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ABSTRACTS

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BABB, THOMAS A.[1], GERALD KLEY[1] and JAMES S. GERIK[2], [1]Spreckels Sugar Company, 40600 County Road 18C, Woodland CA 95776 and [2]Plant Pathology, Holly Sugar Corporation, P.O. Box 60, Tracy, CA 95378. Plant to stand in California: can laboratory tests predict field emergence?

Planting to stand in California is attempted by fewer than 10% of growers. A laboratory test that predicts field emergence would remove some of the uncertainty of planting to stand. The objective of this study was to document emergence rates for fall, spring and summer plantings and find any relationship to laboratory tests, particularly vigor (stress) tests. Treatments were eight seed lots selected according to laboratory germination and vigor tests. Laboratory tests rated seed lots for blotter germination, 2 and 3 day warm germination and 14 day cold germination. Plots were 40 feet in length on 30 inch beds arranged in a latin square design. Four trials were planted in the fall, three in spring (February-April) and five in summer (May and June). In fall planted trials (September and October), field emergence correlated well with a 2 day warm, (r^2=0.88), 3 day warm (r^2=0.81) and 14 day cold germination (r^2=0.85). No significant relationship was shown for blotter germination. Field emergence averaged 86.6% in these trials. In contrast, spring and summer plantings averaged 50.3% emergence and correlated best with blotter germination (r^2=0.69, $p<0.01$). Field emergence was erratic in spring and summer, with trial means ranging from a low of 24.8% to a high of 77.3%. The results suggest that under ideal emergence conditions for fall planting, vigor tests should be used to rate seed lot quality. Emergence results in the spring and summer are confused by seedbed conditions, seedling disease and other factors unrelated to seed quality. Therefore, in these trials blotter germination was the best predictor of field performance; a 1% increase in blotter germination resulted in a 2% increase in field emergence.

BEYER, THOMAS, BMA AG, P.O.Box 3325, 38022 Braunschweig/Germany.
Development of a large-scale fluidized-bed reactor for biological waste water treatment

After successful tests with a small reactor test unit of 1 m³ (35.32 cu ft) active volume in 1990 and a larger unit of 10 m³ (353.2 cu ft) active volume in 1992, it was decided in 1994 to install the first large scale fluidized-bed reactor for biological treatment of high-load sugar factory waste water. The treatment process is an anaerobic one operating at high volume loads, allowing the reactors to be much smaller than conventional plants and thus reducing their costs. The fluidized-bed reactor has an active volume of 500 m³ (17,660 cu ft) and is designed for a COD load of 25,000 kg (55,125 lb) per day, equivalent to a volume load of 50 kg COD/(m³×day) (3.12 lb COD/(cu ft×day)). The carrier used for the anaerobic bio-mass are special granules which are kept in a fluidized bed by water flowing upwards which is fed into the lower reactor cone through a ring pipe. The anaerobic bacteria which are fixed on the carrier granules are provided with substrate by this evenly distributed water, thus providing excellent conditions for optimum substrate decomposition within a minimum of space resulting in an excellent plant efficiency. Bio-gas which is produced by the decomposition of the organic substrate, ascends in the reactor together with the water to the top and is withdrawn from the reactor head through a safety facility. It is then fed into the sugar factory's pulp dryer furnace where it is used as fuel and thus saves primary energy. In summation, the outstanding technical, technological and economical features are: • high volume load, allowing for a small and low-priced plant, • small floor space requirements, • high decomposition efficiency, • low energy consumption, • bio-gas used for heating purposes, saving primary energy.

BIANCARDI, ENRICO, GIUSEPPE MANDOLINO* and WALTER BOSCHETTI. Istituto Sperimentale per le Colture Industriali, Viale Amendola 82, 45100 Rovigo, Italy. A study of the sugar beet root system by endoscopic techniques

Three years trials were performed in order to evaluate the effectiveness of a non-destructive technique for the study of the root system, up to now scarcely employed in sugar beet. The measurements were made using a particular video camera capable, once inserted in transparent plexiglass tubes (minirhizotrons), of inspection of the root system in field conditions. After the reduction of the high variability, this system allows a precise and reproducible examination of the root dynamics during the whole vegetative cycle. In the present study, the root development of four commercial cultivars with different genetic traits resulted significantly different in each of the three years of the test. However, this behaviour is not constant through the years, probably because of the high interaction with environmental factors. In 1994, a higher root system development and a higher sucrose production were observed in comparison to the years 1995 and 1996. The influence of nitrogen nutrition has been tested in an experiment including three different nitrogen fertilization levels (0, 100 and 200 kg/ha), performed in a soil with low nitrogen content. The root development observed was higher in the plots without nitrogen fertilization: this suggests that sugar beet has the capability of exploring with its root system a larger volume of soil, to limit the effects of the nitrogen deficiency.

BOSSE, DIETRICH, BMA AG, P.O. Box 3325, 38022 Braunschweig/Germany. Increase in dry substance of pressed pulp by addition of pressing aids into the press.

The cost of primary energy at a sugar factory essentially determines the economic efficiency of sugar production. Therefore, manufacturers and users of pulp presses endeavor to increase the final dry substance content of the pressed pulp in order to save energy for subsequent drying. Quite often, a higher dry substance content of the pressed pulp is achieved by reducing the spindle speed and so extending the pressing time, resulting in a considerably lower throughput. Accordingly, this requires additional capital input for the necessary provision of further presses. In practical operation, the use of pressing aids, e.g. gypsum, is therefore of great importance. Pressing aids are additives or measures which increase the dry substance content in the pressed pulp without reducing the pulp press throughput. Where tower pulp presses are employed it turned out that feeding gypsum suspension directly into the pulp layer in the lower part of the press entails considerably higher frictional forces and, consequently, a higher torque on the press spindle - along with a significant increase in the dry substance content of the pressed pulp. The undissolved gypsum dissolves in the press water present in the feed area and flows into the extraction plant. Special pumps feed the gypsum suspension directly to the press stops, ensuring uniform distribution of the gypsum within the pulp layer. There, by way of ion exchange processes in the pulp pectin, the gypsum further improves the dry substance content. In this way the dry substance of the pressed pulp can be increased by up to three points at the same press throughput. In conjunction with the other advantages of the vertical tower pulp press, this is another important step towards reducing the production cost at a sugar factory.

BRANTNER, JASON R. and CAROL E. WINDELS, Northwest Experiment Station, University of Minnesota, Crookston, MN 56716. Variability in sensitivity to metalaxyl and control of *Pythium* spp. on sugarbeet.

Pythium spp. cause seed rot and damping-off of sugarbeet in Minnesota and North Dakota. Seed treatment with Apron (metalaxyl) has been used successfully to control *Pythium*, but occasionally producers notice erratic, uneven stands. Objectives of this study were to evaluate isolates of *Pythium* spp. (cultured from dying sugarbeet seedlings in Minnesota and North Dakota) for sensitivity to metalaxyl (Apron 50WP), pathogenicity to sugarbeet, and control by metalaxyl seed treatment. Isolates of *Pythium* spp. (104 total) included *P. ultimum* var. *sporangiiferum* (76), *P. aphanidermatum* (21), *P. irregulare* (4), and *P. acanthicum* (3). Sensitivity to metalaxyl was determined by radial growth on corn meal agar amended with 0, 0.01, 0.1, 1, 10, and 100 µg/ml a.i. after 48 hr in the dark at 20-22 C. EC_{50}'s were estimated from fitted regression lines of logit-transformed percent inhibition plotted against log-transformed fungicide concentration. Variation among isolates was significant (P=0.05) within and between species. EC_{50} means were 0.04-1.44, 0.08-1.00, 0.12-0.30, and 0.98-3.52 µg/ml for *P. ultimum*, *P. irregulare*, *P. acanthicum*, and *P. aphanidermatum*, respectively. Pathogenicity tests in *Pythium*-inoculated soil showed that 98 of 104 isolates significantly decreased final plant stands compared to non-inoculated controls, and 82 of 104 isolates resulted in final plant stands below 10%. Pathogenicity to sugarbeet and sensitivity to metalaxyl were not correlated (r = 0.102). All isolates tested were controlled by a standard metalaxyl seed treatment, but some less sensitive isolates resulted in a significantly (P=0.05) decreased level of control.

BREDEHOEFT, MARK[1]*, ALAN CATTANACH[2] AND LARRY SMITH[3]. [1]Southern Minnesota Sugar, P. O. Box 500, Renville, MN 56284, [2]North Dakota State University, Department of Soil Science, Fargo, ND 58105, [3]Northwest Experiment Station University of Minnesota, Crookston, MN 56716. Cercospora leaf spot control in Minnesota and North Dakota.

Cercospora leaf spot control has changed dramatically over the past two years. The discovery of tolerance of cercospora leaf spot to TPTH has changed the outlook on control of cercospora leaf spot. This has increased the need for new fungicides to be used for cercospora leaf spot control. In 1996 a cooperative effort was undertaken in Minnesota and North Dakota to evaluate registered as well as unregistered fungicides for control of cercospora leaf spot. Four locations were established in a randomized complete block design. A total of 31 treatments were evaluated by collecting cercospora leaf spot control rating as well as yield and quality data. The untreated check gave a significantly lower sugar production and higher cercospora leaf spot rating, in comparison to all other treatments. This indicates the importance of good cercospora leaf spot control. The best treatment was a unregistered fungicide Tetraconazole which produced 7,169 pounds of sugar and a 3.0 cercospora leaf spot rating compared to 5,513 pounds of sugar and a 6.7 cercospora leaf spot rating for the untreated check. The standard treatment of Supertin at 3.75 oz/Acre (TPTH based product) was significantly higher on cercospora leaf spot rating at 3.7 and significantly lower on yield and quality in comparison to the Tetraconazole treatment. Unregistered fungicides TX-2343-02, Terranil, Bravo Weather Stiker, IB14121 and RH7592 all performed as good or better than the standard treatment of Supertin. Supertin alternated with other fungicides performed as good or better than Supertin alone. The performance of Topsin (Benzimadazole based product) was variable depending on location. In southern Minnesota where cercospora leaf spot tolerance to Benzimadazole was more prevalent Topsin did not perform as well as in northern Minnesota where cercospora leaf spot tolerance to Benzimadazole was less prevalent.

CAMPBELL, L. G.[1], A. W. ANDERSON[2], L. J. SMITH[3], and R. DREGSETH[2], [1]USDA-ARS, Northern Crop Science Lab., Fargo, ND 58105, [2]Entomology Dept., North Dakota State Univ., Fargo, ND 58105, and [3]Northwest Experiment Station, Univ. Minnesota, Crookston, MN 56716. Root yield losses associated with sugarbeet root maggot damage.

Sugarbeet root maggot, *Tetanops myopaeformis*, is the major insect pest of sugarbeet in Minnesota and Eastern North Dakota. Root maggot damage is routinely rated on a 0 (no damage) to 5 (severe) scale. Forty-two trials were utilized to examine the relationship between visual damage and root yield. The mean damage rating in the absence of insecticides was 3.3, compared to a mean of 1.7 for the highest yielding treatment in each trial. Mean root yield of the highest yielding treatment in each trial was 48.8 Mg ha^{-1}, compared to a mean of 29.0 Mg ha^{-1} when no insecticides were applied. Regression analyses within individual trials indicated the yield loss associated with each increment of the damage rating scale fluctuated widely, ranging from near zero to 15.7 Mg ha^{-1}. The percent yield reduction in the absence of insecticides ranged from 9.8% to 83.6% when compared to the treatment providing the most effective control in each test. The regression equation from a combined analysis indicated that little or no yield loss occurs with damage ratings below 1.4. These results are useful in estimating losses, developing recommendations, and providing a standard of comparison for alternative control strategies.

CARLSON, JEFFREY L., KEN A KUBAT, and RON ELHERT. Minn-Dak Farmers Cooperative , 7525 Red River Road, Wahpeton, ND 58075-9698. Getting the Most from Sugar-Loadout. Product-Detection Devices at Minn-Dak Farmers Cooperative

Minn-Dak, in conjunction with United Sugars has recently upgraded the final product protection equipment and program for the sugar being loaded into railcars and trucks. All outgoing sugar passes through magnets, a metal detector and a rotex screen. A schedule of checking and testing these devices is rigidly followed and audited. The program has been a success not only from the standpoint of product protection but also it is used to identify mechanical minor failures before they result in major break downs.

CARLSON, JEFFREY L., KEN A. KUBAT, GREG W. GOLOVANOFF, and PETE W. JENSEN, Minn-Dak Farmers Cooperative, 7525 Red River Road, Wahpeton, ND 58075-9698. Gypsum, the affect the pressing aid has on sugar manufacture.

It has been well established that gypsum ($CaSO_4 \bullet 2H_2O$)is an effective pressing aid for the mechanical dewatering of exhausted beet pulp. To get a better understanding of how the pressing aid affected pressed pulp, diffusion, juice purification and molasses exhaustion, the constituents of the various process streams were analyzed and the results examined throughout the 1994-95 and 1995-96 sugarbeet-processing campaigns. It was found that almost all of the calcium from the gypsum was absorbed into the pulp while much of the sulfate went into the raw juice. Some of the sulfate precipitated during juice purification and was removed with the lime mud, some precipitate as scale in the process and some of it carried through into molasses, decreasing the extraction. When processing beets in good and condition, the precipitation of this excess sulfate in juice purification results in higher natural alkalinity of thin juice.

CARLSON, JEFFREY L., PETE W. JENSEN, DENNIS L. KALLSTROM, and KEITH J. LEIPOLD, Minn-Dak Farmers Cooperative, 7525 Red River Road, Wahpeton, ND 58075-9698
Minn-Dak's anaerobic adventure: Sixteen years of lessons in anaerobic wastewater treatment.

Minn-Dak Farmers Cooperative installed an anaerobic wastewater treatment system in 1980 consisting of a 2.8 million gallon tank, with one mixer to keep the sludge suspended and a parallel-plate clarifier to separate the sludge from the effluent. Through the years many problems were encountered that hindered the efficient operation of the system but modifications and additions to the system have overcome the original deficiencies and now dependable operation of anaerobic digestion is hopefully achieved. The two major operational problems with anaerobic processing of sugarbeet wastewater are retaining enough anaerobic sludge to provide highly-efficient BOD reductions while at the same time keeping it suspended in the treatment vessel. Other problems experienced include keeping a evenly loaded wastewater coming to the system and the variation in the wastewater constituents due to temperature-dependent activity in the wastewater holding ponds.

CARLSON, JEFFREY L., Minn-Dak Farmers Cooperative, 7525 Red River Road, Wahpeton, ND 58075-9698. Pesticide and herbicide residues in mud pond water and treated wastewater at Minn -Dak Farmers Cooperative.

Minn-Dak Farmers Cooperative tested mud pond water and treated wastewater for pesticide and herbicide residues. The 45 chemicals for which the water waste tested were ones used by farmers in growing sugar beets and those used at the factory to control weeds around buildings, fence lines and ponds. All of the tests were conducted by EPA certified laboratories with most of the tests being standard EPA methods 8150, 8080 modified, and 3510. There were no standard EPA-test methods for some of the chemicals so methods were obtained with the cooperation of the farm-chemical producers. Two residues were found at levels near the detection limits of the analysis: Dicamba and ingredient in Banval™ from Sandoz and chlorpyralid an ingredient in Stinger™ from Dow Elanco, both of these herbicides are used for weed control on Minn-Dak property. Both copper and tin were detected at low levels but it is inconclusive if these are residues from anti-fungal chemical. No other residues were found.

CARLSON, JEFFREY L., KEN A. KUBAT, GREG W. GOLVANOFF*, and PETE W. JENSEN, Minn-Dak Farmers Cooperative, 7525 Red River Road, Wahpeton, ND 58075-9698. The investigation of calcium and organic scales on heat-exchange surfaces at Minn-Dak Farmers Cooperative.

In the energy intensive industry of beet-sugar manufacture, clean heat transfer surfaces for optimal economy. Since most heat-exchangers are cleaned with a combination of chemicals and heat, it was felt that an exact understanding of the type a scales that coat different pieces of equipment would aid in the optimization of cleaning. Samples of scale were collected from various heat-exchangers at Minn-Dak Farmers Cooperative and analyzed at the lab. Then different cleaning combinations of cleaning agents were tried. The results show that while some combination cleaning agents used most often (HCl, sulfamic acid, soda ash, and caustic) worked well for most scales, other acids, bases and hydrogen peroxide were also effective and possible specific applications for them are discussed.

CARLSON JEFFREY L., PETE W. JENSEN, and DENNIS L. KALLSTROM, Minn-Dak Farmers Cooperative, 7525 Red River Road, Wahpeton, ND 58075-9698 Use of total organic carbon analysis to monitor and control wastewater treatment at Minn-Dak Farmers Cooperative.

Traditionally chemical oxygen demand (COD) and/or five-day biological oxygen demand (BOD_5) are used to monitor wastewater treatment system loading and performance. Both these methods work well but each has disadvantages. The COD test is conducted with chemicals that pose safety and health hazards for workers and generate hazardous waste which has both costly disposal and an ongoing liability. BOD_5 testing is dependent upon living organisms and at minimum takes five days to complete. Total organic carbon (TOC) analysis is quick, safe, reproducible and generates no wastes. Its results have correlated well with both COD and BOD_5 test and has now replaced COD testing at Minn-Dak.

CARLSON, JEFFREY L., KEN A. KUBAT, GREG W. GOLOVANOFF, and PETE W. JENSEN, Minn-Dak Farmers Cooperative, 7525 Red River Road, Wahpeton, ND 58075-9698. Variation in the composition of juices, syrups and molasses as a result of long-term beet storage at Minn-Dak Farmers Cooperative.

Cold, long winters, and forced-air ventilated piles enables Minn-Dak Farmers Cooperative to store beets in excess of 200 days. As the beets are stored, aging, degradation and freezing all have affects on the composition of the juice and syrups and ultimately the sugar production from the beets. In an effort to characterize these changes, and how they affect beet-sugar manufacture, the composition of the juices syrups and molasses were analyzed during the 1994-1995 campaign. Glucose, fructose, sucrose, raffinose, lactate, formate, acetate propionate, butyrate, sulfate, chloride, nitrite, nitrate, and phosphate were measured using ion chromatography. Calcium, sodium, potassium and magnesium were measured by atomic absorption. Total organic carbon and inorganic carbon were measured using a TOC analyzer and ammonia was measured with and electrode. In addition, temperature, RDS, oven-dry dry substance and pH were also measured. The results show that the inorganic constituents coming from the beets remained constant throughout campaign but the organic nonsugars increased steadily with time and there were dramatic increases at the very end of campaign.

CARLSON, ROBERT B., R. J. DREGSETH, A. J. SCHROEDER*, Entomology Department, North Dakota State University, Fargo, ND 58105. Monitoring of sugarbeet root maggot adults in the Red River Valley.

In an effort to determine the relationship between fly populations and maggot damage to sugarbeet, monitoring of adult populations of the sugarbeet root maggot (SBRM) was carried out adjacent to 14 commercial sugarbeet fields over a period of two years. The growers agreed to leave a minimum of six rows of beets untreated in each of these fields. The remainder of each field was treated with a soil applied granular insecticide at planting and in some instances a post-emergence insecticide application. Fly counts were made on sticky-stake traps throughout the period of fly activity. Root damage ratings and harvest results were obtained for both treated and untreated beets in each field. This allowed us to examine the potential gains to the producer from post-emergence treatment of sugarbeets when no prior treatments have been made and when a planting time treatment is in place. High variability in the relationship between root damage ratings and fly counts as well as high variability between damage ratings and yield results indicate that establishment of economic threshold values based on fly counts is going to be difficult. Two fields in this study also had a temporary, oat cover crop seeded over the beets. Data from these two fields has prompted more detailed plot studies in 1996 which indicate a possible increase in insecticide efficacy when the cover crop is used.

CATTANACH, ALLAN* AND DAVE FRANZEN, Soil Science Department, Walster Hall, North Dakota State University, Fargo, ND 58105. Sugarbeet Yield and Quality Using Site-Specific Sampling and Fertilization.

One field in 1995 and two fields in 1996 were grid sampled using a 4-4.5 acre grid the fall before sugarbeet production. The fields were split into zones of variable-rate application of N based on the grid nitrate-N results, and zones of uniform N application based on a composite sample of the field. In 1995, based on the fall of 1994 grid sampling, yield, and sugar concentration increased and impurities decreased in the grid sampled area. The variable-rate application produced $50/Acre more net profit than the conventional application. In 1996, based on the fall of 1995 grid sampling of two fields variable rate and conventional fertilization practices gave similar responses at one location. At the second location, grid sampling and variable rate fertilization increased net profitability. Grid organic matter level was also used as a factor to determine required N fertilization rate at one site in 1996.

CONFAL, THOMAS[1], GODFREY, LARRY. D.[1] and BABB, THOMAS[2]. [1]Dept. of Entomology, Univ. of Calif. Davis, CA. 95616 and [2]Spreckels Sugar Company. Woodland, CA. Effects of the western potato leafhopper (*Empoasca* spp.) on sugar beet yields.

In the Central Valley of California the *Empoasca* leafhopper is considered a major pest. Yield trials were conducted from 1995-97 near Woodland, California to determine what effect the *Empoasca* leafhopper has on sugar yields of current beet varieties. Field plots of Spreckels 'SS-781R' (50' X 40' each) were arranged in a randomized block design with 4 replications. Two approaches were used in the study; 1.) the effects of different densities of leafhoppers (LD) and 2.) the influence of different durations of leafhopper infestations (LID). Populations were controlled using Monitor® 4E and Sevin XLR Plus®. In 1996, beet yellows virus was introduced to a portion of the field using viruliferous green peach aphids to evaluate the potential interacting effects of the leafhopper and virus stress. Monitoring consisted of counting leafhoppers (nymphs and adults) with leaf turns and sweepnet samples. Yields were evaluated for both fall and spring harvests. Beets were processed by Spreckels Sugar Company for weight and sucrose content. In 1995 the leafhopper pressure averaged from 5091.5 leafhopper days to 17775 leafhopper days (LD) and from 5112 leafhopper days to 20181 leafhopper days (LID). Fall harvest sugar yields averaged from 3.4 tons/acre to 3.9 tons/acre (LD) and from 3.5 tons/acre to 4.1 tons per acre (LID). In this study the *Empoasca* leafhoppers had little effect on sugar yields. The leafhopper pressure in 1996 was higher than 1995 The yield analysis for 1996 are ongoing.

