ABSTRACTS

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Section A, Agronomy
Oral Presentations

CAPPY, JAMES J., DAVID A. LONG and KEVIN THORSNESS, Bayer CropScience, P.O. Box 12014, Research Triangle Park, NC 27709. **Status of isophorone-free sugarbeet herbicide formulations.**

EPA has issued a data call-in to manufacturers for the solvent isophorone which may result in the mandatory removal of it from use in pesticides. Isophorone is a key component in widely used sugarbeet herbicides containing desmedipham and phenmedipham. In response to the data call-in Bayer CropScience has initiated an ongoing program to develop new isophorone-free formulations of Progress, Betamix and Betanex herbicides. The first isophorone-free formulations were developed and field tested in 2003 and 2004. The efficacy and crop tolerance of the new formulations were comparable to the currently marketed products. Manufacturing issues will prevent the introduction of the isophorone-free formulations in 2005. The issues surrounding development of new formulations for the sugarbeet marked will be discussed. A new generation of isophorone-free formulations of Progress and Betamix is under development and scheduled for field testing this field season.

DEXTER, ALAN G*., and JOHN L. LUECKE, North Dakota State University and the University of Minnesota, Fargo, ND 58105. **Herbicide combinations for kochia and common lambsquarters control.**

Kochia was named as worst weed by 46%, common lambsquarters by 18% and pigweed spp. by 27% of the respondents to the 2003 annual survey of sugarbeet growers in eastern North Dakota and Minnesota. In 1993, kochia was named as worst weed by 13%, common lambsquarters by 6% and pigweed spp. by 38% of the survey respondents so kochia and common lambsquarters have increased in importance in sugarbeet over the past 10 years. Postemergence herbicide combinations including desmedipham, phenmedipham, triflusulfuron and clopyralid were applied an average of three times per field in 2003 so nearly all sugarbeet growers used the postemergence herbicides available for broadleaf weed control in sugarbeet. Only 29% of the acreage was treated with a preemergence or preplant incorporated herbicide in 2003. Research results in 2004 indicated that kochia and common lambsquarters control could be improved by increasing the application rate of postemergence treatments; using ethofumesate as a preemergence treatment ahead of postemergence treatments; adding postemergence ethofumesate at 0.09 to 0.125 lb/A to postemergence herbicide treatments and adding metamitron at 1.5 lb/A to postemergence herbicide treatments. However, even preemergence ethofumesate at 3.5 lb/A followed by four applications of conventional rates of postemergence desmedipham plus phenmedipham plus ethofumesate plus triflusulfuron plus clopyralid did not provide adequate control of a dense population of kochia.

GILES, JOSEPH F.*, and LARRY J. SMITH, Department of Soil Science, North Dakota State University, Fargo, ND 58105, University of Minnesota, Northwest Research and Outreach Center, Crookston, MN 56716. **Effect of spent lime on sugar production and crops following sugarbeet in the Red River Valley of the North.**

Crushed limestone is used in the processing of sugarbeet to improve the sugar recovery. Traditionally this spent lime, after being filtered out of the process, has been stockpiled near the factory due to lack of a suitable use given the calcareous nature of

most of the soils in the Red River Valley and southern Minnesota. The material has taken up many acres of space over the years factories have operated in this region. The analyses data of spent lime shows the material contains nutrients which are separated from the sugarbeet juice as sucrose is recovered. The acid neutralizing is not reduced much from that of pure lime. Established studies have shown soil P increased and K, Cl, and Na decreased with spent lime application. Yield responses of sugarbeet and other crops from various studies will be presented. No detrimental affects have been observed from spent lime application.

GUZA, COREY J.*, and JAMES F. STEWART, Michigan Sugar Company, 725 South Almer St., Caro, MI 48723. **Implementation of Beetcast, a predictive model for managing cercospora leafspot, in Michigan.**

Beetcast was implemented for the 2004 growing season in Michigan. Beetcast is a predictive model for improving fungicide application timing when managing cercospora leafspot. The objective of this study was to evaluate the accuracy of Beetcast in Michigan. Studies were conducted at six locations throughout the growing region. Treatments included applying fungicides based on Beetcast and applying fungicides based on visual disease symptoms. Sugarbeets were evaluated for visual disease symptoms, root weight and quality. Applying fungicides using Beetcast resulted in leafspot control equal to or greater than scouting alone.

HUBBELL, LEE A.*, and DAVID WISHOWSKI, Michigan Sugar Company, 2600 S. Euclid Ave., Bay City, MI 48706. **Would smooth root beets reduce the cost of disposing of soil at our factories?**

Disposing of soil that adheres to the beets as they are delivered is a large expense. Regulations regarding disposal are also a concern. The USDA-ARS in East Lansing, Michigan has developed and released a series of smooth root lines. There is a noticeable difference in the shape of the root. The root is more smooth and round and has less root hairs. The test was developed to see how much less soil is held on the smooth root beets. We compared three smooth root lines SR 87, SR 95, and SR 97 with three traditional varieties being sold to our growers. After harvesting, the beets were cleaned in our tare room beet washer and the tare compared. There was significantly less soil on the smooth root releases. Comparing the average of three locations each year the percent tare was reduced from 3.73% to 1.73% in 2002, and reduced from 1.84% to .72% in 2003. Tests are also being conducted in 2004.

KAFFKA, STEPHEN R.[1]*, and HERMAN MEISTER[2], [1]Department of Agronomy and Range Science, University of California, Davis., CA 95616; [2]UCCE, Imperial County, Holtville, CA California 92259. **Fertilizer N management for high-yielding, fall-planted sugarbeets in the Imperial Valley**

Average sugarbeet yields have increased by 30 % or more in California in the last decade. They are highest in the Imperial Valley (IV). Current yields exceed those used previously as a basis for existing fertilizer management programs. A N management trial was carried out during 2003-2004 in the IV to quantify sugarbeet response to different rates (0 to 290 lb/ac) and timing of fertilizer N. Beets were harvested monthly from January through July, and dry matter accumulation, root and sugar yields (April to July), and plant N content were determined. The two most commonly used varieties in the IV were compared (SS Phoenix, Beta 4430). A second objective was to correlate changes in petiole N levels in controlled experiments in plots with those in growers' fields, to help guide

late season N management. Petiole samples were collected in plots and additional petiole samples were taken in four different field locations selected to be representative of the soil types and management practices found in the IV. Optimum N fertilization levels depended on the time of harvest, but highest root and gross sugar yields (75 t ac-1 / 22,000 lb ac-1) were achieved at approximately 200 lb N ac-1 in both June and July harvests. Fertilizer optima were lower for April and May harvests. There were no significant dry matter or root yield differences between the two varieties. Current sugarbeet varieties did not need greatly increased amounts of N fertilizer to achieve record root and sugar yield levels.

KHAN, MOHAMED F.R.[1]*, RANDY NELSON[2], and LARRY CAMPBELL[3], [1]North Dakota State University & University of Minnesota, Soil Science Department, Fargo, ND 58105-5758, [2]North Dakota State University, Soil Science Department, Fargo, ND 58105, [3]USDA Agricultural Research Service, Northern Crop Science Laboratory, Fargo, ND 58105. **Optimum plant population of Rhizomania resistant sugarbeet varieties for highest recoverable sucrose per acre.**

Use of Rhizomania resistant varieties has increased due to the prevalence of Rhizomania in the Red River Valley. The objective of this study was to determine the optimum population of Rhizomania resistant sugarbeet varieties that would result in the highest recoverable sucrose per acre. Trials were conducted in Foxhome, MN. Van der Have (VDH) 46177 (2N) was planted in 2003, and VDH 46177 and Beta 4818 (3N) were planted in 2004. Plots were comprised of six 22-inch wide rows that were 30 feet long. Experiments were arranged in a split-plot design with four replications. Plots were planted at 3 inch seed spacing, and thinned at the four to six leaf stage. Plant populations after thinning were 100, 125, 150, 175, 200, and 225 plants per 100 ft. of row. The middle two rows of each plot were harvested and root yield and quality were determined. In 2003, there was no significant difference in recoverable sucrose among treatments. However, the175 plants per 100 ft. of row population resulted in the highest recoverable sucrose among treatments. In 2004, both VDH 46177 and Beta 4818 at 175 plants per 100 ft. of row, resulted in the highest recoverable sucrose. The data suggest that a plant population of 175 plants per 100 ft. of 22-inch wide rows would result in the highest recoverable sucrose per acre for Rhizomania resistant varieties, irrespective of whether they are diploids or triploids.

KHAN, MOHAMED F.R.1*, LARRY J. SMITH2, MARK BREDEHOEFT3, STEVE ROEHL3, and RANDY NELSON1, 1North Dakota State University & University of Minnesota, Soil Science Department, Fargo, ND 58105-5758, 2University of Minnesota, Northwest Research and Outreach Center, Crookston, MN 56716, and Southern Minnesota Beet Sugar Cooperative, Renville, MN 56284. **Managing Cercospora leaf spot on sugarbeet with fungicides.**

Cercospora leaf spot is the most serious foliar disease of sugarbeet in Minnesota and North Dakota. The objective of this study was to evaluate the efficacy of labeled and experimental fungicides, and determine the best fungicide rotation for managing Cercospora leaf spot. In 2002, studies were conducted at Crookston, Breckenridge, and Willmar, MN. In 2003, studies were conducted at Crookston, Foxhome, and Renville, MN. Each plot comprised of 6 22-inch wide rows, 30 or 35 feet in length. All experiments were arranged in a randomized complete block design with four replications. Treatments were applied with 4-nozzle boom sprayers calibrated to deliver 20 gal/acre of solution at 100 psi pressure to the middle 4-rows of plots. Treatments were applied at 14 or 21 d intervals. Cercospora leaf spot severity was assessed throughout the season. The middle 2-rows of plots were harvested and root yield and quality were determined. All sites

were affected by Cercospora leaf spot. Disease severity varied from moderate to high at the different locations. In 2002, at Crookston and Breckenridge, the use of two, three, or four different classes of fungicides in an alternation program, provided significantly better Cercospora control and significantly higher recoverable sucrose than the untreated check. At Willmar, 4 applications of two different classes of fungicides provided effective disease control and significantly high recoverable sucrose than the untreated check. In 2003, at all locations, all fungicide alternations resulted in significantly better disease control and significantly higher recoverable sucrose compared to the untreated check. In both 2002 and 2003, treatments that included Eminent, and/or Headline or Gem, consistently provided effective Cercospora control.

KNISS, ANDREW R.1, ABDELO. MESBAH2, and STEPHEN D. MILLER1. 1University of Wyoming, Dept. 3354, 1000 E. University Ave., Laramie, WY 82071, and 2University of Wyoming, Powell R&E Center, 747 Road 9, Powell, WY 82435-9153. **Response of 37 sugarbeet cultivars to clopyralid.**

Field studies were conducted at three locations in 2004 near Torrington and Powell, WY to investigate sugarbeet cultivar response to the herbicide clopyralid. Thirty-seven cultivars were evaluated with respect to visual injury, stand, and yield following application of clopyralid. Four herbicide treatments included a treated control with no clopyralid, clopyralid applied at 0.094 lbs ai/A at the sugarbeet 2 or 4 true-leaf stage, and clopyralid applied at 0.02 lbs ai/A in a micro-rate treatment at the sugarbeet cotyledon, 2 true-leaf, and 4 true-leaf stages. The experimental design was a split-block factorial with three replications at all three locations. While differences between cultivars were observed, neither herbicide treatment effects nor herbicide treatment by cultivar interaction effects were significant. This indicates that some cultivars responded differently to herbicide treatment, but differences between cultivars could not be attributed to clopyralid applications. Post-hoc power analysis of the ANOVA F test indicated that given the interaction effect levels observed in this study, 3 additional blocks (888 plots, >1 acre) would be required to find significant interaction effects with respect to visual injury; 22 additional blocks (3,700 plots, 4.7 acres) to detect significant interaction effects with respect to crop stand; and 488 additional blocks (72,668 plots, 91.8 acres) to detect significant interaction effects with respect to yield. It is therefore concluded that any differences that may exist between cultivars with respect to clopyralid tolerance are small enough not to be agronomically meaningful.

NITSCHELM, JENNIFER J.*, and PETER J. REGITNIG, Rogers Sugar Ltd, 5405-64th Street, Taber, AB T1G 2C4. **Effect of composted cattle manure on sugar beet production.**

Sugar beets grown on land treated with cattle manure often exhibit decreased extractable sugar content due to excessive levels of added nitrogen. Composting cattle manure reduces the nitrogen content and offers other benefits such as reduced weed seed viability and reduced product volume. Our objective was to determine if sugar beets treated with composted cattle manure have lower extractable sugar content than sugar beets treated with inorganic nitrogen fertilizer. From 2001 to 2004, research plots at Taber, Alberta were treated with 2, 4 or 8 tonnes of compost prior to the production of sugar beets each year. The compost contained 1.7% total nitrogen, of which one-fourth is estimated to be available in the year after application. The compost treatments were amended with urea fertilizer as necessary to achieve target levels of nitrogen fertility; other treatments received only urea fertilizer or were not amended with nitrogen. In three of the four study years, extractable sugar per tonne (EST) did not differ between

the unfertilized check treatment and any of the compost treatments. In 2003, EST values were significantly lower for the compost treatments than for the unfertilized check, but were comparable to EST values for urea-only treatments. In each of the four study years, beet yield was significantly higher by 13-14% for sugar beets amended with compost compared to the unfertilized check treatment. Nitrogen fertility does not appear to be the main factor explaining this yield increase, as urea-only treatments did not consistently yield more than the unfertilized check.

NILSSON, STAFFAN*, Syngenta Seeds AB, Box 302, Landskrona, Sweden.
Tropical Sugar Beet.

It has taken 200 years of selection and advanced plant breeding to develop the sugar beet we today are growing in the temperate climates of Europe and North America. A big part of the gene pole behind the modern sugar beets is, however, to be found in the Middle East and around the coasts of the Mediterranean Sea. Developed from Italian and Spanish varieties we already have a Tropical Beet that grows very well in saline, alkaline, dry and hot conditions and with a water consumption which is less than 50 % of what sugar cane needs to produce the same amount of sugar. The Tropical Sugar Beet varieties are tolerant to the leaf and root diseases we know from warm climates and we will soon incorporate traits like *Sclerotium* root rot tolerance and resistance to Root Knot nematodes. Other new selection criteria can be an even better heat and salt tolerance during germination, and decreased transpiration. But it is just not a question of advanced breeding. A most important base for successful beet growing is a locally adapted cultivation technique. An economically interesting factor is the length of the vegetation period. A beet factory in Sudan or Pakistan will run up to 300 days/year with stops only for maintenance and repairs. As we do not have to consider the botanical maturity of the beet and we are working in a stable climate with limited variations between seasons, the grower and the industry can together decide about when the beet shall be ready for delivery. The practical beet vegetation period will range between 5 to 8 months and the technical maturity and high juice purity will be achieved by a strict fertilization- and irrigation scheme.

ODERO, DENNIS C., ABDEL O. MESBAH, and STEPHEN D. MILLER. University of Wyoming, Department 3354, 1000 E. University Ave., Laramie, WY 82071, and University of Wyoming, Powell R & E Center, 747 Road 9, Powell, WY 82435-9153.
Economics of weed management systems in sugarbeet.

