American Society of Sugar Beet Technologists

ABSTRACTS

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ANDERSON, ALBIN W. AND ROBERT B. CARLSON, Department of Entomology, North Dakota State University, Fargo, ND 58105. - Forecasting emergence and activity of the sugarbeet root maggot in the Red River Valley.

Day degree accumulations have been used to forecast adult root maggot activity in previous years with some success. These predictions used ambient temperature and a sine wave calculating method with a lower threshold of 47.5° F and an upper threshold of 99°F. With this procedure, the first 80° day following accumulation of 600 DD usually coincided with peak activity in new beet fields. The weakness in this method has been use of temperature data from distant locations and differences between ambient and soil temperatures being dependent on year. Establishment of a network of weather stations, sticky-stake sampling for flies and temperature data on a "next day" basis has renewed our interest in forecasting. Access to soil temperatures has prompted examination of soil-DD to fly emergence as a tool which would give warning of pending fly activity in new beet fields. Studies in the laboratory indicate a DD accumulation of 450 (based constant daily temperature and a threshold of 47° F) correlated with 50% emergence of adults. In the past two years, peak activity in fields from which adults are emerging has occurred near the time of 450 DD accumulation based on average soil temperature and a 47° threshold. Peak activity in current beet fields then occurred 4 to 10 days later when temperatures reached near 80°. Timely prediction of fly activity and populations, along with effective post-emergence treatment options may lead to reduced treatment at planting.

Barnum, J. Mike and Clinton C. Shock, Malheur Experiment Station, Oregon State University, 595 Onion Ave., Ontario, Oregon 97914.- Water use efficiency for sugarbeet production.

In response to concerns over sugarbeet irrigation efficiency, trials were conducted in 1992 and 1993 at Ontario, Oregon. The objectives were to determine what yield and sugar losses might result if irrigation was discontinued approximately 6 or 10 weeks prior to the normal mid September termination date and to compare production under full season furrow versus full season sprinkler irrigation. The following irrigation strategies were tested: 1) furrow, full season; 2) furrow, full season with one-half the water; 3) furrow, terminated July 1; 4) furrow, terminated July 1 plus one recharge irrigation; 5) furrow, terminated August 1; and 6) sprinkler, full season. Sugarbeets, WS PM-9, were planted on 22 inch row centers on both bottom soil (shallow water table) and bench soil (deep water table) in each year. Over two years significantly more beets and sugar were produced under the full season furrow strategy than under the July 1 or August 1 termination strategies. On bottom soil the mean beet and sugar yields, respectively, were: full season furrow, 35.8 and 5.5 t/ac; July 1 termination, 20.0 and 3.0 t/ac; and August 1 termination, 27.6 and 2.4 t/ac. On bench soil the mean beet and sugar yields, respectively, were: full season furrow, 30.6 and 4.4 t/ac; July 1 termination, 15.8 and 2.4 t/ac; and August 1 termination, 19.6 and 3.0 t/ac. Over both sites and years, full season sprinkler beet and sugar yields averaged 35.3 t/ac and 5.3 t/ac, respectively, while full season furrow yields averaged 33.5 t/ac and 5.0 t/ac. Full season sprinkler irrigation used 36 percent less water. On bottom soil the two year mean beet and sugar yields/ac.ft. of water for sprinkler irrigated beets were, respectively, 19.2 and 19.0 percent greater than on bench soil.

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The FCB Continuous Vacuum Pan

FCB continuous vaccum pan presents special features such as the number of compartments, feeding of liquor, anti clogging devices, control principle, allowing its use on every kind of massecuite, from low purity to refined strikes. Particularities of calandria, combined with the continuous process make of this pan a major equipment for energy saving.

BINFORD, G.D., T.M. BLACKMER, and J.S. SCHEPERS, University of Nebraska, 4502 Avenue I, Scottsbluff, NE 69361, Keim Hall, University of Nebraska and USDA-ARS, Lincoln, NE 68583. - Remote sensing techniques for characterizing nitrogen stress in sugar beets.

Nitrogen management practices have a major impact on the profitability of sugar beet production. Various techniques have been developed for monitoring the nitrogen status of a sugar beet crop at selected times during the season. Remote sensing is a technique that has potential for monitoring the nitrogen status of sugar beets during the season. Recently a procedure was developed that utilizes an adequately fertilized reference strip and remote sensing technology for improving nitrogen management practices in corn. Remote sensing could be especially useful when variable rate technology is used for applying fertilizers. Our objective in this study was to evaluate the potential of using remote sensing to characterize the nitrogen status of sugar beets. Canopy reflectance was measured with a spectroradiometer at various times during 1993 and 1994 on nitrogen rate experiments (10 rates; 4 replications); aerial photographs were also taken from these experiments in 1994. Reflectance measurements were significantly influenced by degree of nitrogen stress. These reflectance measurements, however, were not consistent throughout the season. Greatest differences in reflectance measurements among treatments tended to occur near the 675 nm wavelength. Good relationships were observed between sugar yields and digitized aerial photographs; the best relationships were observed in the red wavelengths. Preliminary results would indicate that remote sensing can identify differences in nitrogen status in a controlled study and can be used to identify problem areas within fields, but it's use as a direct tool for managing nitrogen in sugar beets is uncertain.

BINFORD, G.D., and A.D. BLAYLOCK, University of Nebraska, 4502 Avenue I, Scottsbluff, NE 69361 and University of Wyoming, 747 Road 9, Powell, WY 82435. - Relationship between in-season soil nitrate concentrations and sugar beet yields.