CUMMINGS, DAVID L., and DON BADT, LARRY E. RIGGS, RUSS FULLMER, RICHARD S. PARRILL, Holly Sugar Corporation, East Holly Str., Sidney, MT 59270. Storage and processing aspects of frozen beets.

The freezing of sugar beets as a mechanism of long term storage is rapidly becoming a common method for long term storage at factories with climatic conditions favorable for this practice. Over the 1995-1996 campaign, a relatively small scale pilot study was conducted at the sugar beet factory located in Sidney, Montana. A larger scale study was performed over the 1996-1997 campaign. The primary objectives of the study included (1) assessing the technological value of frozen beets vs. beets stored under normal ventilation practices, (2) a practical evaluation of Sidney's current equipment for the processing of frozen beets, and (3) the development of the potential economic impact of frozen beets to the Sidney factory. All laboratory data was derived using the instrumentation and methodology (polarimeters, refractometer, spectrophotometer, various wet methodologies) typical of the daily factory operations. Frozen beets, while providing some difficulties in handling and processing, were found to be of significantly better technological value than normally ventilated beets, improving the economic contribution of the factory and the long range outlook for the expansion of the factory.

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[1]Holly Sugar Corporation, Drawer 1778, Hereford TX 79045 and
[2]Cargill, P. O. Box 1389, Dalhart TX 79022. Conventional Fertilizer Application compared to Site Specific Application.

In theory, efficient sugar production should be optimized by maximizing yield and sugar content if the proper amount of nutrients are added using an "as needed" method. Our objective in this study was to determine if there is an advantage to using grid sampling combined with Variable Rate Technology application method for Nitrogen addition. The field we selected for our test contains approximately 117 acres. The soil type is sandy loam. The soil type is quite uniform throughout the field. The field is irrigated using a low pressure, low volume sprinkler system. The field was divided into two equal sections. One half of the circle was sampled using the conventional method of one core per ten acres. Nitrogen was added using an average of the overall requirement for the field. The corresponding half of the circle was grid sampled on a 3.3 acre basis. This half of the circle was fertilized using Variable Rate Technology. Prior to harvest each soil test site was sampled for sucrose and yield data. The fields were then harvested commercially. Results from each half will be kept separate.

DELOREY, DEAN C., The Amalgamated Sugar Company, P.O. Box 87, Nampa, Idaho 83653-0087 - Air Quality Impacts from Carbon Monoxide Emission Sources at a Sugar Beet Processing Facility.

An analysis of the air quality impacts from carbon monoxide emission sources was conducted using an air dispersion model for a sugar beet processing facility. Ambient air quality concentrations were predicted using the Industrial Source Complex - Short Term (ISCST3) air dispersion model. Emissions and stack parameter data for boilers, pulp dryers, and lime kilns were inputted into the model, along with meteorological data. The modeling data inputs were varied to determine the impacts on ambient air quality CO concentrations. Predicted ambient concentrations demonstrate that CO emissions are in compliance with the National Ambient Air Quality Standards.

DEXTER, ALAN G. and JOHN L. LUECKE, Plant Sciences Department, North Dakota State University and the University of Minnesota, Fargo, ND 58105. Interaction of postemergence herbicides with sugarbeet varieties.

Sugarbeet growers and agriculturalists commonly report suspected variability in susceptibility of sugarbeet varieties to postemergence sugarbeet herbicides. The varieties in this experiment were selected to represent a range of sugarbeet injury from agriculturalist observations. Sugarbeet varieties were Beta 3712, Hilleshog/Mono-Hy Glacier, Hilleshog/Mono-Hy Horizon, Maribo 875, Maribo 9363, Mitsui Monohikari, and Van der Have H66168. Herbicide treatments were applied on May 29, June 4 and June 11. Sugarbeet was in the cotyledon to two-leaf stage on May 29. Herbicide rates chosen were 25 to 30% higher than normal rates. Herbicides and rates at the three dates were: Betanex at 0.33/0.4/0.5 lb/A, Betamix Progress at 0.33/0.4/0.5 lb/A, Betanex + Stinger at 0.33 + 0.12/0.4 + 0.12/0.5 + 0.12 lb/A, and Betanex + UpBeet at 0.33 + 0.02/0.4 + 0.02/0.5 + 0.02 lb/A. An untreated check of each variety was included. Plots were cultivated and hand weeded. Averaged over varieties, visual evaluation of sugarbeet injury was 13% from Betanex, 17% from Betanex + UpBeet, 21% from Betamix Progress and 24% from Betanex + Stinger. Averaged over varieties, sugarbeet treated with Betamix Progress and Betanex + Stinger yielded less extractable sucrose per acre than untreated sugarbeet. Mitsui Monohikari, Beta 3712 and Hilleshog/Mono-Hy Glacier were injured more by the herbicide treatments than the other varieties based on a visual evaluation of injury on June 17. However, all varieties recovered well from the injury. The only significant reduction in extractable sucrose in the data from individual varieties was from Betanex + Stinger on Hilleshog/Mono-Hy Glacier and Betanex + UpBeet on Maribo 9363.

DEXTER, ALAN G.[1], JOHN L. LUECKE[1] and MARK W. BREDEHOEFT[2], [1]Plant Sciences Department, North Dakota State University and the University of Minnesota, Fargo, ND 58105 and [2] Southern Minnesota Beet Sugar Cooperative, P.O. Box 500, Renville, MN 56284. Postemergence herbicide combinations in North Dakota and Minnesota.

UpBeet first received registration for use on sugarbeet in the United States in June of 1996. UpBeet has a limited spectrum of weeds controlled so it will generally be used in combination with other postemergence sugarbeet herbicides. The objectives of the experiments reported in this paper were to determine the benefit from adding UpBeet to a conventional herbicide treatment, compare two applications to three applications of herbicides, determine weed control from reduced rates of UpBeet and other herbicides and to evaluate the effect of an oil additive on weed control and sugarbeet injury. UpBeet has provided improved control of several weeds including redroot pigweed, kochia, common mallow, eastern black nightshade, wild mustard and velvetleaf when combined with other sugarbeet herbicides. Three applications of herbicides gave better weed control than two applications even when application rates were reduced with three applications. For example, Betanex + UpBeet applied twice at 0.25 + 0.0156/0.33 + 0.0156 lb/A gave less weed control than Betanex + UpBeet applied three times at 0.08 + 0.004/0.08 + 0.004/0.08 + 0.004 lb/A. The first application was to cotyledon to two-leaf sugarbeet and treatments were 6 to 7 days apart. Betanex + UpBeet + oil adjuvant gave better control of wild buckwheat than Betanex + UpBeet.

DORAN, JOY B., and JENNIFER CRIPE, Central Michigan University, Dept. of Biology , Mt. Pleasant, MI 48859. Ethanol production from sugar beet pulp components using genetically engineered bacteria.

Studies were conducted using glucose, xylose, arabinose and galacturonic acids to evaluate the feasibility of sugar beet pulp as a substrate for fermentation processes using genetically engineered ethanol producing bacteria. Using beet pulp to produce ethanol may help provide an added value for a beet processing coproduct. Ethanol may be sold as an alternative fuel, or used by the processing plant itself to reduce energy costs. Galacturonic acid and arabinose are not fermentable to ethanol by conventional yeasts traditionally used in corn based fermentations. Recombinant ethanol producing microorganisms have been developed in the laboratory of Dr. L. O. Ingram (University of Florida) by introducing *Zymomonas mobilis* genes encoding alcohol dehydrogenase and pyruvate decarboxylase to provide a functional ethanol pathway in enteric bacteria, thus diverting pyruvate metabolism during fermentation from a mixture of acids to ethanol. *Zymomonas mobilis* produces ethanol at a high concentration, but has a very narrow substrate range. *Escherichia coli* KO11 exhibits a novel pattern of galacturonic acid fermentation producing equimolar amounts of acetate and ethanol accompanied by formation of CO_2. *Erwinia chrysanthemi* EC16 (pLOI555) secreted enzymes which appear to aid in the conversion of sugar beet pulp to ethanol. Polymers of carbohydrates in biomass must be cleaved by either cooking with dilute acids or by reacting with enzymes. Enzymes from fungi are commercially available and have been utilized to degrade biomass into smaller carbohydrates. In simultaneous saccharification and fermentations (SSF), fermenting organisms consume simple sugars as they are produced by fungal enzymes, effectively relieving end-product inhibition of the enzymes. In SSF experiments recombinant *Erwinia* strains produced additional enzymes effective in degrading sugar beet pulp, thus increasing the economic feasibility of a biomass conversion process to produce ethanol.

DUFFUS, J.E.[1], G.C. WISLER[1], H.Y. LIU[1], E.G. RUPPEL[2], and E.D. KERR[3], [1]USDA, Agricultural Research Service, 1636 E. Alisal St., Salinas, CA 93905, [2]USDA, Agricultural Research Service, 1701 Center Ave., Fort Collins, CO 80526, and [3]University of Nebraska, Panhandle Research & Extension Center, 4502 Ave. I, Scottsbluff, NE 69361. A new aphid-transmitted yellowing virus disease of sugarbeet in Colorado and Nebraska.

A disease of sugarbeet exhibiting severe foliage yellowing and necrosis has been occurring with increasing frequency in Colorado and Nebraska during recent years. Symptoms resemble those induced by beet western yellows virus (BWYV), including yellowing of the older and middle leaves, thickening, brittleness and the development of *Alternaria* on the yellowed tissue. The virus inducing this disease has been shown to be transmitted by the green peach aphid. Preliminary host range, serological and molecular studies indicate that the new virus is not BWYV. The host range is distinct from common isolates of BWYV found in the USA and from typical isolates of beet mild yellowing virus (BMYV) which is found in Europe. This new virus can be distinguished from BWYV and BMYV by its ability to infect *Chenopodium capitatum* but not *Capsella bursa-pastoris*. Serological and molecular studies have indicated differential reactions from BWYV and BMYV, but have not yet produced a specific probe to distinguish the virus. The disease appears similar to yellowing isolates found in California and Texas, and thus may have wide distribution. Little information is presently available regarding the ecological and epidemiological factors that allow this virus to increase over such a wide area.

ECKHOFF, J.L.A. AND J.W. BERGMAN, Montana State University, Eastern Agricultural Research Center, 1501 N. Central Ave., Sidney, MT 59270. Influence of harvest date on sugarbeet yield and economic return.

Sugarbeets in the Northern Great Plains are planted in April or May and harvested in October. Early harvest in September is one way to increase the quantity of sugarbeets that are processed. Reports on variety by harvest date interactions conflict, with some reporting significant interaction and others reporting no interaction. Recently, varieties with high sucrose content have been promoted as particularly adapted for early harvest. The objective of this study was to study the influence of harvest date on yield, quality, and economic return of several sugarbeet varieties. The study was conducted for eight years at the Eastern Agricultural Research Center in Sidney, MT, under furrow flood irrigation. Soil type is Savage silty clay. Three varieties (Beta 1230, M-102, Beta 1443) were tested from 1984-1987 and four varieties (M-403, Monohikari, Monoricca, Beta 3265) were tested from 1988-1991. Differences among varieties in root yield and sucrose content were greater late in the harvest season than early in the harvest season. Generally, within a year and across years, the variety with the greatest sucrose content at the earliest harvest date had the greatest sucrose content throughout the harvest season. Gross economic return was more closely associated with root yield than with sucrose content. The highest yielding variety in one year was not necessarily the highest yielding variety every year. Within a year, the variety with the greatest root yield and greatest economic return early in the season generally had the greatest root yield and greatest economic return late in the season.

EDYE, LES A. and MARGARET A. CLARKE, Sugar Processing Research Institute, Inc., 1100 Robert E. Lee Blvd., New Orleans, Louisiana, USA 70124. Analysis of sugarbeet brei by near infrared (NIR) spectroscopy.

Sugarbeet brei can be successfully analyzed by NIR, using a large sample cuvette for sample presentation, in reflectance mode (Edye, L. A. and Clarke, M. A., Zuckerind. (1995) 120: 284-286). However, time required for analysis is about one minute, too long for large tare labs in the U.S. Trials on NIR measurement of brei composition using a fiber optics reflectance probe and a direct light analyzer are reported. Both sample presentations require less time than the standard cuvette. The most recent approach is the use of a plate, on a horizontal instrument. Results for rapid analysis of brei components are presented and discussed.

EDYE, LESLIE A.[1], MARGARET A. CLARKE[1], FRANK COLE[2], and JANE L. KITCHAR[3], [1]Sugar Processing Research Institute, Inc., 1100 Robert E. Lee Blvd., New Orleans, LA 70124, [2]M. A. Patout & Son, Ltd., 3512 J. Patout Burns Road, Jeanerette, LA 70544, and [3]Solvay-Genencor Corp., P. O. Box 4228, 1230 Randolph St., Elkhart, IN 46514-0226. Effects of dextranase enzyme (*Chaetomium gracile* source) on dextran removal.

Dextran levels in sugarcane factories become high when cane shipments are delayed by bad weather, or when cane is frozen and thawed (analagous to the increase in dextran levels in sugarbeet after freeze). Trials on addition of dextranase enzyme (made from *Chaetomium gracile*) at a sugarcane factory, when high levels of dextran were reported, are described. Enzyme was added at the evaporator station. Effects were measured across crystallization and in sugar. Effectiveness of enzyme in syrups traveling through pan boiling is discussed. Similar treatment is proposed for sugarbeet factory juices showing high levels of dextrans.

EGGLESTON, GILLIAN, Southern Regional Research Center, USDA-ARS, P. O. Box 19687, New Orleans, LA 70179. Formation of Color and Sucrose Degradation Products Across Evaporators in a Sugar Beet Factory.

Sucrose chemical loss, and degradation product formation including color compounds, across a beet factory's five-step evaporator was investigated. Kinetic samples of pre-evaporator juice and evaporation syrups were obtained hourly. Ion Chromatography with integrated pulsed amperometric detection (IC-IPAD), an accurate carbohydrate analysis technique was used to measure sucrose, glucose and fructose levels, using a NaOH gradient method. IC-IPAD, with a strong NaOH/NaAcetate gradient method, was used to determine oligosaccharide degradation products. Conventional sugar factory analyses for monitoring sugar losses, i.e., pol, pH and color, were compared to IC-IPAD analyses. pH dropped ~0.22 pH units across the evaporators and there was a concomitant increase in color of 418 $ICUMSA_{420nm}$ units. Color increased the most across the first two evaporator stages. An excellent correlation (r^2=.997) existed between polarizations measured at 589 and 880nm.

EHRENBERG, JOACHIM E., Wiedemann KG, 31154 Sarstedt, P.O. box 1464. The use of radio frequency for measurement of Brix and pan boiling control.

For the 1995 campaign a new generation of RF-probes for pan boiling control was commissioned at Tulln sugar factory of AGRANA Sugar Group, Austria. The probe in question is governed by a microprocessor unit, equipped with digital display and automatic temperature compensation dependent on product purities. The Wiedemann RF-probe transmitter consists of a probe (electrode) fitted with a head containing the frequency generator and microprocessor unit which is connected to a controller unit via a single co-axial cable. The controller contains a power supply, a microprocessor, keypad and display and is also used to supply power to the probe, control the probe, receive signals from the probe, calculate brix from these measurements and provide digital indication plus 4 - 20 mA output signals for connection into PID controllers or DCS. One control box can operate two probes in multiplex; for each probe there are two 4 - 20 mA analog outputs, one for density and one for temperature. The close relationship between supersaturation of mother liquor and series capacitance measured at radio frequency in high purity massecuite is shown. Practical results in comparison to nuclear density measurement are listed for a batch pan at Könnern Sugar factory, Germany. In 1996 the Wiedemann RF-probe was implemented in automatic pan boiling control in the cane sugar industry for the first time. The density measurement was always reproducable and in close correlation to the laboratory figures.

EMMA, PHILIP, PETER A. BURROUGHS AND ALAN SCISSIONS. British Sugar Technical Centre, Norwich Research Park, Colney, Norwich NR4 7UB ENGLAND. Studies on sugar colour reduction at factories using tower diffusers.

Raw juice from tower diffusers has a lower dissolved oxygen content than a raw juice from an RT design diffuser. One consequence of this is that polymerisation reactions of phenolic compounds, catalysed by polyphenol oxidase, are less complete resulting in less elimination of colour during carbonation. Experimental work has been carried out, both in the laboratory and in a factory, in order to understand the chemistry involved and to develop options to reduce colour formation at tower factories. One option, that of introducing oxygen into diffusion has been tested over two campaigns and initial results showed that thick juice colours could be reduced by about 1000 ICUMSA units. The effect on sugar colour during trials in the 1996/97 is presented.

FAHNERT, MELISSA L.[1], GIOVANNI PICCINNI[1], CHARLES M. RUSH[1], and LEON L. NEW[2], [1]Texas Agric. Exp. Stn., P.O. Drawer 10, Bushland, TX 79012 and [2]Texas Agric. Ext. Serv., 6500 Amarillo Blvd. West, Amarillo, TX 79106. Effect of different irrigation regimes on sugar beet growth in a disease stressed field.

A study was conducted to evaluate the effect of frequency and amount of irrigation on disease development in sugar beets. The objective of the study was to determine the optimum irrigation regimes for the highest yield and percent sucrose in a soilborne pathogen infested field. There were three main irrigation treatments: a Low Energy Precision Application (LEPA) system where 100%, 75% and 50% of the full rate of the pivot system (800 gpm) was applied, a LEPA system with on/off valves in which the plots were irrigated at different frequencies, including every time, every other time, and every third time the grower irrigated, and a system in which the canopy was irrigated from above with 100%, 75%, and 50% the full rate of the sprinkler system. During the season, the following measurements were taken: top fresh weight, top dry weight, root fresh weight and number of beets per meter. Soil moisture was measured every foot, to a depth of six feet using a hydroprobe moisture gauge. At harvest, root yield, number of beets per meter, disease index, percent sucrose, and stand counts were determined. The highest percent sucrose (13.5) and lowest disease indices were in plots irrigated at different frequencies. Based on three 25 ft. subplots replicated four times, sugar beets irrigated every other time had the highest yields, while sugar beets that were irrigated every third time had the lowest yield. The highest disease index and lowest percent sucrose occurred in plots irrigated at the full rate. There were no significant differences in sugar beet net weight or disease index among the treatments where different amounts of water were applied. However, in the treatments irrigated the least there was a significantly higher percent sucrose than in those irrigated at the full rate. These results indicate that disease losses can be reduced and yields increased with improved irrigation management.

FARES, K., Q. R'ZINA AND M. CUEGGOUR. University Cadi Ayyad, Faculty of Sciences, Department of Biology, BP S. 15, Marrakech, Morocco. Some data about the technical beet quality in the Mediterranean area.

The internal technical quality of sugar beet delivered by the Moroccan sugar factories has been studied during the last sugar campaigns in three factories localized in two different areas. The high concentrations in sodium (usually about 30 mmol/100 g sugar), as well in nitrogen compounds and invert sugar (more than 2 g/100g sugar) can be considered as a characteristic of this beet. A comparison with data from factories in south of Spain and Italy and in Greece shows a similar situation. The beet storage in the Mediterranean countries after harvesting under summer's temperature which can reach 40°C in Morocco together with the nitrogen fertilization are responsible of this situation, while other parameters in relation with the climate could also play a role. In the Mediterranean area, more than in other regions, the harmful effect of nitrogen should not be given only as alpha nitrogen value but in term of proportions of different nitrogen fractions such alpha-nitrogen, nitrogen from amids and betaine because the concentrations of these elements should not be influenced in the same way by the dry Mediterranean climate. A measure of total nitrogen by Kjeidahl method, the alpha nitrogen by blue number technique, the nitrogen from amids by distillation after hydrolysis and betaine by HPLC gives these proportions. Using the same methods, the contribution of amino-acids to decrease the juice's alkalinity is shown with an example of one Moroccan sugar beet factory.

FISCHER, C. GARY, American Crystal Sugar Company, 101 North Third Street, Moorhead, MN 56560. Using Microsoft Excel for modeling and training.

Rapid calculations and material for instruction of factory mass balances are cumbersome and often inaccessible to the general factory work force. Microsoft Excel can be programmed to calculate the mass balance of a sugar factory. Using Excel, one can balance various losses against slice rate, fuel or any other factory variable. The developed program comes in two forms, an operating report and a model, which combine technical process results and determine their financial impact. The program allows the operator to fix critical variables and model their impact on the other parameters. The program is documented on each page so the tool can be used for training and teaching of operators as to how the calculations are performed and how they can influence the results of an operation. The following is accomplished: 1) Tests operating concepts and philosophies; 2) Identifies opportunities vs. actual; 3) Identifies problem areas; 4) Allows review of "trade offs" of economic estimation and impact; 5) Training; a) Process accounting; b) Cause/effect relationships; c) Nomenclature; d) Economic impact of decisions; e) Provides introduction to sugar processing.

FORNSTROM, K. JAMES and STEPHEN D. MILLER, Departments of Civil Engineering and Plant, Soil and Insect Sciences, University of Wyoming, University Station Box 3295, Laramie, WY 82071. Weed management after mid-season sugarbeet defoliation.

