected to document the new accessions. Collection locations ranged from 0 to 416 meters elevation from the coastal and semi-desert scrub ecosystems.

LAFTA, ABBAS M. and KAREN KLOTZ FUGATE*, USDA-ARS, Northern Crop Science Laboratory, 1605 Albrecht Blvd. N., Fargo, ND 58102-2765. **Metabolic changes associated with elevated respiration rate in stored sugarbeet roots after injury.**

Although respiration is estimated to cause 60 to 80% of the sucrose loss that occurs during storage, the mechanisms controlling sugarbeet root respiration rate are unknown. Previous research suggested that sugarbeet root respiration was limited by the availability of respiratory substrates, which are synthesized from sucrose by the combined action of sucrose-degrading enzymes, the glycolytic pathway, and the tricarboxylic acid cycle (TCA). To identify possible restrictions in these pathways that may limit respiratory substrate availability and thereby limit respiration, changes in the concentration of compounds that are substrates, intermediates, or cofactors in the respiratory pathway were quantified in roots whose respiration was elevated by injury. In wounded tissue, respiration increased an average of 186%, fructose, glucose 6-phosphate, ADP and UDP concentrations increased, and fructose 1,6-bisphosphate, triose phosphate, citrate, isocitrate, succinate, ATP, UTP and NAD+ concentrations decreased. In the nonwounded tissue of wounded roots, respiration rate increased an average of 21%, glucose 6-phosphate, fructose 6-phosphate, glucose 1-phosphate and ADP concentrations increased, and isocitrate, UTP, NAD+, NADP+, and NADPH concentrations declined. In wounded tissue, the data suggests that activities of early glycolytic enzymes limited carbon flow through glycolysis, although these restrictions were likely overcome by use of metabolic bypasses that allowed carbon compounds to enter the pathway at glycolytic and TCA cycle downstream locations. In nonwounded tissue, the data suggests that glycolysis and the TCA cycle

were generally capable of supporting small elevations in respiration rate. Although the mechanism by which respiration is regulated in wounded sugarbeet roots is unknown, localized and systemic elevations in respiration were positively associated with one or more indicators of cellular redox status.

LI, HAIYAN*, SENTHILKUMAR PADMANABAN and ANN C. SMIGOCKI, USDA-ARS, Molecular Plant Pathology Laboratory, 10300 Baltimore Avenue, Beltsville, MD 20705. **Sugar beet root maggot (*Tetanops myopaeformis*) genes modulated by resistant and susceptible interactions with *Beta vulgaris*.**

Sugar beet root maggot (SBRM) is one of the most devastating insect pests of sugar beet, infesting two-thirds of all U.S. sugar beet acreage. No completely resistant germplasm for its control has been identified. To develop effective SBRM control strategies, our laboratory has been characterizing sugar beet root defense responses incited by SBRM in a moderately resistant F1016 and a susceptible F1010 sugar beet line. More than 150 sugar beet root ESTs were identified using suppressive subtractive hybridization (SSH) following SBRM infestation of sugar beet roots. Several of these genes are currently being studied to define their particular role in the resistance mechanism. However, our knowledge of SBRM response to plant launched defense is limited. We are currently focusing our studies on the identification of SBRM genes that are responsive to resistant and susceptible interactions with sugar beet roots. PCR-select SSH was used to generate cDNA libraries enriched for SBRM genes that are modulated during the interaction of the pest with F1016 and F1010 germplasm. After 72 h starvation, SBRM larvae were fed F1016 or F1010 roots. At 1, 6, 24, 48 and 72 h after infestation, 20 larvae were collected for each time point for further analysis. Three complete subtractions were conducted using pooled tissues from the five time points: SBRM fed on F1016 vs. unfed, SBRM on F1010 vs. unfed, and SBRM on F1016 vs. on F1010. Screening of differentially expressed SBRM genes is ongoing. Genes identified as being important in resistant or susceptible pest-plant interactions will be selected for further analyses. New insights into the molecular response elicited by SBRM in interactions with sugar beet roots will advance the development of novel approaches for more effective SBRM control.

LINDSEY, RAYMOND S.[1] and J. MITCHELL McGRATH[2]*, [1]Crop and Soil Sciences, Michigan State University and [2]USDA-ARS, SBRU, 494 PSSB, Michigan State University, East Lansing, MI 48824-1325. **Examining salt stress for improvement of seedling vigor.**

Emergence and stand establishment through the first 10 weeks after planting continue to be primary concerns of sugar beet growers worldwide. Our goal is to understand the genes and genetics of seedling vigor, with vigor defined here as the ability of seedlings to tolerate adverse environments. Ongoing work shows an apparent induction of vigor via hydrogen peroxide that results in mobilization of stored lipid reserves for heterotrophic growth in good emergers, and that exogenous hydrogen peroxide can rescue the adverse effects of NaCl stress on germination percentages. We used this method to screen a series of adapted and unadapted germplasm to identify for tolerance to NaCl during germination, and selected and enhanced a number of germplasms that perform reasonably well under ion toxicity stress, notably progeny derived from Ames3051. Characterization of Ames3051 progeny showed that germination was retarded in 75 mM or 150 mM NaCl relative to water or hydrogen peroxide, but final germination was not significantly affected. Candidate genes were identified from the literature that were shown to be involved in response(s) to salt stress, and their cognate genes were identified from sugar beet nucleotide sequence collections. These will have been used to examine differential gene expression during salt stress germination. Accumulation of small molecule metabolites (proline, glycine betaine) quantified via mass spectroscopy will help to characterize the mechanisms of salt stress tolerance in sugar beet.

LONG, JORDAN, HEATHER WEBB and STEPHEN HARPER*, Germains Seed Technology, Hansa Road, King's Lynn, Norfolk, PE30 4LG, UK. **Speed and uniformity of sugar beet seed germination determined by automated image capture and time course analysis.**

Yield potential of sugar beet crops is reduced by slow and protracted emergence. Smaller seedlings trap less of the available solar radiation and poor root uniformity causes greater losses at harvest. Seed priming confers a degree of tolerance of adverse seedbed conditions, but affects yield potential primarily because of faster and more uniform germination. Speed of laboratory germination has been shown to be closely correlated with speed of emergence in the field. We have developed technology for automated germination time course analysis that finds application both in priming protocol development and in commercial product quality assurance. Pictures of germinating seed are taken at intervals, of 3 hours in our standard protocol, and analyzed for germinated seedlings thus providing a de-

tailed germination time course profile. Changes in speed, such as after priming, can be expressed simply as the difference in time taken for 50% germination ($T_{50}$). In tests at 20°C (68°F), XBEET is typically 20 hours faster to $T_{50}$ than non-primed seed. This equates to 25% of the time taken to reach $T_{50}$ by unprimed seed. Uniformity, expressed for example as the time between 25% and 75% germination ($T_{25}$-$T_{75}$) is also increased.

PADMANABAN, SENTHILKUMAR*, HAIYAN LI, DAVID P. PUTHOFF and ANN C. SMIGOCKI, USDA-ARS, Molecular Plant Pathology Laboratory, 10300 Baltimore Avenue, Beltsville, MD 20705. ***Beta vulgaris* promoters for directed tissue-specific root transcription.**

Several sugar beet (*Beta vulgaris* L.) insect pests and microbial pathogens specifically target the tissues of the taproot. The use of root tissue-specific promoters to confer expression of pest and disease resistance genes in a targeted manner has the potential for genetic improvement of commercial sugar beet varieties. Using suppressive subtractive hybridization our laboratory has identified sugar beet root genes responding to infestations by the sugar beet root maggot (*Tetanops myopaeformis*) in both a moderately resistant F1016 and a susceptible F1010 line. These sugar beet EST libraries were subjected to macroarray analyses using RNA isolated from various sugar beet tissues. Several genes were identified that exhibited high levels of expression in the root peel, crown and cortex tissues as compared to young roots and vegetative tissues. Fifteen of these genes were selected and their expression verified by RT-PCR analysis. Our results show that these genes are expressed preferentially in different parts of the root tissue. One clone in particular (*BvSRP1*) expressed specifically in the root peel and not in leaves of lines F1010 and F1016. In an unrelated line FC607, *BvSRP1* expression was detected in root and leaf tissues in contrast to what we observed in F1010 and F1016 roots. This implies that cis-acting elements in the *BvSRP1* promoter in F1010 and F1016 may regulate the expression of this gene in a peel specific manner. Based on the macroarray and RT-PCR analysis we are in the process of cloning several of the most interesting promoters by genome walking. Further molecular analyses will facilitate the targeting of resistance gene expression to tissues most prone to root diseases and insect attack.

SAVARY, BRETT J.[1,2]*, PRASANNA VASU[1], DAYANANDAN ANANDAN[1] and ANN C. SMIGOCKI[3], [1]Arkansas Bioscience Institute & [2]College of Agriculture, Arkansas State University, Jonesboro, AR 72467 and [3]Molecular Plant Pathology Laboratory, USDA-ARS, Beltsville, MD 20705. **Biochemical and proteomic profiling of polysaccharide-modifying enzymes in root cell walls of *Beta vulgaris*.**

There is continuing need to improve sugar beet (Beta vulgaris L.) plants for disease and pest resistance and to develop energy-efficient post-harvest processes for converting pulp residues to liquid biofuels or high-value biobased co-products. The common interface of these needs is the cell wall and its component polysaccharides. We report a demonstration project to integrate classic enzymatic approaches with contemporary structural (proteomic) technologies for the goal to build a comprehensive profile of cell wall polysaccharide-modifying enzymes expressed in sugar beet roots. Our approach is to differentially extract, isolate, and identify representative cell wall-associated enzymes in "juvenile" roots (i.e., expressing primary developmental growth). We present our results using hairy-root cultures to characterize root growth and protein expression patterns and to identify proteins profiled by enzyme assay screening and by MALDI-TOF mass spectrometry peptide mass fingerprinting. Our results establish the basis for using complementary molecular approaches to 1) identify and isolate corresponding genes for root-specific cell wall polysaccharide-modifying enzymes and to 2) determine their transcriptional patterns during growth and development of roots. This will promote use of genomic resources and biotechnology tools for *in-situ* manipulation of sugar beet root cell walls for improved plant resistance and efficient biomass processing.

WINTERMANTEL, WILLIAM M., USDA-ARS, 1636 East Alisal Street, Salinas, CA 93905. **Induced resistance to beet curly top virus.**

Curly top management in many parts of the West has focused on the large-scale application of insecticides to beet leafhopper over-wintering grounds (perennial weeds) to control the leafhopper vector, often combined with host resistance. Insecticide application to rangeland has been challenged by environmental groups, and resistance has been difficult to move into high-yielding sugarbeet varieties due to the multigenic nature of resistance. In order to provide more reliable control in a wider array of hosts, we are developing methods to engender resistance to the two primary curtovirus species in the United States. Partial replication gene (C1) sequences of *Beet severe curly top virus* (BSCTV) and *Beet mild curly top virus* (BMCTV) were inserted into a *Tobacco rattle virus* (TRV)-based vector to test the ef-

fectiveness of the sequences in suppressing infection of BSCTV and BMCTV through virus-induced gene silencing (VIGS). TRV containing curtovirus VIGS-inducer constructs were agroinoculated into *Nicotiana benthamiana* seedlings. BSCTV and BMCTV were inoculated separately at various time points following treatment with TRV/VIGS inducers. Test plants were monitored for the development of curly top symptoms over time and scored for disease severity, plant weight and virus concentration. Results with two silencing constructs delayed and reduced curly top symptom development in infected plants and decreased virus concentration compared to plants not treated with silencing constructs. Efforts are in progress to develop systems that will efficiently deliver silencing inducers in field production.

## Section C – Entomology and Plant Pathology
## Oral Presentations

BOETEL, MARK A.[1]*, AYANAVA MAJUMDAR[2], ROBERT J. DREGSETH[1] and ALLEN J. SCHROEDER[1], [1]Department of Entomology, North Dakota State University, Dept. 7650, P.O. Box 6050, Fargo, ND 58108 and [2]Gulf Coast Research and Extension Center, Alabama Extension Service, Fairhope, AL 36532. **Managing sugarbeet insect pests with seed treatment insecticides.**

Several soil-dwelling insect pests are capable of causing major yield losses in North American sugarbeet production systems. Although conventional granular and liquid insecticide formulations have been used to manage these pests for decades, recently labeled insecticidal seed treatments have been widely adopted by producers. This research involved multiple field trials between 2004 and 2009 to compare insecticidal seed treatments with conventional insecticides for efficacy against the following: 1) sugarbeet root maggot (SBRM), *Tetanops myopaeformis* Röder; 2) wireworms (*Limonius* spp.); and 3) subterranean springtails (*Onychiurus* spp.). Poncho Beta (clothianidin + betacyfluthrin at 60:8 g active ingredient [a.i.] per 100,000-seed unit, respectively), Cruiser 5FS (thiamethoxam; 60 g a.i./unit), and NipsIt Inside (clothianidin; 60 g a.i./unit) provided similar levels of springtail control and associated yield benefits to that of Counter 15G (terbufos) applied at either 6 or 8 lb product/ac. Excellent wireworm control was provided by Poncho Beta, Cruiser 5FS, and Counter 15G. All seed treatments were significantly outperformed by Counter 15G with regard to SBRM control, irrespective of whether Counter was applied at its high or moderate (12 or 10 lb product/ac, respectively) labeled rate. The three insecticidal seed treatments we evaluated appear to perform at a comparable level to

that of moderate rates of currently labeled conventional soil insecticides for controlling wireworms and subterranean springtails; however, they should not be relied on as the sole control tactic for high SBRM infestations. Postemergence tools to augment SBRM control will also be discussed.