Recent studies in the Corn Belt have shown good relationships between corn yields and concentrations of nitrate in the surface 12-inch layer of soil when corn plants are 6 to 12 inches tall (i.e., presidedress). The value of this test is that it is essentially an "in-situ" mineralization test, which can allow adjustment in fertilizer N rates for amounts of N mineralized during the spring. This test should have potential for any high N using crop, such as sugar beets. The objective of the study reported here was to evaluate the potential of using an in-season soil test for improving N management during production of sugar beets. Six N rate studies were utilized in Nebraska and Wyoming during the 1993 and 1994 seasons. Ten rates of N (0 to 270 lb N/acre; 4 replications) were applied at each location as broadcast ammonium nitrate in the spring shortly before planting sugar beets. Soil samples were taken from the surface 12-inch layer of soil in two-week intervals from early May through July and analyzed for nitrate concentration. Relationships between yields and concentrations of soil nitrate tended to improve with time. The optimum sampling time appears to be somewhere between mid-May and late June. The critical concentration of soil nitrate in the surface 12-inch layer of soil appears to be near 22 ppm N, and surprisingly, does not appear to change significantly between mid-May and mid-June.

Bosse, Dietrich, BMA AG, P.O. Box 3325, 38022 Braunschweig/Germany - A new tower pulp press:

It has been a long-standing objective to improve mechanical dewatering of pulp to reduce energy requirements for the downstream drying process. It has been common practice to use a large number of horizontal double-spindle presses for this purpose. To improve efficiency, a high-capacity press was developed on the basis of the following design parameters: - Low pressure, - Extended pressing time, - Internal shearing in the screen area at a low relative pulp to screen velocity, - Large open screen area. This objective was reached by the construction of a vertical press, which avoids the bending stress on the spindle and screen basket encountered in horizontal presses. In summation: the outstanding technical, technological and economical features are:

Technically: low-pressure principle, hence • reduced pulp destruction, • less fine pulp, • less energy consumption, • minimized wear, • low maintenance and repair cost; technologically: • optimized removal of press water through perforated spindle and screen basket, • self-cleaning effect, • negligible infections, • reducing sugar losses, • no need for screen rinsing, • very clear press water due to extremely low pulp destruction, reducing fine pulp content; economically: • small floor space requirements, i.e. • optimum installation in connection with extraction tower, • short conveying distances, • no steel structures required, only a baseplate.

MARK BREDEHOEFT*, A. G. DEXTER, AND J. L. LUECKE. SOUTHERN MINNESOTA BEET SUGAR COOPERATIVE, RENVILLE, MN 56284*, NORTH DAKOTA STATE UNIVERSITY AND UNIVERSITY OF MINNESOTA, FARGO, ND 58105. ECONOMICS OF SOIL APPLIED AND POSTEMERGENCE HERBICIDES APPLIED ALONE AND IN COMBINATION.

There are multiple management practices that are considered each year and management of weed control is always a concern of producers. The primary concerns are to use or not to use preemergence or postemergence herbicides. Economics determine many management decisions pertaining to weed control. Trials were conducted in 1994 with soil applied and postemergence herbicide on sugarbeets and lambsquarter. Experimental units were hand weeded after herbicide applications were completed. Hand weeding labor cost and cost of herbicide for each treatment was calculated in consideration of economics.

Frontier gave twice the sugarbeet injury compared to other preplant herbicides but also tended to give higher revenue. Ro-Neet at 2.66 pints per acre gave common lambsquarters control similar to Ro-Neet at 5.33 pints per acre.

Postemergence herbicides increased control of common lambsquarters so that 50% rates of preplant or preemergence herbicides plus postemergence herbicides gave common lambsquarters control similar to 100% rates of preplant or preemergence plus postemergence herbicides. Stinger added to Betamix significantly increased common lambsquarters control compared to Betamix applied alone.

Revenue tended to be directly related to weed control. Revenue tended to be as high or higher with 50% rates of Eptam + Ro-Neet plus Betamix + Stinger or Betamix Progress compared to 100% rates of Eptam + Ro-Neet plus Betamix alone.

BRIMHALL, PHIL B., Michigan Sugar Company, P.O. Box 107, Caro, MI 48723. - Effects of applied factory waste lime on crop yields grown on high pH soils.

Two studies in 1989, one in 1990 and one in 1993 were initiated to determine the effect of factory waste lime on yields on soils with high pH readings. All studies had a pH reading above 7.5. Rates of lime were 0 ton, 1 ton, 2 tons and 4 tons per acre. Plots were 30 ft. by 30 ft. and arranged in a Latin-square design. Lime used in these studies had an average analysis of 89.6% neutralizing value, calcium carbonate equivalent of 1270 lbs. per cubic yd., 2.9% magnesium carbonate and a sieve analysis of 92.6% thru an 8 mesh, and 58.2% thru a 100 mesh screen. At all locations, lime was applied in the spring and incorporated into the top 3-5 inches of soil. Dry edible beans were always the first crop planted after lime application. The reason for planting dry beans the first year was that if high rates of lime on high pH soil was going to have an adverse effect, it would likely show up on dry beans. Crops grown after the first year varied among locations, but included sugarbeets, winter wheat and beans. The addition of lime had the most effect on increasing soil pH the first year after application. The effect of the 3 lime rates 1, 2 and 4 tons per acre had no significant effect on crop yield at any location or crop year after application. Even though there were no significant effects at any location, the average of the 4 locations showed a trend for higher crop yields with all 3 rates of lime applied. The conclusions drawn from these studies were: Application of factory waste lime on high pH soils had no adverse effect on crop yields. No visual differences in crop growth or color could be observed between treatments.

BUGBEE, W.M., C.A. WOZNIAK, and G.A. SMITH, USDA, Agricultural Research Service, Northern Crop Science Laboratory, PO Box 5677, State University Station, Fargo, ND 58105-5677. A two-way approach to improve root rot resistance.