Defoliation of sugarbeet by mid-season hail storms opens the field up for late season weed invasion. This research was conducted at the Torrington Research and Extension Center in 1995 and 1996 to develop weed management guidelines for sugarbeet fields that have been defoliated in mid-season. Sugarbeet plot areas were treated as a production field with best management practices until layby herbicides were applied and included: planting sugarbeet to stand; preplant incorporated herbicide; and post emergence herbicide application. Three replications were arranged in a split plot randomized complete block. Defoliation date treatments were split to include application timing and herbicide treatments. Herbicides were applied layby and after defoliation and included dimethenamid, EPTC and triflurin. Weed populations were nearly five times higher with early season defoliation than when sugarbeets were not defoliated. Weed control with post defoliation treatments was 8-15 % higher than with layby treatments. Dimethenamid provided the best weed control in 1995 but EPTC plus triflurin was better than dimethenamid in 1996. Sugarbeet returns were 30% less with mid-August defoliation than when sugarbeets were not defoliated.

FRANZEN, DAVE[1] AND LARRY SMITH[2], [1]Soil Science Department, Walster Hall, North Dakota State University, Fargo, ND 58105. [2]Northwest Experiment Station, University of Minnesota, Crookston, Crookston, Minnesota 56716, Mapping Field Soil Fertility Levels With Sampling Grids, Topography and Yield Monitor Data.

Fields were sampled using relatively dense grid spacings. Less dense sampling grids were compared to the original grid for both correlation and field pattern similarity. Topography was measured at each location. When available, yield data from GPS referenced combined yield monitors were also used to identify important soil areas. Sampling by topography was compared to grid sampled nitrate-N levels. Topographic sampling was correlated most often with nitrate-N, when compared to one sample per acre grids. Phosphate was less correlated, although topographic sampling was often better correlated than 2.5 acre or 5 acre grid sizes. Yield monitor data was helpful in identifying unusual soil areas not readily observed from topographic data.

FROMMELT, BERND, H. Putsch GmbH & Comp., P. O. Box 4221, D-58042 Hagen. Juice purification, system Putsch - experiences and results from the sugar factories of Klein Wanzleben/Germany and Moorhead/USA.

In 1994 a juice purification plant was installed and started-up in the sugar factory of Klein Wanzleben and in 1995 another one in Moorhead/USA. In the factory of Klein Wanzleben the juice purification plant is part of a new construction of a factory with a capacity of 9,000 t/d (approx. 10,000 sht/d), in the factory of Moorhead however the existing system was replaced by a new PUTSCH juice purification plant with a higher capacity (7,000 t/d equivalent to 7,700 sht/d). Considering the special conceptions of the clients, different possibilities of treating frozen beets are realized at the construction of the plants. The presented juice purification plants are equipped with proven and special developments made by PUTSCH. In both factories was choosen the space-saving installation of so-called combination tanks. Considering the almost opposite climatic conditions and the different periods of campaign, the experiences and results which are made in both factories with the PUTSCH juice purification plant are described.

GALLIAN, JOHN J.[1], DEL. J. TRAVELLER[2], and RONALD L. ROEMER[1]. [1]University of Idaho, Twin Falls R&E Center, P.O. Box 1827, Twin Falls, ID 83303-1827, and [2]Amalgamated Sugar Co., P.O. Box 127, Twin Falls, ID 83303-0127. Fumigation with 1,3-dichloropropene for rhizomania control in Idaho using two application methods.

Fumigation with 1,3-dichloropropene (Telone II) has been shown to be efficacious in California and Texas, and is the only chemical commercially available for rhizomania control. The purpose of this study was to (1) determine if fumigation is cost effective under Idaho conditions using resistant varieties and (2) whether in-row placement of fumigant improves control compared with broadcast application. Fumigation treatments were applied March 29-April 5 in a randomized complete block design with 8 replications. Fumigant rates were 0, 8, 12, 16 and 20 gal/acre, both broadcast applied and bedded in-row. Each plot was planted to a rhizomania resistant (Beta 4581) and susceptible (WS-91) variety on May 4. All other farming operations were standard grower cultural practices. Roots were lifted by variety and fumigation treatment, rated for rhizomania symptoms, weighed and two samples per treatment were analyzed for percent sugar and conductivity. Three of the five bedded susceptible treatments and one bedded resistant treatment were significantly higher in yield than the corresponding broadcast treatment. Seven of eight fumigation treatments were higher than the untreated checks with bedded application, while only two were higher with broadcast application. Most disease ratings for both the susceptible and resistant varieties were lower with the bedded than the broadcast application. Sugar content, gross sugar, and recoverable sugar/acre were significantly higher in the susceptible variety untreated bedded check than the untreated broadcast check, possibly a result of improved water relations due to shanking. Except for disease ratings, this effect was not seen with the corresponding resistant variety checks.

GERIK, JAMES S., GREGORY A. FISHER, AND DONNA J. NABBEN-SCHINDLER, Holly Sugar Corporation, P.O. Box 60, Tracy, California 95378. Population dynamics of *Polymyxa betae* and beet necrotic yellow vein virus in soil.

Polymyxa betae, the vector of beet necrotic yellow vein virus (BNYVV) has been reported to be able to survive for long periods of time. In California, the normal rotation cycle for sugarbeet production is much longer than in most areas. Rotation cycles of 7 years of more between sugarbeet crops are quite common. This longer rotation time should allow for a greater attrition rate of *Polymyxa betae* between sugarbeet crops compared to shorter rotations. Reports from the Netherlands indicate yield loss and disease severity increase with increasing initial inoculum levels. Recently, fields in California have been observed to have less yield loss due to rhizomania than several years earlier when a previous sugarbeet crop was grown. A study was undertaken to observe the rate on inoculum decrease after a sugarbeet crop. Following harvest in June 1995, soil samples were collected from two fields in the Imperial Valley of California that expressed symptoms of rhizomania during the 1994-1995 sugarbeet crop. The soil samples were air dried and ground. The soil samples were serially diluted using soil from the same fields that had been previously pasteurized. Seven 5-fold dilution series were made with each sample. Sugarbeet seed was planted into each of the diluted soils and the sugarbeets were cultivated for approximately 8 weeks. Roots removed form the soils were assayed for infection by *Polymyxa betae* and BNYVV. The inoculum levels of the initial soil samples for both *Polymyxa betae* and BNYVV were determined by the most probable number (MPN) technique. Samples were again collected from the same area of the fields at approximately 6 month intervals. During the interval between the first 2 sample dates the MPN of BNYVV dropped in both fields by 38% and 48%. The MPN of *Polymyxa betae* remained constant in one field but dropped by 60% in the second. Results from 2 more sample dates will be reported.

GILES, JOSEPH F*., ALLAN W. CATTANACH, and NORMAN R. CATTANACH, Department of Soil Science, North Dakota State Univ., P.O. Box 5638, Walster Hall, Fargo, ND 58105. Effect of wheel traffic on sugarbeet production.

To understand and assess damage to sugarbeet production by soil compaction generated by vehicular traffic, ten grower fields on various soil types were selected and sampled at harvest in 1996. Plant counts, beet weights and quality analyses were obtained from rows away from, next to, and between the tractor dual tires. Six replications were obtained from the planter/cultivation and planter/sprayer tracked areas in each cooperators commercial field. Results show a significant reduction in recoverable sugar at one location. At eight of the ten sites, a nonsignificant increase in recoverable sugar resulted from the vehicular traffic.

GILES, JOSEPH F*., ALLAN W. CATTANACH, and NORMAN R. CATTANACH, Department of Soil Science, North Dakota State Univ., P.O. Box 5638, Walster Hall, Fargo, ND 58105. Sugarbeet plant stand establishment and sugar production using Deere MaxEmerge 2 planter attachments.

Placement of sugarbeet seed within the row can be a factor in sugar production. In recent years, numerous modifications and attachments for the Deere MaxEmerge 2 planter have appeared in the market. A field study was initiated with the primary objective of determining the performance from these modifications and attachments in seed placement accuracy and the effect on sugarbeet stand establishment and sugar production. Seed tube configuration, seed furrow attachment and closing wheel design had a significant effect on stand establishment, root yield and extractable sucrose.

GODFREY, LARRY D.[1], CHRISTINA L. ALEXANDER[1], CHERYL A. WEBER[1], & PEGGY A. MAUK[2], [1]Dept. of Entomology, Univ. of California, Davis, CA 95616, and [2]Univ. of California, Coop. Extension-Riverside Co., Moreno Valley, CA 92557. Influence of Beet Yellows Virus Infection on Fall and Spring Yield of Sugar Beets and on the Production of Viruliferous Bean Aphids.

The management of beet yellows closterovirus (BYV) in California largely depends on the use of several beet production districts, which attempt to temporally and spatially separate older (potentially infected) plantings from new plantings. In recent years to facilitate management of this serious disease, it was recommended that infected spring plantings, that could potentially be overwintered, be harvested in the fall. This would reduce the virus sources and mitigate virus movement by aphids the following spring. The threshold virus infection level for fall harvest was needed to implement this system and depended on 1.) the influence of percentage virus infection on sugar beet tonnage increase during overwintering and 2.) the influence of percentage virus infection on the production of viruliferous aphids in the spring. Field plots were set up in May 1995 and 1996 with BYV infection levels ranging from 0 to 100% in increments of 25%. Target infection levels were achieved by systematically infesting 3-week old beet seedlings with viruliferous green peach aphids. Actual virus infection levels were determined with ELISA. Yields were evaluated in October and again the following April. In October 1995 and 1996, beet yields were reduced by 26.1 and 49.7%, respectively over the 0 to 100% infection treatments. Overwintered sugar beet yields (April 1996) increased by ~10 t/a in the 0-75% treatments (actual infection=2.9 to 38.6%) compared with only 3.5 t/a in the 100% treatment (actual infection=58.5%). Studies to determine the influence of field percentage virus infection on production of viruliferous bean aphids are underway.

GODSHALL, MARY AN, Sugar Processing Research Institute, Inc., 1100 Robert E. Lee Blvd., New Orleans, LA 70124. Colorant precursors on the surface of white sugar crystals that may contribute to color formation on storage.

The tendency of a white sugar to form color on storage is an important element of quality. Color on storage may be caused by several factors, acting in concert. Environmental conditions such as the temperature and humidity of storage are certainly key contributors. So too, is the quality of the sugar, with parameters such as pH, moisture, ash and crystal size having an effect. Trace components on the surface of white sugar crystals have been isolated and identified by mass spectrometry, which may also play a role either in forming color or in catalyzing its formation. Among the compounds identified are organic acids, fatty acids, phenolic acids, pyroglutamic acid and fructose anhydrides. Also noted is oleanolic acid, which may be implicated in floc formation. These compounds arise both from the sugarbeet plant and from sugar degradation reactions. They are present in the low parts per million to sub-parts per million range.

GOLOVANOFF, GREG W., JEFFREY L. CARLSON, Minn-Dak Farmers Cooperative, 7525 Red River Road, Wahpeton, ND 58075-9698. Particle Size Analysis of Sugar.

Sugar granulation distributions are of considerable economic importance. Data from a representative sieve test is subjected to different transforms and graphical representations. Mean Aperture and coefficient of variance is calculated by direct numerical computation. Powers and Rosin-Rammler-Sperling methods. The data is also used to calculate crystal population and surface area distributions. The most significant conclusion is that the impact of fine particles underestimated by using weight fraction frequencies in granulation distributions.

GOLOVANOFF, GREG W., JEFFREY L. CARLSON, Minn-Dak Farmers Cooperative, 7525 Red River Road, Wahpeton, ND 58075-9698. Use of Atomic Absorption Spectrophotometry for Lime Balance.

Measurement of the distribution of calcium in lime based purification systems is important to operations. Calcium can be analyzed by use of Atomic Absorption Spectrophotometery. Reporting the results as percent CaO allows current concepts of the purification balances to be used. Measurements of Ca in the clarifier overflow provides information to 2nd Carbonation filter loading. Calcium measurements after 2nd Carbonation filtration provide information for 2nd Carbonation efficiencies. Also information on mono-cations to calcium relates to the natural alkalinity concept. Measurements of magnesium is show calcium ion exchange levels where magnesium is added.

GRIGUS, MICHAEL E., Niro Inc., 1600 O'Keefe Road, Hudson, WI 54016. The application of reverse osmosis membrane filtration technology to the effluent streams from beet molasses chromatographic separators.

Beet molasses chromatographic separators generate two or more dilute streams which require concentration. Presently this concentration is accomplished with evaporation. Pilot studies have been conducted to determine the viability of and the operating and performance parameters for reverse osmosis ("RO") membrane filtration technology to pre-concentrate these dilute streams. There are a number of different types of beet molasses chromatographic separators, however only three general types of effluent fractions are generated by the separators: a sucrose fraction, a raffinate fraction, and (sometimes) a betaine fraction. Samples of these fractions from different types of separators from a number of beet sugar plants were tested in both small scale and larger in-plant pilot tests. The tests were conducted at an operating temperature of 30° C and an operating pressure of 600 to 800 psig. Samples of the feed, concentrate and permeate were analyzed (for RDS, sucrose, betaine, raffinose, etc.). Results indicate that reverse osmosis was able to: (1) concentrate the raffinate fractions from various separators to at least 15 RDS; and (2) concentrate the betaine fractions from various separators to at least 15% dry solids. This represents a 65% to 90% reduction in the volumes of fractions. In addition, the quality of the permeate water (as measured by conductivity, pH, dry solids, etc.) was sufficient for reuse in the plant for many applications. Long-term testing has shown the performance to be stable and repeatable. The results of the pilot studies indicate that reverse osmosis technology is viable and may be well suited as a method of pre-concentration of these dilute effluent streams.

HALL, THOMAS, VERN HOFMAN, LES BACKER[1] and LARRY SMITH[2], [1] Agricultural and Biosystems Engineering Department, Box 5626, North Dakota State University, Fargo, ND, 58105 and [2] Northwest Experiment Station, 108 Ag Research Center, University of Minnesota, Crookston, Minnesota, 56716. Monitoring Sugarbeet Yield on a Lifter.

Site-specific yield mapping is one of the basic building blocks of a precision farming program. It can help identify and quantify crop responses to soil types, nutrient level, plant population, chemical rates, crop diseases and many other applied or existing crop factors. The objective in this study was to develop or modify a sugarbeet yield sensing system compatible with current harvester designs and collect site-specific sugarbeet yield information so a yield map could be produced. Three types of weighing systems were used which included a load cell mounted under each side of the conveyor chain supporting a single idler wheel, tandem mounted idler wheels and a slide bar assembly. The paper describes each system and discusses the advantages and disadvantages of each.

HALLOIN, JOHN M.[1,2], DAVID J. JOHNSON[2], DEBRA A. GANOFF[2], and ALLAN H. LAMMERS[2]. [1]USDA, Agricultural Research Service, Sugarbeet and Bean Research Unit, and [2]Department of Botany and Plant Pathology, Michigan State University, East Lansing, MI 48824. Evaluation of resistance of sugarbeet seedlings to *Aphanomyces cochlioides*: conditions affecting disease severity in a model system.

Aphanomyces cochlioides causes damping-off of sugarbeet seedlings throughout U.S production areas. We present a method for uniform production and inoculation of seedlings and evaluation of disease severity. Seeds of a susceptible variety were placed on moist germination papers which were then folded and rolled to form cylindrical "rag dolls"; these were kept under constant light at 22°C for 4 days. Seedlings longer than 5 cm were transferred in groups of 25 to water (controls) or to suspensions of *A. cochlioides* zoospores and incubated for 10 minutes. They were placed in new rag dolls, incubated in growth chambers at 15, 20, 25, or 30°C for 5 days under constant light, and were evaluated for disease development 1,3, and 5 days after inoculation. Disease severity was rated on a scale of 0 to 4 (0 = no disease, 1 = 1 to 25%, and 4 = >75% of tissue rotted). Inoculated seedlings incubated at 30°C had mean ratings of ca. 4 after 3 days, whereas seedlings at 15°C were moderately diseased (mean score ca. 2) after 5 days. The rate of disease development was intermediate at 20 and 25°C. Occasional symptoms observed on control seedlings usually were attributable to breakage during handling. These methods provide a useful means for assessment of disease development in large populations of seedlings. Future experiments will use these methods to discriminate between resistant and susceptible varieties and to select resistant individuals for breeding purposes.

HALLOIN, JOHN M.[1,2], ALLAN W. CATTANACH[3], JOSEPH J. COOMBS[2], and GARRY A. SMITH[4]. [1]USDA, Agricultural Research Service, Sugarbeet and Bean Research Unit, [2]Department of Botany and Plant Pathology, Michigan State University, East Lansing, MI 48824, [3]NDSU/U of MN, Box 5758, Fargo, ND 58105, and [4]USDA, Agricultural Research Service, P. O. Box 5677-University Station, Fargo, ND 58105. Use of systemic acquired resistance for control of sugarbeet diseases.

Systemic acquired resistance (SAR), disease resistance induced by prior infections or by chemicals that are themselves non toxic, has been demonstrated in numerous crops. Resistance to *Cercospora* leaf spot of sugarbeets was induced by one such chemical in greenhouse experiments (Nielsen, et al., 1994. Physiol. Mol. Plant Pathol. 45:89-99). We tested reported resistance-inducing chemicals for control of sugarbeet diseases under field conditions. Experiments in MI in 1995 demonstrated that putative inducers of SAR did not enhance stand density or size of seedlings. Similarly, no decrease in severity of crown and root rot caused by *Rhizoctonia solani* AG-2-2 was observed in disease nurseries in either 1995 or 1996. Partial protection of plants against *Cercospora* leaf spot was observed in experiments in MI in 1995, but this protection diminished when foliar sprays with the inducing chemicals were discontinued. Experiments in 1996 in MN and ND on control of *Cercospora* leaf spot produced mixed results: SAR-inducing chemicals proved partially effective at reducing leaf spot severity and increasing yields of a susceptible variety, but had little effect with a partially resistant variety at one of the locations. No significant effects were observed at a second location for either variety. Additional experiments on use of SAR for control of *Cercospora* are planned for both MI and ND in 1997.

HAMPTON, RICHARD O.[1] and GEORGE BURT[2], [1]USDA-ARS, Oregon State University, Corvallis 97331, and [2]West Coast Beet Seed Company, Salem, OR 97303. Endemic beet western yellows virus in western Oregon: Inoculum reservoir and influence on sugarbeet seed yields.

The Willamette Valley of Oregon has been a premier U.S. sugarbeet-seed production area for more than 60 years. Our work during 1989-95, based on ELISA serology, demonstrated that beet western yellows luteovirus (BWYV) is endemic in this region, in at least 25 crop and weed species, six of which had not been previously reported. Four species of aphids known to be BWYV vectors occur in western Oregon on one or more of these 25 plant species; however, only Myzus persicae (green peach aphid) has been investigated and found to be a principal vector of BWYV in the Pacific Northwest. Specific types/varieties of vegetable crops grown commercially in the Willamette Valley can be severely damaged by BWYV, particularly lettuce, spinach, garden beet, Swiss chard, and turnip. Because sugarbeet seed crops were sometimes perceived as the primary BWYV inoculum source, we sought to examine all components of the inoculum reservoir. This study also permitted a cursory assessment of BWYV infection on seed yields of selected sugarbeet varieties. Sugarbeet-seed crops were found to comprise one of three sub-reservoirs of BWYV inoculum, along with vegetable crops and both annual and perennial weed species. Limited data suggested that BWYV exerts little effect on sugarbeet seed yield.

HARDCASTLE, GORDAN R., The Amalgamated Sugar Company, P.O. Box 700, Paul,ID 83347. A computer program using grower production records to improve beet quality.

A lot of statistical and agronomic information can be gathered on commercial fields planted to sugarbeets. Putting the information in a usable form is very time consuming. Our objective was to create a computer program that would manage the data for us. The resulting program runs on a laptop computer and is easy to use. Beet quality is improved when fieldmen use this tool in discussions with growers. The program can access grower field records for the previous five years. Statistics can be compiled by district, station, or grower. Growers averages can be graphed against the station average. Reports and graphs are printed out on 8 1/2" x 11" paper using an Epson compatible printer.

HARDWICK, FREDERICK G. HARDWICK, HAROLD LANGE,* AND JAMES B. MARTIN, Michigan Sugar Company, 300 Plaza North Building, 4800 Fashion Square Boulevard, Saginaw, MI 48604-2690.

Operation of a single pulp press in a factory and operating parameters affecting the press ability and throughput of the unit.

The decision making process that resulted in operating a single pulp press in a factory is outlined. A description of the factory flow from the slicer through the pulp drier including equipment type before and after the press installation is provided. Upon concluding to operate a single pulp press, operational parameters, such as pH, type of pH modifier, and calcium addition, temperature, chute height, retention time and cossette quality were examined to determine which variables may have the greatest impact on the overall operation. The control system from the slicer through the drier is described with emphasis on press speed manipulation. The impact from this control system to the operation is highlighted. Results from two campaigns are compared and conclusion are stated.

HEINBAUGH, F.A. (TONY)[1], and STANLEY J. SELLE[2], [1]American Crystal Sugar Company, 101 North Third Street, Moorhead, MN 56560, and [2]Northwest Research, Inc., P.O. Box 5156, Grand Forks, ND 58206-5156. Estimating operational impacts of enhanced pulp dryer performance.

American Crystal Sugar Company (ACS) operates ten pulp dryers at five Red River Valley factories. In recent years, dryer performance has been upgraded to meet particulate emission standards, while improving fuel efficiency. The key to this success has been the application of an R&D approach to problem solving: defining the problem through consistent data accumulation; establishing the relationships between operating conditions and performance; and effective application of findings to everyday operation. The main sources of improvement have been reduced total system gas throughput, elimination of uncontrolled air infiltration, and optimized use of dryer gas recycle. Dryer gas flow reductions of 23.5% and 55.6% have been documented. Experience has shown the importance of dryer discharge integrity, since fine particulates entrained by inleakage air are difficult to remove using the multiclone collectors on these facilities. Test data have shown a 16.3% increase in emission levels due to poor discharge operating practices. Instrumentation has been installed to provide operators with consistent real-time system performance information and on-line monitoring of equipment status. Fuel savings of over 20% have been demonstrated. The ability to predict the impact of operational changes on particulate emissions can enhance confidence that the dual requirements of maximum dryer capacity and acceptable emission levels are satisfied.