Irrigated field studies were conducted at the Research and Extension Centers at Torrington and at Powell, Wyoming in 2004 to evaluate several herbicide programs for weed control in sugarbeet and to determine the most economical program for weed control in 38 cm, 56 cm, and 76 cm row spacing with or without manual labor. The 38 and 76 cm row spacing were sprinkler irrigated whereas and the 56 cm row spacing was furrow irrigated. Seven treatments in the 38 or 76 cm row spacing provided 90 to 100% weed control. The treatment including preplant incorporated ethofumesate followed by three full rate applications of postemergence herbicides provided 100% control with both row spacing. Weed populations in the 56 cm row spacing were low (< 2/m_) and performance of all the treatments was good. Sugarbeet yields were different among herbicide treatments and were closely related to late season weed control. Hoeing minimized yield differences between treatments.

OGATA, NAOKI*, KAZUNORI TAGUCHI, HIROYUKI TAKAHASHI, KAZUYUKI OKAZAKI and KEIJI NAKATSUKA, National Agricultural Research Organization,

Shinsei, Memuro, Hokkaido, Japan 082-0071. **Relationships between amino nitrogen amounts and *Rhizoctonia* root rot resistance on crown root in inoculate condition for sugar beet.**

In this study, it was investigated for the relationships between Rhizoctonia root rot resistance and amino nitrogen (A-N) amounts for sugar beet O types in inoculate conditions for 3 years. Inoculums used was *Rhizoctonia solani* AG2-2 pf-28, and inoculated on July, after inoculation changes of A-N amounts and disease degree from 0 as healthy to 5 as plant dead or disease areas (%) on crown root epidermis with the passage of time. As results, firstly the materials were classified clearly to resistance to susceptible one. Especially for NK280mm-O, although symptoms caused by Rhizoctonia were observed, but almost of all plants could survive till the harvest time on October and it could be possible to use as sugar materials. But susceptible materials have been plant dead at 40 days after inoculation. Secondly in many materials, A-N amounts included in whole crown root were increased more at 10 days after inoculation comparing with uninoculated plots, and the maximum amount of A-N were shown at 30 days after inoculation. But the resistance O-types showed high A-N amounts at least 2 meq/100g over in both sample of inoculated and uninoculated one. Furthermore the distribution of A-N amounts in an inoculated plant were not uniform in each part, inside, middle and outside of roots, so A-N amounts were decreased as following the inside to the outside part of roots as same as the results of sugar content. On the other hand, about Potassium and Sodium amounts, the distribution changes were not observed in such as the A-N amounts. From these results, it would be concluded that A-N amounts related to the some kinds of mechanism for *Rhizoctonia* root rot resistance in sugar beets.

REARICK, D.E.[1]* and LEN KERBS[2], [1]Amalgamated Research Inc., P.O. Box 228, Twin Falls, ID 83303, [2]Amalgamated Sugar Co. LLC, P.O. Box 127, Twin Falls, ID 83303. **Effect of crowning on sugar beet storage.**

During the 2002-03 campaign, a study using captive samples in regular sugar beet storage piles was carried out to determine the effect of beet crowning technique on storage characteristics. Beets from the same field row were subjected to three sample treatments: uncrowned; removal of a small or “dollar-sized” crown (approximately 2 inch diameter cut surface); and full crowning to the lowest leaf scar. Replicate weighed mesh bags of beets were stored in three locations: a conventional unventilated pile; an outside, ventilated pile; and an indoor, ventilated pile. Composited material from ten replicates of each treatment was analyzed for beet quality before storage and after approximately 120 days of storage at each location. Quality parameters evaluated were: moisture content; sucrose content by both polarimetry and gas chromatography; juice purity and synthetic thin juice purity; invert level; and raffinose content. In general, under poorer storage conditions, all sugar-related parameters were lowest in uncrowned beets, slightly higher in fully crowned beets, and highest in dollar-size crowned beets. For example, the unventilated pile samples gave mean values of: uncrowned sugar 18.11%, synthetic thin juice purity (STJP) 88.92%; fully crowned, sugar 18.34% , STJP 89.92%; dollar-sized crown sugar 18.78%, STJP 90.55%. Invert results had the expected opposite trend of: uncrowned invert 1.16%/beet; fully crowned invert 0.94%; and dollar-sized crown 0.82% invert. From sample weight before and after storage, sugar losses during storage and total extractible sugar were also calculated. Sugar loss was found to be lowest and extractible sugar the highest in the dollar-sized crowned beets. These trends were less pronounced under better storage conditions (ventilated pile).

SMITH, JOHN A.[1]* and MICHAEL F. KOCHER[2], [1]University of Nebraska Panhandle

Research and Extension Center, 4502 Ave. I, Scottsbluff, NE 69361, and [2]University of Nebraska, Lincoln, NE 68583. **Evaluating growers' sugarbeet planter metering units and seed drop tubes on the University of Nebraska electronic planter test stand.**

Pre-season planter clinics are commonly conducted in sugarbeet growing areas to help assure correct seed population and uniform seed spacing necessary for high yields of sugarbeets. These planter clinics typically use subjective observation of seed spacing on a grease belt test stand and include only the metering component of the planter being examined. The objective of this study was to evaluate both the planter metering mechanism and the seed drop tube of growers' planters using the electronic planter test stand system developed at the University of Nebraska. Over 1100 sugarbeet planter row units were evaluated in 10 locations in 4 states prior to planting season in 2002 and 2003. The metering mechanisms and seed drop tubes of these planter row units were tested before and again after inspection and repair. The Deere MaxEmerge model planter was the most common planter model evaluated, but other models included the Deere 71 Flexi-Planter and the Case-IH ASM planter. The electronic seed spacing instrumentation provided accurate, numerical seed spacing information, including horizontal position of the seed as it was released from the seed drop tube. Seed spacing accuracy was improved by the inspection and repair process on over 90% of the planter rows tested. Over 30% of the Deere MaxEmerge planter rows examined had measurable improvement in seed spacing accuracy by replacing the seed drop tube. This study provides numerical information that planter seed spacing accuracy can be improved and optimized on most planters by using an electronic based test stand, by testing both the metering unit and seed drop tube, and by coupling the testing with a thorough inspection and repair process.

SPRAGUE, CHRISTY L.*, KAREN A. RENNER, and GARY E. POWELL, Michigan State University, Plant and Soil Sciences Building, East Lansing, MI 48824. **Overcoming azoxystrobin interactions with micro-rate herbicide applications in Michigan sugarbeet production.**

Rhizoctonia root and crown rot (*Rhizoctonia solani*) and weed control are two major challenges in Michigan sugarbeet production. Azoxystrobin (Amistar), a commonly used fungicide for Rhizoctonia management, when applied with micro-rate herbicide applications of desmedipham & phenmedipham (Betamix) + triflusulfuron (UpBeet) + clopyralid (Stinger) + methylated seed oil or desmedipham & phenmedipham & ethofumesate (Progress) + triflusulfuron + clopyralid + methylated seed oil has been shown to cause excessive sugarbeet injury. Field trials were conducted at the Saginaw Valley Bean and Beet Research Farm in 2003 and 2004 to examine methods to reduce sugarbeet injury caused by this interaction. In 2003, azoxystrobin was applied in combination; at 3 d and 1 d prior to; and at 1 d, 3 d, and 7 d after a micro-rate herbicide application. In 2004, azoxystrobin was applied in combination; and at 2 d, and 4 d after the third micro-rate herbicide application. In 2003, applications of azoxystrobin 1 d and 3 d prior to the micro-rate herbicide application lessened sugarbeet injury compared to a tank-mixture of azoxystrobin and the micro-rate herbicides. However, sugarbeet injury from these treatments was still greater than the micro-rate herbicide treatment alone. Sugarbeet injury from azoxystrobin applied after the micro-rate herbicides was similar to the micro-rate herbicide treatment alone. In 2004, azoxystrobin applied after a micro-rate application was less injurious than the fungicide-herbicide tank mixture. Furthermore, applying azoxystrobin 4 d after was safer than 2 d after the micro-rate herbicide application. Therefore, we recommend for growers in Michigan that use micro-rate herbicide treatments to apply azoxystrobin for Rhizoctonia management no less than 3 d prior to or 3 d after a micro-rate herbicide application.

STEWART, JAMES F.*, and COREY J. GUZA, Michigan Sugar Company, 725 South Almer St., Caro, MI 48723. **Evaluation of a predictive model, Beetcast, for managing cercospora leafspot in Michigan.**

Cercospora leafspot is a serious disease problem in Michigan. The disease can reduce sugarbeet yield by 10 to 20%. Cercospora leafspot can be managed using fungicides. Fungicides are applied after the first disease symptoms appear and every 14 to 21 days after the initial application as stated on the fungicide label. Injury to the sugarbeet plant can occur prior to visual symptoms of the disease, and cercospora leafspot development is closely linked to weather conditions. Timing fungicide applications prior to visual symptoms of disease may improve sugarbeet yield. The objective of this study was to evaluate the efficacy of Beetcast for managing cercospora leafspot. A study was conducted for 3 years comparing applying fungicides based upon scouting to fungicide applications based on a disease severity value from Beetcast. Sugarbeets were evaluated for visual disease symptoms, root weight and quality. Cercospora leafspot disease levels were reduced and sugarbeet yield was increased by utilizing Beetcast to time fungicide applications compared to scouting alone.

Section A, Agronomy
Poster Presentations

BULLOCK, MURRAY S., The Amalgamated Sugar Company, LLC, P.O. Box 700, Paul, ID 83318. **Sugar beet yield increases following oil radish green manure nematode trap crops in south central Idaho.**

Nematode resistant oil radish green manures have been researched extensively for almost 20 years in southwestern Idaho with effective cyst nematode reduction documented (Hafez et al.). However, sugar beet yields on fields with low nematode pressure (1 viable cyst or less per 500 g soil) following oil radish green manures have not been as well noted. A study was initiated on two fields in south central Idaho following winter wheat. Straw was baled and stubble shred. Field A was harrowed and disked prior to broadcast applying fertilizer and oil radish seed. Soil incorporation was accomplished with another harrow pass on August 15, 2002. Field B farmer directly broadcast fertilizer and oil radish seed after straw shredding and packed and harrowed on August 27, 2002. After several irrigations and an application of 2,4-DB for broadleaf weeds and Assure II for grass weeds (mostly volunteer grain), the radish was plowed under in late October. In the spring, sugar beets were planted with only CounterCR, insecticide applied during the growing season. Field A had a 4.4 ton/ac yield increase and 0.13% higher sugar yield over the check strip. Field B had a 3.3 ton/ac yield increase and the same sugar percent compared to the check strip. At $35/ton the gross payback would be $154.00/ac for Field A and $115.50/ac for Field B. Estimated cost to grow the oil radish was $125.00 for Field A and $85.00/ac for Field B with a net profit of $30.00/ac for both scenarios. Oil radish green manures have the potential to increase yields even when cyst nematode pressure is low.

CAMP, STACEY D.*, and PAUL W. FOOTE, The Amalgamated Sugar Company LLC, P.O. Box 700 Paul, ID 83350. **Late season increase in weight and sugar percent of sugar beet.**

Sugar beet producers of the Amalgamated Sugar Company growing area are paid an incentive to deliver sugar beets before permanent storage begins. There is limited late season yield information to determine the incentive growers should receive. The objective in this study was to determine late season growth and sugar percent increase. In 2002 and 2003 five locations throughout the growing area were chosen to determine yield increase of weight (tons/acre) and sugar percent (pol sucrose). In 2004 two locations representing the growing area were chosen. Each location was a randomized complete block design using 6 blocks in 2002 and 8 blocks in 2003 and 2004. The center two rows of four rows were harvested, topped, cleaned by hand, and weighed every two weeks beginning approximately September 10 and finishing the middle of October totaling four harvest dates. Two sugar samples were analyzed by pol sucrose from each plot. The Amalgamated growing area was divided into two areas, Mini-Cassia/Twin Falls and Nampa/Nyssa, that vary in yield from weather conditions. The average yield and sucrose increase for the Mini-Cassia/Twin Falls area over the four harvests is 3.24 t/a, 2.33 % sucrose and 2.98 t/a, 3.27 % sucrose for the 2002 and 2003 years, respectively. The average yield and sucrose increase for the Nampa/Nyssa area over the four harvests is 3.61 t/a, 1.83 % sucrose and 5.4 t/a, 2.47 % sucrose for the 2002 and 2003 years, respectively. The 2004 data is forthcoming.

ECKHOFF, J.L.A., MSU Eastern Agricultural Research Center, 1501 N. Central Ave, Sidney, MT 59270. **Sugarbeet (*Beta vulgaris*) response to applied N under flood and**

sprinkler irrigation.
Nitrogen management is critical for best sugarbeet quality and yield. Each year, more land in the irrigated Lower Yellowstone River Valley is converted from flood irrigation to sprinkler irrigation because sprinkler irrigation is more water-use efficient and requires less labor. Nitrogen recommendations in this region were developed under flood irrigation and may not be best under sprinkler irrigation because of different water management, runoff, and leaching. The objective of this study is to fine-tune N recommendations for sugarbeets produced under sprinkler and flood irrigation. This study has continued for two years, and one or two more years of data will be collected. Soil residual N was determined in a field with flood and sprinkler irrigation capabilities. Applied N rates used were the recommended rate, -10% and -20% of the recommended rate, and +10% and +20% of the recommended rate. A treatment with no applied N was included. Plots were set up in a RCB design under each irrigation system. The two plot areas used were as close as possible to one another and still allow proper irrigation. ECH2O soil probes were placed under both irrigation regimes to monitor soil moisture and to determine irrigation scheduling. Wells that reached the ground water were placed under each irrigation system, and samples were collected throughout the season for nitrate-N determination. Under flood irrigation, root yields were greatest with applied N that was 10% greater than the recommended rate, while greatest sucrose yield was achieved with the recommended rate. With just one year of data, extractable sucrose was greatest with the recommended rate. Under sprinkler irrigation, greatest root yield and sucrose yield were achieved with applied N that was 10% less than the recommended rate. With just one year of data, extractable sucrose was greatest when applied N was 10% less than recommended.

LAMB, JOHN A.[1], MARK W. BREDEHOEFT[2], and STEVE R. ROEHL2, [1]Univ. of Minnesota, St. Paul, MN 55108, and [2]Southern Minnesota Beet Sugar Cooperative, Renville, MN **Management zones for nitrogen management.**

Optimum use of nitrogen fertilizer is needed to produce the most sucrose. Variable nitrogen application could be a key component. To use this technology in Southern Minnesota, a soil nitrate-N map is needed for the field. Several methods could be used to develop this map. A study was conducted in Southern Minnesota with the objectives to determine if management zones for variable rate N fertilizer application will result in better root yield and quality than the use of a single N fertilizer rate for the whole field and to determine what information is necessary to best delineate management zones in a southern Minnesota landscape. A three year study was initiated in 2001 in a Southern Minnesota Beet Sugar Cooperative grower's field near Danube, Minnesota. The 32 acre field was in a soybean-corn-sugar beet rotation. The treatments for the study were the following four nitrogen application strategies: 1. no N fertilizer applied to determine the need for N fertilization, 2. N applied based on a nitrate-N soil test for the whole field, 3. N applied at a rate based on a nitrate-N soil test from a management zones determined from the soil survey, and 4. like 3, N would be applied based on soil tests from the management zones. The basic difference between treatments three and four is the knowledge used to create the management zones. The use of nitrogen fertilizer did not increase root yield and recoverable white sucrose per acre but did reduce the sucrose concentration. There were differences in the root yield and recoverable white sucrose between the two zone treatments. The use of an order 2 soil survey for creating zones did not yield as well as the use of zones based on crop and soil parameters. Neither zone treatment affected the measured parameters different than the conventional treatment based on the average soil nitrate-N for the field.