Pectin lyase, produced by *Rhizoctonia solani*, was found associated with crown and root rot on sugar beet. The sugar beet also was found to produce a pectin lyase inhibitor protein (PNLIP). The behaviour of PNLIP in controlled experiments prompted efforts to pursue the goal of manipulating PNLIP for enhanced root rot resistance. Polyclonal and monoclonal antibodies to PNLIP were used to probe sugar beet cDNA libraries. Transformed *E. coli* colonies were lifted with nitrocellulose membranes, lysed directly on the membranes and probed with antibodies. The monoclonals appeared to be more specific than the polyclonals. Colonies whose lysates reacted positively with monoclonals, were electrophoresed and the protein bands were electroblotted to nitrocellulose. None of these fractionated bands reacted with the monoclonals. Nine amino acids at the amino terminal of PNLIP were sequenced. Two oligonucleotides were synthesized based on the amino acid sequence and will be used in further efforts to isolate the PNLIP-encoding DNA. The polyclonal and monoclonal antibodies were used in a double antibody sandwich ELISA protocol to estimate the PNLIP content in small samples of sugar beet extract. Plants with high or low levels of PNLIP were cloned by apical meristem culture. Clones were interpollinated to create four synthetic lines. In a small greenhouse trial, the effect of this selection technique was not conclusive.

CAMPBELL, L. G., and G. A. SMITH, USDA, Agricultural Research Service, Northern Crop Sciences Laboratory, Fargo, ND 58105-5677. - The association of Cercospora resistance and yield in commercial hybrids.

Incorporating disease resistance while maintaining or increasing yield and quality is a constant challenge for plant breeders. This task is more difficult if the disease is not simply inherited, such as Cercospora leaf spot (Cercospora beticola) of sugarbeet (Beta vulgaris). This study examines the trade-off between Cercospora resistance and performance. Forty hybrids, all recommended for Cercospora-threat areas, were grown at Fargo, North Dakota (no Cercospora) and at Ft. Collins, Colorado (inoculated with Cercospora) in 1991 and 1992. Diseases severity (0 = none to 9 = severe) was recorded at Ft. Collins. Root yield was measured at both locations. Regression analysis indicated that Fargo root yields increased 1.2 ton/acre for each increment of increased susceptibility. A 1.3 ton/acre decrease for each increment of susceptibility indicated that under the severe epidemic at Ft. Collins in 1991 Cercospora resistance provided substantial protection. Under a moderate epidemic in 1992 there was no apparent relationship between yield and resistance at Ft. Collins, suggesting that the benefits of resistance were similar to the yield potential sacrificed to obtain the resistance.

CARLSON, HARRY L.[1]*, and KENNETH A. RYKBOST[2], [1]University of California Intermountain Research and Extension Center, P.O. Box 850, Tulelake, CA 96134 and [2]Klamath Experiment Station, Oregon State University, Klamath Falls, OR 97603. - Effect of planting date and plant population on beet and sugar yield in the Klamath Basin.

Sugarbeet production is a new industry to the Klamath Basin of Southern Oregon and Northern California. The region has a high desert climate characterized by a short growing season with warm days and cool nights. Because sugarbeet yields are limited by the short growing season, it was assumed that early stand establishment would result in increased yields; although, it was further assumed that stand establishment would be more difficult under the cool, wet conditions typical in early spring. To test these assumptions, a series of sugarbeet planting date experiments were conducted from 1991 to 1993 at Klamath Falls, Oregon and Tulelake, California to determine the effect of date of planting on beet and sugar yields. While the sugar percentage in the beets was unaffected by planting date, beet yields declined with each delay in planting. Beet yield, total sugar production per acre and gross profits dropped 1.75 T/A, 660 lb/A and $100/A respectfully for each week planting was delayed after May 1. Studies with varied plant populations, conducted in 1994 demonstrated that growers may be better off with poor stands established early in the season than with good, replanted stands established three weeks later in the season.

CARTER, RICHARD A., Great Lakes Sugar Company, 1101 North Front Street, Fremont, OH 43420. - Influence of pure and varied stands of weeds on yield of sugarbeets. This study was conducted to determine the yield loss associated with varied weed pressure. The weed species, velvetleaf(Abutilon theophrasti Medic.) and redroot pigweed(Amaranthus retro flexus), were manipulated, one at each of two test locations. Each site consisted of four replications of five varied weed densities(0,10, 20,30,and 40 weeds per 100 ft.) on 30 inch rows. Once established, the plots were maintained until harvest. Both root yield and percent sugar were statistically analyzed using an RCB analysis. Generally, there was a ton of yield loss per acre for each 10 weed increment per 100 ft. of row. There was no significant change in percent sugar.

Allan W. Cattanach, Extension Sugarbeet Specialist, North Dakota State University and University of Minnesota, Fargo, North Dakota. - Factors affecting stand establishment in the Red River Valley.

Optimum plant populations promote maximum yields of high quality, high yielding sugarbeets in Minnesota and North Dakota. Tare lab and field determination of harvestable root numbers indicate growers frequently harvest 5,000 to 10,000 fewer roots per acre than is optimum. Field research/demonstration experiments were conducted in 1993 at the University of Minnesota, Northwest Experiment Station to dramatize to growers factors effecting stand establishment. Factors evaluated included (1) sugarbeet planter maintenance; (2) planter operating speed; (3) starter fertilizer rate; (4) broadcast fertilizer rate; (5) and planting depth. Other recent research determined effects of herbicide application rate, and rate and method of insecticide application on sugarbeet yield and quality. Use of excessive planter operation speed decreased sugarbeet stand establishment by 13%. Emergence was reduced 31% by excessive planting depth. Poor plate planter maintenance reduced plant establishment by 12%. Broadcast urea nitrogen applications of 100 and 200 lb/A reduced plant emergence by 12 and 30% respectively. Use of higher than recommended modified in-furrow liquid starter fertilizer reduced sugarbeet stand by 23%. Improper rate or method of use of insecticides reduced sugarbeet stand establishment by 10 to 50%.