BRANTNER, JASON R.* and CAROL E. WINDELS, University of Minnesota, Northwest Research and Outreach Center, Crookston, MN 56716. **Efficacy of in-furrow and post-emergence fungicides in controlling Rhizoctonia on sugar beet.**

Rhizoctonia diseases of sugar beet, caused by *Rhizoctonia solani* AG 2-2, are increasing in Minnesota and North Dakota. Field trials were conducted to assess efficacy of in-furrow or post-emergence fungicides for control of *R. solani*. The in-furrow trial was infested with *R. solani* by broadcast of inoculum (whole barley grain, 35 kg ha-1) and incorporation into the top 4 inches of soil. Sugarbeet was sown May 19 and in-furrow fungicides including pyraclostrobin (Headline), penthiopyrad (LEM 17), picoxystrobin (Acanto), Q8Y78 (2:1 premix of penthiopyrad and picoxystrobin), and azoxystrobin (Quadris) were applied (0.6, 1.6, 1.3, 1.6, and 0.6 fl oz product/1000-ft row, respectively) in a 4-inch band with a nozzle placed directly behind the disk opener. The post-emergence trial was sown on May 17. On June 24, when plants reached the 6- to 8-leaf stage, the same fungicides as applied in-furrow (and the same rates) plus prothioconazole (Proline, 5.7 fl oz of product $A^{-1}$) were applied in a 7-inch band; rows were inoculated with *R. solani*-infested ground barley inoculum (28 g/30 ft row) later that day. Both trials included non-inoculated and inoculated, no fungicide controls. In-furrow applications of picoxystrobin and Q8Y78 were phytotoxic (stunted plants, reduced stand) compared to other fungicides and controls. Azoxystrobin, pyraclostrobin, and penthiopyrad applied in-furrow significantly increased stands and yields and decreased root rot compared to the inoculated, no fungicide control. All fungicides applied post-emergence significantly increased numbers of harvested roots and yields and decreased root rot compared to the inoculated, no fungicide control. Fungicides applied in-furrow provided full-season protection from Rhizoctonia crown and root rot while post-emergence fungicides provided excellent protection when applied before disease establishment.

BREDEHOEFT, MARK* and CHRIS DUNSMORE, Southern Minnesota Beet Sugar Cooperative, 83550 County Road 21, Renville, MN 56284. **PCC for enhancement of sugar beet production and evaluation of Rhizoctonia disease suppression.**

Factory lime (PCC) use in the Southern Minnesota Beet Sugar Cooperative (SMBSC) growing area has increased significantly over the past 5 years, Research conducted by Dr. Carol Windels showed that PCC reduced *Aphanomyces cochloides* in sugar beets. Due to the use of PCC, Tachigaren, tolerant varieties and grower cultural practices, *Aphanomyces cochloides* in the SMBSC growing has been significantly reduced. However, *Rhizoctonia solani* has become more prevalent in the SMBSC. The sugar beet growing areas across the U.S. list *Rhizoctonia solani* as a prominent disease. Studies were established on sites with *Rhizoctonia solani* intraspecific groups AG-2-2 IIIB and IVA evaluating PCC and turkey manure for suppression of the disease. PCC increased sugar beet production in the absence of the disease and consistently enhanced sugar beet production in the presence of the disease. Turkey Manure applied alone or in combination with PCC did not influence *Rhizoctonia solani* effect on sugar beets. The increase in sugar beet production as influenced by PCC is greater in the presence of *Aphanomyces cochloides* compared to *Rhizoctonia solani*.

CHRIST, DANIELA and MARK VARRELMANN*, Institute of Sugar Beet Research, Department of Phytopathology, Holtenser Landstr. 77, 37079 Göttingen, Germany. **Mycotoxigenic potential and pathogenicity of *Fusarium* species isolated from sugar beet.**
In many economically important crops, *Fusarium* species cause yield and quality losses as well as mycotoxin contamination. They can also infect sugar beet in all growth stages and during storage. In a previous field trial at two locations in Germany, 13 different *Fusarium* species were detected in freshly-harvested and stored sugar beet. Isolates of all species were tested for pathogenicity to sugar beet following root dip inoculation. Re-isolation of all species from root tissue was possible, but only *F. graminearum* and *F. sambucinum* caused symptoms comparable to a *F. oxysporum* f. sp. *betae* control, suggesting a high infestation rate of sugar beet with endophytic *Fusarium* strains. Additionally, saprotrophic colonization of sugar beet tissue was evaluated in humid chambers and in the greenhouse. Plugs of *Fusarium* cultures were used for inoculation of sugar beet slices and growing sugar beets following mechanical injuries. In these assays, isolates of *F. cerealis*, *F. culmorum*, *F. graminearum*, and *F. sambucinum* induced rapidly severe rotting symptoms whereas for *F. redolens* and *F. oxysporum* only slight discolorations of beet slices and wound healing in growing beets was observed. The mycotoxigenic po-

tential of 34 *Fusarium* strains isolated from sugar beet was characterized in rice culture in order to identify target toxins for future analysis of sugar beet and sugar beet products. A total of 26 mycotoxins were detected by LC-MS/MS, including trichothecenes, zearalenone, and especially high amounts of beauvericin, enniatins, and moniliformin. The known biological properties of these different secondary metabolites, their possible natural occurrence in sugar beets as well as the impact of sugar beet residues on crop rotation are discussed.

DIRCKS, CHRISTINE[a]; ANNEKE BEHN and MARK VARRELMANN*, Institute of Sugar Beet Research, Department of Phytopathology, Holtenser Landstr. 77, 37079 Göttingen, Germany.
**Optimization of sugar beet Rhizoctonia solani resistance test in field trials by irrigation and fleece cover.**
[a]: First and second author contributed equally to this work

Over the past years the European sugar beet cultivation is increasingly affected by the late root and crown rot disease, caused by the soilborne fungus *Rhizoctonia solani* AG2-2IIIB. Estimated 36.000 ha are currently infected with the fungus. As a consequence of this disease, 60% plant loss and an eminent yield decline can occur. In the USA the total economical loss is estimated 2% due to the infection with *R. solani*. At present there is no registered fungicide available in Europe. The most important measure for Rhizoctonia control is growth of resistant sugar beet cultivars. In Germany sugar beet varieties are tested for Rhizoctonia root rot resistance in field trials. Fields are artificially infected by drilling Rhizoctonia infested barley-grains directly before sugar beet is sown. However, significant variable results between environments and locations are often obtained due to variable weather conditions which influence disease pressure. Therefore valid results can only be obtained with increased number of independent locations. As *R. solani* aggressiveness is known to be fostered by increased soil temperature and humidity, a field trial with variation of irrigation and fleece covering for a four week period following canopy closure was carried out at two locations in Germany. Soil temperature and humidity were monitored and three time harvests as well as rating of diseased beet surface were performed. By applying four cultivars carrying different resistance levels, it could be shown that the two treatments or a combination of both nearly doubled the disease severity in the susceptible cultivar whereas the increase in highly resistant cultivars was much less pronounced. Fleece and irrigation produced similar increase in disease severity but additive increase was not observed when both factors were combined. The variable response of the cultivars to increased temperature and humidity can be used as additional criteria for cul-

tivar performance and for a better and safer evaluation of the quantitative resistance traits. The practicability of the treatments for improvement of Rhizoctonia resistant cultivar evaluation is discussed.

FOGG, RALPH[1]*, JAMES F. STEWART[2], LEE A. HUBBELL[2] and BRIAN GROULX[2], [1]Michigan Sugar Company, 2600 S. Euclid Avenue, Bay City, MI 48706 and [2]Michigan Sugar Company, 1459 S. Valley Center Drive, Bay City, MI 48706. **Influence of variety tolerance, application timing and fungicide efficacy on control of Cercospora leafspot in Michigan.**

Cercospora leafspot, caused by the fungus *Cercospora beticola*, is the most serious foliar disease of sugarbeets in Michigan. Research trials conducted in Michigan show that poorly controlled Cercospora (25 to 50% canopy desiccation) resulted in losses of 2 to 4 tons per acre and from 0.25 to 1 point of sucrose. Cercospora leafspot is controlled by a combination of cultural methods, variety selection and fungicides. Trials are conducted each year to determine the susceptibility of approved varieties to Cercospora leaf spot. Approximately one fourth of our varieties have good Cercospora tolerance, close to half have fair tolerance and one fourth to one third have relatively poor Cercospora tolerance. Growers rely principally on triazole and strobilurin fungicides to protect their crop. Most growers make from two to three fungicide applications, however, in some years four applications may be needed to keep Cercospora levels below an economic damage level. Research results are conducted yearly to monitor the efficacy of available fungicides. In recent years Inspire XT appears to be our most effective fungicide followed closely by Eminent, Headline and Proline. Gem and Enable + Dithane have also provided good Cercospora control. To effectively control Cercospora in Michigan fungicides should be applied just prior to the first sign of the disease. The BeetCast prediction model has worked well in Michigan for timing our fungicide applications. Our region is divided into Cercospora risk zones and 50 weather stations provide growers with spray recommendations which are appropriate for the grower's location. Application timings are also modified by the Cercospora tolerance level of the variety being grown.

HANSON, LINDA E.* and J. MITCHELL McGRATH, USDA-ARS, SBRU, 494 PSSB, Michigan State University, East Lansing, MI 48824-1325. **Rhizoctonia seedling damping-off in sugar beet in Michigan.**

*Rhizoctonia solani* is an important seedling pathogen of sugar beet, causing damping-off following seedling emergence. Historically,

anastosis group (AG)-4 has been the primary seedling pathogen reported on sugar beet. However, recent screening has found high incidence of infection by AG-2-2. As resistance to AG-2-2 IIIB has been identified in ARS germplasm EL51, an understanding of the prevalence different AG and ISG is important to determine the impact of this resistance and to ensure resistance screening involves prevalent pathogens. Isolations were made from seedlings with symptoms in Michigan over a three year period. Pure cultures of *R. solani* were obtained by hyphal tip transfer. Isolates were characterized to their AG by paired isolate testing and molecular methods and tested for growth at 22 and 35 C. Pathogenicity was confirmed on sugar beet seedlings. The response of different sugar beet germplasm to various isolates from different AG was compared. In all three years, *R. solani* AG-2-2 predominated on seedlings collected in Michigan. Over half of the AG-2-2 isolates had high temperature tolerance, characteristic of AG-2-2 IIIB. Sugar beet germplasm showed variability in response to different isolates of both AG-2-2 and AG-4. Resistance to AG-2-2 IIIB was found in additional ARS germplasm, with good plant survival in both greenhouse and field screening.

JACOBSEN, BARRY J.[1]*, KEN KEPHART[2] and JOYCE ECKOFF[3], [1]Department of Plant Sciences and Plant Pathology, Montana State University, Bozeman, MT 59717-3150, [2]Southern Agricultural Research Center, Huntley, MT 59037 and [3]Eastern Agricultural Research Center, Sidney, MT 59270. **Fungicide and insecticide seed treatments: effects on stands, yields and disease control**

Sugarbeet stands profoundly influence the recoverable sucrose yield per acre by influencing both tons/A and quality factors such as impurities and sugar loss to molasses. Seed decay, soilborne pathogens such as *Pythium* sp. *Aphanomyces cochlioides*, *Fusarium* sp. and *Rhizoctonia solani*, plus seedborne pathogens such as *Phoma betae* can dramatically reduce stands. Fungicide seed treatments must protect the seed from seedborne pathogens, a wide range of soilborne seed decay fungicide prior to germination and plus post emergence damping-off caused by the aforementioned fungi. With the advent of systemic insecticide seed treatments we can now control a range of soil inhabiting insects and insects such as the beet leaf hopper that transmits the curly top virus. In four years of field research at Huntley, MT and Sidney, MT and greenhouse research at Bozeman, MT we have compared new insecticide and fungicide seed treatment combinations to a standard thiram-metalaxyl (Apron, Acquire, Allegiance) seed treatment. Research has shown that clothiodan (Ponch/NipsIt) and thiamethoxam (Cruiser) are compatible with a wide range of fungicides and that control of curly top infection is equal at the 60 gm ai. insecticide/seed unit rate. Control of curly top

was dependent on using a variety with at least a moderate level of resistance. The addition of the fungicides azoxystrobin (Dynasty), hymexazole (Tachigaren), pyraclostrobin (Stamina) and some experimental materials has provided significant stand and yield increases in some environments. Greenhouse testing has shown that combinations of insecticides plus one or more of the aforementioned fungicides results in improved control of *Pythium* sp. *A. cochlioides*, *Fusarium* sp. and *R. solani* compared to the standard thiram-metalaxyl seed treatment.

KHAN, MOHAMED F. R.[1],[2]*, AARON L. CARLSON[1], GARY A. SECOR[1], VIVIANA V. RIVERA[1] and MELVIN D. BOLTON[3], [1]Plant Pathology Department, North Dakota State University, [2]University of Minnesota, Fargo, ND 58108-6050 and [3]USDA, ARS, NCSL, Box 5677, University Station, Fargo, ND 58105. **Effect of fungicides on disease control, yield and quality of sugar beet inoculated with different sources of *Cercospora beticola* inocula.**

Cercospora leaf spot caused by *Cercospora beticola* is the most damaging foliar disease of sugar beet in Minnesota and North Dakota. Growers use a combination of partially resistant varieties, crop rotation, incorporation of debris by tillage operations, and timely applications of fungicides for effective disease control. It is know that misuse, overuse and prolonged usage of fungicides may lead to the development of fungicide resistant isolates of *C. beticola* and reduced disease control in field conditions. *C. beticola* inocula were obtained from two different sources and used to artificially inoculate two trials at Foxhome, MN. Plots were treated with multiple applications of the same fungicide with the first application in late July. Fungicides from different chemical classes – triphenyltin hydroxide (SuperTin), triazoles (Eminent, Proline and InspireXT), and strobilurin (Headline) were applied. There was also an untreated check. Cercospora leaf spot disease ratings were done after each fungicide application and before harvest. The middle two rows of each plot were harvested, weighed, and samples were collected and analyzed for quality at American Sugar Company tare laboratory at East Grand Forks, MN. The results from the trials will be presented and discussed.