HENSON, M. ANN*1, Robert Wilson2, Karen Renner3, Alan Dexter4, Don Morishita5, Robert Norris6, and Mark Bredehoeft7, 1DuPont Ag Products, Longmont, CO 80501, 2UN Panhandle Sta, Scottsbluff, NE 69361, 3MSU, East Lansing, MI 48824, 4NDSU, Fargo, ND 58105, 5Univ Idaho, Twin Falls R&E Center, Twin Falls, ID 83301, 6Univ CA, Davis, CA 95617, 7Southern MN Sugar, Renville, MN 56284. UpBeet™ herbicide weed control programs: comparison to commercial standards.

Weed control improvement is needed on several broadleaf species such as kochia, redroot pigweed and lambsquarter. Control of small seeded broadleaf weeds using commercial programs and new UpBeet™ postemergence programs were compared using small plot replicated trials. Benefits to the grower in terms of yield, recoverable sugar and weeding costs are compared to standard programs. A standardized test protocol was selected for use in all the US production areas but may not have fit the most common local weed problem. The use of UpBeet™ improved weed control (0-100% visual scale) and handweeding time was reduced compared to current post programs. This resulted in highest net revenues if either hand labor or no labor was used. Soil applied pre + post programs required the least handweeding but net revenues varied. If Nortron fb Betamix was selected, revenues were equal to the UpBeet™ post program.

HIEB, KATHY L., The Amalgamated Sugar Company, P.O. Box 127, Twin Falls, ID 83303-0127. Waste water management with pivot irrigation.

There are several benefits of waste water application with center pivots over other methods of irrigation. The most significant advantages are realized with the even application of waste water. This allows for small increases in hydraulic and constituent loadings over the acreage. Freezing, flooding, and odor problems are also reduced with this type of watering system. A final benefit of pivot irrigation is the reduction in manual labor.

HILL, DON[1], and PATRICIA R. FULLER-PRATT[2],[1] Western Sugar Company Ft. Morgan and [2]Denver, 1700 Broadway Suite 1600, Denver, CO 80217. Reduction of boiler stack particulate emissions and scrubber water flow using low-sodium coal.

Two 1947 coal-fired stoker boilers, using a low-pressure mid - 1970's design venturi scrubber, were able to demonstrate compliance at one-half the regulated particulate limit and less than 0.1 lb/MMBTU by converting to a low-sodium coal. The sodium content in coal impacts the particulate emissions and is the cause of higher particulate emissions and higher opacity. Analysis indicates that the sodium content must be less than 2.5 percent, or the ash to sodium ratio must be greater than 40, to be effective in reducing particulate emissions and opacity. The higher ash content provides sites to absorb or attach the sodium in the boiler without overloading the pollution control devices. The increased ash bed also insulates the grates and allows for better combustion efficiency.

HUBBELL, LEE*, and PAUL PFENNINGER, Monitor Sugar Company, P.O. Box 39, Bay City, MI 48707. Effect of previous crop residue on nitrogen needs in Michigan and factors leading to the use of more nitrogen.

Our average yield per acre is more than 2.5 tons below the average yield established in the 1980's. This caused re-examination of practices by both the growers and company personnel. Noticeable trends over the last several years include new seed varieties, higher populations per acre and more beets in rotation after corn. Applied nitrogen per acre has risen along with a much improved sugar content. This is contrary to popular belief – higher sugars with higher amounts of applied nitrogen. Nitrogen tests over the last 25 years have consistently indicated 90 pounds of applied nitrogen was sufficient. Results of new tests and analysis of related tests indicate the need for additional applied nitrogen when crop residues are high such as when beets follow corn in rotation.

HUBBELL, LEE*, Monitor Sugar Company, P.O. Box 39, Bay City, MI 48707. Effect of weed populations on yield and profitability in sugarbeet production.

Weeds can be a serious problem in sugarbeet production if not properly controlled. The impact from excessive weeds not only influences yield at harvest, but also increases pile storage losses and reduces factory efficiency. The grower is responsible for weed control in the field and must understand the economics of proper weed management. In this test, weed stands of 0, 6, 12, 18 and 24 weeds per 100 feet of row were studied in a properly managed stand of beets. The weeds were redroot pigweed, Amaranthus retroflexus, lambsquarters, Chenopodium album and a few common ragweed, Ambrosia artemisiifolia. There is a significant loss in tons per acre and recoverable sugar per acre at the 12, 18 and 24 weed stands. In 2 of the 3 years, the loss was significant with only 6 weeds per 100 feet. Economic impact is used as an educational tool for grower meetings.

Jacobsen, B.[1], S. Kiewnick[1], A. Cattanach[2], L. Smith[3], J. Bergman[4], J. Eckhoff[4] and M. Bredehoeft[5]. [1]Dept. Of Plant Pathology, Montana State Univ.-Bozeman, MT 59717-3140 [2]Dept. Of Plant Sciences, North Dakota State Univ., Fargo, ND 58105 [3]Univ. of Minnesota, Northwest Experiment Station, Crookston, MN 56716 [4] Montana Eastern Agricultural Research Center, Sidney, MT 59270 [5]Southern Minnesota Beet Sugar Cooperative, Renville, MN 56284 .

Integrated Management of Cercospora Leafspot with Resistant Varieties and Synthetic Chemical and Biologically-based Fungicides

Cercospora leafspot(CLS) has become more difficult to control due to the presence of "TPTH-tolerant" strains in MN and ND production areas. This coupled with the potential loss of triphenyltin hydroxide (TPTH) to EPA regulatory action suggests that alternative control strategies are needed. An experiment comparing three varieties with differing levels of a resistance to CLS with and without applications of the fungicides TPTH (Super-Tin); propiconazole (Tilt); a biologically-based fungicide, BAC J; a systemic resistance elicitor, CGA245704 (CGA), and combinations of BAC J, Tilt or CGA was executed in 9 different sites in MT, ND and MN. Where CLS developed to economic levels, disease severity was lowest on the variety ACH 309, intermediate on Monohikari and highest on VDH66140. All fungicide treatments reduced disease severity with TPTH giving the best control followed by Tilt-BAC J, Tilt, BAC J, CGA alone or in combination with BAC J or Tilt. In unsprayed plots, sugar yields did not differ significantly between varieties and all varieties had higher yields with fungicide treatments, although all increases were not significant. Sucrose yields where CGA was used were commonly lower due to lower ton/A, although not always significantly. At Sidney, MT, impurity indexes were higher for CGA treatments and lowest for TPTH, Tilt-BAC J and Tilt treatments. CLS can be economically managed without TPTH by combinations of resistant varieties, Tilt, BAC J or Tilt- BAC J, although TPTH treatments provided the best control.

JANSEN, RUDOLF[1], and STANDER, J.R.[2], [1]KWS Kleinwanzlebener Saatzucht, AG, P.O. Box 1463, D-37555 Einbeck, Germany, and [2]Betaseed, Inc. P.O. Box 859, Kimberly, ID 83341.

Performance trial results of transgenic glufosinate ammonium (Liberty™) tolerant transgenic sugarbeet hybrids.

Yield trials were conducted in France, England and the U.S. in 1996 to test the performance of two transgenic sugarbeet hybrids which are tolerant to glufosinate ammonium (Liberty™). The trials were designed to compare the performance of these hybrids when treated with glufosinate ammonium to their performance and the performance of local check varieties and near isogenic hybrids under standard herbicide regimes.

JOURNET, GERARD[1], OTTO BULTAS[2], and FRANÇOIS ROUSSET[3*], [1]FCB, Sugar Division, Bd de l'usine, 59015 Lille Cedex, France, [2]Swenson Process Equipment, Inc., 15700 Lathrop Avenue, Harvey, IL 60426, [3]Applexion Inc., 15700 Lathrop Avenue, Harvey, IL 60426. Mechanical stirring in a continuous evaporating cystallizer - the new FCB continuous vacuum pan.

In an FCB continuous evaporating crystallizer (vacuum pan), the massecuite is stirred only by natural convection due to evaporation. Energy savings can be achieved by reducing the quantity of water evaporated during the crystallization operation by feeding such crystallizers with syrups of higher dry substance content. As a consequence, agitation in the evaporating crystallizer will be insufficient and have a detrimental effect on the heat exchange coefficients and the crystallization rate, as well as increasing the fouling of the calandria. One way of solving these problems and always ensuring adequate massecuite agitation is to produce agitation by external means, that is, mechanical stirring.

An experiment conducted on the second half of an FCB continuous evaporating crystallizer at the Colleville sugar factory resulted in a gain of about 2 °K on the total Δt and 1 to 1.5 points in the crystallization exhaustion.

Extrapolations from these results have led to an upgrading of the design of the FCB continuous vacuum pan to one with a new shape of calandria which makes possible the installation of mechanical stirrers. The expected thermal gains with this new design are 5 to 6 °K minimum on white beet sugar*(total Δt)*.

KAFFKA, STEPHEN R.* and GARY R. PETERSON. Department of Agronomy and Range Science, University of California, Davis, CA 95616-8515. A comparison of different sugarbeet seed conditioning and preplant treatments on seedling emergence in diverse California locations.

Different pre-plant seed treatments were applied to two sugarbeet cultivars to determine whether they improved or inhibited seedling emergence under a diverse set of soil and temperature conditions found in several California locations. Treatments included bare, processed seed as the control, washing, matric conditioning, and several commercial seed treatments including film coating, pelleting and matric conditioning for comparison. Control, washed, and matric conditioned seeds also were compared with and without fungicide applications in some of the trials. Tests were carried out over a three year period in the Imperial Valley (IV), Davis (D) in the Sacramento Valley, and Tulelake (TL), a high elevation location. The same cultivars, but different seed lots were used each year. Soil temperatures during the trials ranged from 0° C in TL to 40° C in the Imperial Valley. On average, treatments involving matric conditioning resulted in significantly faster rates of emergence to 50% and 90% levels. Differences varied from 1 to 2 days at 50% emergence to as many as 4 days at 90% emergence, depending on location and year. In general, pelleted (unprimed) seed required longer to reach maximum emergence, but achieved high emergence levels in most locations. Maximum emergence varied across locations from approximately 57 % in TL to 79 % in IV. Treatment by cultivar interactions also differed by location and year over a range of 20 % in TL to more than 40 % in the IV. Cultivar differences were consistent and significantly different in most locations and years, with the less vigorous cultivar reaching maximum emergence levels 3 % to 10 % lower on average than the more vigorous cultivar. Maximum emergence percent was not significantly different between most treatments, but the best performing treatments were superior to the control.

KAFFKA, STEPHEN R.[1*], PETERSON, GARY R.[1], and KIRBY, DONALD[2]. [1]Department of Agronomy and Range Science, University of California, Davis, CA 95616-8515 and [2]Intermountain Research and Extension Center, Tulelake CA. Irrigation cut-off treatments applied to sugarbeets grown in soils with a shallow water table.

In the Tulelake region near the Oregon border, beets are grown on organic soils reclaimed from shallow lakes. Groundwater is present continuously throughout the season at approximately 1.1 m depth in most fields. Typically, April and May planted beets are irrigated until mid-September and harvested in October, however environmental restrictions may reduce farm water supplies in the future. To determine if sugarbeets could be grown with less irrigation water, five irrigation cut-off treatments were applied in 1995 and 1996 to replicated, large plots at approximately two week intervals starting in mid-July. Harvests were made at each cut-off date, together with a final harvest, and soil samples were collected simultaneously to 1.1 m to compare soil water and nutrient contents. In each year, irrigation applications plus precipitation ranged from approximately 200 mm to 600 mm across the treatments. Maximum sugar yields were achieved by cutting off irrigation 7 to 9 weeks prior to harvest. In both years, root yields increased with increasing irrigation rates from to 54 to 63 Mg ha^{-1}, but sucrose percent declined from 19.5 % to 18.5 % with continued late-season irrigation, resulting in equivalent gross sugar yields over the last three cutoff dates. There was a non-significant tendency for sugar production to decline with September irrigation. In 1995, beets in cut-off treatments reduced the soil water content in the surface 0.6 m depth, compared to fully irrigated treatments, but there were no significant differences in soil moisture content deeper in the horizon. Soil nutrient contents were unaffected by cut-off treatments but changed through the season. Farmers can save 150 to 200 mm of irrigation water by cutting off irrigation to sugarbeet crops 7 to 8 weeks before harvest under these soil and climate conditions.

KEARNEY, MIKE, Amalgamated Research Inc., 2531 Orchard Dr. E., Twin Falls, Idaho 83301. Advances in the Beet/Cane Raw Juice.

The ARi raw juice chromatographic separator process was piloted for the fourth year of continuous operation. Improvements include nearly complete elimination of invert and betaine by the chromatographic separation step. Previously these were removed from raw juice at a level of about 30-50% and represented the poorest eliminated materials. As a result, it has been demonstrated that nearly all the raw juice nonsugars can be removed by industrial grade chromatography prior to crystallization.

Integration of full-scale membrane modules into the pilot plant land their operation for the entire campaign provided details concerning the suspended solids removal step.

KEARNEY, MIKE, Amalgamated Research Inc., 2531 Orchard Dr. E., Twin Falls, Idaho 83301. Application of evolutionary computational techniques to a chromatographic separator pilot test.

A method previously proposed for determining the differential migration rates of components in equilibrated moving/simulated moving bed chromatography was applied to a pilot test with beet molasses. The approach was developed because of the difficulty of determining the basic chromatographic mechanisms and interactions present when complex feed mixtures are treated by continuous counter-current chromatography. A variant of evolutionary computation is used and does not assume any *a priori* chromatographic causative factors or functions. The procedure is analogous to natural selection and involves cumulating small incremental improvements to candidate solutions.

KERR, ERIC D.[1*], JOHN A. SMITH[1], and GARY L. HEIN[1], [1]University of Nebraska Panhandle Research and Extension Center, 4502 Ave. I, Scottsbluff, NE 69361. Effect of 1,3-D soil fumigant on nematode control and sugar yield when applied before beans vs before sugar beets in a corn-bean-sugar beet rotation.

In northern sugar beet production areas, cold soil temperatures in late fall and early spring limit the time available for proper application of 1,3-D soil fumigant for control of plant parasitic nematodes in sugar beet. In western Nebraska, soil temperatures are favorable for 1,3-D application for at least a two month period prior to planting dry beans in a corn-dry bean-sugar beet crop rotation. Our objective in this study was to compare efficacy and benefits of 1,3-D applied preplant before dry beans vs. before sugar beets for control of Heterodera schachtii, and Nacobbus aberrans. The fumigant was chiseled broadcast at 11 inch depth at 12.5 gal of Telone II formulation/acre and sealed immediately with a disk and roller harrow. Infection severity by H. schachtii, 2.5 and 3.8 for prebean and presugar beet treatments, respectively, as measured by adult females/8 roots 57 days after planting, was not significantly different between dates of application, but both were less than the 22.4 severity for the nontreated control. N. aberrans root galls/8 roots were significantly reduced in the presugar beet application but not for the prebean application. Sugar yields of 7480 and 7615 lbs/acre in prebean and presugar beet treatments were not significantly different but both were greater than the 6133 lbs/acre for the nontreated control.

ERIC D. KERR[1*], JOHN A. SMITH[1], GARY L. HEIN[1], and ROBERT G. WILSON[1], [1]University of Nebraska Panhandle Research and Extension Center, 4502 Ave. I, Scottsbluff, NE 69361. Performance of rhizomania tolerant sugar beet varieties in a newly infested field.

Sugar beet varieties tolerant to rhizomania are an important component of disease management strategy for known infested fields. However, performance of rhizomania tolerant varieties in Nebraska is not well documented since these were developed in other production areas. Our objective in this study was to compare tolerant varieties that were expected to be available to growers within the next few years, with varieties commonly grown in the western Nebraska production region. Three seed companies submitted 13, 10, and 8 tolerant varieties, respectively, for the 1993, 1994, and 1995 field trials. Seedex Monohikari, Monohy 55, and Betaseed 1399 were included as reference varieties in all three years. The study included one site each year in non-rhizomania infested soil plus one site in 1993 and 2 sites in 1994 and 1995 in moderately infested soil. A randomized complete block design with eight replications was used. A field with scattered infestations of the disease was used for the test because it was the only site available after the disease was first detected in Nebraska. In infested sites, tolerant varieties provided improved root yields and sugar content compared to reference varieties. But in noninfested sites, sugar content was lower in resistant varieties though root yield was no different than in the reference varieties. We also examined the usefulness of visual indicators to rate the incidence of rhizomania at the time of harvest. Wine glass shape of roots, root hairness, and root tip vascular discoloration were not consistent or reliable indicators of rhizomania disease based on associated plot yields and ELISA tests for beet necrotic yellow vein virus. These symptoms were sometimes visually similar to symptoms of the sugar beet cyst nematode that was present in the test sites.

KIEWNICK, SEBASTIAN and BARRY. J. JACOBSEN, Department of Plant Pathology, Montana State University, Bozeman, MT 59717-0314 - Control of sugar beet crown and root rot caused by *Rhizoctonia solani* Kühn with biocontrol agents and fungicides

In a two year field study the fungicides Quadris (ICIA5504, ZENECA), Folicur (BAYER) and six bacterial biocontrol agents were tested for their ability to control *Rhizoctonia* crown and root rot on sugar beet. In the 1995 trial fungicides were applied as in-furrow sprays at planting with 0.05, 0.10, 0.20 oz ai for Quadris and 0.184 fl oz/1000ft row for Folicur. Five weeks after planting, a barley kernel inoculum of *R. solani* (AG-2-2) was applied at a rate of 20g/20ft row. In the 1996 trial Quadris (0.05, 0.10), Folicur (0.184) and six strains of antagonistic bacteria were sprayed on the crown five weeks (four leaf stage) after planting. The concentrations of the bacterial suspensions ranged between 10^6 and 10^9 cells/ml. Inoculation with *R. solani* followed after 24 hours. In 1995, when a very severe disease level occurred only Folicur significantly reduced the percentage of wilted and dead plants four weeks after inoculation compared to the untreated control. At harvest all treatments significantly reduced the disease index (0 = healthy; 7 = dead plant) with Folicur and Quadris 0.05 giving the best disease control. In 1996 with a less severe disease level Quadris (0.05; 0.10), Folicur and all six biocontrol agents significantly reduced the percentage of wilted and dead plants. Both rates of Quadris, Folicur and two bacteria gave the best control. Furthermore the same treatments significantly reduced the disease index at harvest with Quadris 0.10 showing the best control. In both field trials efficient disease control increased root yield, % sugar and sucrose yield/acre.

KNOERR, PAUL B., and KAREN A. RENNER, Department of Crop and Soil Sciences, Michigan State University, East Lansing, MI 48824. Sugarbeet Production with a Winter Wheat Cover Crop.

Coarse-textured soils in Michigan's sugarbeet producing areas present a challenge in establishment and protection of sugarbeet seedlings from wind erosion damage. Research was conducted in 1995 and 1996 to compare sugarbeet production in conventional tillage to production in no-tillage and zone-tillage with a winter wheat cover crop. In no-tillage and zone tillage systems, glyphosate at 0.75 lb a.e./A, clethodim at 0.25 lb a.i./A, and sethoxydim at 0.29 lb a.i./A, alone or in conjunction with cultivation, were applied at various timings to control winter wheat. Sugarbeet populations, yield, sugar percentage, and net return were calculated for each treatment. Sugarbeet yield was reduced where winter wheat was controlled by cultivation only. Sugarbeet populations were greater in zone and conventional tillage treatments as compared to no-tillage treatments in 1995. In 1996 sugarbeet populations were greatest in conventional tillage treatments. Higher yield and net return occurred in conventional tillage treatments in 1995 and 1996 and in zone-tillage treatments in 1995 where a herbicide was applied for control of winter wheat.

KOCHERGIN, VADIM, Amalgamated Research Inc., 2531 Orchard Dr. E., Twin Falls, Idaho 83301. Membrane filtration of various sugar solutions.

Possible applications for membrane technology in the sugar industry are reviewed. Factors affecting the feasibility of a process using membrane filtration are discussed. Ceramic and hollow fiber polymeric membranes were tested on various sugar-containing streams: beet and cane molasses, raw beet juice, and press water. Analytical results and performance data are reviewed. Use of ultra- or microfiltration processes as a pretreatment for chromatographic separation of sugar-containing streams is considered to be the most advantageous application.

KOCHERGIN, VADIM, Amalgamated Research Inc., 2531 Orchard Dr. E., Twin Falls, Idaho 83301. Sugar storage in silos: A slow conditioning approach.

An economical solution to store and condition bulk sugar in silos is reviewed. The proposed method allows sugar to be stored at optimal temperature and relative humidity while maintaining explosion-proof conditions in the head space of a silo. The "slow" conditioning does not require significant amounts of air or dehumidification capacity and existing non-insulated silo clusters can be economically retrofitted. The applicable features of ARi's fractal air distribution system are discussed. It is expected that the new approach will improve sugar quality as well as increase safety in operation and cleaning.

KORNIENKO A.V., All-Russian Research Institute of Sugar Beet and Sugar, Ramon, Voronezh region 396030 Russia. Development of scientific basis of mutation sugar beet breeding (*Beta vulgaris L*).

For the first time, there was considered a problem of experimental mutagenesis on beet. Mutagenic effect of 22 physical and chemical factors was studied. There have been worked out methodical recommendations on using experimental mutagenesis, including starting material choosing, characteristics and classification of mutagenic factors (chemical and physical), and physiologically active agents (PAA) and their doses, exposure and methods of interaction to produce new valuable mutants of sugar beet. Technique using selective media is suggested to screen genotypes, resistant to abiotic environmental stress factors, and also to isolate and develop starting material with resistance, based on different reactions and elimination of non-resistant genotypes. To evaluate a degree of sugar beet plants resistance to stress factors it is suggested a coefficient of depression (CD), that is a ratio of the trait quantity before and after influence of stress factor. The suggested new working hypothesis of sugar beet ploidy genetics is based on the principle of interallelic complementation and partial allelism. There have been worked out methods to screen non-bolting forms of sugar beet, determine sugar beet resistance to cercospore disease, develop non-bolting forms. Investigations of many years have resulted in development of new mutant lines and sources of genes, that are widely used in practical breeding.