Allan Cattanach, Joseph Giles, Norman Cattanach and John Lamb. Soil Science Departments, North Dakota State University and University of Minnesota. - Primary tillage effects on soil susceptibility to erosion after sugarbeet harvest.

Erosion damages hundreds of thousands of acres of arable land producing low residue crops in MN and ND each year. An annual sugarbeet grower survey showed the tillage tools used after the 1991 harvest were chisel plows, disks, field cultivators, and deep tillage tools; 48, 24, 14, and 7 percent respectively. Six experiments were conducted to determine effect of tillage after sugarbeet harvest on subsequent crop yields, percent ground cover, surface roughness, and soil aggregate size. Use of a field cultivator after beet harvest increased residue cover by 72 percent versus untilled checks. Residue cover was increased by 22 percent with a disk and 10 percent with a chisel plow, but reduced 85 percent with a moldboard plow. Field surface random roughness was greatly increased by moldboard plowing and significantly increased by the chisel plow and disk operations. Soil aggregate geometric mean diameter (GMD) in the fall was greatly increased by moldboard plowing and small increases occurred after fall tillage with a disk and chisel plow. Tillage with a field cultivator after beet harvest had almost no effect on soil aggregate GMD. Overwinter weathering processes reduced GMD of aggregates about 20-50% for the no-till, chisel, disk, and field cultivator treatments. GMD remained above the 0.84 mm minimum particle size erosion threshold for all operations in all years. Grain yields the year following fall tillage were not affected by treatment at any location.

CHERRY, R.*[1], K. NOAH[1], K. BARRETT[1], K. HIEB[2], and M. FOWERS,[2], [1]Idaho National Engineering Laboratory, PO Box 1625, Idaho Falls ID 83415-2203, and [2]Amalgamated Sugar Co., PO Box 127, Twin Falls ID 83303. - Microbiology of flume systems and its role in odor generation.

Odor generation by beet processing plants can present a major community relations problem. To find ways of controlling these odors, we conducted a study of the evolving microbiological, chemical, and process conditions in the flume system of an operating plant at three different times during the 1994-95 campaign. This plant uses flume water to transport and wash beets and also to absorb SO_x compounds from a coal-fired scrubber on a beet pulp drier. The water system is anaerobic and, despite pH levels as high as 10, contained high counts of fermentative and sulfate-reducing bacteria (SRBs). Fermentative bacteria convert sugars to organic acids in the absence of oxygen. By the start of February, the total organic acid content of the flume water was 2.2%, mainly acetic (1.48%), propionic (0.21%), and lactic (0.36%). SRBs use these acids to reduce sulfate from the scrubber to hydrogen sulfide. This hydrogen sulfide remains as nonvolatile HS^- ion when a high pH is maintained, but when pH drifts towards 7 the HS^- shifts to H_2S which can then volatilize. Furthermore, in the flue gas scrubber the sorption of SO_x reduces the water pH to 6, shifting all the HS^- to H_2S which is stripped out by the flue gas. As H_2S, though, it does not appear in analyses for SO_x. Our main recommendations include better control of the water pH at high levels (pH 9-10) and minimizing sugar spills into the flume. Aeration to remove carbon sources and to reoxidize HS^- to sulfate can be considered.

CHRISTENSON, DONALD R., AND M. B. BUTT, Crop and Soil Sciences Department, Michigan State University, East Lansing, MI 48824. - Differential response of sugarbeet to applied nitrogen following corn and navy bean.

Crop rotations affect the amount of crop residues returned to the soil and the amount of nitrogen needed for sugarbeet. This study was conducted to determine the effect of nitrogen rate on sugarbeet yield and quality when sugarbeet followed corn compared to following navy bean. Sugarbeet plots in a long term cropping systems study were split and 4 nitrogen rates (0, 40, 80, and 120 lb N/acre) were applied. Leaf area during the growing season and yield and quality at harvest were measured. Leaf area of beets 14 weeks after planting following corn was approximately 70% of when following navy beans. Increasing nitrogen rate did not compensate for the slower growth. Yield of sugarbeet was 3 tons less following corn at 80 lb N/acre and 2 tons less at 120 lb N/acre. Recoverable sugar was 730 and 350 lb/acre less at 80 and 120 lb rates, respectively. Preliminary evidence suggests that sugarbeet requires 30 lb N/acre following navy beans than following corn. However, it does not appear that the difference can be completely compensated for with additional nitrogen. Earlier evidence showed that an interaction between carry-over Bladex used on corn and Pyramin used on sugar beet may be a factor in the yield difference. Sugarbeet following corn had more fibrous roots and smaller leaves than following navy beans. Greenhouse data showed a decrease in fibrous root:tap root dry weight ratio when Bladex and Pyramin were applied to sugarbeet.

CLARKE, NIGEL A.[1], HELEN M. HETSCHKUN[1], MELANIE REDFEARN[1], VALENTINA NAUMENKO[2] and TUDOR H. THOMAS[1]*, [1]IACR-Broom's Barn, Higham, Bury St Edmunds, Suffolk IP28 6NP, UK, and [2]Institute of Cell Biology and Genetic Engineering, Ukrainian Academy of Sciences, Kiev, Ukraine. - Responses and tolerance of sugar beet to stress.