KHAN, MOHAMED F. R.[1],[2] and AARON L. CARLSON[1]*, [1]Plant Pathology Department, North Dakota State University and [2]University of Minnesota, Fargo, ND 58108-6050. **Efficacy of fungicides for controlling *Rhizoctonia solani* on sugar beet.**

Rhizoctonia root rot caused by *Rhizoctonia solani*, is the most difficult disease to control in Minnesota and North Dakota. Varieties

that have good resistance to Rhizoctonia root rot are limited and typically have lower yield potential than susceptible varieties. Labeled and experimental compounds were evaluated for controlling Rhizoctonia root rot at Hickson, ND, and Foxhome, MN. The Hickson site was artificially inoculated with *R. solani* AG 2-2IIIB grown on sterilized barley, and the Foxhome site had a history of Rhizoctonia root rot. Plots were planted to a known Rhizoctonia susceptible variety in mid-April, 2009. One or two fungicide applications were made in a 7 inch band to the 4 middle rows of 6 row plots in June. Stand counts were taken during the growing season and just prior to harvest. The fungicides Quadris and Proline provided effective Rhizoctonia root rot control compared to the untreated check. The results of efficacy trials conducted in 2010 will also be discussed.

KHAN, MOHAMED F. R., Plant Pathology Department, North Dakota State University and University of Minnesota, Fargo, ND 58108-6050**. The journey from catastrophe to success.**

Minnesota and North Dakota produce 60% of the United States sugar beet, *Beta vulgaris*. One of the major limiting factors for sugar beet production is the foliar disease, Cercospora leaf spot caused by the fungus *Cercospora beticola*. Cercospora leaf spot destroys the leaves of the plants and thus impacts the photosynthetic capability of the plants. This disease results in significant reduction in root yield, recoverable sugar, percent sucrose, and increases concentration of impurities resulting in higher processing costs. In 1998, growers at American Crystal Sugar Company lost $45 million because of a leaf spot epidemic, and growers surveyed that year indicated Cercospora leaf spot as their worst production problem. Research was conducted to determine how best to control Cercospora leaf spot with experimental, and labeled fungicides that were not very efficacious against *C. beticola*. Research sites were used for demonstration at field days. Research results were disseminated to growers, other educators, and advisors of growers at seminars, using research production guide, reports, bulletins, and a radio program conducted during the growing season. Research data was used in securing a section 18 exemption for the use of Eminent on sugar beet. Growers quickly adopted the research-based recommended practices and successfully controlled Cercospora leaf spot, saving millions of dollars in the process. Fungicide usage was reduced by 58% from an average of 3.74 applications in 1998 to 1.56 applications in 2009 resulting in and average saving of $14 million annually. Growers who considered Cercospora leaf spot as their worst production problem decreased from 36% to less than 1% and 98% of growers reported excellent or good Cercospora leaf spot control with fungicides.

KHAN, MOHAMED F. R.[1,2]* and AARON L. CARLSON[1], [1]Plant Pathology Department, North Dakota State University and [2]University of Minnesota, Fargo, ND 58108-6050. **Effect of Penthiopyrad as a seed treatment for controlling *Rhizoctonia solani* on sugar beet.**

Rhizoctonia root rot, caused by *Rhizoctonia solani*, is considered the worst production problem for growers in Minnesota and North Dakota. Varieties that have good resistance to Rhizoctonia root rot, coupled with high sugar yield, are limited. Most growers in Minnesota and North Dakota use Quadris or Proline as a foliar application to control Rhizoctonia root rot. It will be advantageous for growers if a seed treatment could be used to control this root disease. Penthiopyrad is a new class of chemistry. It was used at different rates as a seed treatment on a Rhizoctonia root rot susceptible and resistant variety. Treatments were evaluated for controlling Rhizoctonia root rot at Hickson, ND and Glyndon, MN. Stand counts were taken during the growing season and just prior to harvest. Disease severity was higher at the Hickson site. Samples were taken at harvest and analyzed at the American Crystal Sugar Company tare laboratory at East Grand Forks, MN. The results of this trial at multiple locations will be discussed.

LIU, HSING-YEH* and ANJU GULATI-SAKHUJA, USDA-Agricultural Research Service, 1636 E. Alisal Street, Salinas, CA 93905. **Biological and molecular characterization of beet oak-leaf virus.**

Beet oak-leaf virus (BOLV) was first isolated from Rhizomania infested fields in California in early 2000. The infected sugar beet leaves showed oak-leaf pattern symptoms in some breeding lines different from Rhizomania, while some beet cultivars were symptomless. BOLV is transmitted by *Polymyxe betae* and also can be transmitted by rub inoculations. The host range of BOLV is similar to Beet necrotic yellow vein virus (BNYVV) and *Beet soil-borne mosaic virus* (BSBMV), which mainly infects Chenopodiaceous plants. BOLV has been purified from rub inoculated spinach (*Spinacia oleracea*) plants. The particle morphology is identical to BNYVV. The molecular mass of the capsid protein was estimated to be 46.0 kDa. A polyclonal antibody from rabbits has been produced from purified BOLV virions and can be used in enzyme-linked immunosorbent assay (ELISA), western blot, and immunogold labeling tests. BOLV is serologically distinct from BNYVV, BSBMV, and *Beet soil-borne virus* (BSBV). BOLV has also been found in Colorado, Michigan, Minnesota, Nebraska, and Wyoming. BOLV was found in sugar beet alone or co-infected with BNYVV or BSBMV. The interaction tests between BNYVV and BOLV indicate that BOLV may suppress BNYVV in mixed infections.

MARTENS, ROY[1]*, GEERT JANSSEN[2], THOMAS KRAFT[2] and REBECCA LARSON[1], [1]Syngenta Seeds, Inc., 1020 Sugar Mill Road, Longmont, CO 80501 and [2]Syngenta Seeds AB, Box 302, SE-26123 Landskrona, Sweden. **Root aphid tolerance in sugar beet; field screening & resistance mapping.**

Root aphid tolerance is a key trait needed in sugar beet varieties in many production areas, including the western United States, Michigan and parts of southern Minnesota. Syngenta has developed a nursery for hybrid evaluation and line selection that relies on manipulation of various stresses to enhance pest pressure naturally occurring in the environment. Concurrently, to gain a better understanding of the heritability and create new tools for selection, efforts were undertaken to map the resistance in sugar beet. A mapping population consisting of 226 S2 lines was developed from a cross between a resistant and a susceptible line. All lines were tested in the field and scored for root aphid resistance. There was a clear segregation of the population into susceptible and resistant lines, and based on this classification we could map the resistance as a single locus on chromosome 4.

MARTENS, ROY[1], GEERT JANSSEN[2], RIKARD JONSSON[2] and REBECCA LARSON[1]*, [1]Syngenta Seeds, Inc., 1020 Sugar Mill Road, Longmont, CO 80501 and [2]Syngenta Seeds AB, Box 302, SE-26123 Landskrona, Sweden. **Methods for field evaluation of sugar beet tolerance to Rhizoctonia.**

Rhizoctonia Root and Crown Rot is a growing concern in many sugar beet production areas throughout the United States. Over the last 10 years, much knowledge has been gained about the genetic diversity within the *Rhizoctonia* population, as well as the influence of rotational crops on disease pressure in the sugar beet crop. Hilleshög-Syngenta has relied on a number of selection approaches to introduce tolerance to Rhizoctonia into its germplasm, from greenhouse screens to molecular markers. However, to date, one of our most effective means of selections remains field screening under high disease pressure. Using techniques initially developed by Dr. Earl Ruppel of the USDA in the 1970s, we have optimized field evaluation protocols that allow us to select for durable Rhizoctonia tolerance that's proven effective in markets worldwide.

POINDEXTER, STEVEN S.* and THOMAS J. WENZEL, Michigan State University Extension, One Tuscola St., #100, Saginaw, MI 48607. **Application strategies utilizing Quadris™ fungicide for control of *Rhizoctonia solani* root rot on sugarbeets.**

*Rhizoctonia solani* infections on sugarbeets are a significant problem in the Great Lakes growing region. This disease impacts sucrose yield by reducing tonnage, percent sugar and clear juice purity. The objective of this study was to determine the efficacy of different application strategies utilizing Quadris™ from Syngenta Crop Protection for controlling *Rhizoctonia solani* root rot. Research was conducted in fields with a known high disease history. Infections occurred under natural field conditions and where not artificially inoculated.

A susceptible Rhizoctonia variety was planted at five locations in 2009 and 2010. Infection levels were significant at all locations. Trials were established as strip trials in grower fields. Treatments included T-band in-furrow, banded foliar treatments and combinations of both at different rates and growth stages. Generally the best efficacy of 80% plus occurred with a combination of T-band in-furrow followed by a foliar application at the 6-8 leaf stage. In-furrow applications and 6-8 leaf applications applied individually were generally the next best treatments. Banded foliar applications applied at the 2-4 leaf stage were less effective. All treatments improved tonnage, percent sugar and clear juice purity over the check.

SECOR, GARY A.[1]*, MELVIN D. BOLTON[2], VIVIANA V. RIVERA[1] and MOHAMED F. R. KHAN[1], [1]Department 7660, Box 6050, North Dakota State University, Fargo, ND 58108 and [2]USDA, ARS, NCSL, Box 5677, University Station, Fargo, ND 58105. **Correlating reduction in fungicide sensitivity in *C. beticola* with loss of disease control.**

Practical resistance can be defined as a situation in which reduced sensitivity (resistance) of a fungal pathogen to a fungicide results in poor disease control in the field and the resistance is confirmed by laboratory testing. Although we have many years of data showing reduced sensitivity of *C. beticola* isolates to fungicides based on increased $EC_{50}$ values, there is a paucity of data showing how this *in vitro* resistance correlates with actual loss of disease control. Ultimately, we want to be able to determine if decreased sensitivity to the fungicide detected by laboratory testing ($EC_{50}$ values), results in reduced disease control in the field. Using greenhouse trials, sugarbeet plants susceptible to Cercospora leaf spot were treated with tenfold dilutions of the fungicides Eminent or Headline using a spray bar to insure uniform coverage. One day later, each group of fungicide treated plants was inoculated with spores from isolates designated

as sensitive moderate, or resistant to the fungicide based on EC50 values and incubated for disease development. Disease severity was measured by counting the number of infection sites (spots) on four of the inoculated leaves of each plant and correlated with fungicide concentration and $EC_{50}$ values of *C. beticola* isolates used for inoculum. Preliminary data shows that disease severity increases using isolates with reduced sensitivity (resistance) at comparable fungicide concentrations. There appears to be a correlation between decreased fungicide sensitivity and loss of disease control in greenhouse trials.

SHETTY, KIRAN* and CHAD SELTON, Syngenta Seed Care, P. O. Box 18300, Greensboro, NC 27419. **Introducing CruiserMaxx Sugar beets: A comprehensive seed care product concept for broad spectrum disease and insect protection for sugar beets.**

Treating sugar beet seed is a well understood practice in sugar beet production. The only caveat is that older seed treatment chemistries have sometimes caused seed germination problems, and in some areas the suggested high doses of old products has changed the seed characteristics such as seed size and resulting plant ability. CruiserMaxx Sugar Beets is a new product concept offered to sugar beet growers with improved disease and insect protection. This product concept provide broad spectrum protection against several seed and soil borne disease, including *Rhizoctonia* sp. The product also offers broad spectrum protection against beet leaf hopper, which consequently reduces or eliminates curly top virus in sugar beets. CruiserMaxx Sugar beets also provides protection against root maggots, spring tails and wireworms and could be integrated as part of an overall pest management program for sugar beets.

SMITH, MADELEINE J.*, RODOLFO ACOSTA-LEAL and CHARLES RUSH, Texas AgriLife Research Amarillo, 6500 Amarillo Blvd. West, Amarillo, TX 79106. **Variation in the p25 region of resistance breaking *Beet necrotic yellow vein virus* from infected plants in Minnesota.**

Rhizomania disease in sugar beets is caused by *Beet necrotic yellow vein virus* (BNYVV) and is found throughout all beet growing areas in the world. Rhizomania causes both a reduction in sugar yield and sugar purity. Over a period of four years, isolates of BNYVV were collected from diseased plants in Minnesota. Diseased plants were tested for the presence of the appropriate Rz-mediated resistance. The p25 region of RNA3 of BNYVV isolates from plants which tested positive for the resistance loci were then sequenced to determine the amino acid motifs present in the hypervariable region known to be

associated with BNYVV pathogenicity. In diseased spots in the field, the dominant motif at p67 was V. In wild type isolates there is an A at p67. However, in blinker plants (individual diseased plants located at random throughout field) the amino acids found at p67 were more heterogeneous and V did not predominate as in the diseased spots. From this study we believe that V in position 67 is not only associated with resistance breaking but also with viral fitness. Over time the V at position 67 becomes fixed in the viral population because it confers an advantage in overcoming the plant's resistance, and patches of disease develop in the field. It is therefore important when screening for resistance to rhizomania, that breeders and seed companies should be aware of the viral haplotype they are using to challenge their germplasm. Presence of a large number of blinkers in a field does not guarantee that those same haplotypes will be present during the next crop. These results also demonstrate that other mutations other than those in the hypervariable region of RNA 3 p25 are associated with breakdown of *Rz* mediated resistance in sugar beets.