KORNIENKO A.V., and UDOVIDCHENKO L.P., All-Russian Research Institute of Sugar Beet and Sugar, Ramon, Voronezh region 396030 Russia. Reduction of nitrogen losses in black earth soil of Russia.

Mineral nitrogen, applied to black earth soil of Russia, is nitrified for 3-7 days completely. Plants can't assimilate a big quantity of it at once. So, there is a real threat of significant losses of mineral nitrogen in gaseous form, that is connected with intensive nitrification and following denitrification. To reduce fertilizer nitrogen losses in soil there were used inhibitors of nitrification applied together with urea before autumn plowing. Results of the investigation showed, that, during the sugar beet vegetative season, dicyandiamide made number of *Nitrosomonas* 2-3 times less and *Nitrobacter* 1.6-2.0 times less, without depressing the total biological activity. As a result of its effect, the content of mineral nitrogen in soil increased, that is probably connected with reduction of its losses during autumn and winter. It favored the better plant growing, raised the content of chlorophyll in leaves and enlarged assimilative surface, that, in the end, increased harvest of sugar beet roots by 8-12%.

KROMER, KRAL-H., MARTIN THELEN AND LARS HEIER*. University of Bonn, D-53115 Boon. Field research equipment for sugar beet.

The growing systems and the equipment of high influence on successful sugar beet farming. Therefore the effect of growing systems, seeders and harvesters on plant population and yield has been tested. The same equipment is used for the evaluation of varieties, cultural and regional aspects. Special equipment was designed and tested under field conditions. In detail was developed a seeder test stand for laboratory and field conditions and a plant counter for quasi real time measurement of working quality and plot based populations, including modern positioning systems.

KROMER, KRAL-H., LARS HEIER, MARTIN THELEN AND CHRISTOPH STEPHAN*. University of Bonn, D-53115 Boon. Mulch seeding of sugar beet.

Economical and ecological objectives of sugar beet production systems can be solved by reduced tillage, intercropping, mulch seeding, tramlines and eventually bed systems. Results of 8 years research on speed and amount of field emergence, beet and sugar yield are presented as influence by different growing systems; technical data tables reviewing the status of seeding techniques. GPS and GIS application is discussed.

KROMER, KRAL-H*., MARTIN THELEN AND PETER DEGEN. University of Bonn, D-53115 Bonn. Status of sugar beet harvesting in Europe.

Under changing boundary conditions of sugar beet production the harvesting system, technique and quality are of economical and ecological importance. The authors are commenting their rest result of harvesting since 1976 till Oct. 1996. Technical data tables presenting the present stage of harvesting , e.e. in Germany 55% of the sugar beet growing area is harvested by 6-row tank harvester with 65% organized by coops and contractors. The root less ranges from 1.1 to 3.1%, the dirt tare from 3.5 to 11.5% to the correct topped beets from 31.4 to 56.7% and the surface damage from 27 to 200 cm^2/100 beets. The paper includes row and weight based cost functions for the available machinery.

KUBAT, KEN A., JEFFREY L. CARLSON, PETE W. JENSEN, and GREG W. GOLOVANOFF*, Minn-Dak Farmers Cooperative , 7525 Red River Road, Wahpeton, ND 58075-9698. Juice-component-profile of the BMA-65 juice purification system.

Traditional raw- or diffusion-juice-purification systems are designed to remove some nonsugars and stabilize others so they will not affect the sugar in concentration or crystallization steps. Minn-Dak farmers cooperative at Wahpeton uses the BMA-65 juice purification system and three surveys were conducted to profile the performance of the system and its affect on the concentration of various nonsugars. Glucose, fructose, sucrose, raffinose, lactate, formate, acetate propionate, butyrate, sulfate, chloride, nitrite, nitrate, and phosphate were measured using ion chromatography. Calcium, sodium, potassium and magnesium were measured by atomic absorption. Total organic carbon and inorganic carbon were measured using a TOC analyzer and ammonia was measured with and electrode. In addition, temperature, RDS and pH were also measured. The profiles are consistent with the current understanding of a lime-purification system and are useful as a learning tool to understand exactly what is happening in each of the vessels.

LANCRENON, XAVIER, Applexion Inc., 15700 Lathrop Avenue, Harvey, IL 60426. Innovative separation technologies: Development of new applications in the sugar industry in North America; a decade of steady progress between 1986 and 1996.

The author indicates how the implementation of new separation technologies, such as ion exchange, chromatographic separation, and membrane crossflow filtration--not used commercially in the U.S. sugar industry until 1985--has been improving the profitability of the industry since the mid-eighties.

Examples are given of:

- New deliming, with no production of effluent.
- Desugarization of beet molasses.
- Purification of sugar juices by ultrafiltration.
- Production of liquid sugar by ion exchange.

LARSON, DAVID O., DAVID P. GRUENEICH and JOHN M. HELGE, Nalco Chemical Company, 2415 Annapolis Ln #100, Plymouth, MN 55441. Evaporative Condensate Quality and its Effect on Steam Purity.

Beet sugar factories are historically plagued unreliable steam purity. Physical carryover of boiler water in what is supposed to be pure steam leads to deposits in superheaters, tube metal overheating, and unscheduled boiler outages. Solids not depositing in the superheater tubes cause deposition on control valves and on the blades of the steam turbines used to produce electricity for the beet sugar factory. Loss of turbine efficiency and increased maintenance costs due to corrosion and/or vibration damage result. For many years these deposits were thought to be the result of boiler operator error in overfeeding of sodium hydroxide in response to isolated episodes of organic acid contamination in the returning process condensate. During the 1994-95 processing campaign Nalco conducted in depth steam purity studies using on-line specific ion analyzers on three boilers in one factory. In spite of "normal" operating conditions we found the steam quality from all three boilers to be unsatisfactory for reliable superheater or turbine operation. Steam purity did not improve with any conventional change in boiler water chemistry. When the factory turbine was physically inspected after the 1994-95 campaign significant deposition and caustic-induced corrosion was found. During intercampaign this factory made significant mechanical and operational changes to its evaporator train system. The Nalco steam purity study conducted during the 1995-96 campaign showed tremendous improvement in steam quality. Physical inspection of the factory turbine showed no deposition or corrosion after the 1995-96 campaign. These significant improvement can be directly attributed to the mechanical/operational changes this factory made to their evaporator system. No changes were made in boiler water chemistry.

LEWELLEN, R. T. USDA-ARS, 1636 E. Alisal St., Salinas, CA 93905. Comparison of two sources of resistance to rhizomania and associated high temperature root rots in sugarbeet.

Under severe rhizomania, *Rz* (Holly factor) provides only intermediate levels of resistance. Higher levels of resistance appear to be available from an enhanced sugarbeet x *Beta vulgaris* spp. *maritima* population developed at Salinas. This population called R22 was originally released as C50 and subsequently released as C51 after multiple cycles of selection for resistance to rhizomania. Backcross derived sugarbeet breeding lines in multigerm and monogerm backgrounds also were released as C79-8 and C890-8. In ongoing breeding work these C51 type lines have given high levels of protection against severe rhizomania and associated root rots. Tests were run in overwintered trials in Imperial Valley to compare resistance conditioned by *Rz* and C51 factors. Three hybrids were compared in May (moderate temperature) and July (high temperature) harvests grown with and without rhizomania. The hybrids were (i) a susceptible commercial, (ii) *Rz* experimental, and (iii) C51 experimental (25% *B. v. m.* germplasm). Without rhizomania, the susceptible commercial had the highest sugar yield and C51 hybrid the lowest. With rhizomania the opposite occurred. The *Rz* hybrid was intermediate in both situations. The C51 hybrid had the least root rot and plant loss. For the three hybrids harvested in May, the sugar yield losses were 43, 34, and 12%, respectively. In July under extremely high temperatures, the sugar yield losses were 70, 44, and 28% and root rot killed 40, 13, and 4% of plants. These results suggest that these resistance sources did not fully protect against rhizomania, but that resistance from C51 was stronger than from *Rz* factor. However, in these hybrids the resistance factors at best were heterozygous and fewer than 100% of the plants carried resistance. In addition, some losses across all hybrids may have been caused by other soil-borne problems (e.g., cyst nematode) that increase when rhizomania infested test areas are established.

MEI-YEH JADE LU[2] and DANIEL R. BUSH[1,2,*] [1]Photosynthesis Research Unit, USDA-ARS and [2]Department of Plant Biology, University of Illinois, Urbana IL 61801. Cloning and molecular analysis of the sucrose transporter from sugar beet.

Sucrose transporters are fundamental components of the assimilate partitioning pathway in many plants. In sugar beet, the key sucrose carrier in assimilate partitioning is the proton-sucrose symporter that mediates phloem loading. Our lab has described the transport properties of this carrier using purified plasma membranes and imposed proton electrochemical potential differences. More recently, we have cloned this transporter using RT-PCR and sequence information derived from conserved regions of previously cloned symporters. Two PCR fragments showed good sequence identity to the previously cloned sucrose symporters. A full-length clone was isolated for one of these from a sugar beet cDNA library. The clone contains 1939 nt that include an open reading frame that encodes a protein consisting of 539 amino acids. This carrier is 84% identical to the spinach clone at the protein level. Northern analyses showed that the gene is primarily expressed in leaves, petioles, and hypocotyls. We are exploring the structure of sucrose symporters using functional expression in yeast. We have used site-directed mutagenesis to identify an essential histidine residue in the protein, and showed that a unique substitution of this amino acid increases sucrose transport activity two-fold. We believe this gene has enormous potential for transgenic modification of sugar beet yield.

LUESCHEN, W. E.[1]*, J. K. GETTING[1], and E. L. FOLAND[2], Department of Agronomy and Plant Genetics, 411 Borlaug Hall, University of Minnesota, St. Paul, MN 55108, and American Cyanamid Company, Northfield, MN 55057. AC 299,263 and Imazethapyr Carryover Potential in a Soybean/Sugarbeet Rotation.

Sugarbeet injury was evaluated the year following postemergence application of AC 299,263 at either 0.036, 0.071, or 0.140 kg ha^{-1} and imazethapyr at either 0.036 or 0.071 kg ha^{-1} in mid to late June to soybean. The sites used in 1993-1994 and 1994-1995 had soil pH levels of 8.1 and 6.1, respectively. Early season sugarbeet injury symptoms were observed with both rates of imazethapyr in 1994 (soil pH 8.1) but plant stands and yield were not reduced by either rate of this herbicide. Neither injury, stand losses, nor yield reductions were observed with any of the AC 299,263 treatments. In contrast to the 1993-1994 study, in 1995 (soil pH 6.1) both rates of imazethapyr applied to soybeans in 1994 resulted in severe sugarbeet injury, stand reductions, and reduced sugar yields. With AC 299,263 only the 0.140 kg ha^{-1} rate (approximately 4X rate) caused sugarbeet injury and reduced sugar yields. Two sites were established in 1995-1996 that were approximately 300 m apart but differed in soil pH. The low pH site had pH values that ranged from 5.0 to 6.0 and the pH levels at the other site ranged from 6.2 to 8.1. Treatments were either 0.036 or 0.071 kg ha^{-1} of AC 299,263 and 0.071 kg ha^{-1} of imazethapyr applied postemergence to soybeans on June 16, 1995. Sugarbeets were planted in 1996. On the high pH site in 1996, imazethapyr at 0.071 kg ha^{-1} resulted in sugarbeet injury early in the season but by early August little injury was observed with this treatment. In contrast, on the low pH site, imazethapyr carryover caused severe injury and greatly reduced the sugarbeet stands. On the high pH site AC 299,263 at either 0.036 or 0.071 kg ha^{-1} caused no injury to sugarbeets. The highest rate of AC 299,263 caused significant sugarbeet injury and stand reduction on the low pH site.

MCARDLE, JOHN, C., ANTHONY C. ERINGIS and ANDREW J. SANTOS, KOCH Membrane Systems, Inc., 850 Main Street, Wilmington, MA 01887. Do membranes have a future in beet sugar processing?

Crossflow membrane filtration has been practiced for many years in a variety of food processing industries. During this time much effort has been expended on developing useful membrane processes for the sugar beet industry; for example, clarification of diffusion juice, with limited commercial success. However, anticipated benefits from membrane system are extremely attractive, so it is certain that these efforts will continue. Why have attempts to date not lived up to expectations? Several possible reasons are considered in this paper including, (a) Operating limitations of membranes, (b) High equipment and operating costs of membrane systems, and (c) Lack of systems approach. Recent membrane and equipment improvements have led to the successful application of spiral polymer configuration in high temperature (85° C) and high viscosity processing; for example, PVA size, kaolin clay, protein solids and dextrose. Cost estimates indicate that polymer spiral systems are less than half the cost of ceramic membrane systems for clarification of beet diffusion juice, with similar operating costs. Recent approaches consider membrane filtration as one unit operation in a combination of pretreatment, ion-exchange, chromatography and electrodialysis processes. Membrane and equipment improvements along with an appropriate systems approach is expected to result in significantly lower operating costs and higher sugar yield and quality than possible with traditional chemical treatment.

MCGILLIVRAY, TERRY[1]*, CHRISTINE M. STUART[2]*, SHELDON SEABORN[1], and DAVID O. LARSON[2], [1]American Crystal Sugar, 1700 N. 11th Street, Moorhead, MN 56561, and [2]Nalco Chemical Company, One Nalco Center, Naperville, IL 60563. Detection of sugar beet thin juice in multiple effect evaporator condensate systems using fluorescence.

Condensate from the multiple effect evaporators used for concentrating sugar juice is frequently reclaimed and returned to the boiler. Evaporator condensate typically contains few contaminants and has a relatively high Btu value, making the condensate an ideal candidate for reuse as makeup water to the boiler. Occasionally, the condensate becomes contaminated with sugar from the process. Such "sugar shots" cause a depression in boiler water pH as the sugars break down into organic acids. Fluorescent monitoring techniques were successfully used to detect low concentrations of sugar juice in evaporator condensate. Second effect evaporator condensate was monitored on line at the American Crystal Sugar Plant in Moorhead, MN. Fluorescence readings were directly compared to a sodium analyzer and alpha naphthol readings. Development and field trial data will be discussed in the paper.

McGRATH, J. MITCHELL, USDA, Agricultural Research Service, Dept. of Crop and Soil Sciences, Michigan State University, East Lansing, MI 48824-1325. Total protein profiles in sugarbeet tissues revealed from one-dimensional SDS-PAGE.

Sugarbeet tissues contain a wide variety of proteins, ranging from structural to enzymatic, which could be used as genetic or developmental markers. Extracts of tissues can be directly applied to protein denaturing solid matrix sieves and separated according to molecular weight in a voltage gradient, a rapid and reliable technique known as SDS-polyacrylamide electrophoresis (SDS-PAGE). The resulting separation of proteins can be used to gauge the complexity of proteins expressed in different tissues, such as leaf, stem or root, as well as to follow changes in protein composition during development, for instance between vegetative and reproductive phases. In certain cases, protein profiles can serve as a 'fingerprint'. We have begun to examine sugarbeet tissues for differences in total protein profiles which exist between East Lansing breeding lines that may be useful genetic or developmental markers. Specifically, we are examining three pairs of cms-lines and their matching O-types as well as one near O-type line. We are particularly interested in (1) determining the protein profiles in roots and whether these may correlate with amino-N in sugarbeet juice and (2) whether SDS-PAGE can supplement the indexing of cms maintainer lines.

MANDOLINO, GIUSEPPE, WALTER BOSCHETTI and ENRICO BIANCARDI. Istituto Sperimentale per le Colture Industriali, Viale Amendola 82, 45100 Rovigo, Italy. Use of RFLP markers in the analysis of genome diversity within the genus *Beta*.

In this work, it was performed an analysis of the genetic diversity between seven subspecies and species of the genus *Beta*, belonging to the Sections Beta and Procumbentes, the two most important for breeding purposes. About 200 genomic clones deriving from a *Beta vulgaris* plasmid library (prepared from total DNA of the CMS line MS2R) were screened using as probes total genomic DNAs digested to completion with Sau3A from *Beta vulgaris*, *Beta vulgaris* ssp. *maritima*, *Beta macrocarpa*, *Beta patellaris* and *Spinacea oleracea*, in order to identify the extent of the differences in the hybridization signals, and possibly subspecies-, species- and Section-specific probes. Different classes of genomic probes were identified according to the strenght of the hybridization signals in dot blot experiments, and these probes were subsequently used in Southern blots experiments. The Southern analysis was carried out using both high resolution denaturing polyacrilamide gels (4%) to separate restriction fragments generated by four-cutter enzymes, and agarose gels (1%) for the separation of DNA fragments generated by six-cutter enzymes. In total, 27 enzyme-probe combinations giving readable patterns were tested, and for these, 239 markers were scored for seven subspecies and species of the genus *Beta*; the same probes were also used to fingerprint the genomic DNA of the two related genera *Spinacea oleracea* and *Chenopodium quinoa*. The RFLP data were transformed into matrix data, and dendrograms were constructed based on the similarity matrix using the UPGMA method and the software NTSYS. A number of species-specific and Section-specific probes were found; in the latter case two genomic probes corresponding to highly repeated DNA in the Section Beta, failed to give any hybridization signal for the Section Procumbentes.

MARTIN, SUSAN S.[1], and ANDREW W. LENSSEN[2], [1]USDA, Agricultural Research Service, 1701 Center Ave., Fort Collins CO 80526, and [2]Dept. of Entomology, Montana State University, Bozeman MT 59717. Glucosinolate content through development of trap crops for the sugarbeet cyst nematode, *Heterodera schachtii*.

Although some cultivars of oil radish (*Raphanus sativus* L.) and yellow mustard (*Sinapis alba* L.) are good hosts and allow full reproduction of the sugarbeet cyst nematode (SBCN), others have been selected that continue to allow the early steps of nematode colonization, but disrupt SBCN reproduction. The latter are said to "trap" SBCN, inducing cyst hatching and attracting juveniles to the root, but allowing production of few or no new cysts. We followed qualitative and quantitative content of glucosinolates (GSLs), a class of toxic chemicals produced by plants in the mustard family, through development of uninfested susceptible and trapping ("resistant") oil radish and yellow mustard cultivars. Plants were greenhouse grown and harvested at one of five defined growth stages: (1) 5 leaves; (2) 15 cm stem extension; (3) flower buds; (4) initial anthesis; and (5) first pods with full-size seeds. At harvest, fibrous roots, hypocotyl (radish only), and shoots (all above-ground portions) were washed and lyophilized, then ground and subsampled for analysis of GSLs by HPLC. Radish and mustard have different GSL profiles, so results were analyzed separately for each species. For both plants, concentrations of most individual GSLs and of total GSLs (per unit dry wt) differed with growth stage, but the cultivar X stage interaction was mostly nonsignificant. Concentrations of some GSLs differed among cultivars, but the differences were not consistent in direction and did not appear to correlate with known nematode response to those cultivars. Thus, our results do not support a direct role for preformed GSLs in non-infested trap crops in conferring resistance to SBCN.

MELIN, DAVID C., Holly Sugar Corporation, P.O. Box 581, Brawley, CA92227. Continuous improvement in plant population and irrigation practices yields an average 11,220 pounds of sugar per acre in the Imperial Valley of California.

During the 1980's the future of the sugrbeet industry in theImperial Valley was at risk of being lost due to poor sugarbeet quality. Improvements in field preparation, and irrigation practices have increased the number of harvested beets per acre. Post thinning stand counts compared to actual beets per acre harvested have influenced growers to increase plant populations. Planting on beds using two seed lines on 40 inch beds has allowed growers to increase plant populations to 50,000 plants per acre at emergence time. Growers using single seed line 30 inch rows have increased plant populations by increasing the number of beets left at thinning to as many as 60,000 plants per acre. Yields have increased from 26 tons per acre to an average of 34 tons. along with sugar content increasing from 16% to 16.8%. The use of the 40 inch beds with 2 seed lines has allowed growers to irrigate in 110 degree temperatures with less risk of saturating the soil around the beet inducing rot. The number of rotten beets harvested has been reduced from over 10% to a low 2% during the late July harvest period. Planting of Rhizomania tolerant varieties has greatly increased the yield and sugar content of beets harvested in Rhizomania infected fields. Variety improvement has increased the vigor of seedlings at emergence which helps reduce the number of seedlings lost to heat stress in the 90 degree soil temperatures of September. Nitrogen management using deep soil sampling to evaluate fields selected for sugarbeet production has effectively lowered the ppm of brei nitrate at harvest time.

MESBAH, MAHMOUD[1], OLGA E. SCHOLTEN[1]*, THEO S.M. DE BOCK[1], JOHANNES M. SANDBRINK[1], RENÉ M. KLEIN-LANKHORST[1], J. HANS DE JONG[2] AND WOUTER LANGE[1]. [1]DLO-Centre for Plant Breeding and Reproduction Research (CPRO-DLO), P. O. Box 16, NL-6700 AA Wageningen, The Netherlands and [2]Wageningen Agricultural University, Department of Genetics, Dreijenlaan 2, NL-6703 HA Wageningen, The Netherlands. Studies on monosomic additions in *Beta vulgaris*, carrying an extra chromosome of species of the section *Procumbentes*.

Alien monosomic additions (2n=19) have been made. This are plants of cultivated beet (*Beta vulgaris* 2n=18), carrying different individual chromosomes of *B. procumbens* (2n=18) or *B. patellaris* (2n=36). The alien chromosomes were identified with the aid of DNA fingerprinting, using repetitive DNA probes. In this way the available set of nine different monosomic additions of *B. procumbens* could be improved. Monosomic additions of *B. patellaris* could be grouped in nine different groups, many of them with two sub-groups. Two of the DNA probes were used to study contracted alien chromosomes, as well as extended chromosome fibres, using FISH (Fluorescence In Situ Hybridisation). In greenhouse experiments the monosomic additions were subjected to infections with the beet cyst nematode (*Heterodera schachtii*), with *Cercospora beticola*, and with viruliferous *Polymyxa betae*, the vector of the beet necrotic yellow vein virus (BNYVV). In most cases it was possible to identify the chromosomes carrying the gene(s).