REGITNIG, PETER J.* and JENNIFER J. NITSCHELM, Rogers Sugar Ltd., 5405 – 64th

Street, Taber, Alberta, T1G 2C4. **Sugar beet injury from simulated herbicide drift.**

Sugar beet injury can occur from postemergence chemical drift when herbicides are applied to crops in adjacent fields. Visual injury patterns are often irregular and can be difficult to quantify in commercial fields. Quantitative information on extractable sugar per acre loss from selected herbicides would assist growers and agriculturists in evaluating drift damage. Seven treatments consisting of 15% of the labeled rate of selected herbicides were applied to 6-leaf sugar beets using a broadcast boom equipped with 8001VS nozzles. Visual injury was documented and photos were compiled in a digital presentation. Significant reductions occurred in both extractable sugar/acre (ESA) and beet yield. In 2003, ESA was reduced by 27% for 2,4D + dichlorprop (Estaprop), 14% for dicamba + MCPA K-salt (Dyvel DS), 13% for bromoxynil + MCPA (Buctril M), 13% for rimsulfuron (Prism), 12% for bentazon (Basagran), 9% for MCPA + mecoprop + dicamba (Target) and 6% for metribuzin (Sencor). The poster will compare 2003 results with an identical test conducted in 2004.

SIMS, ALBERT L., and KIM R. HOFF. University of Minnesota, Northwest Research and Outreach Center, 2900 University Ave, Crookston, MN 56716. **Sugar beet production response to N fertilizer rates following corn in the Red River Valley of Minnesota.**

Corn residue, while having similar to higher N concentrations than wheat residue, will generally be coarser and in 2-3 times the quantity of wheat residue. These factors all affect residue decomposition rate and potential soil nitrogen (N) availability. As corn production has increased in the Red River Valley concerns have been expressed that the current N fertilizer recommendations are too low for sugar beet grown after corn. Field experiments were initiated to examine sugar beet production response to N fertilizer rates when grown after corn and to examine the affects of the corn residue itself on this response. Corn was grown and harvested in the year preceding sugar beet. Immediately after corn harvest whole plot treatments were established by either removing above ground residue or leaving it as is. The following spring six N fertilizer rates were applied in each whole plot and sugar beet was planted. After two years of experimentation, sugar beet root yield response curves to increasing N fertilizer rates were similar whether corn residue was present or removed, but yields were 3.5 tons A-1 less in the presence of residue. Sugar beet root net sucrose concentration was not affected by corn residue, but began to decline at N rates above that which would have been recommended. The 2004 growing season was the third year of this experiment and will be included in the discussion. At this point we conclude that current N recommendations for sugar beet production after corn production are adequate to optimize production.

WILSON, R.G., University of Nebraska, 4502 Ave. I, Scottsbluff, NE 69361.
Influence of Preplant Nitrogen Fertilizer on Sugarbeet, Weeds, and Postemergence Weed Control

A field study was initiated near Scottsbluff, NE to examine the influence of preplant applications of nitrogen fertilizer on sugarbeet stand, weed density, and weed control from postemergence herbicides. Ammonium nitrate was applied at 0,45, 90, 179, and 358 kg/ha and incorporated with a roller harrow before sugarbeet planting. As preplant nitrogen rates increased sugarbeet stand decreased, common lambsquarters and kochia densities increased, and hairy nightshade density decreased. Weed control from three postemergence applications of phenmedipham plus desmedipham plus triflusulfuron plus clopyralid was similar in plots treated with all rates of nitrogen.

YONTS, C. DEAN* and ROBERT G. WILSON, University of Nebraska, 4502 Ave. I, Scottsbluff, NE 69361. **Drought tolerance of sugarbeet.**

Drought and ground water depletion continues to impact growers throughout much of the Western Sugar Cooperative growing region. Growers are concerned that crop water use for sugarbeet is high and therefore question their ability to grow or continue to grow sugarbeet in the future. Surface water supplies have been limited due to long term drought and ground water pumping is being limited in many areas due to governmental restrictions. Previous water stress research has concentrated on stressing sugarbeet during early and late season growth. The objective of this study is to determine the production of sugarbeet when irrigation is a limiting factor and drought stress occurs during mid-season growth. Field studies were initiated in 2003 and 2004 under sprinkler irrigation. Five irrigation treatments were used during mid-season growth and ranged from full irrigation during a five week period to no irrigation for a four week period. In 2003, sugarbeet root yield and sugar content were similar for the five water stress treatments used. Stressing the sugarbeet plant in mid-season did have an affect on sugarbeet root hairs or shape since percent tare was influenced by stress. Stressed plants had less tare while no stressed plants had significantly higher tare.

Section B, Genetics and Germplasm Enhancement
Oral Presentations

HAMID REZA EBRAHIMIAN[1], and ZABIOLAH RANJI[2] ,[1]Agricultural Research Center of Esfahan, P.O.Box 81785, Amir hamzeh St., keshavarz highway, Isfahan, Iran, [2]Kardaj, Sugar Beet Seed Institute **The devlopment of hybrid varieties tolerant to salinity using half sib family selection.**

Increasing use of low quality water for irrigation requires the development of salt tolorance varieties. For development of the salt tolorance Sugarbeat hybreed, the open pollination diploid multigerm population (7233-p.29) and a cytoplasmic male sterile (MSC2), and equal otype (Otype C2) and secondray Otype (A1) were planted in a filed with soil salanity of 12-16 ds/m. At the end of growing season, the roots with desirable morfological chracterristic were selected and stecklings were vernalized (for 3 month) each diploid multigerm pants were divided into two part and were keeps in a cage with a male streile plant (MSC2) to produce S1 and F1 seeds. For elimination of male sterile plant, the S1 and F1 seeds again were put in a cage. Filed and laboratory investigation revealed that some lines were able to preseve it's male sterility up to 75% in S2 seeds. Therefore, the remaing were eliminated, and 11 crossess, including controll (male and female parent)were planted in Rodushat in a soil with soil salinity of 16 dS/m, the root yield and quality were measure for each one. According to the results the highest root yield of 31.57 ton/ha were obtained from hybrid no. 8, and the lowest yield of 22.62 ton/ha from hybrid no.1 and the difference were significant ($p>0.05$). The highest sugar content of 20.52 percent was obatined from hybreed 12, but the difference were not significant ($p>0.05$). The highest suger yield of 6.17 ton/ha which were not significant ($p>0.05$) and the white suger yield which were significant different ($p>0.05$) from control obtained from hybred No. 8.

LEWELLEN, ROBERT T., and LINDA M. PAKISH, USDA, Agricultural Research Service, 1636 E. Alisal St., Salinas, CA 93905. **Performance of sugarbeet cyst nematode resistant cultivars and a search for sources of resistance.**

Sugarbeet cyst nematode (SBCN) (*Heterodera schachtii*) is a major problem of sugarbeet worldwide. Sugarbeet hybrids and lines with resistance to SBCN were evaluated in field trials at Brawley and Salinas, CA. These trials were under nondiseased and SBCN/rhizomania conditions. Resistance to SBCN was derived from both *Beta procumbens* and other sources and included entries from USDA-Salinas, Syngenta, and Betaseed. At Brawley under high SBCN populations and low to moderate rhizomania, hybrids with SBCN resistance had sugar yields from 170 to 230% higher than the SBCN susceptible/rhizomania resistant commercial checks. At midseason and at harvest, soil cores were taken adjacent to the selected entries and SBCN eggs + larvae counted. Total counts were about five times higher from the commercial checks as compared to counts from either source of SBCN resistance. In greenhouse tests, cyst counts from both sources of resistance were nearly equally low. At Brawley in the comparison of relative sugar yields between infested and noninfested companion tests, the yield of the commercial checks was about 60% lower under infested conditions, whereas the SBCN resistant hybrids were 10-20% lower. Results suggested that alternative sources of resistance may be equal to the B. procumbens sources for suppression of SBCN populations and superior for sugar yield. Germplasm lines developed at Salinas and released as C927-4, CN12, CN72, and others showed promise as sources of resistance to SBCN. Progeny families are being evaluated

and screened in greenhouse and field tests for high levels of resistance.

MCGRATH, J. MITCHELL*, TERESA K. KOPPIN, and TIM M. DUCKERT, USDA-ARS, 494 PSSB, Michigan State University, East Lansing, MI 48824-1325. **Breeding for genetics: development of Recombinant Inbred Lines (RILs) for gene discovery and deployment.**

Genetic diversity underlies breeding advancement, and selection is the act of concentrating relevant genes (alleles) in populations for ultimate deployment to growers. Measures of genetic diversity indicate perhaps fewer than 25% of the alleles present in Beta vulgaris are present in sugarbeet, suggesting future genetic gains will be found within wild and unadapted germplasm. Germplasm collections exist, but attention to deploying their allelic diversity is stymied, with notable exceptions. Systematic efforts to deploy this germplasm held in public trust are needed, coupled with systematic efforts to identify, map, and catalog relevant agronomic genes. Both objectives can benefit from development of RILs, which represent 'immortal' segregating genetic populations. RILs have not been developed for sugarbeet, and their utility lies in the simple (if lengthy) construction process, their defined genetic relationships within populations, their homozygosity which limits phenotypic diversity to environmental variance components, and the ability a single molecular map to phenotypic values from many environments. RILs are derived via single seed decent (facilitated by self-fertility) from an initial segregating population, are highly inbred progeny derived from a single parent, and sample the genetic diversity of parental lines used to construct the hybrid. Our strategy has been to use a common male sterile (nuclear or cytoplasmic) self fertile seed parent (e.g. C869) to which one of 38 pollen donors has been mated to date, generally followed by selection for vigor and fecundity of the F1 hybrid, then by single-seed descent for five generations. As of October 2004, 5,968 S2, 819 S3, 245 S4, and 102 S5 plants are in process. Phenotypic, sucrose, and water content evaluations on one in-process population (C869 X Table beet) indicate the general utility of RILs for genetic analyses, and effectively couples the process of gene discovery with gene deployment in sugarbeet.

SPIJK, AB C. van*, STEVE BARNES, and JAN PERTIJS, Advanta Seeds BV, P.O. Box 1, 4410 AA Rilland, Netherlands. **Monitoring the nematode resistance gene in tetraploid pollinators by using genetic markers.**

Nematode resistance coming from the Beta procumbens is introduced in Beta vulgaris as an addition on chromosome number 4. Due to this addition the transmission of the resistance to the offspring is not stable; in the meiosis the addition is eliminated frequently. In triploid and tetraploid plants the consequences of this instability are less drastic. However the number of chromosomes carrying the addition has to be monitored closely. The development of genetic markers has been a major improvement in the breeding process. Comparisons of the F1 and F2 generations are giving an indication about the stability of the transmission of the resistance. In the breeding program backcrosses have been made and marker assisted selection applied to bring the resistance into highly-performing pollinators. Yield comparisons made under infested and non-infested conditions show that significant improvements have been made over the different backcross generations for sugar content and juice purity, resulting in a better recoverable sugar yield.

Section C, Entomology and Plant Pathology
Oral Presentations

BOETEL, MARK A.*, ROBERT J. DREGSETH, and ALLEN J. SCHROEDER, Department of Entomology, North Dakota State University, Fargo, ND 58105. **Impact of tank-mixed insecticide and fungicide combinations on sugarbeet yield and quality.**

The tarnished plant bug (TPB), Lygus lineolaris (Palisot de Beauvois), is an occasional economic insect pest of sugarbeet in the Red River Valley growing area. Damaging populations of TPB typically occur late in the growing season and often overlap with cercospora leaf spot (CLS) disease infections in the same fields. Cercospora leaf spot, caused by Cercospora beticola Sacc., is the most damaging foliar disease of sugarbeet in Minnesota and eastern North Dakota. Application cost savings and time efficiency provide a strong impetus for producers to combine insecticide treatments for TPB control with fungicides for CLS management. Field experiments were carried out during the 2003 and 2004 growing seasons to determine if late-season broadcast applications of tank-mixed insecticide/fungicide combinations affect sugarbeet yield parameters. In 2003, treatment with Lannate LV (1 pt/A) + SuperTin (5 oz/A), Dibrom 8 (1 pt/A) + Eminent 125SL (13 fl oz/A), and Lorsban 4E (1 pt/A) + Eminent (13 fl oz/A) resulted in significant losses in both root yield and recoverable sucrose. Recoverable sucrose yield for these combinations was reduced by 20.2, 21.2, and 23.2%, respectively, when compared to counterpart plots that received the insecticides without a tank-mixed fungicide. The experiment was repeated in 2004 and expanded to include Mustang insecticide and Headline fungicide. Findings from the second year will be presented and the overall implications of this two-year study will be discussed. Additional research is planned to determine the following: 1) if using lower labeled rates of the insecticides can reduce phytotoxicity of the tank-mix combinations; and 2) whether split applications of the fungicides and insecticides will be necessary to avoid yield losses.

BREDEHOEFT, MARK W.*, AND STEVE ROEHL, Southern Minnesota Beet Sugar Cooperative, 83550 Co. Rd. 21, Renville, MN 56284. **Tachigaren influence over time on Aphanomyces cochlioides presence in soil and the effect on sugar beet production.**

A. cochlioides has posed a significant production problem for the sugar beet industry. Tachigaren as a seed treatment has shown to reduce the influence of A. cochlioides on sugar beet production. The objectives of this study were 1) Study the influence of A. cochlioides over time in soil subjected to consecutive years of sugar beet production 2) Investigate the influence of Tachigaren at 0, 45, and 75 grams per unit of seed (100,000 seeds) on yield and quality. The experiment was established near Buffalo Lake and Clara City, Minnesota in the spring of 2000. Experimental design was a randomized complete block design with 4 replications. Soil barriers (fence) were installed between replications and experimental units after planting to prevent movement of soil across treatments. Presence of A. cochlioides in the soil was determined by root rot index (RRI) conducted by the Plant Disease Clinic at the University of Minnesota – Crookston. The initial RRI indicated a very low levels at both locations. RRI after one year of sugar beet production increased to high levels at the Buffalo Lake, MN site and remained low at the Clara City, MN site. RRI levels at the Buffalo Lake, MN site indicated a suppression of A. cochlioides accrual in the soil that was directly related to Tachigaren rate. The very low level of A. cochlioides at Gluek, MN site did not allow for a significant change in the presence of the disease at this site. Yield factors were non-homogeneous across years, but were homoge-

neous between locations within years. When considering the sites combined within years, yield and recoverable sugar per acre were significantly higher with Tachigaren applied to the seed at the 45 and 75-gram compared to 0 gram Tachigaren rate.

HANSON, LINDA E.*, AMY L. HILL, and LEE PANELLA, USDA-ARS, SBRU, 1701 Centre Avenue, Fort Collins, CO 80526. **Diversity in Fusarium from sugarbeet.**

Fusarium yellows of sugar beet can cause reductions in root yield in addition to reducing sucrose percentage and purity in the root. The primary causal agent is Fusarium oxysporum f. sp. betae (FOB), although F. acuminatum can cause Fusarium yellows symptoms. Fusarium species also can cause root rot or seedling symptoms in sugar beet. We investigated the variability in isolates of Fusarium isolated from sugar beet in respect to their pathogenicity and virulence on sugar beet in greenhouse tests. FOB isolates also were examined for genetic variability. Five-week-old beet plants (Fusarium-susceptible germplasm FC716) were inoculated by dipping roots in spore suspensions of the different isolates. In addition to isolates of F. oxysporum, isolates of F. solani, F. acuminatum, F. avenaceum, and F. verticillioides also were pathogenic in our greenhouse assay. Several additional species were isolated from sugar beet roots. Isolates of FOB were analyzed by RAPD analysis using nine primers. Based on RAPD patterns, FOB and non-pathogenic isolates clustered together. Some FOB strains from different georgraphic regions showed divergent patterns. By DNA sequence analysis, a small subset of these isolates also showed significant variability in the beta-tubulin gene. Thus FOB is a diverse group within F. oxysporum. When isolates were tested on different sugar beet germplasm and varieties, some isolates gave different reactions with different varieties. This may indicate the existence of races within FOB.