A biochemical test has been devised which is at least as accurate as current methods for determining seed vigour, particularly under conditions of field stress. Tests are also being developed that can be used in breeding programmes to improve the stress tolerance of sugar-beet plants. Leaf discs are subjected to either heat shock, water deficiency stress or UV irradiation and stress tolerance is subsequently determined from their chlorophyll fluorescence signals. The parameter F_v/F_p (the ratio of variable to peak fluorescence) is proportional to the quantum efficiency of light utilisation by the thylakoids and can be used to quantify the extent of damage. Evaluation of 22 commercial sugar-beet varieties indicates that reductions in F_v/F_p due to stress can vary up to ten-fold, providing a useful indication of their potential stress tolerance. The use of excess nitrogen fertiliser in the field can mask yellowing symptoms caused by beet yellows virus (BYV) and beet mild yellowing virus (BMYV). However, the effects of the virus on yield are equally severe whether the symptoms are masked or not. The apparent health of the high nitrogen, virus infected leaves seems to be due to elevated chlorophyll synthesis which is not matched by an increased pool of PSII electron acceptors.

CLARKSON, VERN[1]*, CAROL GABBERT[1], JAMES SCHUELLER[1], SARAH GALT[2], CARYN JOHNECHECK[2], KENT MCREYNOLDS[2], and JEAN-PIERRE MONCLIN[3],
[1]SOUTHERN MINNESOTA SUGAR BEET COOPERATIVE, RENVILLE, MN 56284, [2]THE DOW CHEMICAL CO., MIDLAND, MI 48674 AND [3]CAMECO INDUSTRIES INC., JEANERETTE, LA 70544.
- THE BEET SUGAR FACTORY OF THE FUTURE.

The traditional procedure for producing thin juice from raw juice is through the use of lime followed by carbonation. An alternative process for production of thin juice will be discussed in this paper. Preliminary results using SELECTFLO**CMF membranes for raw juice clarification followed by DOWEX**OPTIPORE** adsorbent for removal of color, odor, taste and viscosity components will be presented. Initial results indicate that the process does produce a thin juice-like product with some potentially significant advantages. These advantages include, no limestone waste, higher thin juice purity, higher sugar recovery and lower operating costs.
** - Trademark of The Dow Chemical Co.

ABSTRACT

J.P. CLAUDE, DuPont de Nemours Belgium, Mercure Center, Rue de la Fusée 100, B-1130 Bruxelles / Belgium
DPX 66037, a new tool for weed control in sugarbeet : the European approach.

DPX66037, triflusulfuron-methyl is a selective post-emergence sulfonylurea herbicide for weed control in sugarbeets which has been commercially launched in France and Belgium in 1994. Some of the keys of the product positioning were : DPX 66037 is the broadest spectrum sugarbeet herbicide active with particular strenghts against several difficult weeds. It forms the building block of a program of tank-mix treatments with reduced rate of a range of partners. DPX 66037 is taken through both leaves and roots giving it contact and residual activity. The breakdown characteristics of DPX 66037 mean that it gives appropriate residual weed control in sugarbeet without risk of damage to following crops. In total 90.000 ha have been treated with DPX 66037 in France and Belgium in 1994 (15 % of the ha planted), the product being used in mixture in 92 % of the cases. In all cases PMP was part of the mixes, metamitron being mixed for 55 %, chloridazon for 15 % and lenacil for 10 %. The product was used mainly at early crop stages and was fully integrated in existing programs, replacing mainly ethofumesate and clopyralid in mixtures with reduced rates of the tank mix partners. Market surveys revealed also a trend to reduce pre-emergence when DPX 66037 is used in post programs. The level of user satisfaction was, both for weed control, efficacy and crop safety, more than 85 %. The perceived reasons of satisfaction being for 70 % broad sprectum herbicide, 15 % crop safety, 10 % easy to use and 5 % low rate product.

CROOK, TERESA M. Research Agronomist, Michigan Sugar Company, Carrollton, MI 48724.
Sugarbeet response to zinc in Michigan.

ABSTRACT

Zinc's availability decreases as soil pH increases. "Deficiency is especially noted on crops growing on spoil-banks, over tile lines where calcareous sub-soil is mixed in, or where high rates of phosphorus are applied." The objective of this research was to determine if sugarbeet yield or quality responded to soil applied zinc under high soil pH conditions coupled with elevated phosphorus levels. This research was conducted at three locations within each of three years (nine location-years). Zinc was applied broadcast at planting time by spraying a soluble zinc source dissolved in water onto the soil surface. Zinc rates were 0 (untreated check), 5, 10, 20 lb Zn/acre. Over the nine location-years, soil pH ranged from 6.8 to 7.8; phosphorus (P_2O_5) ranged from 76 to 434; and zinc (ppm) ranged from 3.9 to 14.0. Yield (tons/a) and harvest population (B/100) were determined from 27 feet of harvested row. Percent sugar (% sugar) and amino-nitrogen (NH_2-N) were determined from a frozen juice sample taken from plot sub-samples. No interactions existed between zinc rate and location-year. Treatments averaged 5868 recoverable white sugar per acre (RWSA); 21.7 tons/a; 19.0 % sugar; 108 B/100 ft and 10.2 meq/100g sugar NH_2-N. Sugarbeets did not respond in yield or quality to 5, 10, 20 lb Zn/acre applied under high soil pH conditions coupled with elevated phosphorus levels compared to the untreated check.

ABSTRACT

DELOREY, DEAN C., The Amalgamated Sugar Company, P.O. Box 87, Nampa, Idaho 83653-0087 - Experience with Title V Air Operating Permits.

Major stationary sources in the United States (with potential to emit 100 tons/year of any regulated air pollutant) are required to have operating permits per Title V of the 1990 Clean Air Act Amendments. States with Federally approved programs will administer these permits. Title V operating permits will be significantly more detailed and complex than previous permits issued by State regulatory agencies and will require verification of compliance. All beet sugar production facilities will likely require Title V operating permits due to intensive fuel energy use. The requirements for permit applications and permits are outlined as well as experience with the first Title V permit application submitted in our industry. Permit fees paid to the regulatory agency are also outlined. The primary challenges of the Title V operating permit rules and regulations are to permit the emission sources at their highest operating capacity, ensure that each source and facility is in compliance with the rules and regulations, and to minimize annual permit costs.