MILLER, STEPHEN D. and K. JAMES FORNSTROM, Departments of Plant, Soil, Insect Sciences and Civil Engineering, University of Wyoming, Laramie, WY 82701. Postemergence grass control in sugarbeets.

Sethoxydim was the only postemergence grass herbicide registered for use in sugarbeets for over ten years. However, clethodim, quizalofop and a new formulation of sethoxydim were all recently labeled in sugarbeets for similar purposes. Experiments were conducted at Torrington and Powell, WY in 1995 and 1996 to compare the effectiveness of these herbicides for grass control in sugarbeets when applied alone or in combination with desmedipham plus phenmedipham. Plots were 10 by 30 ft. with three to four replications arranged in a randomized complete block design. Herbicide treatments were typically applied when the grasses were 2 to 4 inches tall with a CO_2 pressurized knapsack sprayer delivering 10 gpa at 40 psi. Weed control was based on visual evaluations made 2 to 4 weeks following treatment. Clethodim and quizalofop have provided more effective small grain control than either sethoxydim formulation. Further, foxtail control with sethoxydim and clethodim has generally been better than with quizalofop. Control of other grass species has generally been similar at labeled rates. Clethodim was antagonized less by desmedipham plus phenmedipham than sethoxydim or quizalofop. Oil additives generally reduced the antagonism between desmedipham plus phenmedipham and the grass herbicides but also increased the risk of sugarbeet injury.

MILLER, STEPHEN D., and K. JAMES FORNSTROM, Departments of Plant, Soil, Insect Sciences and Civil Engineering, University of Wyoming, Laramie, WY 82071. Reduced preplant rates with a postemergence herbicide program.

Soil applied herbicide treatments in sugarbeets often have increased the effectiveness of postemergence treatments by increasing weed susceptibility and/or broadening the window of postemergence application especially under adverse weather. The current trend; however, in sugarbeets has been to fewer soil applied treatments and multiple postemergence applications. Experiments were conducted at Torrington, WY in 1994, 1995 and 1996 to compare weed control and sugarbeet response with reduced and normal rates of soil applied herbicides alone or in combination with multiple postemergence herbicide applications. Plots were 10 by 30 ft. with three replications arranged in a randomized complete block design. All herbicide treatments were applied with a CO_2 pressurized knapsack sprayer delivering 20 gpa at 40 psi. Weed control, sugarbeet injury and hoe times were determined 7 to 10 days following the last postemergence herbicide application. Weed control was better and hoe times reduced with complementary preplant incorporated/postemergence treatments than with preplant incorporated or postemergence treatments alone. Weed control and hoe times with the complementary treatments were similar whether the preplant incorporated herbicide treatment was applied at the full or reduced rate. However, sugarbeet injury with the complementary treatments was reduced when the post treatments were applied over the reduced compared to the full rate soil applied treatment.

MILNER, TED D.[1], and DERRALD H. HOUSTON[2], Silver-Weibull, 14800 E. Moncrieff Place, Aurora, CO 80011. Continuous processing of higher purity sugars.

Three major concerns encountered in the processing of high purity sugars in a continuous centrifugal were: (1) preserving crystal integrity, (2) minimizing wash media consumption, and (3) gaining the highest possible color reduction with high capacity. Our objective was to utilize a continuous centrifugal to complement the industry move to a continuous process flow, on higher purity sugars such as: (1) High Raw Stations, (2) Affination Steps, (3) Some high grade raws out of the cane industry both final product and pre-refinery steps. We placed units on high raw beet steps, affination steps and high grade cane. We were able to utilize a basic module machine with a 25◦ basket, enhanced capability of steam conditioning, and vacuum assisted crystal "cleaning". Various modular features were used for specific applications. These included "crystal saving" device, internal magma mixing, internal melting, variable frequency drive to allow varying "G" force requirements for specific applications.

MORAGHAN, JOHN[1]*, KEVIN HORSAGER[1], ALBERT SIMMS[2], and LARRY SMITH[2], [1]Soil Science Department, Walster Hall, North Dakota State University, Fargo, ND 58105. [2]Northwest Experiment Station, University of Minnesota, Crookston, Crookston, Minnesota 56716, Sugarbeet Tops and Soil Nitrogen Fertility.

Sugarbeet tops at harvest contain from 60 to 300 pounds N per acre. The contribution of the tops to the N status of fields, however, often varies greatly within fields. Areas with yellow tops frequently contain 2 to 2.5 tons/acre of day matter with N concentrations of 1.3 to 1.7 percent. In contrast, areas with green to dark-green tops in the same fields contain 3 to 4 tons/acre of day matter with N concentrations of 2.5 to 3.3 percent N. A unit of N in high N tops is approximately twice as effective as a unit of N in low N tops for a following wheat crop in the Red River Valley. Areas of low and high N tops within fields can be identified by aerial photography. This information can be digitized and utilized by operators of variable fertilizer rate equipment to optimize N fertilizer requirement within fields of crop following sugarbeets. This technology is likely to reduce N fertilizer application in the Red River Valley.

NICKSON, THOMAS[1], PAUL TENNING[2], ERLING SMED[3], AND ANNEMIE HONTIS[4]. [1]Ceregen, a unit of Monsanto Company, 700 Chesterfield Parkway North, St. Louis, Missouri, 63198, USA; [2]Hilleshög AB, P.O. Box 302, S-261 23, Landskrona, Sweden, [3]DANISCO Seed, Højbygårdvej 14, DK-4960 Holeby; [4]Monsanto Europe Ltd., 1348 Louvain-la-Neuve, Belgium. Transgenic sugar beet tolerant to glyphosate, substantial equivalence of Roundup Ready™ sugar beet compared to other beet.

Weed control is a critical element of maximizing yields in sugar beet production. Most current herbicide programs suffer from a narrow spectrum of weeds controlled as well as crop injury. Monsanto and Sandoz Seeds have been working together for several years in an effort to offer farmers in Europe and the US sugar beet tolerant to glyphosate. The use of Roundup® in sugar beet production will afford broad spectrum weed control without crop injury. Because the Roundup Ready trait was initially introduce using techniques of biotechnology, these improved beets must be approved by regulatory agencies around the world for food and feed use and unconditional environmental release. Researchers at Monsanto, Sandoz, and DANISCO have completed a detailed two year, multi-site analysis of these new sugar beets looking at 17 individual components. Based on comparisons to the results of analyses of a control, nonmodified line, and comparing to acceptable ranges published, we conclude that Roundup Ready sugar beet are substantially equivalent to other beet. Furthermore, these improved beets present no greater risk than is currently present with other sugar beets. The results of these analyses will be discussed in detail.

PAHL, SCOTT, J., Seed Systems, 8333 Swanston Lane, Gilroy, CA 95020. The reintroduction of pelleted sugarbeet seed at the Southern Minnesota Sugar Cooperative.

Virtually no pelleted sugarbeet seed was used by the growers of the Southern Minnesota Sugar Cooperative (SMSC) during the early 1980's. The slow and uneven emergence characteristics of the old clay-based pellets had discouraged their continued use in this and many other growing areas of the United States. Germain's (Seed Systems) introduced a new pellet formulation in 1988 which was designed to emerge better under a wider range of soil moisture levels. This new pellet emerged better than or equal to non-pelleted sugarbeet seed in low soil moisture test conditions in trials at North Dakota State University and the University of Minnesota, Crookston. Extensive field trials confirmed the consistent emergence characteristics under a wide range of grower management systems. Explanations of the improved performance of the new pellet formulation were: (1) Substituting organic based materials for the clay as the primary component in the formulation. (2) The introduction of a new seed priming or steeping process. (3) Institution of a series of quality assurance tests to identify seedlots suitable for pelleting. Growers noted that pellets improved planter accuracy which produced a more uniform crop that was easier to defoliate and harvest. The piling of properly defoliated and uniformly sized sugarbeets is an important component in successful sugarbeet storage during of the 200+ day slice campaign at SMSC. The registration Tachigaren to control the seedling disease *Aphanomyces* caused a major surge in the popularity of pelleted seed. The introduction of a new, advanced priming process, called PAT, also increased interest. Pelleted sugarbeet seed use by the SMSC has increased from less than 1000 pounds in 1988 to over 315,000 pounds in 1996. Nearly 80% of SMSC's 110,000 harvested acres were planted to pellets in 1996, including 27,000 acres of Tachigaren treated pellets and 8000 acres of PAT pellets.

PANELLA, L.[1] and C. R. SMITH[2], [1]USDA, Agricultural Research Service, 1701 Center Ave., Fort Collins, CO 80526 and [2]Summit Plant Laboratories, Inc., 2301 Research Blvd., Suite 106, Ft. Collins, CO 80526. An example of government-industry partnering in which both sides benefit.

The USDA Cooperative Research and Development Agreement (CRADA) provides a framework for cooperation that protects the interests of the Agricultural Research Service researcher and industry collaborator. The Sugarbeet Research Unit in Fort Collins has a CRADA with Summit Plant Laboratories, Inc. (SPL) to optimize production of clonally propagated sugarbeets. There are many research and breeding uses for sugarbeet clones, including: 1) production of hybrid seed for combining ability tests, 2) minimization of space needed to maintain genotypes undergoing progeny (or clonal) testing, 3) identical genotypes for research experiments, and 4) to archive unique genotypes over time. However, the production of tissue culture-derived clones requires expensive facilities and trained personnel, and even labs that do tissue culture research often are not designed to produce, economically, sufficient clones for field testing. SPL provides plant propagation services and products via laboratory and greenhouse technologies, and specializes in large scale production of elite, disease-indexed planting stocks. The development of new or improved techniques and new plant products is essential to remain competitive and profitable as a small business. Collaboration with USDA-ARS provides access to expertise and research capabilities that exceed R & D resources available within the company. For SPL, this CRADA has resulted in: 1) a reliable protocol to clonally propagate sugarbeets that can be offered as a new service/product; 2) a product development model, which estimates costs and times lines when entering new markets; 3) training of technicians in designing and reporting experiments; and 4) exposure in private and public sectors as a vendor of propagation services. For ARS, and other public and private researchers who do not have access to the facilities necessary to produce clonal material on a research or production scale, this CRADA provides access to a commercial source of sugarbeet clones.

PANELLA , L.[1], S. MITCHELL [2], C. JESTER [2], R. DEAN [2], E. G. RUPPEL [1] and S. KRESOVICH[2], USDA Agricultural Research Service [1] Sugarbeet Research Unit, 1701 Center Ave., Fort Collins, CO 80526, [2]Plant Genetic Resources Conservation Unit, University of Georgia, Griffin, GA 20223. Determination of genetic relationships among isolates of *Rhizoctonia solani* Kühn based on DNA sequence.

Understanding the genetic relationships among different isolates of a plant pathogen is a necessary prerequisite to understanding the interaction between that pathogen and the host plant. Sequence data from 75 isolates of *Rhizoctonia solani* were used to develop a phylogeny, with emphasis on anastomosis group (AG) 2-2, which contains isolates pathogenic to sugarbeet. The internal transcribed spacers and 5.8S rDNA gene were sequenced with an Perkin-Elmer/Applied Biosystems model 377® automated sequencer. The sequencing reaction was PCR-based and used primers flanking the large and small nuclear rDNA genes, as well as internal primers on the 5.8S rDNA gene. The neighbor joining method was used to construct a phylogenetic tree. There was agreement between the phylogenetic grouping and anastomosis grouping. The four isolates that were originally grouped by sequence data outside their anastomosis group were found to have been assigned to the wrong anastomosis group when retested. Distinct subgroups within anastomosis group also were delineated. There were two groups within AG1, one containing isolates from the U.S. and one containing isolates from Japan. Subgroups AG-2-2IIIB and AG-2-2IV also were distinctly grouped within AG-2-2. It is also hoped that unique sequences can be found that are diagnostic of anastomosis group and specifically of the sugarbeet pathogenic isolates within AG-2-2. This research increased our understanding of the genetic relationships among the anastomosis groups of this important plant pathogen.

PANELLA, LEE[1], CAROL E. WINDELS[2], AND EARL G. RUPPEL[1]. [1] USDA, Agricultural Research Service, 1701 Center Ave., Fort Collins, CO 80526 and [2]Northwest Experiment Station, University of Minnesota, Crookston, MN 56716. Sugarbeet germplasm with resistance to Rhizoctonia effective against several pathogenic isolates of *Rhizoctonia solani* AG-2-2.

The USDA program at Fort Collins has released sugarbeet germplasm with resistance to Rhizoctonia root and crown rot to the sugarbeet seed industry for over 30 years. Germplasm has been screened in the field by creating artificial epiphytotics with a pathogenic isolate of *Rhizoctonia solani* AG-2-2 (R-9). Isolates of *R. solani* AG-2-2 vary in virulence, and the concern has been raised whether *Rhizoctonia*-resistant germplasm withstands other highly virulent isolates. The objective of this study was to compare *Rhizoctonia*-resistant germplasm inoculated with *R. solani* AG-2-2 isolate R-9 (the Colorado standard) and four isolates of AG-2-2 that are very virulent on sugarbeet in Minnesota. In 1995, germplasm (six entries resistant to *Rhizoctonia* and a susceptible check) were evaluated in field trials at Fort Collins, CO and Crookston, MN. Crowns of 9- to 10-wk-old plants were inoculated with *R. solani* grown on barley grains that had been dried and ground. Roots were evaluated on a 0-7 scale (0=healthy, 7=plant dead) in September (CO) and October (MN). When the *Rhizoctonia*-susceptible entry was excluded from the ANOVA, there were no interactions among germplasm and isolates of *R. solani* AG-2-2 at either location. *Rhizoctonia*-resistant germplasm differed significantly (P=0.05) in severity of root rot, but followed the same trends at both locations. All isolates of *R. solani* AG-2-2 were equally virulent at both locations. Disease index values averaged across the germplasm entries were 1.4 (CO) and 2.3 (MN) and across isolates of *R. solani* were 1.4 (CO) and 2.5 (MN). Multigenic resistance of the USDA germplasm to Rhizoctonia root and crown rot of sugarbeet was stable against the highly virulent isolates of *R. solani* AG-2-2 in both locations.

PICCINNI, GIOVANNI, CHARLES M. RUSH, and MELISSA L. FAHNERT, Texas Agricultural Experiment Station, The Texas A&M University System, P. O. Drawer 10, Bushland, Texas 79012. Control of soilborne pathogens by managing irrigation of sugar beet.

Two soilborne sugar beet viruses known to occur in the Texas Panhandle, beet necrotic yellow vein virus (BNYVV) and beet soilborne mosaic virus (BSBMV), are transmitted by the fungus *Polymyxa betae*. The incidence and severity of diseases caused by soilborne viruses and fungi can be higher when a precise irrigation schedule is not followed. Fields are often irrigated excessively, based on the assumption that increasing the amount of water applied to the crop increases tonnage. However, this assumption is incorrect when field soils are infested with soilborne pathogens. The goal of this research is to identify the economic threshold of yield reduction due to soilborne pathogens in order to provide growers with useful information to maximize net return by saving water and energy and reducing chemical applications. An experiment was conducted in Bushland, Texas, in order to quantify the effects of different irrigation frequencies on sugar beet yield under disease pressure. Four irrigation regimes (every two, three, four and five weeks) and four inoculation treatments (BNYVV, BSBMV, BNYVV+BSBMV and non-inoculated control) were arranged in a split-plot design replicated four times. Crop growth, soil moisture, disease incidence, yield and sucrose content were evaluated. The treatment irrigated every four weeks showed the lowest disease incidence and a yield that was not significantly different from the treatment irrigated every two weeks. Also, sucrose content was significantly higher in the four-week irrigation treatment than in treatments irrigated every two and three weeks. Plots inoculated with BNYVV had a significantly higher disease incidence than BSBMV and BNYVV+BSBMV treatments. Yields were also significantly affected by the inoculation treatments. Beets in the BNYVV+BSBMV treatment had a significantly higher yield than beets in the BNYVV treatment.

POWERS, LYNN E., and GARY L. LARSON. Holly Sugar Corporation. 400 Main Torrington, WY 82240. Membrane pressure cavity filters and resultant lower moisture and sugar retention.

In 1994 two Putsch membrane pressure filters were installed at the Holly Sugar factory in Torrington, Wyoming, to lower moisture content of the Precipitated Calcium Carbonate that was being transported to the landfill and decrease sugar loss in the lime cake. A comparison study was made between the new membrane filters and the rotary vacuum filters formerly in use. Sugar losses in the limecake and moisture content of the P.C.C. were significantly reduced. Improved carbonation due to a higher quality filtrate and improved slacker control resulting from higher quality sweet water were noted in addition to lower water consumption and decreased fuel costs.

PRATT, JOHN B.[1], and JOHN E. SCHAEFFER,[2]*, KABO Chemicals Inc., P.O. Box 3236 Jackson Hole, WY 83301. Preserving sugar beets using Propionic Acid

Sugar loss during long term beet pile storage and long distance transportation accounts for major expense in the sugar beet industry. The object of this study was to determine if reduction in sugar loss can be obtained by using a proprietary blend of propionic acid and surfactant. Field tests were conducted in California on whole beets and beets chopped into four pieces, henceforth referred to as sliced beets. Treated beets were submerged in a solution of propionic acid for 2 minutes then allowed to remain outdoors, unprotected from direct sunlight for up to 13 days. Untreated beets were used as a control. All samples started at 15.6% sugar and 82.64% purity. No attempt was made to protect them from direct sunlight; daytime ambient temperatures were in excess of 110°F. Percent sugar and percent purity were tested on days 0, 4, 6, 11 and 13. The % sugar in the beet, sliced or whole, was higher after 6 days compared to that when the beet was first harvested. The increase in % sugar in all samples during the first six days was the result of dehydration as decreasing water content in the beet was evident. A marked decrease in % sugar began after day 6 in each of the untreated beet samples reaching a low of 8.55%. The % sugar in every treated sample was higher than the starting point throughout the entire test, reaching a high of 20.16% Propionic acid was instrumental in preserving sugar content in the sugar beet, *Beta vulgaris.* This increase in sugar content could produce a significant decrease in transportation costs for the sugar beet industry. In addition, tests will be conducted to determine the effectiveness of Propionic acid on piled and frozen beets.

PRINCE, JOHN, British Sugar plc, P. O. Box 26, Oundle Road, Peterborough PE2 9QU, United Kingdom. The commercial experience of primed advanced sugar beet seed (PAT) in the UK.

Adequate plant populations are important in maintaining consistently high yield in the UK. Early drillings in the UK can also lead to higher yields; a mean increase of 0.02 +/ha of recoverable sugar is gained for each day the drilling date can be brought forward in March. There is however increased risk in sowing in early March from (a) low and non-uniform plant population, and (b) a higher level of bolting, caused by exposure to cold and wet conditions. Priming advancement treatment was developed by Broom's Barn Experimental Station to help reduce the detrimental effect of these constraints to early drilling. (Durrant and Jaggard J Ag Sci (Camb), 1988 110; 367-374). In extensive field trials since 1988 British Sugar has evaluated PAT in combination with the commercial pelleting system. Using seed bulks of commercial quality, compared to standard (steeped) pellets. [1] PAT consistently speeds emergence, typically by 2-4 days at the 50% stage and under situation of high stress then 7 days advancing has been observed. [2] There is usually little effect on final establishment from a PAT treatment. [3] PAT increases foliage cover at the end of May and the amount of light intercepted by the crop, May and June. [4] Seed treated with PAT appears to have fewer bolters when the crop experiences fewer than 40 cool day (mean temperature below 12°C). PAT has been a commercially available treatment to UK growers for three years, produced as pelleted seed by Germains UK. Usage has increased from 600 units in 1995 to 10,000 units in 1997, particularly by growers in Eastern England who can normally drill early.

REARICK, D. E.* and C. MCKAY, Amalgamated Research Inc., 2531 Orchard Dr. E., Twin Falls, Idaho 83301. Determination of Betaine in Sugarbeet Byproducts Using Mid-range Infrared Spectrophotometry.

Sugarbeet byproduct solutions can be analyzed using conventional mid-range infrared (IR) spectrophotometry provided that analysis techniques and cell materials compatible with aqueous solutions are used. A zinc selenide horizontal attenuated total reflectance cell was used to record IR spectra of concentrated betaine byproduct solutions and molasses. Using various mathematical techniques, infrared absorbtion intensities characteristic of particular components, such as betaine, were correlated with component concentration. The advantages and disadvantages of this technique, relative to near infrared (NIR) analysis, will be discussed.

REGITNIG, PETER J., Rogers Sugar Ltd., 555 Hervo Street, Winnipeg, Manitoba, R3T 3L6. Nitrogen fertilizer rate x time of application studies.

Post emergence applications of nitrogen fertilizer were discouraged in Manitoba prior to the 1990's. With the advent of quality payment for sugar beets and the achievement of consistently higher plant populations over the past decade, the option of applying some nitrogen after planting was reevaluated. Five experiments were conducted between 1990 and 1992 to assess the effect of splitting the nitrogen fertilizer applied so a portion was added after sugar beets had emerged. Another six experiments were conducted between 1993 and 1995 to further evaluate splitting the nitrogen application, using a wider range of nitrogen fertilizer rates. 1990-92 tests indicated that splitting the nitrogen fertilizer application 2/3 fall:1/3 post emergence produced similar extractable sugar/acre (ESA) as applying all the recommended nitrogen fertilizer in the fall. Higher populations of sugar beets did not need greater amounts of nitrogen fertilizer than what was recommended, to obtain maximum ESA. A 1/3 lower than recommended nitrogen rate was sufficient for maximum ESA when low populations of sugar beets were established. 1993-95 tests also indicated that the timing of nitrogen fertilizer application did not significantly effect ESA or EST (extractable sugar/tonne) of sugar beets on soils with N recommendations ranging from 74 to 134 lbs N/acre. Splitting the nitrogen application produced comparable results to applying it entirely in the fall. Tests conducted from 1990-92 and from 1993-95 indicated that applying some of the nitrogen recommendation after planting, would be a reasonable option if a grower wanted to adjust the nitrogen rate once a population of sugar beets was established.