HEIN, GARY L.* and JOHN THOMAS, University of Nebraska, Panhandle Research and Extension Center, 4502 Ave. I, Scottsbluff, NE 69361. **Screening for varietal resistance to sugarbeet root aphid.**

The sugarbeet root aphid is a common pest seen throughout all of the sugar beet growing areas close to the Rocky Mountains. The aphid's severity in the region results from the proximity of the growing areas to the Rockies where the primary host for the aphid, the narrowleaf cottonwood, is distributed widely. Sugarbeet root aphids are also a sporadic pest in several other sugarbeet growing areas of the US. Varietal resistance is the primary tool to manage root aphid populations; however, not all growing areas have highly resistant adapted varieties. Because of the importance of resistant varieties to managing this destructive insect, the development of effective and efficient screening procedures is critical to the development of improved varieties. Our objective was to develop improved greenhouse screening methods to identify the resistance levels of varieties. Maintaining sugarbeet root aphids in the greenhouse is difficult because soil moisture must be maintained at optimum levels. Soil cannot be too wet or aphid colonies become saturated and do not survive, and if the soil is too dry, secondary roots the aphids feed on can die, starving the colony. It is difficult to maintain aphids consistently in this optimum zone for long periods of time. To meet this soil moisture need, we have developed rearing and screening methods that incorporate soil cavities within the rearing and screening pots. These cavities allow the aphids to develop under humid conditions that maximize secondary root growth and thus aphid buildup, but do not become over-saturated and threaten aphid survival. These methods allow consistent survival in both colony and screening situations. We use the methods in greenhouse screens that provide reliable data on aphid resistance levels and allow us to establish segregation levels for varieties.

KHAN, MOHAMED F.R.[1]*, LARRY J. SMITH[2], MARK BREDEHOEFT[3], STEVE

ROEHL3, AND RANDY NELSON1, [1]North Dakota State University & University of Minnesota, Soil Science Department, Fargo, ND 58105-5758, [2]University of Minnesota, Northwest Research and Outreach Center, Crookston, MN 56716, and Southern Minnesota Beet Sugar Cooperative, Renville, MN 56284. **Managing Cercospora leaf spot on sugarbeet with fungicides.**

Cercospora leaf spot is the most serious foliar disease of sugarbeet in Minnesota and North Dakota. The objective of this study was to evaluate the efficacy of labeled and experimental fungicides, and determine the best fungicide rotation for managing Cercospora leaf spot. In 2002, studies were conducted at Crookston, Breckenridge, and Willmar, MN. In 2003, studies were conducted at Crookston, Foxhome, and Renville, MN. Each plot was 6 22-inch rows wide by 30 or 35 feet long. All experiments were arranged in a randomized complete block design with four replications. Treatments were applied with 4-nozzle boom sprayers calibrated to deliver 20 gal/acre of solution at 100 psi pressure to the middle 4-rows of plots. Treatments were applied at 14 or 21 d intervals. Cercospora leaf spot severity was assessed throughout the season. The middle 2-rows of plots were harvested and root yield and quality were determined. All sites were affected by Cercospora leaf spot. Disease severity varied from moderate to high at the different locations. In 2002, at Crookston and Breckenridge, the use of two, three, or four different classes of fungicides in an alternation program, provided significantly better Cercospora control and significantly higher recoverable sucrose than the untreated check. At Willmar, 4 applications of two different classes of fungicides provided effective disease control and significantly high recoverable sucrose than the untreated check. In 2003, at all locations, all fungicide alternations resulted in significantly better disease control and significantly higher recoverable sucrose compared to the untreated check. In both 2003 and 2003, treatments that included Eminent, and/or Headline or Gem, consistently provided effective Cercospora control.

LARTEY, ROBERT T.*1, NEOMA IRENE SOL1 AND SOUMITRA GHOSHROY2,USDA-ARS-NPARL, 1500 N. Central Ave, Sidney, MT 59270, and Dept. of Biology and Electron Microscopy Lab, New Mexico State University, Las Cruces, NM 88003. **Additional evidence of Safflower (Carthamus tinctorius) as an alternate host of Cercospora beticola.**

In the Northern Plains Area (NPA), safflower (Carthamus tinctorius L.) is increasingly being evaluated for rotation with sugarbeet. Safflower and sugarbeet are susceptible to two different species of Cercospora, Cercospora carthami and Cercospora beticola respectively. This study of safflower as a potential alternate host of C. beticola was prompted by observation of unusual spot lesions on safflower at Sidney, Montana in the NPA. Previous report from our laboratory indicated that safflower has potential to serve as an alternate host of C. beticola. We present in this report additional evidence that safflower indeed can serve as a host of C. beticola. Safflower plants were infected with inoculum from four C. beticola isolates (C1, C2, S1 and S2) and sugarbeet with inoculum from single spore cultures from infected safflower lesions. PCR amplified actin gene fragments were cloned and sequenced. The sequences were imported into the Vector NTI (InforMax, Bethesda, MD) and aligned to compare with the C. beticola sequence from GenBank (Accession # AF443281). The aligned sequences from all four isolates from safflower and sugarbeet showed significant homology with sequence from C. beticola. Our results confirm the presence of C. beticola in lesions of infected safflower and substantiate safflower as a host of C. beticola.

OKAZAKI, KAZUYUKI*, NAOKI OGATA, HIROYUKI TAKAHASHI,

KAZUNORI TAGUCHI, and KEIJI NAKATSUKA, National Agricultural Research Organization(NARO), Shinsei, Memuro, Hokkaido, 082-0071, Japan. **The evaluation for resistance to Aphanomyces black root rot by using artificial inoculation method in sugarbeet bred in NARO.**

Black root rot, caused by Aphanomyces cochlioides, is an important soil-borne disease in sugarbeet. This disease cause heavy yield loss, so economical damage has been led in the rainy year. The objectives in this study were to (1) develop the artificial inoculation method to classify the resistance to black root rot for sugar beet varieties, and to (2) evaluate actually the resistance of breeding lines by using developed method. As material, 3 hybrid varieties which were known as different resistance were sowed in paper pot. 1 month later, young plants were inoculated with zoospore suspension (30,000 zoospores / plant), and plants were transplanted to 1/5000a wagner pot. After transplanting, plants were grown in greenhouse (controlled the lowest temperature over 20 degree C) and also excessive watering treatment (300ml/pot_day, during 10 days) was added at two terms. 3 month later after inoculation, symptoms of black root rot were observed clearly at inoculated plants. Roots were rated for disease severity (0-5 scale, 0 = no symptom, 5 = root rotted completely) and disease index (DI) was calculated from these rate. By these DI, 3 materials were classified from susceptible to resistance with statistical significant. When we compared resistance of 8 materials by using this inoculation method, DI were shown from 0.3 to 4.9, and the resistances of them were classified clearly. In these 8 materials, 'Hokkai 90' showed the lowest DI, 0.3 with no obvious lesion. It was cleared that 'Hokkai 90' has the strong resistance to black root rot.

PANELLA, LEE, USDA, Agricultural Research Service, 1701 Center Ave., Fort Collins, CO 80526-2083. **Pathogenicity of different Anastomosis Groups and subgroups of Rhizoctonia solani on sugar beet.**

Rhizoctonia root and crown rot (caused by *Rhizoctonia solani*) continues to be a problem in most sugar beet-growing areas in the United States, and is a growing problem world wide. Understanding the genetic variability of the pathogen provides information for diagnosis and management of the disease. Ninety four isolates of *Rhizoctonia solani* representing fifteen Anastomosis Groups (AG) or subgroups were tested for pathogenicity on susceptible sugar beet hybrid, 'Monohikari', and the resistant germplasm, 'FC708CMS'. Ground, *R. solani*-infested barley was placed by the root of 10 wk old plants in pots in the greenhouse. Roots were evaluated on a Disease Index (DI) of 0 (no damage) to 7 (dead), 28 d after inoculation. Data were analyzed using PROC MIXED (SAS), and means were separated with Dunnett's one-tailed t test, which tested if any isolate caused a significantly ($p = 0.05$) higher DI than the uninoculated control. With few exceptions, only isolates from AG-2-2 (IIIB or IV) were pathogenic on sugar beet, and those from AG-2-2 IIIB were more virulent than the isolates from the AG-2-2 IV subgroup.

PITBLADO, RON and IAN NICHOLS, Ridgetown College University of Guelph, 130 Main St. East, Ridgetown, Ontario, Canada, N0P 2C0. **The implementation of BEETCAST - a weather-timed fungicide spray program for the control of Cercospora Leafspot in Ontario and Michigan.**

One of the most significant foliar diseases of sugarbeets is caused by Cercospora beticola, commonly known as Cercospora Leafspot. Control of this disease has been focused on genetic resistance and the use of foliar applied fungicides. In regions where climatic conditions favour the development of this disease, growers are having to rely more and more on the use of fungicides. Effective control however is achieved only when and how often these fungicides are applied. A number of researchers have developed several spray

models using weather parameters. BEETCAST was developed by the authors using hourly temperature and leafwetness values to determine daily disease severity values (DSV). The program advises the grower to consider spraying when the accumulation of each days values reach 55 DSV. Subsequent spray applications would again be recommended at the next 55 DSV interval and continued until early September in the Michigan and Ontario sugarbeet growing regions. The development and delivery using site specific integration is now feasible with the advancement of geographical information systems (GIS) and an improved agricultural microclimate network recently established in both Michigan and Ontario.

POINDEXTER[1], S., RUPPAL[2], D.A., KIRK[3], W. [1]Michigan State University Extension Sugar Beet Agent / Sugarbeet Advancement, [2] Eastern District Sales Manger, Hilleshog Sugarbeet Seed and [3] Ast. Professor, Plant Pathology, Michigan State University. 1 MSU Extension One Tuscola St. Suite 100, Saginaw, MI 48607. 2 5146 Rogers Rd. Akron, MI 48701. [3] Michigan State University Plant Biology Lab, East Lansing, MI 48824-1312. **Impact of Strobilurin Fungicide on Yield of Sugar Beets With Natural Inoculation of Rhizoctonia Crown Ro**t.

Rhizoctonia Crown Rot of sugar beets is a significant problem in many of the sugar beet producing areas of the United States. The objective of this study was to determine the effect of Strobilurin fungicide (Quadris/Amistar, Syngenta Crop Protection, Inc.) on control of Rhizoctonia Crown Rot on yield. This research was conducted in fields with naturally high levels of Crown Rot inoculums. Most research currently is/or has been produced utilizing artificial inoculation techniques. Two varieties were used, one that is resistant to Rhizoctonia Crown Rot (RH-5) and a susceptible (E-17). Common treatments over three years include In Furrow, 6-8 Leaf, and Check. Additional treatments and rates were added in year two and three. Definite treatment differences occurred between varieties and fungicide timings under high Rhizoctonia pressure. In Furrow treatments, for both resistant and susceptible, provided highest yields. Yields at the 6-8 leaf application stage, of a susceptible variety, were significantly better than the check and similar to the resistant check. Under natural infection and high inoculum levels, an earlier application timing (2-4 leaf) of a strobilurin may provide as good or better control and similar yield. In-furrow application coupled with a Rhizoctonia resistant variety produced highest yields and greatest reduction in disease.

RUSH, C.M.*[1], D. JONES1, K. STEDDOM[1], and L.G. CAMPBELL[2], [1] Texas Agricultural Experiment Station. Amarillo, TX 79012 and [2]USDA-ARS, Northern Crop Science Laboratory, Fargo, ND, 58105. **Investigation of blinkers in rhizomania resistant fields in Minnesota.**

Since rhizomania was first identified in Minnesota in the mid 1990's, acreage planted to rhizomania resistant sugar beet cultivars has increased steadily. In recent years, individual beets have been observed in rhizomania resistant fields that exhibit foliar and root symptoms typical of rhizomania. These symptomatic beets are called blinkers and their incidence has increased during the last two growing seasons. This increase has raised concerns among farmers and seed producers about the stability and longevity of genetic resistance. In September, 2004, sugar beets were collected from rhizomania resistant fields in southern and northern Minnesota. Ten sugar beets, eight blinkers and two apparently healthy, were harvested from each field and a total of 390 sugar beets were collected. Each sugar beet was give a disease rating, tested for presence of BNYVV, scanned with a hyperspectral radiometer to determine the severity of leaf chlorosis, and tested for presence of absence of the Rz gene that confers resistance to rhizomania. Later, percent sucrose was determined for the blinkers and healthy beets from each sample. Forty eight

percent of the apparently healthy beets tested positive for BNYVV but 88% of the blinkers were positive. The mean rhizomania severity rating for the blinkers was 2.98 on a 0 – 4 scale, while the rating for healthy beets was significantly less at 1.2. The mean ELISA reading for blinkers was significantly higher than for infected "healthy" beets and healthy beets averaged 15.62 percent sucrose compared to 13.95 for blinkers. If molecular analysis reveals that blinkers are lacking the Rz gene these results will support the claim that rhizomania is causing significant losses throughout the major sugar beet production areas of Minnesota, but if the Rz gene is present it will suggest that genetic resistance is breaking down.

STEDDOM, K[1]*, D. JONES1, C.M. RUSH[1], and L.G. CAMPBELL[2], [1] Texas Agricultural Experiment Station. Amarillo, TX 79012; [2]USDA-ARS, Northern Crop Science Laboratory, Fargo, ND, 58105. **Foliage color of beets is a poor predictor of rhizomania.**

Rhizomania, caused by *Beet necrotic yellow vein virus* (BNYVV), in the sugarbeet growing regions of Minnesota and North Dakota is generally first noticed in the field when patches of beets with yellow foliage are found. We selected three hundred and ninety sugarbeets from resistant and susceptible varieties in rhizomania strip trials. For each beet the roots were tested for BNYVV by ELISA and the foliar spectra were measured with a radiometer. Logistic regression was performed to determine how well foliar spectra could predict the ELISA results. A model using NDVI, a common vegetative index that measures greenness of foliage, correctly classified 67.5 percent of the beets. This indicates a large percentage of beets had dark green leaves but still tested positive for BNYVV. Past results suggested other vegetative indices may be effective for detecting BNYVV. A stepwise logistic regression model was developed with a number of vegetative indices. This model, using VARI, RGR, and RDVI, correctly classified only 70.2 percent of the beets. These results suggest that yield prediction models using remote sensing methods may have difficulty in fields that have rhizomania.

WEILAND, JOHN. J. Sugarbeet and Potato Research Unit, USDA-ARS-Red River Valley Agricultural Research Center, 1307 18th st. N. Fargo, N.D. 58105. **Cercospora beticola expressing the green fluorescent protein for studies on the biology of sugarbeet leaf spot disease.**

Leaf spot disease of sugarbeet remains an import problem in beet sugar production. The elusive nature of control strategies for the causal organism of leaf spot, *Cercospora beticola*, is due in large part to our poor understanding of Cercospora genetics and biology. A color-marked, transgenic isolate (101004a) of *C. beticola* expressing the green fluorescent protein (GFP) gene from the jellyfish *Aequorea victoria* was produced that can be visualized by fluorescence microscopy. The isolate retained the ability to incite leaf spot disease on inoculated sugarbeet plants. Appropriate light filtering permitted the visualization of *C. beticola* mycelium against the background fluorescence of sugarbeet tissue structural components. Detection of GFP in extracts of isolate 101004a was also possible using a fluorescence microplate reader, allowing for quantitative growth assays to be developed. Isolate 101004a will be used in the examination of seedling root penetration by *C. beticola* and in additional experiments aimed at understanding the biology of this sugarbeet pathogen.