STRAUSBAUGH, CARL A.[1]*, IMAD A. EUJAYL[1] and PAUL FOOTE[2], [1]USDA-ARS NWISRL, 3793 North 3600 East, Kimberly, ID 83341 and [2]Amalgamated Sugar Co., 50 South 500 West, Paul, ID 83347. **Cultivar selection for sugarbeet root rot resistance.**

Fungal and bacterial root rots in sugar beet caused by *Rhizoctonia solani* (Rs) and *Leuconostoc mesenteroides* subsp. *dextranicum* (Lm) can lead to root yield losses greater than 50%. To reduce the impact of these root rots on sucrose loss in the field, storage, and factories, studies were conducted to establish a faster and more accurate screening method. In 2009, 22 commercial cultivars were grown in a commercial field and mechanically harvested, and then inoculated. In each root a cork borer hole at the widest portion of the root was inoculated with Rs and another with Lm, while a third hole was inoculated with both (RsLm). The roots were then incubated in the greenhouse for 3 weeks out of direct sunlight, cross sectioned, and evaluated for rot. The study was repeated with roots that had been stored for 60 days. All roots suffered some rot with the Rs or the RsLm inoculations and the most susceptible cultivar had 3.9 and 2.8 times more rot than the most resistant cultivar, respectively. Only 15% of the roots developed rot with the Lm inoculation. Similar rot results for all three inoculations were obtained with stored roots. With the RsLm inoculation, cultivar ranking at harvest and after storage were correlated ($r = 0.6608$, $P = 0.0008$). The RsLm inoculation may prove to be a faster and more precise method to screen for bacterial rot resistance but screening for fungal rot resistance will likely need to be done using other methods.

WEBB, KIMBERLY M.[1]*, AMY L. HILL[2], LINDA E. HANSON[3], LEE PANELLA[1], MARK BRICK[4] and HOWARD SCHWARTZ[5], [1]USDA-ARS, Sugar Beet Research Unit, Ft. Collins, CO 80526; [2]Current address: The Ohio State University, Dept. of Plant Pathology, Columbus, OH 43210; [3]USDA-ARS, Sugarbeet and Bean Research, East Lansing, MI 48824; [4]Colorado State University, Dept. of Soil and Crop Sciences, Ft. Collins, CO 80523 and [5]Colorado State University, Dept. of Bioagricultural Sciences and Pest Management, Ft. Collins, CO 80523. **Characterization of the genetic diversity of *Fusarium oxysporum* f. sp. *betae* utilizing phylogenetic analysis and vegetative compatibility grouping.**

Fusarium yellows of sugar beet, caused by *Fusarium oxysporum* f. sp. *betae* (FOB), can lead to significant reduction in root yield, sucrose percentage, and juice purity. Previous research into FOB, has demonstrated that isolates known to be pathogenic on sugar beet can be highly variable. This diversity is increased further by the wide geographic distribution of isolates. Although genetic resistance provides some control, growers have reported failures when resistant varieties are grown in different parts of the country, potentially due to the variability of local FOB populations. Isolates of *F. oxysporum* can be categorized into *formae speciales* and further into races according to their ability to cause disease on specific host(s), resistance gene interactions, vegetative compatibility grouping (VCG), and phylogenetic sequence alignment. *F. oxysporum* isolates were collected from symptomatic sugar beets throughout production areas in the United States. These isolates were characterized utilizing pathogenicity, phylogenetic analysis, and vegetative compatibility testing. Based on the combination of findings fro these studies, the FOB population is highly polyphyletic and most likely cannot be classified into distinct races. However, local clades can potentially be described, which may aid in selecting resistant lines for particular production regions.

WINDELS, CAROL E.* and JASON R. BRANTNER, University of Minnesota, Northwest Research and Outreach Center, 2900 University Avenue, Crookston, MN 56716. **Aggressiveness of *Rhizoctonia solani* AG 2-2 on sugar beet and rotation crops.**

Rhizoctonia crown and root rot of sugar beet caused by *Rhizoctonia solani* AG 2-2 intraspecific groups (ISGs) IV and IIIB is increasing in Minnesota and North Dakota. Of 1,000 cultures of AG 2-2 isolated from diseased sugar beet, 24 of each ISG were selected to represent a wide geographic area and previous crops. They were tested for aggressiveness on adult sugar beet roots and on seedlings of sugar beet and rotation crops. Adult sugar beet roots were inoculated when 8-wk old; in seedling tests, a commercial greenhouse soil

was infested with inoculum before planting. Disease was assessed at 12 days after inoculation. Both ISGs were equally aggressive on adult sugar beet roots; root rot indices (RRI = 0-7 scale) averaged 5.0 (range = 3.3-5.6) for IV and 4.9 (3.8-5.9) for IIIB. On seedlings of sugar beet and rotation crops, range of aggressiveness for both ISGs overlapped, but IIIB caused significantly more disease than IV. Sugar beet RRI (0-100 scale) averaged 78 (42-100) for IIIB and 51 (5-100) for IV. Corn RRI (1-5 scale) averaged 3.1 (1.8-4.1) for IIIB and 2.1 (1.2-3.0) for IV. Pinto bean RRI (1-5 scale) averaged 4.4 (3.5-5.0) for IIIB and 2.7 (1.8-4.5) for IV. Soybean RRI (1-5 scale) averaged 4.1 (2.7-5.0) for IIIB and 3.2 (1.9-4.6) for IV. Aggressiveness of AG 2-2 cultures on adult sugar beet roots was unrelated to pathogenicity on seedlings of any crop but there were significant correlations ($P$<0.001) for aggressiveness of cultures on seedlings between crops.

WINTERMANTEL, WILLIAM M., USDA-ARS, 1636 East Alisal Street, Salinas, CA 93905. **Impact of curly top host plants on accumulation, competitiveness, and durability of curtovirus species.**

Curly top disease, caused by viruses in the genus, Curtovirus, has affected sugarbeet production throughout much of the West for over a century; however, over that period the viruses responsible for causing the disease have changed. The two curly top virus species currently affecting production, *Beet severe curly top virus* (BSCTV) and *Beet mild curly top virus* (BMCTV) have not always been the dominant forms, and in some areas new curly top virus species have been identified affecting chili pepper production, although to date the new species have been identified in sugarbeet. In order to identify factors that drive the emergence of new curly top virus species, as well as determine what factors cause a variant to outcompete traditional forms, studies were undertaken to examine virus accumulation and competition among common weed and crop hosts throughout the western United States. Taq-Man probes were developed to selectively amplify distinct curtovirus species by quantitative polymerase chain reaction (PCR). Several weed and crop hosts of curly top viruses were inoculated with BSCTV and BMCTV in both single and mixed infections under controlled conditions, to determine efficiency of accumulation in each host plant species, individually, as well as which virus dominates during mixed infections. Results indicated variation in accumulation by host species. Continuing studies are directed toward clarifying performance of less common or new species in these hosts, and whether the new species can out-compete BSCTV and BMCTV in sugarbeet and other crop hosts. This will determine the potential for the new species to become significant agricultural threats.

## Section C – Entomology and Plant Pathology
## Poster Presentations

BOLTON, MELVIN D.[1]*, GARY A. SECOR[2], VIVIANA V. RIVERA[2] and KESHAV BIRLA[3], [1]USDA-ARS, Northern Crop Science Laboratory, 1605 Albrecht Blvd. N., Fargo, ND 58102-2765, [2]North Dakota State University, Department 7660, Box 6050, Fargo, ND 58108 and [3]North Dakota State University, Fargo, ND 58102. **Mechanisms of DMI resistance in field isolates of *Cercospora beticola*.**

Leaf spot, caused by the fungus Cercospora *beticola*, is an endemic disease of sugarbeets in the North Dakota and Minnesota growing regions. Control measures against the fungus include resistant sugarbeet varieties and crop rotation, but the disease is managed effectively only when combined with timely fungicide applications. However, *C. beticola* is well-known for the ability to develop resistance to fungicides of several chemical classes. Previous research has shown that mutations in specific genes allow fungi to develop resistance to sterol demethylation inhibitor (DMI) fungicides, which are widely used to control leaf spot disease. DMI fungicides target an enzyme called 14 -demethylase (CYP51). Resistance to DMI fungicides has been shown to relate to specific mutations in the *CYP51* gene, which causes decreased affinity of DMIs to the target enzyme, or over-expression of the *CYP51* gene leading to an over-production of the target enzyme. The objectives of this research were to determine if reduced sensitivity to DMI fungicides in *C. beticola* can be attributed to these or other known mechanisms of DMI resistance in other fungi. Single spore isolate cultures were derived from field isolates and fungicide $EC_{50}$ values to several DMI fungicides were obtained. The full-length *CYP51* gene was cloned and sequence analysis was carried out to test whether specific mutations in the gene correlate with $EC_{50}$ values. Results from these on-going investigations will be presented.

BRADSHAW, JEFF D.[1]*, C. DEAN YONTS[2], DREW J. LYON[3] and JOHN A. SMITH[2], Departments of [1]Entomology, [2]Biological Systems Engineering and [3]Agronomy and Horticulture, Panhandle Research and Extension Center, University of Nebraska-Lincoln, Scottsbluff, NE 69361. **Impact of soil, hydrologic, and production-system variability on sugarbeet root aphids.**

Sugarbeet root aphids (*Pemphagus betae*) are a key pest of sugarbeet in the Central High Plains, but rarely in other production areas of the U.S. This is partly due to the abundance of their winter hosts in this region, primarily narrowleaf cottonwood (*Populus angustifolia*), from which they migrate to sugarbeets each spring. This region

is also known for its highly variable soil types on which both dryland and irrigated production systems are practiced. Here we document some of the soil, hydrologic, and production variability that can be associated with sugarbeets in this region and the resulting impact on root aphid populations.

GOODWILL, THOMAS R. and LINDA E. HANSON*, USDA, Agricultural Research Service, 494 Plant and Soil Sciences Building, East Lansing, MI 48824. **Rhizoctonia belly rot in cucumber fruit using *Rhizoctonia solani* isolated from sugar beet.**

Cucumbers are grown in rotation with sugar beets in some areas in Michigan but their interaction with important diseases affecting sugar beets is not well known. Cucumbers are known to be primarily susceptible to *Rhizoctonia solani* AG-4, but little is known about their susceptibility to AG 2-2 isolates that cause the most severe Rhizoctonia crown and root rot of sugar beet. The objective in this study was to determine if *R. solani* isolates obtained from sugar beet could cause belly rot in cucumber fruit. Cucumbers were placed in direct contact with soil that had been inoculated with AG 2-2 IIIB (1 isolate), AG 2-2 IV (1 isolate), AG 4 (2 different isolates), or a sterile ground barley control. After three weeks cucumbers were visually examined and given a Rhizoctonia belly rot rating on a scale of 0-5, with 0 indicating a healthy fruit and 5 being complete deterioration of the fruit. Average Disease Indices (DI) were calculated. AG 4 isolates produced DI of 2.7 and 3.5, AG 2-2 IIIB was 2.8, AG 2-2 IV was 1.8, and barley control was 0. While AG 4 has been reported as the primary *Rhizoctonia* pathogen of cucumber, it appears that both AG 2-2 types can cause significant damage to cucumbers with the tested AG 2-2 IIIB isolate causing as much damage as one of the AG-4 isolates. From this experiment it is clear that not only can cucumber act as a host for sugar beet isolates, but also that sugar beet isolates can cause belly rot in cucumbers. Therefore, farmers who use cucumbers in rotation with sugar beets need to be careful in managing their fields so as not to create a worsening *Rhizoctonia* problem for either of the cucumber or sugar beet crops.

HANSON, LINDA E.[1]*, IN YOUNG CHO[2] and SUBASHINI NAGENDRAN[3], [1]USDA-ARS, SBRU, 494 PSSB, Michigan State University, East Lansing, MI 48824, [2]Exeter Academy, Exeter, NH 03833 and [3]Dept. of Crop and Soil Science, Michigan State University, East Lansing, MI 48824. **Postharvest Rhizopus rot on sugar beet.**

*Rhizopus* species have been reported as a minor post-harvest rot on sugar beet, particularly under temperatures above 5 °C. In 2010,

*Rhizopus* was isolated from beets collected from Michigan storage piles in February at a low frequency. However, recent evidence from Michigan has found a high incidence of *Rhizopus* infecting beets with Rhizoctonia root rot. This has the potential to provide inoculum for post-harvest rot and could increase prevalence of this pathogen in storage. Research was undertaken to improve our understanding of *Rhizopus* as a post-harvest rot of sugar beet. Beets of variety USH20 were inoculated with isolates of *Rhizopus stolonifer* and *Rhizopus oryzae* and incubated optimal conditions for *Rhizopus* growth under high humidity. Both species were able to cause extensive rot of beet tissue on beets that had been stored at 4 °C for 2 months or more. Little damage was observed on beets that had been stored for 1, 2, or 3 weeks at 4 °C. When tested, no significant differences were found in the amount of rot produced over three days on four different sugar beet germplasm, but individual *Rhizopus* isolates varied in the amount of damage caused on sugar beet variety USH20. Isolates of *R. oryzae* generally caused more rot than isolates of *R. stolonifer*. When tested on cherry or strawberry, no significant difference in rotting was observed for these species. Further tests at lower temperatures and with additional beet germplasm are ongoing.