ROBERTS, EARL J. and MARGARET A. CLARKE*, Sugar Processing Research Institute, Inc., 1100 Robert E. Lee Blvd., New Orleans, Louisiana, USA 70124. Sugarbeet saponins and acid beverage floc.

Saponin from sugarbeet has been reported, for many years, as the causative agent of acid beverage floc. Recent work on isolation procedures for saponins from sugarbeet have shown that some procedures extract only a portion of saponin (oleanolic acid) and not the whole molecule. Further work on comparison with isolation of complete saponin is reported. Effects of saponin and oleanolic acid alone and in combination with other possible floc-causing compounds, on appearance of floc in beverages are reported. Possibilities for causes of acid beverage floc are discussed.

RUSH, CHARLES M.[1], KAREN-BETH G. SCHOLTHOF[2], and BRETT TELFORD[1], [1]Texas Agricultural Experiment Station, P.O. Drawer 10, Bushland, TX 79012, and [2] Plant Pathology & Microbiology Dept., Texas A&M University, College Station, TX 77843. Analysis of beet soilborne mosaic virus RNA 2 nucleotide sequence.

Beet soilborne mosaic virus (BSBMV), vectored by *Polymyxa betae*, is widespread throughout many of the major sugar beet production areas of the United States but has not been identified outside the USA. Over the last two years, sugar beets exhibiting typical symptoms of rhizomania but testing negative for beet necrotic yellow vein virus (BNYVV) and positive for BSBMV have been recovered from Texas, Colorado, Nebraska, and Minnesota. It is unknown whether the isolates of BSBMV associated with rhizomania-like symptoms cause these symptoms or whether the symptoms are due to environmental conditions or some other unidentified factor. In addition to possible similarities in symptom expression, there have also been reports of serological similarities. In an attempt to better understand the relationship between BSBMV and BNYVV, RNA 2 of BSBMV was cloned and sequenced and the sequence and genomic organization was compared to that of BNYVV. Six putative open reading frames (ORFs) were identified on BSBMV which were nearly identical in size and position to those of BNYVV RNA 2. Comparisons of amino acids encoded by each ORF from BSBMV and BNYVV indicated that the lowest match was 62% in ORF 6 and the highest was 90% in ORF 4. Sequence homology of BSBMV with other furoviruses rarely exceeded 30% similarity. These results indicate that BSBMV and BNYVV are more closely related to each other than to other furoviruses. Because of the genomic similarity between BSBMV and BNYVV, it would not be surprising if some isolates of BSBMV were able to cause severe disease similar to rhizomania in sugar beets.

SAUNDERS, JOSEPH W., USDA-Agricultural Research Service, Department of Crop and Soil Sciences, Michigan State University, East Lansing 48824-1325. Foliar disease lesion mimic mutants in sugarbeet.

Numerous mutations conditioning foliar lesions in the absence of pathogen exposure are known from maize, *Arabidopsis*, and barley. Two such mutant phenotypes have been recovered in our program at East Lansing. The first involves relatively large irregularly shaped necrotic patches on foliage, with inheritance as a monogenic dominant. It was recovered as a somaclonal variant from REL-1. The second mutant phenotype involves round lesions with watersoaked, necrotic, chlorotic, or heavily red pigmented appearance, depending on the individual plant examined, as does the lesion size. Senescing leaves are most likely to display the lesions, often in coalesced condition, but on severely affected plants incompletely expanded leaves can show individual lesions. Many affected plants appear to be senescing prematurely, with loss of photosynthetic area. Initial inheritance studies of this second mutant type indicate strong modifier gene involvement or incomplete penetrance, coupled with a recessive nature. A number of the disease lesion mimics from *Arabidopsis* and barley are associated with resistance to a number of pathogens, but this has not been examined in the case of the two sugarbeet mutants.

SAUNDERS, JOSEPH W.[1], AND CHIA-JUNG TSAI[1], [1]USDA-Agricultural Research Service, and [1]Department of Crop and Soil Sciences, Michigan State University, East Lansing, MI 48824. Genotype and abscisic acid promote somatic embryogenesis in sugarbeet callus.

Clone REL-2 was developed for superior embryogenesis and shoot regeneration, from a cross of biotech clone REL-1 with an embryogenic individual from EL45/2 (essentially SLC 133). REL-2 produces somatic embryos (SE) on primary leaf disc callus initiating on hormone-free medium. In suspension culture plating on hormone-free medium, REL-2 produces up to 35 times more embryos than REL-1. Plating experiments were conducted with combinations of abscisic acid with growth regulators 1-naphthaleneacetic acid (NAA), or 6-benzyladenine (BA), as well as with different sole nitrogen sources or sucrose concentrations with the goal of improving SE production. Higher BA concentrations included in the medium were associated with progressively fewer SE but more shoots. At some concentrations NAA, urea and glutamine individually stimulated greater SE production, but only for REL-1, where there was greater room for improvment. As a common factor in all tests, abscisic acid at some concentrations consistently improved SE production. Secondary embryogenesis, a desired potentially very efficient phenomenon, was not observed. REL-2 is available for application in sugarbeet biotechnology.

SCHLABS, CHARLES, STEVEN R. WINTER*, and CHARLES M. RUSH, Route 2, Box 44, Hereford, TX 79045, Texas Agricultural Experiment Station, P. O. Drawer 10, Bushland, TX 79012. A growers perspective on soil-borne disease management.

Soil-borne diseases have taken a huge toll on the Texas sugarbeet industry. Large scale production began in 1964. Rhizoctonia root rot was the only recognized soil-borne disease until Fusarium root rot was discovered in 1975. Severe losses at Schlabs farm and at research plots were first observed about 1980. Over the last 15 years, many farms with high yield potential have entirely ceased production due to disease pressure. Fusarium, Rhizoctonia, and Aphanomyces root rots, and Rhizomania are the primary disease problems. Problems with these diseases also seem to be increasing in other U.S. beet growing areas most of which are only slightly cooler than Texas. July mean temperature at Bushland is 76° compared to 70° to 75°F for most northern U.S. beet growing areas. At Schlabs farm, yields averaged 29, 27, 23, and 17 tons/acre for first through fourth beet crops on a 4-year rotation. A comprehensive disease management program has brought yields back to the 24 ton/acre range. The primary elements of this program are: an 8-year rotation, plant after summer fallow to minimize prior crop residues (primarily for Rhizoctonia control), thick stands in narrow rows planted early (double row 40-inch, 90,000 seed/acre, without thinning), one irrigation for emergence, never replant late, chisel telone 14 inches deep under each row 2 wks before planting at 8-10 gal/acre, delay first seasonal irrigation until July 1, irrigate no closer than a 3-wk interval during July and August, and plant a disease resistant cultivar. Telone has returned a little over two dollars for each dollar invested. Resistant cultivars can add 4 or 5 tons/acre to yield. Rhizoctonia and Rhizomania resistant cultivars have not worked well. The best cultivars appear to be Fusarium tolerant and seem to possess a generalized tolerance to our soil-borne disease complex. Choosing the proper cultivar and avoiding over-irrigation are the primary components of profitable disease management.

SCHOLTEN, OLGA E., RENÉ M. KLEIN-LANKHORST, DANNY G. ESSELINK, THEO S.M. DE BOCK, and WOUTER LANGE. DLO-Centre for Plant Breeding and Reproduction Research (CPRO-DLO), P.O.Box 16, 6700 AA Wageningen, The Netherlands.
Identification and mapping of random amplified polymorphic DNA (RAPD) markers linked to resistance against beet necrotic yellow vein virus (BNYVV) in *Beta* accessions.

Rhizomania is a major disease problem in many sugar beet growing countries in the world. The disease is caused by the beet necrotic yellow vein virus, which is transmitted by the soil borne fungus *Polymyxa betae*. Breeding for resistance to BNYVV is the only possibility to counteract the disease. Molecular markers linked to resistance against the virus are useful to facilitate the introgression of one or more of such genes in breeding materials. Following the approach of bulked segregant analysis, RAPD markers were identified in four *Beta* accessions Holly, R104, R128 and WB42. Two primers were found which generate RAPD markers tightly linked to resistance in segregating families of Holly, R104 and R128, indicating that the genes for resistance in these accessions might be situated at the same locus. However, other specific primers were identified which generate RAPD markers linked to resistance in only one of these accessions. Short-range maps were established around the resistance locus in these accessions. For WB42, RAPD markers were identified, which were located at a relatively large distance from the gene for resistance.

Scoresby, J. Rene, Dean Maruska, James Stewart, and Kevin Thorsness, AgrEvo USA Company, Little Falls Centre One, 2711 Centerville Road, Wilmington, DE 19808.
Betanex, Betamix, and Betamix Progress alone and Tankmixed with Upbeet for sugarbeet weed control.

During 1996 a comprehensive study was conducted to evaluate the herbicides Betamix, Betanex and Betamix Progress alone and in combinations with Upbeet for postemergence weed control in sugar beets. The trials were conducted in Idaho, Oregon, North Dakota and Michigan. Redroot pigweed, common lambsquarters, velvetleaf, chickweed, kochia, hairy nightshade, wild buckwheat and common mallow were present in the trials. In general Betamix, Betanex and Betamix Progress gave good control of lambsquarters, pigweed, chickweed, wild buckwheat and hairy nightshade and gave fair to poor control of kochia, velvetleaf and common mallow. Upbeet alone gave fair or poor control of lambsquarters, pigweed, chickweed and wild buckwheat and gave good control of kochia, velvetleaf and mallow. Tankmixes of Betamix, Betanex, and Betamix Progress with Upbeet provided good control of all weeds. Herbicides applied at lower than labeled rates, whether alone or tankmixed gave fair or poor control of the weeds. None of the herbicide treatments caused excessive sugar beet injury, however at higher herbicide rates more injury occurred than at lower rates of herbicides.

SMIGOCKI, ANN*, GORDON W. SNYDER, IRIS McCANNA, and LOWELL D. OWENS, USDA, ARS, Plant Molecular Biology Laboratory, Beltsville, MD 20705. Transgenic sugarbeets engineered for production of high cytokinin levels in the taproot.

Cambial initiation and rapid cell division periods in the developing sugarbeet taproot have reportedly been correlated with increased cytokinin levels. To evaluate the effect of increased endogenous cytokinin concentrations on vascular ring development and assimilate transport to the taproot, a bacterial cytokinin biosynthesis gene (*ipt*) was introduced into sugarbeets. To target expression of the *ipt* gene to the taproot, it was fused with a tuber-specific promoter from the patatin gene of potato. Particle bombardment was used to introduce the reconstructed *ipt* and a kanamycin-selectable marker gene into embryogenic hypocotyl callus. Shoots regenerated on kanamycin-containing medium required high auxin concentrations (3 mg IBA and 2 mg NAA per liter) for root initiation, presumably to compensate for the elevated cytokinin levels. One rooted transformant appeared normal except for a slight increase in adventitious shoot development. Another transformant was more difficult to root and exhibited other characteristic cytokinin effects, namely reduced apical dominance and dark green leaves. Southern blots of PCR products digested with various restriction enzymes confirmed the presence of the *ipt* and NPTII genes in these two transformants. Transgenic plants are being further analyzed for expression of the cytokinin gene and sucrose content.

SMITH, GARRY A.[1], JOHN D. EIDE[1], LARRY G. CAMPBELL[1], and LARRY J. SMITH[2], [1]USDA, Agricultural Research Service, 1307 North 18th Street, Fargo, ND 58105 and [2]Northwest Experiment Station, University of Minnesota, Crookston, MN 56716. Biological control of *Tetanops myopaeformis* (sugarbeet root maggot) using the entomopathogenic fungi *Beauveria bassiana* and *Metarhizium anisopliae*.

Sugarbeet root maggot is the most serious insect pest affecting sugarbeets in the upper Midwest. Potential loss of chemical controls and variable results with chemical controls led us to examine biological control measures. Our previous laboratory studies have shown the efficacy of the entomopathogenic fungi *B. bassiana* and *M. anisopliae* on first and third instar sugarbeet root maggots (SBRM). The fungi are also effective against adult flies. Six days after inoculation, mortality rates were 100% for *M. anisopliae* treated flies and 65% for *B. bassiana* treated flies. A three-year field study was initiated with *M. anisopliae* to determine persistence of the fungi over seasons and rotations. Autoclaved barley inoculated with *M. anisopliae* was dried and applied in the spring, fall, or fall plus spring in replicated field plots at Crookston, MN. Sugarbeets inoculated in the fall plus spring had significantly less damage than the control plots and had significantly greater recoverable sugar per acre (8073.6 lbs per acre) than the controls (6320.8 lbs. per acre). These plots also produced more recoverable sugar than Lorsban-treated plots, which averaged 7747.5 lbs per acre. The first year of field data shows that *M. anisopliae* applied in the right combination is as effective in controlling the SBRM as recommended chemical control.

SMITH, GARRY A.[1], LARRY G. CAMPBELL[1], and ARTHUR LAMEY[2]*, [1]USDA, Agricultural Research Service, Northern Crop Science Laboratory, Fargo, ND 58105-5677, and Dept. of Plant Pathology, North Dakota State Univ., Fargo 58105-5012. Current status of triphenyltin hydroxide tolerance in *Cercospora beticola* in Minnesota and North Dakota.

Triphenyltin hydroxide (TPTH) has been used extensively since 1981 in southern Minnesota and the southern Red River Valley of Minnesota and North Dakota following the development of resistance to the benzimidazole fungicides. Bugbee first reported *Cercospora beticola* L. strains tolerant to TPTH that were isolated from sugarbeets grown in southern Minnesota in 1994. In 1995, Bugbee surveyed TPTH tolerance in leafspot samples submitted by agriculturists in the seven factory districts of southern Minnesota and the Red River Valley; from south to north they were Renville, MN; Wahpeton, ND; Moorhead, MN; Hillsboro, ND; Crookston, MN; East Grand Forks, MN and Drayton, ND. The highest level of TPTH tolerance was in the Renville factory district in southern MN, followed by the Wahpeton district in the southern Red River Valley. In the Renville district 96% of samples were tolerant to 0.2 ppm TPTH and 93% were tolerant to 1 ppm TPTH. In the Wahpeton district 82% of samples were tolerant to 0.2 ppm TPTH and 68% to 1 ppm TPTH. In the Moorhead district, 18% of samples were tolerant to 0.2% TPTH and 15% to 1 ppm TPTH. Only a few TPTH tolerant samples were found north of Moorhead in 1995. Surveys in 1996 by Smith and Campbell revealed that TPTH tolerance was much more common farther north than in 1995. In 1996, 96% of Renville samples were tolerant to 0.2 ppm and also to 1 ppm TPTH, 95% of Wahpeton samples were tolerant to 0.2 ppm TPTH and 90% to 1 ppm TPTH, 80% of Moorhead samples were tolerant to 0.2 ppm TPTH and 60% to 1 ppm TPTH, 70% of Crookston samples were tolerant to 0.2 ppm TPTH and 37% to 1 ppm TPTH and 42% of Drayton samples were tolerant to 0.2 ppm TPTH. In contrast to percent samples, the percent of leafspots with tolerance to 0.2 ppm TPTH ranged from 80% at Renville to 10% at Drayton.

SMITH, JOHN A.[1], ROBERT G. WILSON[1], and GREGORY D. BINFORD[2], [1]University of Nebraska, 4502 Ave. I, Scottsbluff, NE 69361, and [2]Pioneer Hi-bred International, Inc., 64 Denny Circle, Newark, DE 19702. Seedbed preparation systems for improved emergence and yield of sugarbeets.

Distinct seedbed preparation systems for sugarbeet production have evolved in various regions of the U.S. and western Europe. One of the most important criteria for selecting a particular system is its reliability for providing rapid and high seedling emergence. Where soil moisture is limited or variable during the seedling emergence period, seedbed preparation systems are preferred that conserve soil moisture at seed depth and provide good seed-to-soil contact. This project compared eight seedbed preparation systems during three crop years with two tillage-planting dates each year. No irrigation was provided until after sugarbeets had emerged using existing soil moisture and natural precipitation. In general, systems that produced a firm seedbed at seed depth with minimal tillage in the spring provided higher and more consistent sugarbeet emergence than others tested. Systems that included extensive spring tillage and/or left a loose seedbed at the time of planting had generally lower sugarbeet emergence. Three of the systems included a tillage implement commonly used in Europe for sugarbeet production. This implement provided firm soil at seed depth, did not invert the soil, and tilled only the top 5 cm of soil to enable a consistent seedling emergence in conditions with limited soil moisture. Sugarbeet yields tended to be highest in treatments with the highest and most rapid emergence.

SMITH, LARRY J.[1], and DOUGLAS W. RAINS[2]*, [1]Northwest Experiment Station, University of Minnesota, Crookston, MN 56716 and [2]American Crystal Sugar Company, Crookston, MN 56716. Effect of three years of grid soil sampling and variable rate nitrogen application on sugarbeet yield and quality in the northern Red River Valley.

The conventional soil test of 20-30 random soil cores (0-4 ft) per field and a single blanket application of nitrogen (N) may result in underfertilization of areas in a field needed to optimize yield, and overfertilization of other areas resulting in reduced quality. Grid soil sampling coupled with variable rate N application should provide for a more balanced N fertility program. The objective in these trials was to 1) determine variability in nitrate-nitrogen NO_3-N levels (0-4 ft) across three fields used in commercial sugarbeet production and 2) determine if variable rate N application, based on grid soil sampling versus random soil sampling and single rate N application would increase yield, quality and profitability. Variability in NO_3-N levels (0-4 ft) across the commercial field used in the 1994, 1995 and 1996 trials ranged from 34-238, 45-144, and 25-643 lb/A respectively. If the conventional random soil test and single rate N application recommendation was followed, the fields would have been underfertilized by 79, 65 and 55 % respectively. Variable rate N application based on grid soil samples increased recoverable sucrose 573, 434 and 756 lb/A respectively.

SMITH, LARRY J, Northwest Experiment Station, University of Minnesota, Crookston, MN 56716. Nitrogen status changes in a three-year sugarbeet rotation following variable rate nitrogen application the sugarbeet year.

Variability in soil nitrate-nitrogen (NO_3-N) levels in commercial sugarbeet fields can affect yield and quality. Grid soil sampling and variable rate nitrogen (N) application in the sugarbeet year of the crop rotation have been suggested as a means to decrease soil NO_3-N variability in the rotation. The objective of this study was to follow the changes in NO_3-N status on a field with a 3-year rotation (sugarbeet, wheat, barley) that had been grid soil tested and variable rate N fertilized in the sugarbeet year of the rotation. NO_3-N in the four-foot soil profile prior to sugarbeet ranged from 35-238 lb/A. Following the sugarbeet crop, the variability decreased to 11-431 lb/A, but increased to 69-250 lb/A following a conventionally fertilized wheat crop. Following the barley crop, to which no additional N was applied, NO_3-N variability ranged from 19-194 lb/A.

SNYDER, GORDON W., JOHN C. INGERSOLL, and LOWELL D. OWENS. USDA/ARS, PMBL, Bldg. 006 BARC-W, 10300 Baltimore Ave., Beltsville, MD 20705. Genetic transformation of sugarbeet using particle bombardment and novel plant pathogen defense genes.

Several transgenic sugarbeets have been produced each containing genes encoding pathogen-defense related proteins under transcriptional control of stress or wound inducible promoters. Promoters used in this study included the CaMV 35S, and those derived from genes encoding osmotin and pathogenesis related protein-S (PR-S) from tobacco, and proteinase inhibitor II (Pin II) from potato. The promoters were cloned 5' to cDNA's encoding either β-glucuronidase (GUS), osmotin, PR-S, barley leaf thionin, or cecropin. A sugarbeet transformation method has been developed using embryogenic callus generated from seedling hypocotyls. To date plants have been recovered which carry the following chimeric genes: 35S-GUS, osmotin-GUS, osmotin-osmotin, osmotin-cecropin, PinII-thionin, PinII-cecropin, PrS-thionin, osmotin-osmotin/osmotin-cecropin. GUS activity in the osmotin-GUS plant while in tissue culture was found to be constitutive with expression 10 times the level found in the 35S-GUS plant with no wound induction. When the plant was transferred into soil, the constitutive level of GUS expression in the leaf was found to be very low. However, GUS activity was inducible by wounding of an excised leaf, with activity peaking at about 48 hours. Most of the plants have been transferred to soil and are being tested for their response to infection by known sugarbeet pathogens.

SULLIVAN, SHAWN, WILLIAM B. KIENZLE, and HARRY CHEN, Holly Sugar Corporation, P.O. Box 700, Torrington, WY 82240. Source testing of pulp dryer and other sources for ammonia emissions to air.

Ammonia is produced at low concentrations during processing of sugar beets, principally by the saponification of glutamine. Ammonia must be reported annually by sugar beet factories under Emergency Planning and Community Right-to-Know Act requirements as a Toxic Release Inventory chemical to the Environmental Protection Agency (EPA) as well as state and local emergency response agencies. Emission fees are charged by some states and additional state or federal regulation is expected in the near future. Determining total ammonia emissions is complicated by the multiple potential sources including pulp dryers, carbonation units, evaporators, lime slaker, rotary vacuum filters, cooling towers, diffuser, in addition to multiple phase discharges of gas and liquid. Very little actual ammonia emission data is available for these sources. Current ammonia emission estimates are usually based on amino nitrogen content of the sugar beets. Source testing of pulp dryer, first and second carbonation units and second and third evaporators for air emissions was conducted using EPA's proposed ammonia method, M-27. Results of these tests, potential effects on ammonia emission estimates and a discussion of additional information needed to further quantify ammonia emissions are included.