DEXTER, ALAN G., and JOHN L. LUECKE, Department of Plant Sciences, North Dakota State University and the University of Minnesota, Fargo, ND 58105, WILLIAM E. LUESCHEN AND JODIE K. GETTING, University of Minnesota, Southwest Experiment Station, Lamberton, MN 56152. - Herbicide carryover into sugarbeet.

Sugarbeet is susceptible to relatively low levels of carryover of several herbicides used in rotational crops in eastern North Dakota and Minnesota. Experiments were initiated in 1989, 1990, 1992, and 1993 on a silty clay soil with 5.7% organic matter and pH 8.0 near Fargo, ND. Plots were evaluated visually but were not harvested. Nicosulfuron at 0.06 or 0.125 lb/A applied in 1989 caused sugarbeet injury in 1990 but not in 1991. Primisulfuron at 0.03 or 0.06 lb/A applied in 1989 caused sugarbeet injury in 1990 through 1993 but not in 1994. Chlorimuron at 0.004 lb/A applied in 1990 caused sugarbeet injury in 1991, 1992, and 1993 but not in 1994 while 0.008 lb/A still caused 14% injury in 1994. Metribuzin at 0.25, 0.5 and 1.0 lb/A and imazamethabenz at 0.15, 0.3 and 0.6 lb/A applied in 1989 caused sugarbeet injury in 1990 but not in 1991. Imazethapyr at 0.06 or 0.12 lb/A applied in 1989 caused sugarbeet injury in 1990 and 1991, but no significant injury in 1992. Observations of commercial fields suggests longer imazethapyr carryover in soil with pH 6.0 to 6.5 than was observed at Fargo in the pH 8.0 soil. Flumetsulam applied in 1991 injured sugarbeet in 1992, 1993 and 1994 in a pH 6.5 soil at Northwood, ND (Dow-Elanco Experiment) while no sugarbeet injury was observed on the pH 8.0 soil at Fargo one year after application in 1992 or 1993. AC 299,263 at 0.063 lb/A did not significantly injure sugarbeet one year after application at Fargo on a pH 8.0 soil or at Hector, MN on a pH 8.1 soil.

DEXTER, ALAN G., and JOHN L. LUECKE, Department of Plant Sciences, North Dakota State University and the University of Minnesota, Fargo, ND 58105, and MARK W. BREDEHOEFT, Southern Minnesota Beet Sugar Cooperative, Renville, MN 56284.- UpBeet efficacy in eastern North Dakota and Minnesota.

UpBeet (triflusulfuron, DPX-66037) is a new sulfonylurea herbicide which should be registered for use in the United States in 1996. UpBeet was applied alone and in combination with other herbicides at several locations to determine weed control and sugarbeet injury and compare UpBeet to available herbicides and combinations. UpBeet is not a broad spectrum herbicide so it usually will be used in combination with another herbicide such as Betanex (desmedipham) or Betamix (desmedipham + phenmedipham). Betanex + UpBeet gave better control of redroot pigweed, wild buckwheat, common mallow, green and yellow foxtail, and kochia compared to Betanex alone. UpBeet was especially effective on kochia, even when used without Betanex or Betamix. Betanex + UpBeet and Betanex + Stinger (clopyralid) gave sugarbeet injury similar to Betanex but Betanex + UpBeet + Stinger gave more sugarbeet injury than Betanex. Weed control from UpBeet alone generally was improved by a spray adjuvant but weed control from Betanex + UpBeet generally was not improved by a spray adjuvant. However, kochia control from Betanex + UpBeet + Stinger was improved by the adjuvants R-11 or Scoil. Sugarbeet treated with Betanex + UpBeet + Stinger + Scoil yielded less than sugarbeet treated with Betanex + UpBeet + Stinger.

Doley, William P., American Crystal Sugar Company, Beet Seed Division, 1700 North 11th Street, Moorhead, MN 56560. - Field tests of glyphosate tolerant transgenic sugar beets in the Red River Valley.

Through our cooperation with Maribo Seed Intl of Denmark, American Crystal's Beet Seed Division conducted field tests of glyphosate tolerant transgenic sugar beets in 1993 and 1994. All transgenic lines provided by Maribo were developed using an *Agrobacterium*-mediated technique. Each transformation event inserts the transgenes in a unique position in the genome, and we refer to each family derived from a transformation event as a position type or positype. In both years, we conducted a small replicated yield trial and a nonreplicated demonstration trial, with allocation of positypes to the two trials based solely on seed availability. There were sprayed and non-sprayed plots of each positype in the yield trials, but only sprayed plots in the demonstration trials. The 1993 test near Hillsboro, ND, included 13 positypes, 4 of which were in the yield trial. Dramatic differences due to position effects were observed after application of 0.75 pt/A glyphosate. The response varied from no damage to killed. Four positypes (58, 59, 32, 33) in the demonstration trial had root yields exceeding the check. The 1994 test near Kindred, ND, included 6 positypes, 5 of which were in the yield trial. Transgenic lines in the yield trial were sprayed with either 0 or 1.5 pt/A glyphosate, while some plots in the demonstration trial were sprayed with 3.0 or 6.0 pt/A. Root yields of three positypes (19, 58, 77) sprayed with 1.5 pt/A glyphosate exceeded the checks. Neither root yield nor sucrose content of these three lines were reduced by glyphosate treatment. The level of expression of glyphosate tolerance is considered to be commercially acceptable, and positype 77 is now on track for commercialization.

DONEY, D. L.[1], and R. J. HECKER[2], [1]USDA, Agricultural Research Service, 1307 North 18th Street, Fargo, ND 58105, and [2]USDA, Agricultural Research Service, Retired, Ft. Collins, CO 80526. - USDA/ARS sugarbeet releases.