HARVESON, ROBERT M.*, KATHLEEN A. NIELSEN and C. CLAY CARLSON, University of Nebraska, Panhandle REC, 4502 Avenue I, Scottsbluff, NE 69361. Determining optimal fungicide timing for **Rhizoctonia root rot of sugar beets in Nebraska based on soil temperatures.**

Rhizoctonia root and crown rot, caused by *Rhizoctonia solani*, is the most widespread, consistently found, and damaging sugar beet disease in Nebraska. It is capable of causing both a seedling disease and two different phases of root rot later in season. These two phases include a crown rot, and a tip rot of the tap root originating beneath the soil surface. Since there are several diverse forms (root rot phases) of the disease observed in Nebraska, it has been difficult to make fungicide recommendations based only on plant growth stage or chronological time of the season. In the attempt to determine more efficient application timings, a study was begun in 2009 with the purpose of making fungicide applications based on measurement of soil temperature. Spray treatments were applied when 10 cm soil temperatures averaged 15°, 18°, 21°, and 24°C for 3 sequential days, with two additional treatments consisting of untreated checks and spraying at symptom expression. Data collected included root disease incidence counts, sucrose and root yield, and sugar loss to molasses determinations. Sugar yields and numbers of diseased plants were significantly improved with the use of azoxystrobin when soil temperature reached 15°, 18° and 21°C, compared to controls and spraying after symptom development.

HARVESON, ROBERT M., University of Nebraska, Panhandle REC, 4502 Avenue I, Scottsbluff, NE 69361. **A rare epidemic of sugar beet seedling rust in Nebraska.**

Sugar beet seedling rust, caused by *Puccinia subnitens*, is a disease that has rarely been observed in sugar beet production. The pycnial and aecial stages occur on sugar beets, while the uredial and telial stages infect the primary host, inland saltgrass (*Distichlis spicata*). In mid-May 2009, lesions indicative of sugar beet seedling rust were found on young sugar beet plants in a field near Bayard, Nebraska. Because of the continued cool weather with above average precipitation throughout May, a survey of sugar beet production fields in western Nebraska was conducted between late-May and mid-June to further document the incidence and distribution of seedling rust caused by *P. subnitens*. Over this time period, 37 of 57 (65%) scouted locations, representing 8 counties in Nebraska contained sugar beet or common lambsquarter plants with pycnia and/or aecia of *P. subnitens*. The majority (89%) of those pathogen-infested fields were located within two counties in the North Platte Valley (Scotts Bluff and Morrill). A similar survey was conducted during May and June 2010, with only 26% of monitored locations yielding infected plants (8 of 31). The results from this survey during 2009-2010 represent the first time the disease has been found occurring naturally from field infections in Nebraska and anywhere else in the world for almost 100 years.

KHAN, MOHAMED F. R.[1,2]*, SOMWATTIE P. DeSOUZA[1], JACOB L. WILDMAN[1] and AARON L. CARLSON[1], [1]Plant Pathology Department, North Dakota State University and [2]University of Minnesota, Fargo, ND 58108-6050. **What is the best time to control Rhizoctonia root rot of sugar beet?**

Rhizoctonia root rot caused by *Rhizoctonia solani* is the most important disease for growers in Minnesota and North Dakota. Timing of azoxystrobin fungicide application is crucial to controlling Rhizoctonia root rot of sugar beet under favorable conditions for disease development. The objective of this study was to determine the best time to apply azoxystrobin relative to the time of inoculation for controlling root rot caused by *R. solani* AG 2-2 IIIB. Treatments included a non-inoculated check where no inoculum was applied to plants; an inoculated check where two grains of barley inoculum were applied to plants; fungicide treatment as a hypocotyl drench at 0, 3, 10, 14 and 21 days following inoculation, and fungicide treatment as a hypocotyl drench followed by inoculations at 0, 7, 14, 21 and 28 days. Inoculations were done using two (~ 0.08g) barley grains colonized with *R. solani* AG 2-2 IIIB. Inoculum was buried at 2.0 cm below soil surface and in close proximity with plant roots. The fungicide used

was azoxystrobin, (Quadris, Sygenta), applied at the recommended rate of 0.67 L/ha. The spray volume was 122 liter per ha with ~ 96 µl of fungicide solution per plant. Sugar beet plants treated first with azoxystrobin followed by inoculation had significantly lower root rot disease severity than where plants were first inoculated then treated with azoxystrobin. Since azoxystrobin provided control for several weeks after application, it may be possible to time fungicide application so as to provide protection from the pathogen when conditions become favorable for pathogen development.

KHAN, MOHAMED F. R.[1,2], SOMWATTIE P. DeSOUZA[1], JACOB L. WILDMAN[1]* and AARON L. CARLSON[1], [1]Plant Pathology Department, North Dakota State University and [2]University of Minnesota, Fargo, ND 58108-6050. **Effect of depth of inoculum placement on development of *Rhizoctonia solani* on sugar beet.**

The worst production problem for growers in Minnesota and North Dakota is Rhizoctonia root rot caused by *Rhizoctonia solani*. Mature sugar beet roots with *R. solani* infection starting towards the tip of the tap roots have been observed. Growers are concerned that infection starting deep in the soil may not be effectively controlled by fungicides. Therefore, the depth at which *R. solani* caused root rot infection of sugar beet was studied by burying *R. solani* AG 2-2 IIIB inoculum at depths of 2.54, 7.62, and 12.7 cm in cones with sugar beet plants at the 4 leaf stage. Root rot infections occurred at all depths. Inoculum buried at the lowest depth had the highest root rot severity and was significantly different from the highest depth with the least root rot severity. Root rot symptoms were prevalent on the upper portion of the sugar beet root just below the soil line irrespective of the depth of placement. Consequently, fungicide application should be directed to protect the upper parts of the root area where *Rhizoctonia* is most active.

MacRAE, IAN V.[1]*, GREGORY J. REYNOLDS[2], ALBERT L. SIMS[3], CAROL E. WINDELS[4] and SOIZIK LAGUETTE[5], [1]University of Minnesota, Department of Entomology and Northwest Research and Outreach Center, Crookston, MN 56716; [2]University of California-Davis, Department of Plant Pathology, Davis, CA 95616; [3]University of Minnesota, Department of Soils, Water and Climate and Northwest Research and Outreach Center, Crookston, MN 56716; [4]University of Minnesota, Department of Plant Pathology and Northwest Research and Outreach Center, Crookston, MN 56716 and [5]University of North Dakota, Department of Earth System Science and Policy, Grand Forks, ND 58202.
**Aerial imaging to assess Rhizoctonia crown and root rot severity in sugar beet fields.**

Rhizoctonia crown and root rot (RCRR), caused by the soil-borne fungus *Rhizoctonia solani* AG 2-2, is a disease of increasing economic importance to the sugar beet industry in Minnesota and North Dakota. In 2008 and 2009, research in inoculated fields measured ground-based hyperspectral reflectance of RCRR-infected sugar beet and identified vegetation indices most suitable for detection of the disease. Seven narrowband and five wideband vegetation indices were assessed and the wideband optimized soil adjusted vegetation index (OSAVI) provided the best overall fit with disease severity ratings. In 2010, image analysis (OSAVI) of a series of aerial imagery obtained with a multispectral camera were used to identify areas within fields that might be symptomatic of RCRR. Fields were subsequently ground truthed for disease rating, potential insect populations and soil nutrient problems. While results were generally consistent with aerial imagery identifying areas of RCRR, there was at least one field where suspected symptomology resulted from another cause. However, overall analysis of aerial-obtained multispectral imagery does seem to have promise in identifying areas of RCRR in the field.

METZGER, MICHAEL S.[1]*, TIM KENYON[2], NEIL BOEDEKKER[2], TOM HERMANN[2], CHRIS MOTTEBERG[2], LYNN DUSEK2, CURTIS FUNK[2] and ALLAN CATTANACH[2], [1]Minn-Dak Farmers Cooperative, 7525 Red River Road, Wahpeton, ND 58075 and [2]American Crystal Sugar Company, 101 North Third Street, Moorhead, MN 56560. **Field strip trial evaluation of seed treatment insecticides in the Red River Valley.**

Sugarbeet growers in the Red River Valley are in constant risk of plant stand losses and corresponding yield reductions caused by soil-dwelling pests. To date, these pests have been managed by the widespread use of both liquid and granular insecticide formulations. Because of their convenience and relative level of application safety, insecticidal seed treatments (ISTs) have gained immense popularity among sugarbeet producers in the Red River Valley over the past two years. Poncho Beta was used on 65% of American Crystal Sugar Company's acreage in its first year of use. Strip trials were carried out during the 2010 growing season to compare the efficacy of commercially available ISTs and conventional insecticides against: sugarbeet root maggot, (*Tetanops myopaeformis*); wireworms (*Limonius* spp.); springtails (*Collembola* spp.) and white grubs (*Lachnosterna* spp.). Each strip trial was conducted utilizing standardized agronomic and pest management practices and was located in commercial fields. Established stand counts taken across all trials revealed that the ISTs may be less likely to cause stand loses due to phytotoxicity than the conventional insecticides and consistently trended higher counts

than the checks. In trials with heavy root maggot pressure, Counter had the highest recoverable sugar per acre (RSA) and the ISTs performed better than the checks. All ISTs gave increased RSA at one springtail location compared to the check and Nipsit and Poncho Beta also increased RSA at a second springtail site. This data indicates the ISTs evaluated in these strip trials are likely to provide similar levels of root protection from targeted pests as the conventional insecticides, but usually provided inadequate protection from serious root maggot infestations.

NEHER, OLIVER T. and TAMARA KEETH*, University of Idaho, Twin Falls R&E Center, 315 Falls Avenue, Twin Falls, ID 83301. **Fungicide trials for the control of *Erysiphe polygoni* causal agent of powdery mildew on sugar beets in Idaho.**

Sugar beets in the western part of Idaho are mainly furrow or surface irrigated and this can create environmental conditions more suitable for the development of powdery mildew (PM) than under sprinkler systems used in other parts of Idaho and Oregon. Powdery mildew is also detected earlier (July) in the western region than in the southern growing regions of Idaho (August). If PM remains untreated or is treated too late, the crop losses can be severe since PM has the ability to multiply rapidly under favorable conditions. Control of PM relies heavily on fungicide applications, preferable before disease is visible or at its first appearance. The objective of this study was to evaluate products containing trifloxystrobin (Gem 500SC), pyraclostrobin (Headline), difenoconazole/propiconazole (Inspire XT), and prothioconazole (Proline 480SC) for their efficacy to control PM on sugar beets. Products were tested alone and in combination with a second, different product as a standard/recommended application prior to visible disease (historically around July 4th) followed by a second application 21 days later. For a more economical treatment, individual products were applied only once at disease onset. Their efficacy was determined based on the area under disease progress curve (AUDPC) which was calculated based on four ratings evaluating the percent mature leave area diseased (%MLAD). When applied alone at visible disease, trifloxystrobin was able to significantly reduce the AUDPC by 38.9% when compared to the non-treated control (NTC). All other products were not statistically different to the NTC when applied once. If products were applied in combination with a second product, before visible disease and at visible disease, they were all significantly different to the NTC based on their AUDPC.

NEHER, OLIVER T.* and TAMARA KEETH, University of Idaho, Twin Falls R&E Center, 315 Falls Avenue, Twin Falls, ID 83301. **Integrated pest management approaches for the control of *Erysiphe polygoni*, causal agent of powdery mildew on sugar beets in Idaho.**

Powdery mildew (PM) is a reoccurring disease problem on sugar beets in many production areas of the Pacific North West. Given that the loss caused by PM is not as apparent as it can be with Rhizoctonia crown and root rot or other diseases, the crop might not be treated appropriately and potential yield losses could be as severe as 35%. Current control measures rely on disease monitoring and fungicide applications made before disease onset. Recently, PM tolerant sugar beet varieties became available in Idaho and could add an additional tool to an integrated pest management approach for the control of PM. The objectives of this research were to compare two varieties (PM tolerant and susceptible) under different spray regimes and to determine their performance in regard to disease resistance, yield, and ERS. Across all treatments, PM9122RR (Syngenta Seed – tolerant variety) showed 98% less disease (as measured by the percent mature leaf area diseased [%MLAD]) than the standard variety Crystal RR929 (ACH Seeds). When individual treatments were compared across the two varieties to the non-treated controls (NTC), Proline 480 SC (0.156 lb ai/A) applied prior to disease onset (July 12th) and followed by a second application 21 days later had significantly ($P \leq 0.05$) lower disease ratings than the NTC. This treatment had the lowest %MLAD but was not significantly different to other treatments (Proline applied before disease onset or with disease present).

OBUYA, JAMES O.[1]*, LINDA E. HANSON[2] and GARY D. FRANC[1], [1]University of Wyoming, Plant Sciences Department, Laramie, WY 82071 and [2]USDA-ARS and Michigan State University, East Lansing, MI 48824. **Mating type idiomorphs distribution and their correlation to benzimidazole-resistance in *Cercospora beticola* from the Central High Plains Region, USA**

Cercospora leaf spot (CLS) of sugarbeet is caused by *Cercospora beticola* Sacc., and is one of the most destructive foliar diseases worldwide. Fungicides used for disease suppression include benzimidazoles. Resistance to benzimidazoles can develop quickly, and was first reported in *C. beticola* in 1973 from Greece. Despite reduced use, benzimidazole-resistance typically persists in the *C. beticola* population. We investigated the correlation between the distribution of mating types and benzimidazole-resistance in 179 *C. beticola* isolates recovered during prior CLS surveys. Representative isolates (173) were selected from 56 fields in 19 counties and four states in the Central High Plains (2004-2009), and six isolates were from Michigan (2008).

Characterization revealed that 110 isolates were sensitive and 69 were resistant to benzimidazole. These isolates were then tested to determine the frequency of mating type idiomorphs by PCR amplification of mating type loci. Results revealed that c.a.80% of *C. beticola* isolates from the Central High Plains contained the MAT1-1 idiomorph in contrast to an equal distribution of mating type idiomorphs reported by a research group in Europe. Our results departed from the expected 1:1 ratio except for states that had low sample numbers, such as Wyoming ($\chi^2$=1.47, df=1) and Michigan ($\chi^2$=1, df=1, P=0.05), which had equal distributions of mating type idiomorphs. The latter observations are similar to that reported for *C. beticola* in the north central region of the United States. The unequal frequency of mating type idiomorphs indicated a potential lack of mating among the *C. beticola* population in sugarbeet growing areas of the Central High Plains region. Therefore, sexual recombination may not be occurring in a *C. beticola* population where benzimidazole resistance is known to persist.