WINTERMANTEL, WILLIAM M.*, AMY G. ANCHIETA, and NERICK F. MOSQUEDA, USDA-ARS, 1636 E. Alisal Street, Salinas, CA 93905. **Genetic variation**

among Beet curly top virus isolates infecting weed and crop hosts in California.

Curly top disease is caused by *Beet curly top virus* (BCTV) and related curtovirus species, and is transmitted by the beet leafhopper (*Circulifer tenellus*). The disease occurs in several large, but geographically separate regions of western North America. BCTV re-emerged in 2001 as a serious threat to agriculture in the San Joaquin Valley of California and has continued to exert pressure on agriculture in this region. BCTV infects a broad range of crop hosts including sugar beet, pepper, and tomato, as well as numerous native weeds. Prior molecular characterization of a limited number of curtoviruses from broad areas of the western United States suggested that two distinct curtovirus species, *Beet severe curly top virus* (BSCTV or CFH strain) and *Beet mild curly top virus* (BMCTV or Worland strain) were responsible for most crop disease, but little information existed on curtovirus species distribution among weed hosts or species prevalence in the California sugarbeet crop. The aim of this study was to clarify the genetic variability among curtovirus isolates in California, and to determine if specific weed hosts might be reservoirs for exceptionally severe virus species, such as BSCTV. Data collected over 2 years focused on molecular characterization of large numbers of BCTV isolates from weed and crop hosts of the beet leafhopper in the San Joaquin Valley. Total nucleic acid was isolated from individual plants, and both universal and specific primers were used to amplify viral DNA. PCR amplification coupled with sequence analysis identified the prevalence of both BSCTV and BMCTV as the predominant curtovirus species in California, infecting both weeds and crops. The Logan strain of BCTV, historically associated with California, was not identified among over 200 isolates characterized.

Section C, Entomology and Plant Pathology
Poster Presentations

BRADLEY, CARL A.[1]*, MOHAMED F. R. KHAN[2], NORMAN R. CATTANACH[2], AND RANDY S. NELSON[2], [1]Department of Plant Pathology, and [2]Department of Soil Science, North Dakota State University, Fargo, ND 58105. **Evaluation of Telone II fumigant and Actigard systemic acquired resistance inducer on sugarbeet in a rhizomania-infested field.**

Rhizomania, caused by beet necrotic yellow vein virus (BNYVV), is an emerging disease that is spreading quickly throughout the sugarbeet production region of the Red River Valley in North Dakota and Minnesota. Although productive resistant cultivars are available to growers for management of rhizomania, alternative management methods need to be identified in case resistance genes break down in this production region. A study was conducted at Glyndon, MN in 2003 and 2004 to evaluate Telone II fumigant and Actigard systemic acquired resistance inducer on performance of sugarbeet cultivars differing in susceptibility to BNYVV in a field infested with rhizomania. A BNYVV resistant and susceptible cultivar were used each year of the study. Telone II was applied to the soil in the autumn of each year prior to planting. Actigard was applied to sugarbeet seeds prior to planting at 3 g / kg seed. Control plots did not receive Telone II nor were planted with Actigard treated seed. Enzyme-linked immunosorbent assay (ELISA) was used to detect BNYVV in roots collected from each plot. Absorbance values of each ELISA reaction were obtained using a spectrophotometer at 405 nm. Plots were harvested and root yield, recoverable sugar, sucrose concentration, and losses to molasses were calculated. In 2003, the BNYVV resistant cultivar consistently outperformed the susceptible cultivar; however, no significant differences among Telone II fumigated plots, plots planted with Actigard treated seed, and untreated control plots were detected. In 2004, the BNYVV resistant cultivar had significantly greater sucrose concentration and less BNYVV titer than the susceptible cultivar. Untreated control plots generally outperformed plots treated with Telone II or planted with Actigard treated seed in 2004.

HANSON, LINDA E.[1]*, REBECCA M. DAVIDSON[1], GARY D. FRANC[2], and LEE PANELLA[1]. [1]USDA-ARS, 1701 Centre Ave., Ft Collins, CO; [2] University of Wyoming, Laramie, WY. **Analysis of benzimidazole-tolerance in Cercospora beticola.**

Cercospora beticola causes Cercospora leaf spot (CLS) of sugar beet and several other hosts in the Chenopodiaceae. On sugar beet, CLS is the most important foliar disease worldwide. The primary disease management methods are host resistance and foliar fungicide treatments. Benzimidazole fungicides target beta-tubulin and are used in some production regions for disease control. However, benzimidazole use is increasingly limited as benzimidazole-resistance becomes more widespread in the pathogen population. We examined isolates of *C. beticola* from different years and production regions for sensitivity to benzimidazole fungicides and for their beta-tubulin gene sequence. Isolates with benzimidazole-tolerance had a mutation in the beta-tubulin gene that corresponded to mutations previously determined to confer benzimidazole-tolerance in other ascomycete fungi. This same mutation has been shown to confer sensitivity to N-phenylcarbamates (NPC). When our C. beticola isolates were tested for sensitivity to the NPC fungicide diethofencarb, benzimidazole-tolerant isolates proved sensitive to the

NPC, while benzimidazole-senstive isolates showed little or no sensitivity to the NPC. C. beticola isolates collected in the central High Plains region of the United States in 2004 are being tested for their response to benzimidazoles and NPC, and a PCR-based method for detection of benzimidazole sensitivity is being investigated.

HARVESON, R. M.[1], L. HUBBELL[2]*, C. E. WINDELS[3], J. A. SMITH1, J. R. BRANTNER3, J. F. GILES[4], and N. R. CATTANACH[4], [1]University of Nebraska, [2]Michigan Sugar Company, [3]University of Minnesota and [4]North Dakota State University. **Evaluating Low Levels of Tachigaren on Minimum Build-Up-Treated Sugar Beet Seed for Protection Against Aphanomyces cochlioides.**

The objective of this study was to evaluate low levels of Tachigaren (hymexazol) as possible standard treatments on sugar beets under low to moderate levels of disease pressure, caused by *A. cochlioides*. The study was conducted for 3 years (2001-2003), at 12 separate sites in Michigan, Nebraska, and North Dakota. Treatments consisted of 1) Apron /Thiram incorporated into minimum build-up coatings with Tachigaren (20g and 30g), 2) Tachigaren applied at 45 g in a standard seed pellet, and 3) Apron/Thiram-treated controls. The same treatments were additionally tested under optimum conditions in the greenhouse in field soils naturally infested with varying concentrations of *A. cochlioides*. Field results varied, but several locations showed higher rates of Tachigaren with minimum build-up treatments (30g) caused reduced seedling emergence. However, few significant differences were observed from yield parameters, suggesting minimal damage to crop at the end of the season. Greenhouse results indicated that using low rates of Tachigaren with minimum build-up coatings exhibited more potential for use in fields with low-moderate levels of A. cochlioides. These same treatments were not consistent in soils with high disease potential.

HEIN, GARY L.* and JOHN THOMAS, University of Nebraska, Panhandle Research and Extension Center, 4502 Ave. I, Scottsbluff, NE 69361. **Screening for varietal resistance to sugarbeet root aphid.**

The sugarbeet root aphid is a common pest seen throughout all of the sugar beet growing areas close to the Rocky Mountains. The aphid's severity in the region results from the proximity of the growing areas to the Rockies where the primary host for the aphid, the narrowleaf cottonwood, is distributed widely. Sugarbeet root aphids are also a sporadic pest in several other sugarbeet growing areas of the US. Varietal resistance is the primary tool to manage root aphid populations; however, not all growing areas have highly resistant adapted varieties. Because of the importance of resistant varieties to managing this destructive insect, the development of effective and efficient screening procedures is critical to the development of improved varieties. Our objective was to develop improved greenhouse screening methods to identify the resistance levels of varieties. Maintaining sugarbeet root aphids in the greenhouse is difficult because soil moisture must be maintained at optimum levels. Soil cannot be too wet or aphid colonies become saturated and do not survive, and if the soil is too dry, secondary roots the aphids feed on can die, starving the colony. It is difficult to maintain aphids consistently in this optimum zone for long periods of time. To meet this soil moisture need, we have developed rearing and screening methods that incorporate soil cavities within the rearing and screening pots. These cavities allow the aphids to develop under humid conditions that maximize secondary root growth and thus aphid buildup, but do not become over-saturated and threaten aphid survival. These methods allow consistent survival in both colony and screening situations. We use the methods in greenhouse screens that provide reliable data on aphid resistance levels and allow us to establish segregation levels for varieties.

JARONSKI, STEFAN T.*, JULIE A. GRACE, and ROB A. SCHLOTHAUER. USDA ARS NPARL, Sidney MT 59270. **Metarhizium anisopliae for biocontrol of sugarbeet root maggot: constraints, challenges, and overall potential.**
The entomopathogenic fungus, *Metarhizium anisopliae*, has been under study by USDA ARS and North Dakota State University as a potential mycoinsecticide for controlling *Tetanops myopaeformis* for the past ten years, but ostensibly without salient success. These fungi can be used in the form of a granular formulation applied at planting, and/or as an aqueous, band-over-row spray of conidia to the bases of the plants just before peak fly oviposition. Most recently we have evaluated another isolate, F52, which holds more promise via greater infectivity, as well as better commercial attributes. Field trials and supplementary laboratory studies of F52, and its predecessor, MA1200, in 2002-2004, have yielded considerable information about the constraints and challenges in using *Metarhizium* in sugar beets, and its overall potential as a successful biocontrol agent.

KHAN, JAHANGIR[1]*, MOHAMED F. R KHAN[2], and RANDY NELSON[3], [1]Department of Plant Pathology, North Dakota State University, Fargo, ND 58105, [2]North Dakota State University and University of Minnesota, Soil Science Department, Fargo, ND 58105, [3]Soil Science Department, Fargo, ND 58105. **Using spore traps for Cercospora beticola in sugarbeet.**

Cercospora leaf spot, caused by *Cercospora beticola Sacc*., is the most damaging foliar disease of sugarbeet worldwide. The disease is polycyclic in nature and the pathogen produces many generations of conidia during the growing season, which are disseminated mainly by wind and rain splash. Timely application of the first fungicide application is crucial in reducing the rate of infection, and contributes to effective season long Cercospora control. Spore traps may be useful to determine the timing of spore dispersal, and the number of spores dispersed. The objective of this study was to determine whether *C. beticola* spores could be trapped, and to compare the efficacy of different spore traps. Seven day volumetric spore traps (Burkard and Osborne) and hand made coffee can trap were evaluated for their utility in trapping conidia of *C. beticola* in sugarbeet fields. Hand made trap was constructed using an empty 1.1 kg 'coffee can' with the lid and bottom removed and attached to a 0.8 m long metal rod. A cut out portion of a hollow door handle was attached by a binder clip to the 'coffee can' and used to hold a wooden cloths pin for mounting a glass slide. A thin layer of petroleum jelly was placed in 2.5mm2 area on one side at the end of a microscope slide. Traps were placed in a Cercospora disease nursery at Crookston, MN, and in a sugarbeet field in Breckenridge, MN, in 2002, and in Breckenridge, and St. Thomas, ND, in 2003. Traps were positioned 0.6 m above ground, recovered every 7 d, and examined microscopically for *C. beticola*. In both 2002 and 2003, *C. beticola* spores were successfully trapped and identified. At all locations, volumetric spore traps collected significantly higher number of *C. beticola* spores than the coffee can trap.

LIU, HSING-YEH*, JOHN L. SEARS, AND ROBERT T. LEWELLEN, USDA-ARS, 1636 E. Alisal St. Salinas, CA 93905. **Biological and molecular analyses of Beet necrotic yellow vein virus isolates that overcome host resistance genes.**

Rhizomania is an important virus disease of sugar beet. The disease is caused by *Beet necrotic yellow vein virus* (BNYVV) and vectored by the plasmodiophorid Polymyxa betae. The disease can only be controlled effectively by the use of resistant cultivars. During 2002 and 2003, several sugar beet fields with cultivars partially resistant to BNYVV grown in the Imperial Valley of California were observed with severe rhizomania symptoms, suggesting that resistance conditioned by Rz1 allele had been

compromised. Soil testing with sugar beet baiting plants followed by ELISA tests was used to diagnose virus infection. Resistant varieties grown in BNYVV-infested soil from Salinas, CA were ELISA negative. In contrast, when grown in BNYVV-infested soil collected from the Imperial Valley, CA all resistant varieties became infected and tested positive by ELISA. Based on host reaction, distinct BNYVV isolates have been identified from Imperial Valley soil (IV-BNYVV) by single local lesion isolation. These isolates do not contain RNA-5 as determined by RT-PCR. From the banding patterns of single-strand conformation polymorphism analyses we concluded that the resistance-breaking BNYVV isolates from Imperial Valley had likely evolved from the original existing A-type. The pathogenicity of IV-BNYVV isolates was studied. PCR products of RNA2 coat protein gene and P-25 protein (encoded by BNYVV-RNA-3, involved in symptom expression) of IV-BNYVV isolates were sequenced. Sequence alignments revealed only minor amino acid changes compared to the existing A-type of California BNYVV isolates.

RATTI, CLAUDIO[1], MARCO DE BIAGGI[2], PIERGIORGIO STEVANATO[2], RITA RESCA[1], ENRICO BIANCARDI[2], and CONCEPCION RUBIES AUTONELL[1], [1]Dipartimento di Scienze e Tecnologie Agroambientali (DiSTA), Viale Fanin 42, 40127 Bologna, Italy, and [2]Istituto Sperimentale per le Colture Industriali, Sezione di Rovigo, viale Amendola 82, 45100 Rovigo, Italy. **A multiplex RT-PCR assay for sugar-beet soil-borne virus diseases survey in Italy.**

Beet necrotic yellow vein virus (BNYVV), *Beet soil borne virus* (BSBV), *Beet virus Q* (BVQ) and *Beet soil borne mosaic virus* (BSBMV) are the most important known sugar beet viruses transmitted by *Polymyxa betae Keskin*. BNYVV, the causal agent of the disease known as rhizomania, was first described in Italy and has since been reported from many sugar beet growing countries in Europe, Asia and in North America. In Italy, a study carried out in soil samples assayed by serological methods found mostly of them infected by BNYVV, often in mixed infection with BSBV. In order to better investigate the sanitary situation of Italian sugar beet growing areas, a molecular protocols, based on multiplex RT- PCR reaction, for simultaneous BNYVV characterisation and BSBV, BVQ, BSBMV and *P. betae* detection has been developed. During 2002 and 2004, 140 soil samples were collected from different sites in 20 Italian provinces. Sugar beet plants (cv. Asso) were grown in the soil and root tissues were later harvested, total ssRNA extracted and then tested by multiplex RT-PCR assay. Results obtained show that 85 % of the samples evidenced single infected by BNYVV and 10 % by BSBV. Moreover 110 samples (78 %) resulted mixed infected by BNYVV and BSBV. The report highlights the importance of BSBV and the presence of strain type A of BNYVV in the main Italian sugar beet production areas. Otherwise BSBMV presence in the soil samples tested was excluded.