It wasn't until the 1920s, due to the catastrophic losses caused by the curly top virus, that the USDA became significantly involved in sugarbeet breeding. Early efforts were located at Salt Lake City, UT and Riverside, CA. Additional breeding stations were added at Salinas, CA, Beltsville, MD, Ft. Collins, CO, East Lansing, MI and Fargo, ND. Smog forced the relocation of the Riverside station to Salinas, CA in the 1960s. The Salt Lake City station was transferred to Logan, UT in 1961; and it was closed in 1983. Breeding at Beltsville, MD was discontinued following the retirement of Gerald Coe in the mid 1980s. The first USDA releases were for curly top resistance, however, the division of breeding responsibilities among USDA breeders has been in response to disease problems, generally related to specific areas. Additional efforts have focused on bolting resistance, cytoplasmic male sterility, O-type maintainers, high combining ability for sugar and root yield, smooth roots, and integration of germplasm from wild sources. The development of monogerm and cytoplasmic male sterile lines by USDA breeders have been landmark achievements for the industry and are of world wide importance. Early releases (cultivar or hybrid) were for commercial use, however, recent efforts have been directed toward parental lines and/or enhanced germplasm. Prior to 1955, releases were shared with industry with little documentation. Between 1956 and 1970, releases were released to the Beet Sugar Development Foundation and published in the Sugarbeet Research Report (Blue Book). Since 1971, an official ARS release document, signed by all involved agencies, has been distributed to all interested parties. Most have been registered in Crop Science and many deposited in the National Seed Storage Lab (NSSL) at Ft. Collins. Since 1987, releases registered in Crop Science have been deposited in NSSL, received a permanent identification number (PI) and included in the GRIN database. All releases deposited in NSSL have been catalogued in GRIN. A listing of all releases (834) along with codes, citations, and limited descriptions has been prepared. While it is difficult to measure the impact USDA/ARS sugarbeet releases have had on industry, it is obvious that they are a major factor in the survival and stability of the sugarbeet industry.

RAPD MARKER FREQUENCY CHANGES ASSOCIATED WITH SUGAR AND PIGMENT CONTENT IN TWO BEET POPULATIONS MODIFIED VIA RECURRENT SELECTION

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Abstract
Utility and extractability of betalain pigments from red beet is dependent upon native concentrations of both pigment and total dissolved solids (sugars). In an effort to develop red beet populations with elevated levels of betalain pigment and decreased levels of solids, recurrent half-sib family selection for high pigment and both high and low solids was practiced for seven cycles. This scheme resulted in the development of a high pigment-high solids and a high pigment-low solids population. Thirty-one RAPD primers were used to assess Random Amplified Polymorphic DNAs marker frequencies on genomic DNA samples isolated from 47 randomly-chosen individual plants in each of cycles 1, 3, and 6 in both populations. A total of 161 Random Amplified Polymorphic DNA markers were evaluated. Chi-square tests revealed a subset of markers which exhibited significant frequency changes across cycles and suggested these changes were associated primarily with selection. Selection was more effective in changing pigment concentration than solids content, however the two populations represent a 3% mean difference in solids values. Population-specific marker frequencies may indicate linkage of markers to genes controlling pigment or solids in red beet.

Eckhoff, J.L.A., and J.W. Bergman, Montana Agricultural Experiment Station, Eastern Agricultural Research Center, PO Box 1350, Sidney, MT 59270. - Strip tillage for seedbed preparation of irrigated sugarbeets.

Seedbed preparation for sugarbeets can result in bare soil with little protection against erosion. Strip tillage is one way to conserve residue on the soil surface while preparing a sugarbeet seedbed. Strip tillage and conventional tillage of plowing, mulching, and leveling were compared at MSU Eastern Agricultural Research Center in Sidney, MT, under furrow flood irrigation. Half the field was strip tilled and half the field was conventionally tilled. In the strip tillage system, small grain produced in the year previous to sugarbeets was grown on corrugations and furrow irrigated. After grain harvest, the field was irrigated and weeds were sprayed with glyphosate. In late fall, 8-inch strips were tilled on the tops of the beds, leaving 16 inches of standing stubble between strips. Ethofumesate was incorporated when the strips were tilled. Sugarbeets were planted to stand directly into the tilled strips the following spring. Stubble between the rows was strip tilled after emergence and sugarbeets were cultivated conventionally. Several nitrogen rates and schedules were tested. Root yield, sucrose content, and impurities were measured, and gross sucrose yield and estimated sucrose yield were calculated. Strip tillage produced higher quality sugarbeets yielding less than the conventionally produced sugarbeets. Sucrose yields did not differ. Amino-N content was significantly lower under strip tillage. These studies indicate that strip tillage can be used as a conservation tillage method for sugarbeets. Studies to improve reduced tillage methods for sugarbeet production are continuing.

EDYE, LES A.*, and MARGARET A. CLARKE, Sugar Processing Research Institute, Inc., 1100 Robert E. Lee Blvd., New Orleans, LA 70124 - Automated analysis by near infrared (NIR) spectroscopy in the sugarbeet factory and tare lab.