REYNOLDS, GREGORY J.[1]*, CAROL E. WINDELS[2], IAN V. MACRAE[3] and SOIZIK LAGUETTE[4], [1]University of California-Davis, Department of Plant Pathology, Davis, CA 95616; [2]University of Minnesota, Department of Plant Pathology and Northwest Research and Outreach Center, Crookston, MN 56716; [3]University of Minnesota, Department of Entomology and Northwest Research and Outreach Center, Crookston, MN 56716 and [4]University of North Dakota, Department of Earth System Science and Policy, Grand Forks, ND 58202. **Remote sensing for assessing Rhizoctonia crown and root rot severity in sugar beet.**

Rhizoctonia crown and root rot (RCRR), caused by *Rhizoctonia solani* AG-2-2, is an increasingly important disease of sugar beet in Minnesota and North Dakota. Disease ratings are based on subjective, visual estimates of root rot severity (0–7 scale; 0=healthy; 7=100% rotted, foliage dead). Remote sensing was evaluated as an alternative method to assess RCRR. Field plots of sugar beet were inoculated with *R. solani* AG 2-2 IIIB at a range of inoculum densities at the 10-leaf stage in 2008 and 2009. Data were collected for 1) hyperspectral reflectance from the sugar beet canopy and 2) visual ratings of RCRR in 2008 at 2, 4, 6, and 8 weeks after inoculation (WAI) and in 2009 at 2, 3, 5 and 9 WAI. Green, red, and near-infrared reflectance and several calculated narrowband and wideband vegetation indices (VIs) correlated with visual ratings of RCRR, and all resulted in strong non-linear regressions. Values of VIs were constant until 25 to 50% of the root surface rotted and then decreased significantly as disease severity increased. RCRR also was detected using airborne, color-infrared imagery at 0.25 m and 1 m resolution. Re-

mote sensing can detect RCRR but not before initial appearance of foliar symptoms.

STRAUSBAUGH, CARL A.[1]*, IMAD A. EUJAYL1 and ERIK WENNINGER[2], [1]USDA-ARS NWISRL, 3793 North 3600 East, Kimberly, ID 83341 and [2]University of Idaho, Twin Falls Research and Extension Center, Twin Falls, ID 83303. **Neonicotinoid seed treatments and foliar sprays on sugarbeet for control of severe curly top.**

Sugarbeet production in semiarid regions is hindered by yield loss caused with *Beet severe curly top virus* and other closely related species vectored by the beet leafhopper. In 2010, a study was established to investigate the level of control from seed treatments and supplemental foliar insecticide sprays under severe curly top pressure, since previous testing was only under low to moderate pressure in Idaho. Two cultivars and 7 treatments were arranged in a randomized complete block design with 8 replications in 4 row plots planted on 3 May. The treatments included a non-treated check, NipsIt (60 g ai clothianidin/100,000 seed) with and without an experimental fungicide, Cruiser Force (60 g ai thiamethoxam + 8 g ai tefluthrin/100,000 seed), and Poncho Beta (60 g ai clothianidin + 8 g ai beta-cyfluthrin/100,000 seed). Poncho Beta was also tested with Movento (spirotetramat; 5 fl oz/A) or Movento + Provado (imidacloprid; 3.8 fl oz/A), which were applied twice (7 days before and again 5 days after inoculation). The plots were inoculated with 6 viruliferous beet leafhoppers per plant on 23 Jun at the 8-leaf growth stage. Plants in the center 2 rows were rated for curly top in Jul, Aug, and Sept and harvested on 6 Oct. The treatments reduced ($P < 0.0001$) curly top ratings by 32 to 43% in Jul, 36 to 60% in Aug, and 37 to 55% in Sept compared to the non-treated check, regardless of cultivar. Treatments yielded 26 to 31 tons/A across the two cultivars, which was significantly greater ($P < 0.0001$) than the non-treated check (1 to 3 tons/A). Yield among treated plots was not different, except Poncho Beta was better than Cruiser Force with Beta 4430R. All the neonicotinoid seed treatments looked promising for control of severe curly top pressure on sugarbeet but the foliar sprays made no difference for curly top control.

WEBB, KIMBERLY M.* and TAMMY BRENNER, USDA-ARS, Sugar Beet Research Unit, 1701 Centre Avenue, Fort Collins, CO 80526. **Environmental conditions that contribute to development and severity of sugar beet Fusarium yellows caused by *Fusarium oxysporum* f. sp. *betae*: temperature.**

Fusarium yellows in sugar beet, caused by *Fusarium oxysporum*

f. sp. *betae*, continues to cause significant problems to sugar beet production by causing considerable reductions in root yield, sucrose percentage, and juice purity in affected sugar beets. Environment plays a critical role in pathogen invasion of plants, influencing pathogen interactions with the host, by determining pathogen effectiveness in colonizing the host, and by regulating the genetic mechanisms associated with expression of resistance to disease in the host. Although Fusarium yellows development is believed to be extremely dependent on temperature, with very little disease occurring at <20C, and optimum symptom development occurring between 24-28C, little information is known how much air or soil temperature(s) individually contribute(s) to *Fusarium oxysporum* successful invasion of sugar beet, and it's potential impact on the effectiveness of resistance. In growth chamber experiments we studied how temperatures corresponding to early (16/6C), mid (26/11C) and late (32/16C) season contributed to severity of disease development on two susceptible varieties (USH20 and FC716), using two isolates of *F. oxysporum* f. sp. *betae* (F19 and Fob 220a) by measuring the area under the disease progress curve (AUDPC). In secondary experiments we will further analyze how increasing temperatures impact effectiveness of resistance against the same isolates. The most disease was observed when plants were grown at 26/11C and the least amount of disease occurring at the coolest temperatures (16/6C). There were differences in severity of disease as well as initial symptom development between the two varieties tested and with the two isolates of *F. oxysporum* f. sp. *betae* used.

YOUDON, TSERING*, GARY D. FRANC, ANDREW R. KNISS and WILLIAM L. STUMP, University of Wyoming, Plant Sciences-3354, 1000 E. University Avenue, Laramie, WY 82071. **Effects of herbicides and sugarbeet cultivars on Rhizoctonia root and crown rot development.**

A greenhouse study was conducted to determine potential effects of herbicides on Rhizoctonia root and crown rot (RRCR) disease development in four glyphosate-tolerant sugarbeet (*Beta vulgaris* L.) cultivars. The cultivars tested were Beta 66RR70, Beta 66RR60, Hilleshog 9027 and Hilleshog 9032. Each cultivar was subjected to either, no herbicide, Roundup WeatherMax, or a conventional herbicide treatment of Betamix plus Upbeet plus Stinger. Additionally, superimposed upon herbicide treatments was the presence or absence of *Rhizoctonia solani* R1 (AG-2-2) inoculation. The main effects of inoculation and cultivar were significant; RRCR disease severity differed significantly among all sugarbeet cultivars ($P \leq 0.05$). The order of decreasing RRCR severity (increasing disease tolerance) was Beta 66RR60, Hilleshog 9032, Beta 66RR70, followed by Hilleshog 9027

($P \leq 0.05$). The interaction between herbicide treatment and inoculation was also significant ($P \leq 0.05$). Both herbicide treatments significantly increased RRCR disease severity compared to no herbicide ($P \leq 0.05$). The conventional herbicide treatment significantly increased RRCR disease severity compared to Roundup WeatherMax ($P \leq 0.05$). Results reveal that herbicide application to glyphosate-tolerant sugarbeet will affect RRCR development and resultant disease severity under greenhouse conditions.

## Section D – Chemistry & Instrumentation
## Oral Presentations

BAKER, CHARLES W., The Sugar Association, 1300 L Street N.W., Suite 1001, Washington, DC 20005. **Dietary sugars and diet quality.**

The food category denominated as "added sugars" is defined as all caloric sweeteners used in processed and home-prepared foods and beverages. The added sugars category includes beet and cane sugar; starch-based products like corn syrups; honey; and edible syrups like sorghum. Since the early 2000s, added sugars have been identified as "nutrients to reduce." A variety of mathematical models have been developed to justify the dietary recommendation to reduce intakes of added sugars. The defects inherent in such theories as nutrient displacement and discretionary calories will be identified. Additionally, intake levels of added sugars are estimates at best. Recent expert reports showing estimated consumption of added sugars is lower than commonly believed will be highlighted. The presentation will show diet quality is determined by the totality of what an individual consumes, not by a single dietary component like added sugars.

EGGLESTON, GILLIAN[1]*, ANDY DILKS[2], MIKE BLOWERS[2] and KEVIN WINTERS[2], [1]SRRC-ARS-USDA, 1100 Robert E. Lee Boulevard, New Orleans, LA 70124, USA and [2]British Sugar plc, Wissington Factory, Wissington, King's Lynn, Norfolk, UK. **Successful application of dextranase in sugar beet factories.**

Dextranases are sometimes applied to hydrolyze dextran polysaccharide in sugar manufacture when bacterial deterioration of sugar beet has occurred. Unfortunately, dextranases only have a small market and low volume sales compared to many other industrial enzymes. Consequently, research and development efforts to engineer properties of dextranases to specific conditions of sugar beet processing have not occurred and are not expected soon. Less than optimum application previously existed because of confusion about where to

add the dextranase in the factory and which commercial dextranase to use. The wide variation in activity of commercially available dextranases in the U.S., Europe and other parts of the world, and a standardized titration method to measure activities at the factory are discussed. Optimization by applying "concentrated" dextranase as a working solution to juice is described. The results and conclusions from a trial of dextranase addition to draft raw juice at the Wissington factory in the UK are discussed with emphasis on the impact on factory throughput and other key operational parameters. The trial demonstrated a significant benefit on second carbonatation filtration which resulted in increased throughput, reduction in process chemicals usage, improved operational stability, a reduction in limesalts, and a reduction in the amount of water discharged to the site effluent treatment plant . A concentrated dextranase gave better cost in use, because an addition rate below that recommended by the suppliers was achieved making the product significantly cheaper.

EGGLESTON, GILLIAN[1]* and JEAN-MARC HUET[2], [1]SRRC-ARS-USDA, 1100 Robert E. Lee Boulevard, New Orleans, LA 70124, USA and [2]Groupement D'Echanges Techniques, Sucrerie de Sainte-Emilie, Ste Vermandoise Industries, 80240 Villers-Facuon, France. **The measurement of mannitol in a sugar beet factory to monitor deterioration and processing problems.**

Sugar beet deterioration can still be a major technological constraint in processing. The major (but not sole) contributor to deterioration in the U.S. and many other countries, particularly where warm and humid conditions prevail, is infection by hetero-fermentative *Leuconostoc mesenteroides* lactic acid bacteria. In recent years it has emerged that mannitol is a major product of *L. mesenteroides* deterioration of sugar beet and a sensitive marker that can predict processing problems. An enzymatic factory method that is rapid, simple, accurate, and inexpensive is now available to measure mannitol in juices and is also applicable to downstream products. The method recently became an Official ICUMSA (International Commission for Uniform Methods in Sugar Analysis) method GS8-12 "The Determination of Mannitol in Beet Juices, Thin Juices and Syrups by an Enzymatic Method." Numerous factories in Europe, particularly France, Germany, and Belgium are now using the method to monitor for *Leuconostoc* activity in beets, press water, raw and thin juice. In two Belgian factories steam disinfections of juice/cossettes heat exchangers are applied when critical levels (>160 mg/L) of mannitol are detected. At a German factory, heaters are treated regularly with sodium hydroxide when mannitol content becomes greater than 50-60 mg/L. In numerous French factories, mannitol levels are helping to control filtration difficulties. Mannitol balances undertaken by

Groupement D'Exchanges Techniques during the 2009 beet campaign are discussed.

KETTLING, ULRICH* and IRINA N. STERR, Süd-Chemie AG, Corporate Research & Development Department, Staffelseestr. 6, 81477 Munich, Bavaria, Germany. **Liquefied sugar beet - the ideal fermentation substrate for your bio-based products.**

The production of bio-based fuels and chemicals requires renewable feedstocks at affordable costs. Sugar beet (*Beta vulgaris*) is among the agricultural crops with the highest sugar yields. Süd-Chemie developed a proprietary and innovative technology for the enzymatic liquefaction of whole sugar beets without using a diffusion method or adding any water. A key figure is Süd-Chemie's own optimized set of enzymes for the liquefaction of beets. Süd-Chemie's Liquefied Sugar Beet (LSB) process can enhance the content of fermentable sugar resulting from sugar beets, as the LSB fermentation substrate contains everything from the sugar beet root, including sugars from the cellulosic and hemicellulosic part of the plant as well as proteins and minerals. This makes LSB an ideal and complete ready-to-use fermentation substrate. Within the process no sugar beet pulp remains, which is mostly dried for usage as animal feed in a very inefficient way. With the LSB process, Süd-Chemie now offers a highly cost-efficient fermentation substrate derived from sugar beet for a variety of bioprocesses, including production of ethanol, lactic acid or succinic acid. With sales of ⇔1.1 billion, Süd-Chemie AG is a worldwide leader in catalyst and adsorber technology and has an outstanding track-record in chemical and agro-chemical innovations for more than 153 years. With more than thirteen research centres and more than 6,400 employees world-wide, the company is one of the most distinguished companies for innovation in the chemical industry. Süd-Chemie AG actively develops sustainable solutions for the post-petroleum area. One of the solutions is the development of technologies for processing cellulosic biomass into fuels and chemicals.