WEILAND, JOHN J.[1] and SHELVER, WEILIN[2]. [1]Sugarbeet and Potato Research Unit and [2]Animal Metabolism Unit of the USDA-ARS-Red River Valley Agricultural Research Center, 1307 18th st. N. Fargo, N.D. 58105. **Antiserum for the detection of Aphanomyces cochlioides.**

Quantitative immunological and nucleic acid detection methods for Aphanomyces have proven useful for the breeding of leguminous crops. A program objective is to develop quantitative tools for the detection of *Aphanomyces cochlioides* in sugarbeet fields and in inoculated, greenhouse-grown sugarbeet. A cell-wall preparation of *A. cochlioides* was used to immunize New Zealand white rabbits in an effort to raise antisera to this organism. Antiserum from rabbit 114 reacted significantly better with Aphanomyces spp than with any other common pathogen of sugarbeet tested, generating

strong positive signals in a direct enzyme linked immunosorbant assay (ELISA) within 30 min. of substrate addition. Due to inherent low reactivity with components in healthy sugarbeet extracts, the antiserum was capable of discriminating sugarbeet seedlings infected with *A. cochlioides* from uninfected seedlings. Use of the antiserum demonstrated that sugarbeet roots received at piling stations in the Red River Valley of Minnesota, although exhibiting characteristic Aphanomyces chronic phase symptoms, possessed little reactive material.

WINTERMANTEL, WILLIAM M.[1]*, STEPHEN R. KAFFKA[2], and ARTURO A. CORTEZ1, [1]USDA-ARS, 1636 E. Alisal St., Salinas, CA 93905, and [2]University of California, Department of Agronomy and Range Science, Davis, CA 95616. **The impact of plant age and genetics on curly top disease development in modern sugarbeet varieties.**

Performance of current California adapted sugarbeet varieties, which have little resistance to curly top disease, caused by *Beet curly top virus* (BCTV), were compared with some of the most tolerant (Inter-mountain West adapted) and susceptible varieties available for effect of infection on disease severity and plant weight. Current and previous field studies demonstrated that sugarbeet plants were more susceptible and losses more severe when seedlings were infected by BCTV, but less severe when plants were larger at the time of infection. To evaluate more precisely the relationship between age at infection and yield loss in modern varieties, individual sugarbeet plants were inoculated with 20 viruliferous beet leafhoppers (*Circulifer tenellus*) each, when plants had either 2, 4 or 6 true leaves. When plants were inoculated at the 2 leaf stage, all varieties became severely stunted with high disease ratings and similar rates of symptom development, regardless of tolerance or susceptibility of the variety. Plants inoculated at 4 and 6 leaf stages exhibited increasing separation between tolerant and susceptible phenotypes, with highly tolerant varieties performing well with low disease ratings and slower symptom development relative to susceptible varieties. California varieties performed only slightly better than the susceptible control line, Seedex Monohikari. At the conclusion of experiments, soil was carefully removed from beet roots by washing, and total plant biomass was determined. All varieties were severely stunted when inoculated at the two leaf stage, as indicated by individual plant biomass. As plants achieved larger size prior to infection, the effect of curly top on biomass was diminished.

Section E, Physiology and Biotechnology
Oral Presentations

SACCOMANI, MASSIMO[1], PIERGIORGIO STEVANATO[2], MASSIMO CAGNIN1, GIAMPAOLO FAMA[2], MARCO DE BIAGGI[2], and ENRICO BIANCARDI[2], [1]Dipartimento di Biotecnologie Agrarie, Università di Padova, viale dell'Università 16, 35020 Legnaro, Padova, Italy, and [2]Istituto Sperimentale per le Colture Industriali, viale Amendola 82, 45100 Rovigo, Italy. **Genetic diversity for root morpho-physiological traits and productivity in sugar beet.**

A better understanding of the complex interaction between plant and environment is required to improve plant yield stability over different locations. For this purpose, we studied the relationships among productivity, root architecture and its physiological function in nutrient acquisition. Root architecture parameters, glucose and fructose concentration in the root tip and sulfate uptake rate were evaluated in 18 sugar beet genotypes characterized by different sugar production ability. Significant genetic differences were observed in total root length, surface area, number of root tips, glucose and fructose concentration in the root tip and sulfate uptake rate after deprivation. Such traits were significantly correlated with root and sugar yield. These results demonstrate the existence of a strict association between morphological and physiological root traits and their relationships with productivity. These coordinated actions at the level of the whole root system contribute to explain plant adaptation to multiple environmental stresses.

HAAGENSON, DARRIN M*, and KAREN L. KLOTZ, USDA-ARS, Northern Crop Science Laboratory, P.O. Box 5677, University Station, Fargo, ND 58105. **Raffinose synthase is influenced by postharvest storage temperature and duration.**

Raffinose is a carbohydrate impurity that decreases the yield of extractable sucrose and alters sucrose crystal morphology, reducing filtration rates and slowing processing. Raffinose concentrations may increase with prolonged periods of cold during sugarbeet growth and storage. Although increased raffinose concentrations have been observed in response to cold temperature, the physiological and biochemical mechanisms associated with raffinose accumulation in sugarbeet are poorly understood. Our objective was to gain a physiological understanding of the environmental and biochemical factors controlling sugarbeet raffinose accumulation. Field-grown beets were harvested at three dates (8 September, 23 September, and 29 October 2004), and stored for 2, 10, and 18 wk at 2 or 6°C. Root tissues were analyzed for raffinose content, and raffinose synthase transcript abundance and enzyme activity. Sugarbeet root raffinose concentrations increased during storage and were three-fold higher in beets stored at 2°C than in roots stored at 6°C. Raffinose synthase transcript abundance was highest in roots stored for 2 wk at 2°C and transcript abundance decreased markedly at 10 and 18 wk. Temperature influenced enzyme activity as roots stored at 2°C maintained a 6-fold higher enzyme activity when compared to roots stored at 6°C. Enzyme activities increased at 2 wk of storage, but unlike transcript abundance, the enzyme activity remained high at 10 and 18 wk of storage. Raffinose synthase transcript abundance and enzyme activities were similar among the three harvest dates at all storage conditions.

KLOTZ, KAREN L.[1]*, DARRIN M. HAAGENSON[1], and J. MITCHELL McGRATH[2], [1]USDA-ARS, Northern Crop Science Laboratory, P.O. Box 5677, University Station, Fargo, ND 58105, and [2]USDA-ARS, Michigan State University, East Lansing, MI 48824. **Sucrose synthase gene expression is tissue-specific, developmentally regulated, and influenced by abiotic stresses.**

Sucrose synthase is the predominant sucrose degrading enzyme in sugarbeet root and is believed to have roles in carbohydrate partitioning to the root during production and sucrose loss during storage. To improve our understanding of sucrose synthase expression and the factors that control it, and to provide the molecular basis for future studies into sucrose synthase function, the genes responsible for sucrose synthase expression were compared, their tissue and developmental specific expression was described, and their response to environmental factors determined. Two genes, sugarbeet sucrose synthase I (SBSS1) and sugarbeet sucrose synthase 2 (SBSS2), contribute to sucrose synthase expression in sugarbeet root. Both SBSS1, first reported by Hesse and Willmitzer in 1996 (Plant Mol. Biol., 30:863), and SBSS2, a newly reported gene isolated from a salt-stressed seedling cDNA library, are predominantly expressed in root tissue. Both genes are expressed throughout root development, although SBSS2 exhibits greatest expression during early development, and SBSS1 exhibits highest expression during midseason development. Differences in steady state transcript levels were noted between the two genes in response to environmental stresses including harvest, wounding, cold and anoxia. Transcriptional differences in expression, however, did not always correspond to differences in sucrose synthase protein levels suggesting that protein stability and posttranscriptional regulation of expression may be important determinants of sucrose synthase activity in sugarbeet root.

VAN DUIJN, BERT[1]*, VAN ZEIJL, MIEKE[1], DRAAIJER, ARIE[1], and VAN ASBROUCK, JOHAN[2,3], [1]TNO Applied Plant Sciences and Sensor Technology, P.O. Box 2215, 2301 CE Leiden, The Netherlands, [2]Callas International, Amsterdamsestraatweg 523, 3553 EE Utrecht, The Netherlands, and [3]ASTEC Inc., P.O. Box 6766, Sheridan, WY 82801 USA. **Q2-test: a new fast and accurate seed quality evaluation test based on automatic single seed respiration measurements; examples from sugar beet seed research.**

In the evaluation of seed batches the time required for the test is often a limiting factor for seed producers, seed treatment companies and seed traders. To obtain full test results requires several days in conventional systems. By using a non-invasive method, based on fluorescence life-time properties of an oxygen sensitive dye, to measure oxygen concentrations we developed a seed evaluation test that is both rapid and accurate. This so called Q2-test measures in a fully automatic way the oxygen consumption of a large number of single seeds within 12 to 48 hours (depending on de species). From the oxygen consumption profiles several important seed quality parameters can be derived. Among these are the homogeneity of a seed lot, the vigorousness of a batch, the presence of dead seeds, the presence of dormant seeds. In addition, presence of fungal infections can be readily seen. Besides these germination related parameters also critical oxygen concentrations (COP) of seed lots can be determined. In the presentation the Q2-test will be introduced based on measurements on sugar beet seed lots.

Section E, Physiology and Biotechnology
Poster Presentations

BARGABUS-LARSON, REBECCA L*[1], JOHN J. WEILAND[2, 1] USDA-ARS, Sugarbeet Research Unit, Crops Research Laboratory, 1701 Centre Ave, Fort Collins, CO 80526, [2] USDA-ARS, Sugarbeet and Potato Research Unit, Northern Crop Science Laboratory, 1307 N 18th St, Fargo, ND 58105. **RNA silencing for the control of Beet necrotic yellow vein virus infection of sugarbeet.**

Beet necrotic yellow vein virus (BNYVV), a multipartite single-stranded RNA benyvirus causing Rhizomania in sugarbeet, is a serious threat worldwide. Tolerant cultivars currently available succumb to Rhizomania under severe disease pressure. The lack of complete control with tolerance prompted investigation into novel means of preventing infection. RNA silencing, a naturally occurring phenomenon, results in the post-transcriptional degradation of aberrant double-stranded RNAs, including mRNAs, preventing protein synthesis. This process has been induced under laboratory conditions for preventing virus infections in numerous plant and animal host-virus systems and may operate in currently deployed genetically enhanced sugarbeets exhibiting BNYVV resistance. In the current study, guide sequences used for eliciting silencing were designed to target blocks of untranslated and coding regions of the RNA1 of BNYVV that encodes for viral replication machinery. The sequences were amplified by reverse transcriptase polymerase chain reaction (RT-PCR), or in the case of small hairpin (hp) RNA, created by direct synthesis of deoxyoligonucleotides with 60 base pair "arm lengths". Silencing constructs were developed by cloning these fragments into a *Barley stripe mosaic virus* (BSMV) vector. When using either the RT-PCR generated or small hpRNA constructs, a higher degree of silencing was achieved using targets for the untranslated regions of RNA1 when compared to constructs containing RNA1 coding region guide sequences, as determined by disease reduction and ELISA assays.

IVIC-HAYMES, SNEZANA D.[1], MARK BOETEL[2], LARRY G. CAMPBELL[3], ROBERT DREGSETH[2] and ANN C. SMIGOCKI[1]. [1]USDA, ARS, Molecular Plant Pathology Laboratory, 10300 Baltimore Ave, Beltsville, MD 20705, [2]North Dakota State University, Department of Entomology, Hultz Hall, Fargo, ND 58105, and 3USDA, ARS, Northern Crop Science Laboratory, Fargo, ND 58105. **An in vitro sugar beet root maggot (*Tetanops myopaeformis*) feeding assay.**

Sugar beet root maggot (SBRM, Tetanops myopaeformis Röder) is a serious pest of sugar beet (*Beta vulgaris L.*) in North America and Canada. Currently, insecticides are the most efficacious measure for control of the insect. Therefore, alternative control measures are being sought. An in vitro system was established to study interactions between sugar beet roots and SBRM. Sources of root material included hairy root cultures, 14-day-old seedlings and taproots from 1-year-old greenhouse plants. Hairy root cultures were stained in 0.01% safranin or crystal violet and placed on petri plates with _ strength B5 medium or water-moistened Whatman 3 filter paper or nylon membrane. Seedlings and taproots were placed on nylon membranes. To reduce contamination, benomyl (10 mg/l), cefotaxime (300 mg/l) and carbenicillin (400 mg/l) were added to the plates. First, second and third instar SBRM, obtained either from eggs of laboratory-reared flies or from soil samples collected from infested sugar beet fields, were placed on the roots. Evidence of SBRM feeding included severed roots and safranin or crystal violet in the frass or intes-

tinal tracts of insects. Some larvae survived for more than 50 days on the roots. This bioassay will be useful for rapid screening of newly developed SBRM resistant sugar beet germplasm, chemical control agents or biocontrol organisms. Insecticidal plant extracts and spores of a biocontrol fungus, Synglíocladium tetanopsis, are currently being evaluated by this assay.

PUTHOFF, DAVID P. and ANN C. SMIGOCKI, USDA-ARS Molecular Plant Pathology Laboratory, BARC-West B004 10300 Baltimore Ave., Beltsville, MD 20705. **Sugar beet genes regulated by sugar beet root maggot (*Tetanops myopaeformis*) infestation.**

The sugar beet root maggot (SBRM) is the most devastating insect pest in U.S. sugar beet production. We are employing the Suppressive Subtractive Hybridization (SSH) method to identify genes regulated in sugar beet roots after SBRM larval feeding. Two beet genotypes are being used in this study: F1010, a susceptible line, and F1016, a moderately resistant line. Root and hypocotyl tissues infested with SBRM for 24 and 48 h were compared to uninfested tissues within each genotype. SSH was conducted between the two genotypes in order to identify genes reciprocally regulated (up-regulated in 1 genotype while down-regulated in the other). Identifying genes from both lines will not only yield a class of genes potentially involved in the defense response of sugar beet to SBRM, but also allows the elucidation of a class of genes associated with the susceptible response. These two classes of genes will be useful in developing future control methods. To date, over 1000 cDNA fragments have been isolated for further characterization that includes, confirmation of differential expression, sequencing, full length cDNA cloning and expression profiling following various plant stresses. Candidate genes identified from all or any of the subtractions will lead to a better understanding of the mechanisms of infestation, resistance and susceptibility.

Section D, Chemistry and Instrumentation
Oral Presentations

GODSHALL, MARY AN*; McKEE, MARIANNE; MOORE, SARA and TRICHE, RON, Sugar Processing Research Institute, Inc., 1100 Robert E. Lee Blvd., New Orleans, LA 70124. **Examination of oligosaccharides, organic acids and high molecular weight components in beet processing.**

Beet raw juice is a "soup" that contains many components that enter the sugar manufacturing process along with the sucrose. These include organic acids, anions, cations, oligosaccharides, fatty acids, nitrogenous compounds, reducing sugars, enzymes, polyphenolics and polysaccharides. The stages of purification are intended to remove the majority of these constituents, but a portion remains to go through the process and to interact to form color and other interaction products. Color is created during carbonation under the high temperature and pH conditions. The color formed during beet sugar processing tends to be very reactive and subject to increasing over time, which could be considered an "auto-catalytic" effect. In this study, the polysaccharides, oligosaccharides and organic acids in various processes were measured, and their tendency to interact and form color is discussed.