TELCK, ALAN B., Holly Sugar Corporation, 2 North Cascade Ave., Colorado Springs, CO 80903.
Holly Hybrid's use of the Internet as an Intranet.

The Internet and e-mail serve as powerful mediums for sending and receiving information. The Internet is a network linking computers throughout the world to each other. This same network can be used for internal communication and, in this manner, is referred to as an Intranet. Holly Hybrids, a division of Holly Sugar, has launched a site on the World Wide Web to help growers receive current information about sugar beet varieties, pests, diseases, and pesticides. In addition, growers are able to link to the National Agricultural Library, sugar market sites, general weather sites, and other sugar company sites. Agricultural support is provided to growers via an e-mail link on the homepage. Holly Hybrids is using e-mail and telnet to distribute sensitive harvest information, data from the AgTrak® agricultural information system, and weather information provided by "in house" weather services. In this manner growers are compelled to access information which assists with timely and interactive agronomic decision making. Because the Internet is not limited to specific hardware or software, the network allows rapid communication at a very low cost when compared to traditional means of communication.

Transgenic sugar beet tolerant to glyphosate, development of Roundup Ready™ sugar beet.

Paul Tenning[1], Marie Mannerlöf[2], Stig Tuvesson[1] and Thomas Nickson[3].
1. Hilleshög AB. P.O. Box 302, S-261 23 Landskrona, Sweden; 2. Hilleshög NK, 12 Chemin de l'Hobit, BP 27, F-31 790 Saint Sauveur, France; 3. Ceregen, a unit of Monsanto Company, 700 Chesterfield Parkway North, St Louis, Missouri, 63198 USA

Hilleshög NK and Monsanto has invested years of research in the develpment of Roundup tolerant sugar beet. Yield trials are now being performed with advanced elite material. Before these hybrids are released on the market, a risk assessment is performed. Such a risk assessment addresses a number of aspects, including a molecular and biochemical characterization of the transgenic plant. This molecular evaluation relates to issues such as a precise determination of the introduced DNA, an estimation of the amount and safety of proteins expressed from the introduced genes, an evaluation of the number of integrated loci and the mendelian inheritance pattern of the introduced genes. And finally a determination of the stability of the integrated DNA and expression of the genes over several generations in a breeding program. The results of this molecular risk assessment will be presented.

THOMAS, KELLY J. , and CLYDE R. TRUPP, American Crystal Sugar Company, 5061 Ustick Rd., Nampa, ID 83687. Effect of gaps on experimental variety plot yield and sugar estimations of sugar beet.

A major problem in obtaining reliable yield data in experimental variety tests is properly accounting for gaps (missing beets) within individual plots then adjusting for this missing plot area correctly. This research was initiated to determine a technique that can be utilized to adjust for gaps within individual plots and their effect on neighboring plots without compromising the reliability of the data.

Two varieties differing in canopy type were established in two row plots using a split plot design and thinned to a normal stand. Eleven gap treatments were created in the right row of the odd numbered plots constituting the gap treatments. By default the even numbered plots became the effect of the gap treatment in the odd numbered plot to the left. Two main gap treatment groups were included, 1) treatments where twelve feet of total plot length was missing using varying sizes and numbers of gaps, and 2) three foot gaps ranging from 1 to 9 per plot.

Yield and sugar data demonstrate the result of gaps of various size and number within a plot and their effect on neighboring plots. Differences on the order of ten percent decrease or increase respectively for gap plots and effect of gap plots were recorded when no adjustment was imposed. Success at correcting for gaps using various methods will be discussed.

THORSNESS, KEVIN B.,DEAN MARUSKA,JIM STEWART, KEVIN STASKA, and PAUL MAYLAND, AgrEvo USA Company, Wilmington, DE 19808. Liberty Herbicide for Weed Control in Transgenic Sugar Beet.

Weed control is an important aspect of sugar beet production. The current herbicides labeled for use in sugar beet are limited by their weed spectrum and in some cases weed size at application. Liberty Herbicide is a non-selective postemergence herbicide with no soil residual and is being developed by AgrEvo USA Company for use on transgenic sugar beet (Liberty Link Sugar Beet). Liberty Link Sugar Beet have been genetically altered by insertion of the phosphinothricin-acetyltransferase (pat) gene and are tolerant to Liberty Herbicide. The pat gene encodes for an enzyme that detoxifies Liberty Herbicide in the Liberty Link Sugar Beet plant. Field experiments were conducted in 1995-1996 at various locations to evaluate weed efficacy and tolerance of Liberty Link Sugar Beet to Liberty Herbicide applications. Liberty Herbicide at 14-34 oz/a was applied to 1, 3, and 5" weeds and applications were repeated 2 more times when newly germinated weeds reached the original size. Weed species present in the trials were redroot pigweed, common lambsquarters, kochia, wild oat, green foxtail, and barnyardgrass. The plots were not cultivated or hand weeded. Weed control with Liberty Herbicide was better when applied to 1" weeds compared to 3 or 5" weeds. Liberty Herbicide at 14 and 17 oz/a gave 85 and 90% overall control of 1" weeds, respectively. However, Liberty Herbicide at 21-34 oz/a gave greater than 95% overall control of 1" weeds. Liberty Herbicide applications to Liberty Link Sugar Beet did not cause any visible injury. Liberty Herbicide will provide sugar beet growers with a tool to produce sugar beet without hand labor and with less or no cultivation.

LASZLO TOTH[1], JOHN SAGASER[2], RON ENGLAND[3], The Western Sugar Company, 1700 Broadway, Suite 1600, Denver, CO 80290. [1] Director, Technical Training & Development, [2] Process Engineering Manager, [3] Director Engineering & Process Technology. Reduced lime Juice Purification System - LIMEX.

In the Beet Sugar industry the most commonly used method for raw beet juice purification is based upon the addition of lime and carbon dioxide. Conventional juice purification systems require an addition of 1.7% to 2.5% CaO on beets which secures various physical and chemical reactions in non sugar elimination. In this work a new juice purification system is described which is based on "MZ method of raw juice purification", patented in the Czech Republic and applied in some European countries as well as in the USA. The new method requires not more than 1.0% to 1.1% of lime on beets (45 to 50 % CaO on nonsugars) to perform with technological results comparable to conventional juice purification systems. The theoretical basis of the new method, Engineering, technological experience and the consequent beneficial economics are presented, based on the Western Sugar's Bayard, Nebraska factory full scale run during the campaign of 1995/96.

The average lime consumption in the Bayard factory before the LIMEX project was 1.8% on beets, after the application of LIMEX regeneration during the campaign of 1995/96 this was reduced to 1.15% on beets. The new lime reducing scheme, which is based on first carbonation sludge recirculation, sludge impurity separation and regeneration is described in conjunction with the actual economic and ecological impact on the factory operation.

TUVESSON, STIG[1], BENSEFELT, JAN[1], TENNING, PAUL[1], and SIMANTEL, GERALD[2], [1]Hilleshög AB, P.O. Box 302, S-261 23 Landskrona, Sweden, and [2]Hilleshög Mono-Hy Inc., 11939 Sugarmill Road, Longmont, Colorado 80501. Yield trials with Roundup Ready™ sugar beet.

During extensive tolerance tests, different transgenic sugarbeet lines with high tolerance to the herbicide Roundup® (active ingredient glyphosate) have been identified. The tolerance genes are crossed into Hilleshög NK conventional elite MS's and pollinators. When introducing the gene into a wide range of sugar beet lines, also including special disease tolerance traits such as Rhizomania-T, Cercospora-T, Nematode-T and Curly Top-T, there will be varieties adapted for different geographical areas, to the coming market introduction.

Several field trials were performed during 1996. Yield trial results from France (2 locations), UK, Denmark and USA will be presented. Data from previous years have shown that breeding of Roundup Ready™ varieties have reached the same level, in yield and quality, as the best conventional varieties.

WANG, SHAOKE[1], BARRY J. JACOBSEN[2], SEBASTIAN KIEWNICK[2], AKIO SUZUKI[1], and DALE YEAROUS[1], [1]Seedex, Inc. 1350 Kansas Avenue, Longmont, CO 80501, and [2]Montana State University, Bozeman, MT 59719. The response of sugarbeet germplasm to fusarium yellows under field and greenhouse condition:

Fusarium Yellows is a fungal disease on sugar beets in several beet growing areas throughout the Western United States. To determine the response of sugar beet germplasm to this disease, both greenhouse and field nurseries were conducted in 1996. All beet germplasm were evaluated by inoculation in the greenhouse at early seedling stage and by planting beets in the field which showed severe disease on sugar beet for many years. The results indicated that most germplasm were susceptible to the disease at various degrees. Those germplasm lines with tolerance to the disease did not show any sign of single gene inheritance (dominate or recessive). In general, Tetraploid materials showed better tolerance than their equivalent diploid lines, and higher ploidy materials, showed more tolerance than diploidy ones. The data analysis suggested that the tolerance of sugarbeets to this disease is quantitatively inherited. The correlations between greenhouse and field evaluation will also be discussed.

WHITE, ASHTON, R.[1], and LESTER STEINBRECHER[2], [1]Parker Amchem, 32100 Stephenson Hwy, Madison Heights, Michigan 48071, and [2]Henkel/Parker Amchem, 140 Germantown Pike, Suite 150, Plymouth Meeting, PA 19462. Corrosion inhibitors -- theoretical aspects and practical uses in industrial cleaning of equipment and fish toxicity studies of raw materials used in conventional acid inhibitors and development of inhibitors of low toxicity.

Corrosion inhibitor mechanism is explained on the basis of an electrochemical corrosion cell formed on the metallic surface. Cathodic and anodic inhibitors are described and mechanisms of metallic corrosion protection offered. Parameters considered when testing and evaluating inhibitors are shown and most significant results obtained are given. The importance of the geometry of the inhibitor is explained. Fish toxicity studies of raw materials used in conventional acid inhibitors are described. The selected inhibitor components chosen for the study and the resulting TL_{50} values for 24 and 98 hours are given. Accompanying the TL_{50} values are relative inhibitive strength of each of the ingredients. The development of new acid inhibitors of low toxicity will also be described.

WIDNER, J. N.[1], G. C. WISLER[2], J. E. DUFFUS[2], H. Y. LIU[2], and J. L. SEARS[2], [1]Southern Minnesota Beet Sugar Cooperative, E. HWY 212, P.O. Box 500, Renville, MN 56284, and [2]USDA-ARS, 1636 E. Alisal St., Salinas, CA 93905.
A new report of Rhizomania and other furoviruses infecting sugar beet in Minnesota: part I. field observations.

Several sugar beet fields in the Southern Minnesota Beet Sugar Cooperative growing area showed patches of unusual pale greenish-yellow foliage in early August that did not resemble other known disorders. The roots from these areas showed various degrees of sprangling, stunting, and proliferation of feeder roots. Serological evaluations of suspect roots showed positive infection of Rhizomania, caused by the beet necrotic yellow vein virus (BNYVV) and other furoviruses. The distribution of infected fields was not isolated to any general area, which indicates that the virus has been present and multiplying in previous sugar beet crops. Severity of infection ranged from mild symptoms with near normal yields and sugar content to moderate to severe root stunting and low sugar content.

WILSON, ROBERT G., University of Nebraska, 4502 Avenue I, Scottsbluff, NE 69361.
Glufosinate-ammonium for selective weed control in herbicide tolerant sugarbeets.

Weeds are one of the most important pest limiting sugarbeet production. The objective of this experiment was to determine the efficacy of glufosinate-ammonium (Liberty) in selectively controlling weeds growing with sugarbeets. The experimental design was a randomized complete block with three replications. Glufosinate-ammonium tolerant sugarbeets were planted on April 24. The first herbicide application occurred when sugarbeets were in the cotyledon to two-true-leaf stage of growth. Herbicide treatments were also applied when the crop was in the four, six, and eight-true-leaf stages of growth. Herbicides were applied with water at 16.6 gallons per acre (155 L/ha). At later growth stages sugarbeet leaves were chloric in color for several days following treatment with glufosinate-ammonium. The injury was temporary and plants quickly recovered. Sugarbeet root yield and sucrose percent of sugarbeets treated with glufosinate-ammonium were similar to plants treated with desmedipham plus phenmedipham plus ethofumesate (Betamix Progress). A single application of glufosinate-ammonium at 0.45 lb/acre (0.5 kg/ha) controlled 95% or more of the common lambsquarter, wild buckwheat, common sunflower and Russian thistle present in plots. Two applications of glufosinate-ammonium at 0.36 lb/acre (0.4 kg/ha) were required to control 99% of the above mentioned weeds plus redroot pigweed, hairy nightshade, kochia, barnyardgrass and green foxtail.

WILSON, ROBERT G., University of Nebraska, 4502 Avenue I, Scottsbluff, NE 69361.
Response of nine sugarbeet varieties to split applications of postemergence herbicides.

Field experiments were conducted in 1995 and 1996 to determine the response of nine sugarbeet varieties to four commonly used postemergence herbicide treatments. The sugarbeet varieties examined were Monohikari, Turbo, Laser, Beta 1399, KW 2398, KW 1492, KW 2262, HMI 6176, and ACH 184. The weed control treatments were desmedipham plus phenmedipham (Betamix) at 0.17 plus 0.17 lb/acre, desmedipham plus phenmedipham plus clopyralid (Betamix plus Stinger) at 0.17 plus 0.17 plus 0.09 lb/acre, desmedipham plus phenmedipham plus ethofumesate (Betamix Progress) at 0.13 plus 0.13 plus 0.12 lb/acre, desmedipham plus phenmedipham plus triflusulfuron (Betamix plus Upbeet) at 0.17 plus 0.17 plus 0.016 lb/acre, and desmedipham plus phenmedipham plus sethoxydim (Betamix plus Poast) at 0.17 plus 0.17 plus 0.28 lb/acre plus a nontreated control. Herbicides were applied twice, once when sugarbeets were in the cotyledon growth stage and again when the crop was in the two-true-leaf growth stage. Sugarbeet varieties differed in reductions in plant vigor, leaf area, root yield, and sucrose percent caused by herbicide treatment. The response of different sugarbeet varieties to herbicides varied between years. In 1995 the greatest contrast in herbicide injury was between the sugarbeet varieties Monohikari and KW 2398, with Monohikari experiencing more herbicide injury than KW 2398. In 1996 more herbicide injury was observed on the sugarbeet variety HMI 6176 compared to Monohikari, Laser, Beta 1399, KW 2398, KW 2262, and ACH 184. In 1995, May and June air temperatures were lower and rainfall greater than the long-term average, and under these conditions desmedipham plus phenmedipham plus triflusulfuron caused more crop injury than the other herbicide treatments. In 1996, with near average May and June air temperatures and precipitation, desmedipham plus phenmedipham plus ethofumesate caused more early season crop injury than the other herbicide treatments.

WINTER, STEVEN R., Texas Agricultural Experiment Station, P. O. Drawer 10, Bushland, TX 79012. Sugarbeet root aphid management in Texas.

Sugarbeet root aphids are a serious pest in Texas. Losses as high as 50% reduction in both root yield and sucrose concentration have been observed. More commonly, susceptible cultivars will suffer losses of several tons/acre plus about 2% points loss in sucrose. Losses are aggravated by dry soil (limited irrigation) and seem to be greater on soils that crack severely when they dry. In furrow irrigated fields, damage may be greater on the lower (drier) end of the field. Insecticides have not been successfully used for control. Cultivars that give nearly complete protection are available. These cultivars have been used with no loss in protection for nearly 20 years. Field selection of cultivars and breeding lines for resistance has been fairly easy and successful most years. Rating can be done by direct examination of the roots or by observation of the amount of white wax in the soil.

WISLER, G.C.[1], J.N. WIDNER[2], J.E. DUFFUS[1], H.Y. LIU[1], and J.L. SEARS[1], [1]USDA-ARS, 1636 E. Alisal St., Salinas, CA 93905, and [2]Southern Minnesota Beet Sugar Cooperative, E. Hwy 212, P.O. Box 500, Renville, MN 56284. A new report of Rhizomania and other furoviruses infecting sugar beet in Minnesota. Part II: laboratory analyses.

Fields planted in sugar beet in Southern Minnesota showing patches of yellowing, upright leaves, reduced root size, and root proliferation characteristic of Rhizomania were evaluated for beet necrotic yellow vein virus (BNYVV) and other sugar beet furoviruses. ELISA tests and western blot analyses using both specific and broadly reactive antisera and recovery by mechanical inoculation of *Chenopodium quinoa* and *Beta macrocarpa* positively identified BNYVV in 59/90 beet samples tested. Beets showing leaf symptoms of vein clearing, vein banding, mosaic and vein necrosis were all identified as being infected with beet soil-borne mosaic virus (BSBMV) only. No systemic leaf symptoms of BNYVV were found in any sample. The BSBMV isolates were identical to one another based on symptomatology of indicator plants and identical molecular weights in western blots (ca. 24 kDa), but symptoms were distinct from other members of the BSBMV serogroup isolates previously studied from Texas, Idaho, Nebraska, and Colorado. The beet soil-borne virus (BSBV) was also recovered by mechanical inoculation and western blot analysis (antisera donated by R. Koenig) in three samples from field collected beets. This is a new report of BNYVV, BSBMV, and BSBV in Minnesota.

WOZNIAK, CHRIS A.[1], and LOWELL D. OWENS[2], [1]USDA, Agricultural Research Service, Northern Crop Science Laboratory, Fargo, ND 58105, and [2]USDA, Agricultural Research Service, Plant Molecular Biology Laboratory, Beltsville, MD 20705. Tungsten-mediated hydrolysis of β-glucuronide substrates following microprojectile bombardment.

Metal microcarriers of gold, silicon carbide and tungsten are used in microprojectile bombardment for the introduction of DNA into plant cells. During the development of a transformation protocol for sugarbeets, it was noted that a blue precipitate was formed following the use of tungsten microcarriers in the absence of *gusA* DNA, which encodes β-glucuronidase (GUS). Further evaluation indicated that tungsten microspheres were capable of catalyzing the hydrolysis of X-gluc, salmon X-gluc, and magenta X-gluc, the histochemical substrates used for detection of GUS. Tungsten microspheres accelerated into sugarbeet cells resulted in a blue precipitate when X-gluc assays were prolonged (>24 hours) and gave rise to blue-stained cells. The fluorogenic substrate 4-methylumbelliferyl β-D-glucuronidase (MUG) was similarly hydrolyzed in the presence of tungsten microspheres in the absence of DNA. Gold microspheres and silicon carbide fibrils did not result in hydrolysis of any of the β-glucuronide substrates tested. Incubation of MUG with millimolar concentrations of Cu^{2+}, Fe^{2+} and Zn^{2+} also resulted in hydrolysis. Heat and protease treatments of tungsten microcarriers, along with standard microbiological analysis, ruled out the presence of contaminating proteins and microbes, respectively. Attention to the use of tungsten microcarriers, metal ions of Cu, Fe and Zn at millimolar concentrations, and the length of incubation during histochemical assays is indicated. The use of DNA-minus and microcarrier-minus controls is recommended when using tungsten microspheres.

YONTS, C. DEAN, University of Nebraska, Panhandle Research and Extension Center, 4502 Avenue I, Scottsbluff, Nebraska 69361. Late Season Irrigation Management for Sugarbeet.

Water for irrigation is a concern whether it is due to increased pumping costs, depletion of ground water, or competition for surface water resources. As a result, irrigated agriculture production must become more efficient in the use of current water supplies. The objective in this study was to determine the effect of late season water stress on the production of sugarbeet. Sugarbeet plots were established under furrow and sprinkler irrigation systems. Irrigation treatments included full irrigation to harvest, limited irrigation after August 15 and no irrigation after August 15. For the 1995 and 1996 seasons, the results show that sugarbeet content, root yield and sugar production were not affected by reducing or stopping irrigation late in the growing season.

YU, M. H., USDA-ARS, U.S. Agricultural Research Station, 1636 East Alisal St., Salinas, CA 93905. Improvement of sugarbeet genotypes with root-knot nematode resistance.

Sea beet, *Beta maritima* L., has the closest phylogenetic relationship with sugarbeet (*B. vulgaris* L.) when compared to any other beet species. The two *Beta* plants are being proposed to combine into one species, simply by reclassifying sea beet as *B. vulgaris* subsp. *maritima* L. or *B. vulgaris* var. *maritima* L. Hybridization crosses between the two species are, thus, easily achievable via exchange of pollination bags. The sugarbeet root-knot nematode resistance, which was identified from rare occurring sea beet sources, has been transferred to sugarbeet through such approach. In the progeny population, phenotypic expression of certain undesirable sea beet characteristics remained. Nonetheless, the sprangled root structure and annual bolting traits have become less intense and sucrose content heightened as additional breeding efforts were built in. Further selection and improvement is underway to develop sugarbeet genotypes with high levels of root-knot nematode resistance and productivity.

ZIEVERS, JAMES F.[1], PAUL EGGERSTEDT[1], PARUL PATEL[1], ELAINE DOHNAL[1], JEFF MILLER[1], and ELIZABETH C. ZIEVERS[2], [1]Industrial Filter & Pump Mfg. Co., 5900 Ogden Ave., Cicero, IL 60804, and [2]Universal Porosics, Inc., 1240 Carriage Lane, La Grange, IL 60525. Dry scrubbing off gases with waste beet lime and other waste products and complete removal of particulate.

The successful use of porous ceramic barrier filters (PCBF) for particulate removal from incinerator off gas has been reported previously. PCBF are ideally suited to work with dry scrubbing systems. This fact has also been previously reported. Continuing research effort has shown that products previously considered waste products can be successfully applied as dry scrubber material for removal of SO_2, H_2S, HCl, and other contaminants. Performance is often superior to conventional dry scrubber additives such as CaO, $Ca(OH)_2$, and $CaCO_3$. Among the materials to be reported on are basic oxygen furnace (BOF) dust, zinc smelter dust, tin oxide dust, cement plant dust, and beet sugar waste lime. Economics and methods of delivery of dry scrubbing materials to the barrier filter system will also be discussed.