McKEE, MARIANNE L.*, RONNIE TRICHE, MARY AN GODSHALL and CHARLEY RICHARD, Sugar Processing Research Institute, Inc., 1100 Robert E. Lee Blvd., New Orleans, LA 70124. **Color formation in white beet sugars.**

Previous studies by SPRI have shown that beet sugar colorants tend to be very reactive and autocatalytic in nature. These studies have shown the development of colorants over the course of sugarbeet processing. Colorants that tend to transfer into the crystal usually have high molecular weight and are formed during processing, most

likely the result of alkaline degradation of invert sugars during carbonation. From this point, the colorants increase throughout the process especially during evaporation where the increase may be as much as 15% to 25%. White beet sugar color increases during storage are usually due to two factors – the syrup layer around the crystal and the high molecular weight colorants found inside the crystal. The differences in these two factors will be discussed for white sugars produced during a beet campaign and a thick juice campaign.

MURNIK, JON* and MIKE THOMPSON, Hydrite Chemical Company, 300 N. Patrick Blvd., Brookfield, WI 53008. **Potential savings from sugar defoamer flow monitoring and display.**

To optimize foam control performance in a sugar factory, defoamer must be applied at the correct minimum dosage and accurately adjusted up or down in response to changing foam control needs. Traditionally, this has been accomplished through manual inspection of tank levels and frequent factory oversight to minimize over and under application. The Hydrite Chemical Company has developed a novel, cost-effective approach to match defoamer feed rates to actual defoamer demand while optimizing defoamer usage efficiency through the application of novel technology that precisely monitors extremely low defoamer flow rates, permits settable alarm points that alert when flow rates are outside permitted values, and remotely provides information to plant personnel and chemical suppliers on a real time basis. New engineering, control, and communication approaches were required to support this endeavor. A solid state sensor that monitors the mass flow in the moving fluid (defoamer) was at the heart of the current approach, and it provided a flow reading that ultimately matched readings taken with lab instrumentation to within a milliliter per minute over the full range of defoamer application rates. Computing support was developed to accept and digitize flow information, perform calculations, and provide graphical displays on the factory floor. Finally, supervisory control and display graphics interface was accomplished over the Internet allowing remote defoamer monitoring and control. This novel approach is currently being implemented at Amalgamated Sugar Company in Nampa (Idaho), and based on initial field trials, it is expected to provide demonstrative cost savings over the unsupervised chemical application by significantly eliminating defoamer waste.

REARICK, D. E.*, CHERI MCKAY and ALLA BAGRAMYAN, Amalgamated Research LLC, P. O. Box 228, Twin Falls, ID 83303. **Distribution of non-sugars in the ARi Coupled Loop molasses desugarization system.**

In the conventional simulated moving bed (SMB) desugarization of sugar beet molasses, strongly ionized non-sugars such as inorganic salts and salts of organic acids are easily separated from sucrose by ion exclusion mechanisms and are eluted in the byproduct or raffinate stream. However, less strongly ionized materials or neutral small molecules may travel through the separation medium at a rate closer to that of sucrose and be included in the product or extract fraction. The Coupled Loop System forces ionic materials to travel with sugar in the first loop and elute together in the upgrade stream while more neutral compounds lag behind and are removed in the betaine stream. The upgrade fraction is then passed through a second chromatographic loop to separate sugar from ionic materials, producing the sugar product fraction (extract) and non-sugar fraction (raffinate). Detailed non-sugar analysis of representative sample streams from a Coupled Loop System shows salts to be still predominantly removed in the raffinate stream. Less ionic materials (such as betaine and some amino acids) although still present at lower levels in the extract stream are removed from sucrose in the first loop more efficiently than in a conventional SMB system and are partially eliminated in the betaine stream.

## Section D – Chemistry & Instrumentation
## Poster Presentations

None Submitted

## Section F – Factory Operations
## Oral Presentations

CHUDASAMA, ARVIND, Informa Agra, Telephone House, 69-77 Paul Street, London EC2A 4LQ, UK. **Biobased products: Opportunities and challenges in the sugar industry.**

Advances in bio-process conversion technologies presages a new dawn for the competitiveness of the sugar industry. This is largely because sugar is a superb feedstock for the production of range of products that are currently produced from non-renewable feedstocks. Compared with the biofuels sector, the biobased products sector in

the biorenewables field is the neglected step-child. It has received significantly less government support both in terms of subsidies and incentives than the biofuels sector. This is perhaps because the biobased sector consists of collection of niche markets for the range of products and biochemicals that are synthesised. The market for chemicals in 2012 is forecast at over $2 trillion for which the biochemicals share is projected to be 7.7%. Significant opportunities for expanding the market share clearly exists, but to realise this, policies have to be in place to incentivise the sector backed by access to finance. This presentation discusses these issues.

CORNELIUS, GARY*, GLENN AUGUSTINE, TODD MAURICE and RON KAWLEWSKI, Southern Minnesota Beet Sugar Cooperative, P.O. Box 500, Renville, MN 56284. **Clarification of high strength wastewater using dissolved air floatation technology.**

Dissolved air floatation (DAF) systems are designed to remove suspended solids from water slurries. Clarification is achieved by the addition of pressurized air as fine bubbles. The microscopic bubbles attach to the solids reducing its specific gravity, allowing the material to float. SMBSC has tested several DAF units to clarify high strength water flows. The test results showed good removal of fine soil particles producing an effluent suitable for the wastewater treatment plant.

GEYER, IRMA[1]* and HANS J. SCHMIDT[2], [1]BMA AG, Am Alten Bahnhof 5, 38122 Braunschweig, Germany and [2]BMA America Inc., 3127 Wild Meadow Lane, Aurora, IL 60504. **Novel design of a continuous centrifugal and its operational benefits.**

After many years the time had come to review the basic design of continuous centrifugal machines. The aim was to develop a completely new concept with superior properties. Based on proven, successful state-of-the-art machine concepts, new ideas have been introduced which deviate significantly from conventional design features. A novel concept was found which has been well received by sugar beet factories as well as sugar cane factories. As a result, this new machine proved to be able to provide higher capacity at improved sugar quality and reduced power consumption. In addition, this centrifugal has a smaller foot-print than its predecessors of comparable capacity. The machine offers high reliability and availability, is easy to operate and needs less maintenance. Highest safety standards are ensured by FEM calculations, tests during fabrication and safety devices incorporated into the design of the machine. First operating results obtained during the last sugar beet campaign will be presented.

GROOM, DAVID[1]*, HEATHER JARSKI[1], TERRY McGILLIVRAY[1] and MIKE GOETTEL[2], [1]American Crystal Sugar Company, 1700 North 11th Street, Moorhead, MN 56560 and [2]American Crystal Sugar Company, 121 Highway 81 N.E., Hillsboro, ND 58045. **Restoring the operational capacity of a coupled-loop molasses desugarization separator.**

Maintaining extract product quality while maximizing recovery of the sucrose in the second (extract) loop was becoming increasingly difficult at the American Crystal Sugar Hillsboro MDS facility. Molasses processing rates were reduced to accommodate increasing pressure drops across the second loop. Frequent high pressure shut downs were leading to increased downtime and poorer separation in the second loop. Fractal plates were removed from second loop cells and viewed under a microscope. Scale was collected and analyzed. Scale was also found in the product stream feeding the second loop. Analysis of the scale indicated it was predominantly calcium oxalate. A fractal plate testing cart was built that allowed a comparison in performance between the scaled (fouled) fractal plates and new plates. Poor flow characteristics were observed in the fouled plates. Several approaches were tried to clean up the fractal plates with limited success. When the fouled plates were cleaned up to some degree mechanically, better flow characteristics were observed. The process of clean up was utilized in the factory. Pressure drops were markedly lower (as much as 60% less) after clean-up. Work is still underway to determine the root cause of the scale that appears from time to time and fouls the separator. This paper reviews the troubleshooting and resolution of a problem that has plagued the process over time.

HAFEMANN, HARTMUT and REINHOLD HEMPELMANN*, BMA AG, P.O. Box 3325, 38022 Braunschweig, Germany. **New approach to sugar drying and cooling.**

The properties of white sugar at the end of the production process have to meet requirements that become more and more stringent. This is evident from the wide range of different certification systems. In this connection, drying and cooling of the centrifuged sugar has a decisive role to play, and this phase in the production process is increasingly developing into a conditioning phase before the sugar is stored, graded and packed. For designing the required processing systems, the underlying physical conditions have to be known and adequately accounted for. Depending on the capacity of a plant, processes can be optimized in different ways.

Results of a process analysis will be discussed, which primarily differ in the sugar cooling process. Plants that are in operation in different factories are used to illustrate differences. The attention is in particular directed at developments in fluidized-bed sugar cooling,

with the following objectives: (1) optimal heat exchange, (2) low air requirements, (3) low space requirements, (4) low residual drying requirements to avoid the formation of sugar lumps.

JARSKI, HEATHER R.* and TERRY D. McGILLIVRAY, American Crystal Sugar Company, 1700 N. 11th Street, Moorhead, MN 56561. **A comparison of anion concentrations across carbonation at the five valley factories of American Crystal Sugar Company.**

A comparative study of changes in anion concentration during carbonation is currently being conducted at American Crystal Sugar Company. The fate of the measured anions (malate, sulfate, oxalate and citrate) across carbonation is discussed with particular emphasis on the oxalate anion.

KLINGER, BLAKE, Southern Minnesota Beet Sugar Cooperative, 83550 County Road 21, Renville, MN 56284. **Process solids separation on raw juices.**

Solids in processing raw juices have caused problems with equipment and plant efficiency for many years. For our study, we wanted to determine the area to install solids separation equipment with the best possible results. Particle size analysis and percent solids were tested to determine the area best suited for the separation. After data was collected, it was determined that the raw juice flow had the best chance to remove the most solids.

KNIEPER, LOUIS H., RON KAWLEWSKI and JEFFREY L. CARLSON*, Southern Minnesota Beet Sugar Cooperative, P. O. Box 500, 83550 County Road 21, Renville, MN 56284-0500. **Determination of oleanolic acid based saponin removal by the wastewater treatment system at Southern Minnesota Beet Sugar Cooperative.**

A quantitative method to determine the amount of one type of beet sugar saponin was used to measure its concentration in wastewater as it passed through treatment at SMBSC. The method included an acid digestion of the sample to cleave the glycosidic linkage and free up oleanolic acid. Its concentration was then determined using liquid chromatographic mass spectroscopy (LC/MS). Glycyrrhetinic acid was used as an internal standard and the samples were spiked with the surrogate hederagenin. The highest concentration of oleanolic based saponins was seen in the water used to wash the sugarbeets. The concentration gradually diminishing as the water

passed through the treatment system and was below the method reporting limit in the final effluent.

KOCHERGIN, VADIM[1]*, MARK SUHR[2] and CHRISTIAN LOHREY[1], [1]Audubon Sugar Institute, LSU AgCenter, 3845 Hwy 75, St. Gabriel, LA 70776 and [2]MS Processes Intl., LLC, 16491 Highway 7 East, Hutchinson, MN 55350. **Utilization of beet sugar factory resources for production of Algal Biodiesel.**

Increased economic pressure in recent decades force sugar producers to consider value-added technologies that can improve industry's sustainability. Carbon dioxide from boiler flue gas, water, and waste heat from sugar beet plants are resources that can be utilized for production of oil-containing algae. Algae production has been considered as a promising method of sequestration of carbon dioxide for conversion into jet and diesel fuels and chemicals. With oil content ranging between 30 and 50 % on dry mass, algae offer productivity10-20 times higher in comparison with oil producing land crops. Algal oil is easily converted into biodiesel via transesterification with ethanol, which can be obtained by fermentation of effluent streams from a sugar factory. Resulting biodiesel can be used to cover harvesting and transportation needs. Authors have previously analyzed the possibility of algal production in connection with raw cane mills. It was found that sugar cane mills can supply sufficient carbon dioxide from flue gas to support mass algae production, as well as provide sufficient electric power and steam required for conversion of algal biomass into biodiesel. In addition, cane mills generate significant amounts of clean water and have ponds available for algal production. Current presentation explores integration of algal technology into sugar beet processing facilities. Material and heat balances will be presented for operation scenarios where algae is produced adjacent to a 10,000 tpd sugar beet plant. Co-location of beet plants and algal production facilities will allow mitigation of greenhouse gases and offer benefits of utilization of existing agricultural infrastructure and resources while maintaining the same level of sugar production.

KOCHERGIN, VADIM* and CY GAUDET, Audubon Sugar Institute, LSU AgCenter, 3845 Hwy 75, St. Gabriel, LA 70776. **Design of clarifiers with turbulence reduction devices.**

Solid-liquid separation technologies are critical for various applications in the sugar beet industry. Computerized fluid dynamics (CFD) simulations of existing clarifier designs demonstrated that particle precipitation was adversely affected by the presence of large-scale turbulent eddies. Settling of first carbonation juice is a good il-

lustration of such inefficiency. Precipitation of flocculated particles that takes several minutes in the laboratory conditions requires 40-60 minutes residence time in the industrial clarifiers. Because of turbulence, lower quality juice overflow is observed; larger size of equipment is required with increased potential for sucrose losses. A new design of trayless juice clarifier based on patent pending turbulence reduction devices has been successfully tested in several Louisiana cane sugar mills. A 20 ft.-diameter single-tray clarifier was retrofitted with nine turbulence reduction devices, uniformly distributed over the cross sectional area. Modified clarifier was operated in parallel with multitray 20 ft. diameter Graver and a 30 ft.-diameter Dorr clarifiers for a 90-day long processing season. On average, the newly designed clarifier performed at a 25 % higher feed flowrate than the Graver clarifier, while delivering juice with 20-25 % lower turbidity. Performance also compared favorably with Dorr clarifier that had twice the residence time. Results of CFD simulations and physical testing of the prototypes and factory operating data will be presented along with the retrofitting options.