MCGINNIS*, T. P., Water and Core Technologies Research, Nalco Company, 1601 W. Diehl Road, Naperville IL, 60563-1198. **Analytical Characterization of Conditioned Diffusion Juices and Related Process Samples.**

A degasification system developed by CO2 Solutions and evaluated by Nalco has been shown to result in improved synthetic thin juice quality. Various analytical techniques have been employed to characterize the composition of juices subjected to conditioning in a number of beet sugar factories. In addition to diffusion and thin juices, samples of condensed vapors were analyzed in order to characterize the types of volatiles liberated from the juices. The analytical results give insight into the improved purity and decreased color of thin juices examined in field studies during the 2003-2004 slicing campaign.

SAMARAWEERA, UPASIRI*; JEFFREY L. CARLSON, KEN A. KUBAT, Minn-Dak Farmers Coop, 7525 Red River Road, Wahpeton, ND 58075. **Efficiency improvements at the Minn-Dak Farmers Cooperative process laboratory**

The Minn-Dak process laboratory increased the laboratory labor productivity by 50% between 2000 and 2003 reducing the labor from sixteen to eight shift employees. Four basic strategies were used to accomplish this reduction. Data entry into the laboratory information system was automated to reduce time and errors. Analytical methods were modified and equipment purchased to enable automatic or simplified sample preparation and analysis. Sample retrieval time was cut down by moving sampling points, having process employees retrieve some samples do some at-line analysis. Programming was done that allowed the process control system to communicate with the LIMS, allowing the pan floor information to be captured directly or input by the pan floor personnel. This paper will discuss the some specific examples as well as problems encountered including some that are still to be resolved.

WEIN, GARY M., AND GARY REINWAND, ChemTreat, Inc., 4461 Cox Road, Glen Allen, VA 23060, Bates, Ron, Imperial Sugar Company, 395 West Keystone Road, Brawley, CA 92227. **Comparison of halogen and organic peroxide oxidizing agents for biocontrol agents in sugar factory cooling water.**

Historically, chlorine or bromine oxidizers have been used for biological control in sugar factory cooling waters. Over two campaigns, evaluation of organic peroxide has demonstrated competitive performance, improved fouling control, and reduced corrosion potential. This presentation will show how halogens and organic peroxide affect corrosion, bio fouling, and microbiological growth in a factory open recirculation cooling system subject to occasional sugar intrusions.

Section D, Chemistry and Instrumentation
Poster Presentations

BEDDIE, DAVID[1], TOBIAS WIRTH[1], JASON GRECH[1], and WALTER HEIN[2], [1]BetaTec Hop Products GmbH, Freiligrathstrasse 7/9, 90482 Nurenberg, Germany, and [2]Zuckerforschung Tulln GmbH, Reitherstrasse 21-23, A3430 Tulln, Austria. **Relative effectiveness of natural and synthetic biocides against bacteria found in sugar factories**

The control of bacterial infections in sugar factories is complex and so it is difficult to achieve optimum results. There are many different types of bacteria, which can vary from one factory to another and resistant strains can develop during a campaign. Furthermore different conditions within the factory (pH, temperature, aerobic/anaerobic), enables particular strains to dominate in different areas of the factory. To combat infections, synthetic biocides and more recently a range of natural anti-bacterial agents (beta acids, rosin acids, fatty acids) are used, but it is not always easy to select which are the best agents to use in particular situations. In this study the effectiveness of natural and synthetic biocides have been compared against important strains of bacteria found in sugar factories. The results show that biocides have different relative activities against these bacterial strains, and this knowledge along with factory trial data helps to target the best biocide or combination of biocides to be most cost effective for the factory.

EGGLESTON, GILLIAN, USDA, Agricultural Research Service, Southern Regional Research Center, 1100 Robert E. Lee Blvd., New Orleans, LA 70124. **Uniform and simple measurement of the activity of dextranases at the sugarbeet factory.**

Currently, the activities or strengths of commercial dextranases in the U.S. cannot be directly compared because there is no uniform method used by vendors and/or distributors to measure the activity. A very wide variation exists in the activities of commercial dextranases, and this is compounded by the fact that activities and prices change regularly. Moreover, the factory storage characteristics of commercial dextranases differ enormously, which further highlights the need for not only a uniform method to (a) measure and economically compare the activities of different commercial dextranases, but (b) one which can be used simply at the sugarbeet factory to measure the activity of factory delivered batches of enzymes, and their changing activities on factory storage. A dextranase activity method, based on simple titration, was identified and modified for easy use a the sugarbeet factory. This method does not need any sophisticated equipment and there is no need for standards and a standard curve.

EGGLESTON, GILLIAN[1]*, POLLACH, GUENTER[2], and TRICHE, RON[3], [1]USDA, Agricultural Research Service, Southern Regional Research Center, 1100 Robert E. Lee Blvd., New Orleans, LA 70124, [2]ZuckerforschungTulln Gesellschaft Tulln, Austria, [3]Sugar Processing Research Instititute, New Orleans, 70124. **Differentiating cane white sugar from beet white sugar using ion chromatography profiles.**

Recently in Europe, there have been reports of illegal trading in Serbia and Montenegro, whereby the origin of white, refined sugar could not be certified. Other

countries in Europe and other parts of the world have also most likely suffered from illegal intermixing of beet white sugar (BWS) with cheaper to produce cane white sugar (CWS). A method is, therefore, urgently needed that is (a) capable of distinguishing between CWS and BWS, and (b) can measure the percentage of CWS in a CWS/BWS mixture (final goal). Raffinose and theaderose have been advocated as differential markers. However, raffinose is present in both BWS and CWS (although to a much lesser extent in CWS). Pure theanderose is not available, and small IC-IPAD (ion chromatography with pulsed amperometric detection) peaks have been found in BWS samples where theanderose eluted in CWS samples. Low raffinose in conjunction with numerous cane marker peaks across IC-IPAD 45min profiles of 7oBrix blind BWS/CWS samples were successfully used to detect 20% CWS adulteration. Increasing the oBrix to 10 allowed detection of 10% CWS adulteration. Chromatography libraries of CWS, BWS and CWS/BWS samples for direct comparisons will aid adulterant detection. Further studies using chemometric modeling are to be undertaken to enhance adulterant detection. At the least, the current use of IC profiles can be used as a screening method before verification and quantification with more sophisticated techniques such as DSC and NMR.

Section F, Factory Operations
Oral Presentations

AUGUSTINE, GLENN*, and RON KAWLEWSKI, Southern Minnesota Beet Sugar Coop, PO Box 500, Renville, MN 56284. **Challenges for the Treatment and Discharge of Low Salinity Wastewater.**

In 1999 SMBSC designed and built a wastewater treatment facility utilizing anaerobic and aerobic processes. The designed capacity of this facility was to treat up to 2 Million gallons per day for direct discharge to surface waters. This wastewater model was selected over irrigation due to area soil types, predicted rainfall, and odor control. Non traditional permit limits related to strict salinity parameters presented challenges to the plant's operation and required a comprehensive salinity management program in order to meet environmental requirements.

CARLSON, JEFFREY L.*, PETE W. JENSEN, Minn-Dak Farmers Cooperative, 7525 Red River Road, Wahpeton, ND 58075-9698 **Environmental mass balance at Minn-Dak Farmers Cooperative.**

Environmental costs at beet sugar processors include wastewater treatment, air emissions control, and solid waste storage and disposal. Many of these costs can be reduced through pollution prevention and control but not all. This study shows that for each pound of sugar and byproduct produced, 8 pounds of non-product discharges were made to the environment at Minn-Dak Farmers Cooperative during the 2003-2004 campaign. It discusses strategies and limitations for reducing environmental costs in light of the volume of discharges.

CARLSON, JEFFREY L.*, PETE W. JENSEN, JOHN R.HAUGEN, and JOHN DUMMER Minn-Dak Farmers Cooperative, 7525 Red River Road, Wahpeton, ND 58075-9698 **Environmentally friendly storage and use of dirt, wastewater biosolids and other solid wastes at Minn-Dak Farmers Cooperative.**

Nutrients in dirt washed from sugarbeets, biosolids from wastewater treatment or other solid wastes are a potential environmental hazard if these wastes are not managed correctly. At Minn-Dak Farmers cooperative nutrient content of solid waste streams are monitored and all storage and disposal practices tailored to prevent nutrients from adversely affecting the soil, ground or surface waters. Practices followed include storage of dirt in a specially constructed mud solids storage area, ground water monitoring and land application rates determined by nutrient content and agronomic practices. Minn-Dak has tried a variety of methods including winter and summer pond cleaning and land applications as well as land application of mud directly from the washhouse after a mud press. This paper discusses the operational problems and benefits of the different land application methods. Nutrient analysis shows that nutrient loading of the dirt from the washhouse varies predictably during campaign with low nutrients in the fall and high nutrients toward the end. The high nutrient load in winter and spring is attributed to the excessive leaching of beet cell content into the flume due to frozen beets.

CARRIER, DANIEL J., The Amalgamated Sugar Company LLC, Nyssa Plant, 105 East Main St., Nyssa, OR 97913. **Flue gas scrubber water de-calcification.**

The Nyssa Oregon plant, in compliance with a *Mutual Agreement and Order* with the Oregon Department of Environmental Quality and operational restrictions of the factory was required to build a segregated scrubber water loop consisting of a 5 million gallon lined settling lagoon and pumping system. The scrubber water is used to scrub particulate and sulphur dioxide emissions from three pulp dryer stacks and one boiler stack. The fly ash scrubbed and settled in the lagoon has a calcium constituent which is soluble and dissolves into the scrubber water as the fly ash soaks in the settling lagoon. Sulphur dioxide scrubbed from the flue gas oxidizes and combines with the calcium to form calcium sulfate. The activity of volumetric reduction of the water by ash and accumulation of calcium and sulphur dioxide from scrubbing caused the solubility point of the calcium sulfate in the scrubber water system to reach saturation in 22 days of operation. The reverse solubility properties of calcium sulfate caused the precipitation of calcium sulfate as scale in the scrubbers, causing significant operational difficulties. Through experimental and empirical determination, a process called Lime Soda Softening was found to be the most efficient and economical method to de-calcify the scrubber water. A 35,000 gallon batch reactor tank and agitator is used to receive 30,000 gallons of scrubber water. A lime slurry is added to raise the pH to ~10.3, the point at which calcium carbonate in solution will precipitate. A soda ash solution is then added to provide the carbonate needed for the calcium to break free from the sulfate and form calcium carbonate and precipitate. The sulfate is tied up with the sodium and is highly soluble and will remain in solution to very heavy concentrations ($CaSO_4 + Na_2CO_3 = CaCO_39 + Na_2SO_4$). Free calcium also forms calcium carbonate and is precipitated ($Ca2+ + Na2CO_3 = CaCO_39 + 2Na^+$). 80 to 140 grains per gallon of calcium hardness are removed per batch treated. The softened water is decanted and returned to the scrubber water loop. The calcium carbonate mud is pumped to the mud pond and the process is started again.

CARRIER, DANIEL J., The Amalgamated Sugar Company LLC, Nyssa Plant, 105 East Main St., Nyssa, OR 97913. **Plant distributive control system expansion.**

For the past three years the Nyssa plant has been in the process of upgrading and replacing outdated and obsolete controls with modern distributive control system technology. The Nyssa facility was first commissioned in the late 1930s. Since then, there had been some periodic efforts to modernize the controls in certain areas of the plant. These installations were not kept up to date with hardware and software modernization. Some areas of the plant had and still have control technology that is 30 to 40 years old. The general plan for the controls modernization will provide a distributive IO configuration with three control domains. All three control domains will be able to communicate, providing communications loop that is plant wide. With proper authorization, any part of the plant can be viewed or controlled from any operator or engineering station on the loop. Communications for the operator bus and IO bus is carried out over proprietary protocol on coaxial or 10-base-t cabling. The engineering communication is carried out with standard Ether Net protocol on cat5 cable. Long distance communication to remote location is handled by fiberoptic communications. Currently, the entire beet end, juice softener, evaporator train and pulp dryer operations projects have been completed. This summer the brown sugar packaging line will be brought on line. Future plans are to bring the boiler house, pan floor and lime kiln on to the DCS.

GULA, FRANCIS[1] , ALAIN BELOTTI[2], XAVIER LANCRENON[1] and DOMINIQUE PAILLAT[1], [1]Applexion and [2]Fives Cail. **Chromatography of the second mother liquor in a new Beet Sugar Factory : An elegant way to increase the sugar yield and to decrease the capital cost of the crystallization.**

The interest of Chromatography of beet molasses to increase the sugar yield in a Beet Sugar Factory, when there is a significant difference between the price of crystal sugar and molasses is well known. The authors demonstrate the importance of a better integration to the process, when a new Sugar Factory is built: It becomes very advantageous to place the chromatographic separator for the recovery of sugar from the second mother liquor (low green syrup). In this case, it is no longer necessary to invest in a third strike of crystallization, and it is possible to better use the equipment out of the season .

GROOM, DAVID R.*, TERRY D. MCGILLIVRAY, JAMES H. HEGGENESS, AND INDRANI SAMARAWEERA, American Crystal Sugar, Technical Services Center, 1700 North 11th Street, Moorhead, MN 56560. **Results of long term storage of coupled loop molasses desugarization extract.**

Storage issues were encountered in Hillsboro ND extract plant during the 2000 and 2001 campaigns. Extract went to storage within the typical acceptable storage parameters for juice. Traditional markers used to monitor extract quality in storage were inadequate. Experimental trials conducted indicated that invertase was present in the stored extract due to microbial activity in the evaporator train. A paper covering the findings was presented in 2003. Since 2001 the Hillsboro MDS facility has been operating the extract evaporator train at elevated temps. The extract has been stable in storage with regard to purity and pH. Color rise in storage has been reduced. Storage conditions are defined. Paper discusses changes in operation the impact on long term storage.

KOCHERGIN, VADIM[1], OLIVER TZSCHAETZSCH[2] , [1]Amalgamated Research Inc., P.O .Box 228, Twin Falls, ID 83301, USA and [2]Escon GmbH, Schlossstrasse 48 a, D - 12165 Berlin, Germany. **Ion exchange thin juice softening using fractal technology.**

Thin juice ion exchange softening technology has been used by the sugar industry for over 25 years. Most existing softening installations have been justified economically as a necessary prerequisite for molasses desugarization systems. Elimination of hardness from thin juice, however, has its own advantages for sugar factory operations, especially when considered along with other innovative solutions, e.g. plate evaporators. So far the economic feasibility of ion exchange softeners in the plants without molasses desugarization appeared to be marginal. Recent application of fractal fluid distributors allowed significant reduction in construction and operation of weak cation ion exchange softener. Since the fractal design concept utilizes 10 times less resin compared to existing weak cation installations (and 100 times less resin compared to strong cation resin systems), the capital and operating cost should be estimated to conclude if thin juice softening could be justified economically based on its own merits. Besides the obvious benefits of energy savings due to scale reduction, elimination of antiscalants and potential increase in factory throughput, and other factors will be discussed that positively affect factory operation and performance. The purpose of the paper is to analyze the economics of thin juice softening process using fractal equipment based on four years of commercial operation. Economic feasibility of various scenarios of process implementation will be discussed taking into account different regional and process specifics.

HEMPELMANN, REINHOLD *, STEFFEN KAUFMANN; BMA AG, P.O. Box 3325,

38022 Braunschweig, Germany. **Factory rehabilitation and optimization by number and capacity.**

The continuing changes in economical and environmental conditions are a great challenge for the sugar producing industry to develop competitive concepts for their factories. Capacity, demand on primary energy, improvement of quality and consideration of more stringent environmental regulations are the most important factors for the decisions to be made. This includes also the evaluation of the optimal number of factories under control of a company.