LARSEN, KASPER GEHL[1]*, FUMIO KIKUCHI[2] and ARNE S. JENSEN[1], [1]EnerDry ApS, Kongevejen 157, 2830 Virum, Denmark and [2]Nitten Beet Sugar Co., Japan. **Steam drying of beet pulp in Japan and latest development of the technology.**

The first steam dryer for beet pulp in Japan is now installed and put in operation by EnerDry. This is at the Bihoro factory on Hokkaido belonging to the Nitten Sugar Company. On Hokkaido the winter is cold like in the Mid West, so the beets can be stored with temperature control around the freezing point in large tents. The cossets are cut very fine, which gives a good pressing and another type of pulp than in the Mid West. The dryer therefore has to be adapted to these new conditions, which was successfully done and even with a saving of power. The development on the drying technology is continuously going on. There are especially spent efforts on new and better ways to discharge pulp out of the pressurized system.

MAGAZINE, FRANK[1]*, JULIE VAUGHN[2], OMAR FUENTES[1] and ERIC KEYES[1], [1]Emerald Foam Control, 311 Cleveland Place, Cheyenne, WY 82007 and [2]Emerald Performance Materials, 2020 Front Street, Cuyahoga Falls, Ohio 44221. **Additives and processing aids. Evolving requirements in food safety.**

Additives and processing aids are used in the food industry in many different applications for product enhancement and processing benefits. In recent years, intentionally and unintentional contami-

nation of food has created major recalls affecting large segments of the population. In some cases, the adulterated food has caused illnesses and even death to pets, livestock, and humans. The food recalls have increased scrutiny by regulatory agencies around the world. Food definition, descriptions of food additives, processing aids, their differences, and the FDA "farm to fork" approach will be discussed. A brief review on some global certification standards will also be discussed.

PATULLO, CHRIS L., American Crystal Sugar Company, 121 Highway 81 N.E., Hillsboro, ND 58045. **Results and experiences with the new Putsch PKF NG.**

Elevated lime cake sugar loss and lack of carbonation mud pressing capacity justified the installation of a new Putsch PKF NG. Modifications made to the PKF NG improved the press's reliability, cycle time and ease of use. In addition, the updated control programming and logic was designed to reduce plate and membrane damage while maximizing the press capacity. As this was a concern with the existing station, these modifications were also done to the existing mud presses. In addition, several modifications to the station after commissioning further improved the mud press station's efficiency. Results of the PKF NG installation and subsequent station modifications lowered the lime cake loss significantly as well as increased the overall station's uptime and cost effectiveness.

RHOTEN, CHRISTOPHER D., The Amalgamated Sugar Company, LLC, Mini-Cassia Factory, 50 South 500 West, Paul, Idaho 83347. **Influence of sugar end syrup pH on overall color rise in the sugar end and color of molasses produced.**

Where chromatographic separation of sucrose from molasses produced is employed to enhance the quantity of recoverable sucrose from beets processed, the color of the molasses feed to the molasses separator operation has a relatively large effect on the color of the sucrose enriched extract produced from the separation process and, as a result, on the overall efficiency of sugar recovery from the molasses separation process. The subsequent sugar end processing efficiency of the separator sucrose enriched extract product to granulated sugar is quite dependent on the color loading of the extract being processed. This study evaluates the effect of manipulating and controlling the pH of the high green, intermediate green and molasses produced to achieve minimal color rise and a low final molasses color from the thick juice processed in the sugar end. It is shown that the pH of the green syrups has a direct influence on the

overall color rise in the sugar end and the color of the final molasses produced. The deliberate and precise control of green syrup pH will produce molasses of the desired color relative to the quality of the beets being processed and the thick juice produced from such beet quality. It is further shown that the color of extract produced is highly dependent on the color of molasses feed to the molasses separation operation. Thus, the manipulation of the syrup pH in the sugar end to control the color of virgin molasses produced results in the production of lower color extract product from molasses separation operations.

RHOTEN, CHRISTOPHER D., The Amalgamated Sugar Company, LLC, Mini-Cassia Factory, 50 South 500 West, Paul, Idaho 83347. **Influence of thin juice pH management on thick juice color in a factory utilizing weak cation thin juice softening.**

In beet sugar factories utilizing weak cation thin juice softening, soda ash addition to thin juice is utilized to pre-soften the juice to a suitable feed hardness for supply to the weak cation reactors. Generally, there is addition of 50% caustic solution downstream of the weak cation reactors to counter the effect of $H^+$ bleed from the freshly regenerated weak cation resin during the reactor service cycle. If not precisely controlled, the post-reactor re-alkalization of the thin juice may result in over-alkalization of thin juice leading to pH rise in evaporation and an associated color rise in the juice during evaporation. The subject investigation was undertaken for the purpose of optimizing the pre-softening of thin juice while also achieving overall optimum pH management thus avoiding juice over-alkalization and the resulting associated color rise in process juices during juice concentration. A means of pre-alkalization control was developed and implemented satisfying both the pre-softening and the overall juice alkalization requirements leading to the complete elimination of the use of liquid caustic for post-reactor re-alkalization and the elimination of excessive color rise in evaporation. Optimum juice pH targets for minimum color rise in concentration are identified resulting in minimum thick juice color and invert concentration while meeting the competing juice processing requirements for the production of soft thin juice.

ROGERS, GALAN M., The Amalgamated Sugar Company, P.O. Box 700, Paul, ID 83347. **Cossette quality and the impact this has on factory operations.**

The benefit of cossette quality has long been established as a precursor of good factory operations. However, the justification of such a

statement, based upon vendor data, was difficult to prove without major capital investment. Consequently, the impact of cossette quality was felt to be real, but never really quantified. The 2010 – 2011 campaign at the Mini-Cassia Factory of The Amalgamated Sugar Company started with a new slicer and beet hopper installation. From the first day of slice, the factory behavior was improved over the previous campaign. The major improvements are as follows: (1) Lower draft, (2) Lower pulp losses, (3) Better pulp press performance, (4) Lower energy demands in the pulp drier and (5) Reduction of unaccountable loss. While there may be other benefits, these were the most notable. Factory operations have improved and are indicating the benefits of the cossette quality.

ROGERS, GALAN M.*, THOMAS T. DOLECHECK and KAREN M. CUMMINGS, The Amalgamated Sugar Company, P. O. Box 700, Paul, ID 83347. **Solids removal from the flume water system Phase V.**

Historically, solids in the flume water system were removed by settling the clarifier underflow in a pond and returning the clarified water for reuse. In 2006, an infection occurred in the pond which did not allow solids to settle, thus returning muddy water back to the flume water system. Since 2006, removal of solids from the flume water system has been an ongoing experiment to see what process will result in the most reduction of solids at the lowest cost. Phase I split the clarifier underflow stream and sent a portion of the flow to rented belt presses and one centrifuge, this reduced solids being sent to the mud pond. Phase II sent a portion of the flow to two hydroclones that removed solids mechanically before being sent to rented centrifuges. Phase III – additional hydroclones and two belt presses were installed to reduce solids along with a polymer make down system that lowered costs. Phase IV added two belt presses to the system to increase solids removal capacity. Phase V installed a solids thickener for conditioning of the solids before the belt presses, lime addition after the clarifier and new inflow settling rings in the clarifier. The belt press operation is optimized when the solids are consistent, thickened and at a pH of 6.5 to 9 before polymer addition. Before the thickener, solids withdrawal rate from the clarifier was reduced to increase the solids content to the hydroclones and the belt presses. This resulted in a dirty overflow from the clarifier and on one occasion, a plugged clarifier underflow line. Lime addition after the clarifier allowed a higher pH in the flume system without adversely affecting polymer efficiency and belt longevity. The new clarifier settling rings increased the effectiveness of the clarifier at varying solids loads and flow rates, shortcutting of solids was eliminated.

SAMARAWEERA, INDRANI S.[1]*, TERRY McGILLIVRAY[1], MIKE GOETTEL[2], SHELDON SEABORN[3] and DENNIS BURTHWICK[4], [1]American Crystal Sugar Company, 1700 N. 11th Street, Moorhead, MN 56560, [2]American Crystal Sugar Company, Route 2, Box 42, Hillsboro, ND 58045, [3]American Crystal Sugar Company, Box 357, Business Hwy 2, East Grand Forks, MN 56721 and [4]American Crystal Sugar Company, 2500 N. 11th Street, Moorhead, MN 56560. **Performance of factory anaerobic contactors operated with and without pre-acidification (PA) of feed to the contactors and comparison to bench PA trials under different conditions.**

American Crystal Sugar Company (ACS) has anaerobic wastewater treatment systems in operation at three factories, Moorhead (MHD), East Grand Forks (EGF) and Hillsboro (HLB). Performance differences have been noted between the systems operated with a heated pre-acidification (PA) system (EGF), one operated with a covered pond with or without heat (MHD), and another with a lagoon system (HLB) for storage of high strength industrial water. A series of bench scale PA trials were carried out at different conditions (temperature, retention time and pH) at the ACS Technical Services Center. These studies showed that the best conditions for conversion of COD to volatile fatty acids and lactic acids with minimal use of NaOH were a minimum temperature of 350C, a minimum pH of 5.0, and a retention time of about 10 days. High strength wastewater of 50,000 – 60,000 ppm COD was not readily pre-acidified and dilution to a concentration of less than 40,000 mg/L COD was found to be necessary. Data from PA trials and operational data from ACS factories at EGF, MHD and HLB (with or without PA) showed that a minimum % VFA (volatile fatty acids) of 20% -35% and % VFA + (including lactic acid) of > 35% was required for continued processing of high strength wastewater at treatment rates of greater than 22 pounds COD per 1000 cu. ft. of contactor per day. A sufficient degree of PA prior to anaerobic treatment appears to have had positive effects on sludge settling rates after the contactor. The MHD factory added macro nutrients and micronutrients and treated 133,000 lbs of COD /day from Dec. 1st to May 31st, 2010. The HLB factory treated 101,931 lbs of COD /day in 2010 and 146,063 lbs COD /day in the 2009 campaign. The EGF factory operating with PA of their wastewater was able to treat 184,538 lbs of COD /day during the same period and achieved sustained treatment rates of >250,000 lbs of COD /day.

SILVA, MARCELO MOREIRA DE[1] and EDUARDO IEDA[2]*, [1]Mecat Filtracoes Industriais, Rodovia Br 060 Km 213, Abadia de Goias, Goias 74 423-970, Brazil and [2]MECAT, Av. Hercules Pereira Hortal, 1366, Bebedouro, Sao Paulo 14 701-200, Brazil. **Initial results and first impressions with the Turbofilter.**

The use of the Turbofilter to remove insoluble solids on the "diffusion juice" and on the "cold lime juice", evaluating its overall performance in the process. On the "cold lime juice", lime is added initially to elevate the pH to 11.1 to precipitate oxalates, citrates and pectins to be removed from the juice; removing them would help the remaining steps of the sugar production.

THORN, JONATHAN, MAC Equipment, Inc., 7901 N. W. 107th Terrace, Kansas City, MO 64154. **Pneumatic Conveying in Sugar Production.**

In sugar production facilities, mechanical conveying methods are a prominent means of handling granulated sugar product. However, recent events and changes to government body policy have made pneumatic conveying an attractive alternative to mechanical means. Maintenance reduction, cleanliness and plant safety are advantages that pneumatic conveying can provide. Sugar is transported through enclosed pipelines with few moving parts to be maintained. Integrated filtration systems allow the sugar to be delivered to its next destination in a clean and dust-free environment. Most importantly, pneumatic conveying of sugar materials more easily facilitates the use of explosion protection methods advocated by the NFPA. While overall power consumption is greater in pneumatic conveying systems, as compared to mechanical systems, this cost can be offset by short and long term savings in protection devices, product safety and maintenance. Bolstered by other advantages such as process flexibility and small plant footprints, pneumatic conveying systems are gaining acceptance in sugar production facilities as a viable means of material transport.

VIDAL, OLIVIER[1]* and OLIVIER DEUR[2], [1]MAGUIN SAS, 2 rue Pierre Semard, 02800 Charmes, France and [2]MAGUIN SAS, Route Nationale 12, F-28410 Serville, France. **Strong and flexible thermal and environmental coupling between pulp drying and sugar process.**

Sugar beet pulp drying is important in energy losses and environmental issues. The objective of the study is to present through low temperature air beet dryer results and indirect triple pass turbo dryer results obtained in large scale plants, a new combination of

both technologies to reduce energy consumption as well as rise pellets quality and lower environmental impact. An original coupling of this combination with the sugar beet factory is studied in order to minimize fossil fuel consumption by enlarging low temperature air beet dryer capacity. Coupling of a low temperature air beet dryer with a beet factory has been successful in Europe to reduce drastically fossil fuel consumption. The purpose of the new combination is to reduce to minimum fossil fuel consumption, to keep actual factory energy production scheme, to reduce coupling impact on beet factory operations and so to ensure lower sugar beet plant adaptations for concept implementation. Based on both equipment obtained performances a simulation of the implemented solution on averaged 10 000 tpd beet sugar factory is detailed.

The concept isolated from sugar beet plant can reduce by factor 2 fossil fuel consumptions. Coupling the concept with sugar beet plant can reduce 80 % and more fossil fuel consumptions for beet drying operation. Elements to ensure such strong economy with minimal impact at reasonable capital cost are detailed in the study. Simulations are showing that even on a low consumption beet sugar plant the economy remains.

## Section F – Factory Operations
## Poster Presentations

None Submitted