Results of a study will be presented that was carried out together with and for Cosumar, Morocco. The main targets of the study were: (1) increase the capacity of one factory and close down a second one, (2) use of the equipment of the closed factory to a maximum extent, (3) add the necessary new equipment and (4) achieve optimized technical and technological conditions.

MANUEL R. HOLST* and FERNANDO MARTÍN DOMÍNGUEZ, Azucarera Ebro R&D center, C/Esperanza 10, Valladolid 47007, Spain. **Influence of several different agronomic, post-harvest and technological factors upon process ionic balance and consequently upon sugar manufacturing industrial yield.**

Over the years 2002, 2003 and 2004 many experiments at different scales (industrial, pilot-plant, laboratory pilots) were finalized in both autumn and spring sown campaigns, that aimed at assessing the impact of different agronomic, post-harvest and technological factors upon process ionic balance (IO). The process ionic balance, which is determined through juice effective alkalinity, is a major factor that influences the sugar production yield and real and potential possibilities to improve IO were identified. Also, new knowledge regarding the impact upon the IO of the above-mentioned factors was obtained for both southern and northern Spanish campaigns. The variation margins of effective alkalinity are exposed and the way they are influenced by factors such as beet variety, nitrogen fertilization, irrigation, post harvest mechanical damage, time between harvest and slicing as well as diffusion and juice clarification parameters. Technical and economical results of preventive and corrective (NaOH addition) measures to obtain a positive ionic balance were compared. It was shown that (1) deficiency in alkalinity provokes an indirect melassigenic effect due to addition of NaOH, (2) that beet variety and nitrogen fertilization have an influence on IO, (3) that mechanical damage coupled with residence time and temperature alter IO as well as inappropriate beet washing, (4) that beet diseases decrease effective alkalinity and (5) that cossette quality, extraction (temperature) and juice clarification parameters significantly affect effective alkalinity.

MCGILLIVRAY, TERRY*, DAVID GROOM, JIM HEGGENESS, JOE WALLEVAND, American Crystal Sugar, Technical Services Center, 1700 North 11th Street, Moorhead, MN 56560. **A review of pilot plant boiling of extract from coupled loop and simulated moving bed molasses desugarization plants**.

Boiling of extract from either the coupled loop or the simulated moving bed separators have presented issues for the factories that are different than are typically found when processing thick juice from beets. This paper reviews work done on boiling of extract produced from two different molasses desugarization facilities. Question addressed during the pilot plant boiling included: the effect of pH on boiling time, pan yield, and Color/NS ratios; and the use of sulfur dioxide during the boiling process for pH reduction and color control. A simple factorial design was used to determine the effect of pH and sulfur dioxide on crystallization rates and yields.

JENSEN, ARNE S., EnerDry ApS, Moelleaaparken 50, DK2800 Lyngby, Denmark.
Steamdrying of Beet Pulp. Latest Developments.

The technology is now more than 20 years, but still improving through development. The new design as at Minn-Dak Farmers has improved capacity, product quality and control of the dryer. The 2 steamdryers at SMBSC in Minnesota have also in 2004 been modified to the new design. It is often assumed that steamdrying will demand more live steam from the boiler house, which is not the case. Introducing steamdrying never demands changes in boiler house, and it can always be fit into the steam system in an existing factory. The increased prices on gas and fuel oil make replacement of conventional drum dryers by steamdryers a healthy investment, which is illustrated by an example. And the air pollution problems are solved for good.

KRELL, LOTHAR, Braunschweigische Maschinenbauanstalt AG, Am Alten Bahnhof 5, D-38122 Braunschweig, Germany. **Reduced energy consumption for pulp drying in a high-capacity fluidized-bed steam dryer.**

Beet sugar factories around the world are faced with the fact that beet processing rates have to be increased in order to cut the cost for the production of sugar. The capacity of the local market to absorb the exhausted or pressed pulp leaving the factory is normally limited, which is not least due to logistic reasons. There is hence an increasing need for the factories to produce dried pulp or pellets that can be stored for some time. However, in view of rising energy costs and more stringent requirements on exhaust-gas emission, conventional pressed-pulp drying in directly heated drum dryers is a rather cost-intensive process.

Against this background, pulp drying with superheated steam in a fluidized-bed steam dryer (FSD) offers an excellent alternative. Apart from some minor radiation losses, this drying technology has no heat requirements of its own. Since 2002, BMA has supplied two high-capacity size 12 dryers of the FSD series. The achieved water evaporation rates in practical operation were higher than 55 sht/h. All technological and design modifications were orientated towards a maximum dryer availability. The most recent results and experience with these two dryers will be discussed.

NIEPOTH , KLAUS ; TOEBE , PETER ; BRAASCH, JOACHIM , GEA Ecoflex GmbH, Helmholtzstr. 144 , 46045 Oberhausen , Germany . **Plate Falling Film Evaporators for the Beet Sugar Industry – New Experiences**

For more than 10 years plate falling film evaporators have been installed in the beet and cane industry, more than 100 single units are running in all parts of the world. This paper will report on new experiences with plate falling film evaporators in the beet sugar industry. Most recent improvements on design details like juice distribution , wetting rate, retention time and appropriate control arrangements lead to a better and safer performance of those units. A new 8-effect evaporation station in Europe , including 7 plate falling film units (6.500 m_ each) and 2 tubular falling film units , shows excellent performance data (improved heat transfer ; reduced juice colorization). Attention will be given to several reference plants using in parallel both vapors from modern pulp dryers and exhaust steam in one single unit as heating steam for the first effect. Any additional steam transformer between vapors from the pulp dryer and the steam chamber of the first effect will not be needed any longer.

PETRIW, DOUGLAS M., Rogers Sugar Ltd, 5405-64th St., Taber, AB., T1G 2C4.

Standard Liquor Filtration using a Putsch Sibomat filter.

Standard liquor filtration is typically accomplished using diatomaceous earth (DE) pressure leaf filters. The Putsch Sibomat filter offers an alternative that does not require the use of DE. The objective of this trial was to test the effectiveness of the Sibomat in terms of filtrate quality and filter capacity and to identify whether elimination of DE filtration could be achieved. DE filtration at Rogers Sugar Ltd (Taber) consumes on average 2 kilograms of DE per tonne of sugar produced, at a campaign cost approaching $100,000. Elimination or major reduction in the DE consumption can produce an attractive economic payback. The Sibomat filter test unit supplied by Putsch is a full-scale assembly with only one filter basket. Fitted with a 55-micron screen element, it was installed in parallel with the factory's DE filter bank in March of 2002. It has been tested during two juice campaigns and one beet campaign and will operate again during the beet campaign commencing September 2004. Test results to date indicate suitable beet campaign operation with significant DE savings, but performance has been unacceptable over both juice campaign periods. During the first juice campaign DE contamination of the Sibomat feed, contributed to the poor results. During beet campaign the Sibomat handled up to 75% of the total juice flow (34 m3/hour average) producing suitable quality filtrate with acceptable cycle times (80 to 90 minutes). The consumption of DE was reduced by more than 50%. During the second juice campaign, the juice filtered well through the DE filters but suitable filtrate quality could not be achieved from the Sibomat. Very fine suspended matter could not be removed even after changing to 33-micron screen element. Many questions regarding the poor filtrate quality remain unanswered. Although there is excellent potential for significant savings when using the Sibomat for beet campaign, current data suggests that total elimination of the DE filtration station cannot be recommended.

HIEB, ALAN*, and GALAN M. ROGERS, The Amalgamated Sugar Company

Removal of sulfur dioxide from boiler scrubber water.

The Mini-Cassa factory of the Amalgamated Sugar Company uses wet scrubbers to remove the SO2 that is contained in the boiler flue gas resulting from burning Powder River Basin Coal. This SO2 was removed from the scrubber water by the implementation of a Flue Gas Desulfurization System (FGD). This FGD system uses soda ash and pebble lime in the forming of a cake that is comprised of calcium sulfite (CaSO3) and sodium and fly ash. The cake contains 50% solids. SO2 removal of 98% has been accomplished from the boiler scrubber water. Development of the F.D. process is ongoing attempting to incorporate drier scrubber water as well. Oxygen scavengers are being explored to aid this attempt. No drier results have been developed as of this time.

SAMARAWEERA, INDRANI S.*, DIANE L. RHEAULT, AND LYNN A. BUSCHETTE, American Crystal Sugar Company, PO Box 1227, Moorhead, MN 56561-1227.

Sanitation protocols and methods of evaluation.

The use of ATP bioluminescence systems for sanitation checks have become very popular and give a quick assessment of gross contamination, if any. However, one draw back in this method of assessment is that it does not give information on contamination of specific microbial types; for instance coliforms, yeast and mold. Therefore, other test methods need to be carried out to obtain this information. Some of the methods used in these studies were the ATP bioluminescence systems "Biotrace" and "AccuPoint" and different types of swab methods "RediSwab," Hygiene SwabCheck, Coliform SwabCheck, and culture swabs which were used in conjunction with microbial plate checks for validation. These assessments were carried out at the East Grand Forks and Moorhead factories after extract tank and syrup truck sanitation protocols had been car-

ried out. Preliminary results with the use of the Hygiene Swab system have been promising. The advantage in use of this method in extract tank sanitation over regular plate checks is the quick turn-around time, 2-24 hrs for a color change (red to yellow) versus 2-3 days for counts from microbial plate checks. In extract tank sanitation checks we have found the use of ATP bioluminescence systems not to be reliable. This is probably due to the pitted nature of the steel tanks in use. Therefore, the Hygiene SwabCheck once its reliability is further validated will be a boon in hygiene monitoring of these tanks. This is of particular importance at American Crystal Sugar Company where about 5-10 million dollars worth of extract is stored in these tanks over a period of 7-9 months during the beet sugar campaign.

SAMARAWEERA, UPASIRI1*; JEFFREY L. CARLSON1, RON E. EHLERT1, KEN A. KUBAT1, RAY E. SMITH,2 Minn-Dak Farmers Coop, 7525 Red River Road, Wahpeton, ND 58075 and 2 United Sugars Corporation, 7401 Metro Blvd., Suite 350, Edina MN 55439. **Hard and Lumpy Sugar Complaints, Is it really Hard and Lumpy?**

Minn-Dak cooperative and United Sugars Corporation have been grappling with hard and lumpy complaints over a long period. A hard and/or lumpy complaint appears to be a "catch all" if sugar does not flow freely during the unloading process. These investigations have revealed that when bulk sugar fails to flow freely during the unloading process, it may have little to do with the condition of the sugar. These investigations have found that the true cause of some complaints were poor unloading and loading practices, defective unloading equipment, the type of the rail car unloading gates and the physical condition of the gates. The paper will describe how the true hard and lumpy sugar is formed with literature references, as an introduction and our experience with issues relating to in bulk rail car loading and unloading.

SANDERS, DAVID, Nalco Company, 1601 West Diehl Road, Naperville, IL 60563. **The Development and Application of a Juice Conditioning System for Increased Sugar Quality and Recovery.**

The sugar industry is slowly trending towards an ultimate global market. Sugar processors face increasing world competition and the need to increase process efficiency while simultaneously managing limited capital funds. The Juice Conditioning System was formed around patented technology recognizing that early removal of non-sugars from the process can significantly enhance the recovery of sugar, and can have a broad impact on the remaining process steps. This presentation will be an introduction to the Juice Conditioning System and will also highlight the results from a pilot trial, which showed improvements in thin juice color and purity.

SAYE*, D. J. AND DANG, X., Separations and Commercial Processes Research, Nalco Company, 1601 W. Diehl Road, Naperville IL, 60563. **Improved Beet Sugar Purification from "Conditioned"Diffusion Juice: Field Studies During the 2003-2004 Campaign.**

A diffusion juice conditioning technology was designed to remove dissolved gasses such as CO_2. Degassing of the diffusion juice resulted in a product juice stream of consistently higher pH, thus decreasing lime demand during juice purification and associated costs. That ability was substantiated with a pilot unit operated at a beet sugar factory in the Midwest United States. In addition to decreased lime demand, pilot testing revealed the potential to significantly improve thin juice color and purity. Subsequently, full-scale juice conditioning systems were installed in two Midwest beet sugar factories. By the

end of the 2003-2004 campaign, these systems were capable of treating the entire flow of raw diffusion juice at the respective factories. Field studies have shown that treatment of diffusion juice prior to pre-liming significantly impacted the quality of the resulting thin juice. This talk describes the results of field studies and related research performed during the 2003-2004 campaign.

THILMONY, PARKER J, and BRENT A. MUEHLBERG, Minn-Dak Farmers Cooperative, 7525 Red River Road, Wahpeton, ND 58075. **Steam drying of sugar beet pulp at Minn-Dak Farmers Cooperative.**

As the slicing capacity of the Minn-Dak Farmers Cooperative sugar beet plant has increased from 4,500 tons per day to 10,000 tons per day, the factory can no longer dry all the pulp produced. The amount of coal burned in the rotary drum dryer was limited due to emissions, therefore natural gas was required to achieve maximum capacity. The installation of a steam dryer for beet pulp was studied, and found to be an attractive method to increase revenue to the shareholders. Minn-Dak ordered a size H steam dryer from Enerdry in April of 2002, to be operational September of 2003. Minn-Dak staff did all engineering, with the exception of the building, with assistance from Enerdry. Since Minn-Dak does not produce electric power, a steam turbine using 250 psig steam was used to drive the 2000 hp main fan instead of an electric motor, reducing electrical operating costs. The steam dryer was started September 12th, 2003. After several modifications, the steam dryer was operational at approximately 80% capacity. The gearbox for the main fan failed due to low quality gears. The gears were replaced with ground gears after 7 days. The dryer was started and continued to operate around 80%, with pulp plugging problems until a major modification was done in February, 2004. After the modification, the dryer achieved the performance guarantee, and tested to approximately 110% capacity. During the off-season, the evaporator was found to have significant damage that has yet to be explained. As of November 4, 2004, the steam dryer has operated at 99% availability for the 2004 campaign. The total budget for the project was around 9 million dollars including evaporator and pelletizing equipment. The steam dryer project has achieved the goals of reducing emissions, increased dry pulp production and virtually eliminating natural gas expense with a project payback of approximately 3 years.

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Section F, Factory Operations
Poster Presentations

MANUEL RUIZ HOLST*, MARTA GARCÍA DE QUEVEDO, EMMANUEL DUFFAUT and FERNANDO MARTÍN DOMÍNGUEZ, Azucarera Ebro R&D center, C/Esperanza 10, Valladolid 47007, Spain. **Technological and economical valuation of the color balance in beet sugar manufacturing.**

The amount of colorants found in the evaporated syrup (thick juice) has a direct and major impact on the sugar-end yield on both technological and economical levels. High colored syrups are detrimental to sugar crystal quality (occlusion of colorants into crystals) and to centrifugal good operations (highly colored masse-cuite), which respectively results in more A-sugar being re-melted and in more sucrose dissolved in run-off syrups due to higher washing in centrifugal. Evidently, this has straight repercussions upon the energy consumption and thus significantly raises the production costs. A study at factory scale over several campaigns before and after the installation of sulfitation and centrifugation experiments at both pilot and factory scale were conducted to develop tools and methods that allow to estimate the technological and economical incidence of color on the process. Equations were developed to forecast the transfer rate of color from masse-cuite to crystal, the color of sugar from the color of thin juice, the amount of sugar produced depending on the color, the excess of mass produced through over-washing due to color. These tools enable to determine optimal color evolution through the process on an economical and technological point of view, taking into account the sugar crystal quality requirements and the technology used.