Analysis of NIR transmission spectra and factory laboratory data of beet factory process streams, collected during the past three beet campaigns in North America, has resulted in the development of universal calibrations for the determination of purity in diffusion, thin and thick juices. Similar analysis of NIR reflectance spectra (in cuvettes) and tare laboratory data of beet brei, collected over the same period, has revealed the potential for the application of NIR spectroscopy to beet quality measurement. Furthermore, our NIR prediction model for pol in brei (correlation coefficient (RSQ) = 0.96, standard error of prediction (SEP) = 0.60 % w/w, 6 factories) is comparable to results of the models developed by other investigators in Northern Europe (RSQ = 0.975, SEP = 0.13 % w/w, 1 factory) and the United Kingdom (RSQ = 0.96, SEP = 0.18 % w/w, 1 factory). However, the method using cuvettes and a bench top spectrophotometer is unsuited to the tare lab since it can not keep pace with the tare lab analysis rate. A fibre optic reflectance probe (FORP), with potential application to automated analysis, was tested during the last beet campaign in North America. Due to attenuation in the optical fiber the high wavelength sucrose absorptions were not exploitable, and therefore, a new calibration model based on partial least squares (1500 to 1900 nm) was developed. The RSQ decreased in the new calibration model (from 0.96 for cuvettes to 0.895 for FORP) and the SEP increased (from 0.20 % w/w, 2 factories for cuvettes to 0.40 % w/w, 2 factories for FORP). An investigation of the source of errors contributing to the SEP of the FORP measurements showed that the main source of error was due to the small sampling surface of the FORP (*ca.* 0.31 $inch^2$) (Mean Differences: duplicate pols = 0.21 % w/w, duplicate NIR pols = 0.58 % w/w, pol *vs.* NIR predicted pol = 0.58 % w/w). While this FORP device is not suitable for beet brei analysis the NIR methodology is still promising, and other devices with larger sampling surfaces (up to 4.0 $inch^2$) are currently under investigation.

EGGLESTON GILLIAN[1]*, and JOHN R. VERCELLOTTI[1], [1]Southern Regional Research Center, USDA-ARS, P.O.Box 19687, New Orleans, LA 70179. - Characterization of the effect of controlled pH and salts on the thermal decomposition of sucrose.

The degradation of sucrose and other sugars in beet sugar manufacture leads to many products, including colored compounds, and results in losses of pure sucrose. Characterization of the kinetic conditions under which sugar losses occur will underpin, and consequently lead to, future technological improvements. This study describes the use of model kinetic systems to measure the effects of controlled pH and salts on initial degradation of concentrated pure sucrose solutions (65°Brix) at 100°C. Polarimetry and ion chromatography with pulsed amperometric detection (IC-IPAD) were used to quantify degradation. Pseudo-first order initial degradation rates, measured by IC-IPAD, were generally higher than polarimetry rates due to trace secondary products which have a positive optical rotation. Observations in alkaline conditions indicated that polarimetry is not viable for measuring sucrose degradation at the levels that occur in unit processes where the pH is alkaline. An initial adjustment of pH to 8.3, markedly depressed the initial degradation of sucrose, with no accelerated degradation and subsequent color formation until after ca.14h. In marked contrast, sucrose held at constant pH 8.3 across reaction time demonstrated color formation and degradation after only 30min. Further reactions that have been observed in concentrated pure sucrose solutions held at constant pH are discussed. Na^+, Mg^{2+} and Ca^{2+} (added as chloride salts), water structure enhancers, slightly increased initial degradation; the latter two ions increased subsequent accelerated degradation. Highly charged cations, e.g., Al^{3+}, increased sucrose degradation through polarized hydrated ions/acidic pH effects. Large cations, e.g., K^+, reducing water structure, increased degradation. Solutes with hydrophobic and non-ionic character, net water structure enhancers, e.g., ethyl alcohol, markedly stabilize sucrose. Water structure breakers, e.g., urea, increased degradation, although under alkaline conditions pH effects were more critical than water structure effects.

EIDE, JOHN D.*, and GARRY A. SMITH, USDA, Agricultural Research Service, 1307 N. 18th St., Fargo, ND 58105-5677.
Defense protein synthesis in response to Cercospora beticola. Sugarbeets synthesize the PR (pathogenesis related) proteins in response to Cercospora fungal attack. We are studying the molecular basis of Cercospora resistance, particularly the role of PR proteins chitinase and glucanase. The objective of this study is to isolate the PR proteins for use in antibody production. These antibodies will be used to screen sugarbeets for Cercospora resistance. The PR protein chitinase was isolated from leaf spot resistant(LSR) leaf tissue by differential centrifugation, ammonium sulfate fractionation and chitin affinity. Optimumization for removal of contaminating proteins was determined to be 12% polyacrylamide, 2.67% bisacrylamide. The apparent molecular weight of the chitinase was 34 kD as determined by polyacrylamide gel electrophoresis. Isolation of β 1,3-glucanase from LSR leaves was accomplished using affinity chromatography. Glucose was bound to polyanhydroglucose and eluted off the column with 0.5% reduced laminarin. The proteins eluted off the column had an apparent molecular weight of 26 to 29 kD. The isoelectric point was determined to be 4.9. The activity of the purified glucanase was 19.9 μM min^{-1} with a specific activity of 142 μM min^{-1} mg^{-1} protein.

ENGELKES, CHERYL ANN*, and CAROL E. WINDELS, N.W. Experiment Station, Univ. of Minnesota, Crookston, MN 56716. - Suppression of Aphanomyces damping-off of sugarbeet affected by soil moisture and rotation precrops.

Soil-incorporation of 4-wk-old oat into soil infested with *Aphanomyces cochlioides* reduces damping-off of sugarbeet in the greenhouse. Our objectives were to evaluate 1) effects of soil moisture during oat decomposition (3 wk) and sugarbeet growth (4 wk) on disease and 2) direct effects of volatiles and extracts from several crops on hyphae, zoospores, and oogonia of *A. cochlioides*. When two sandy loam soils were watered to field carrying capacity (FCC, 25% water by weight), root rot indices (RRI, 0=healthy, 100=plants dead) of beets were the same in soils precropped to oat or that were fallow (RRI≥95). Reduction of soil moisture to 10% of FCC lowered RRI of beets to 21 when oat was a precrop compared to 80 when soil was previously fallow. When soil-incorporated precrops and controls (sugarbeet, fallow soil) had decomposed for 5 days in desiccators, *A. cochlioides* was exposed to resulting volatiles. After 48 hr, hyphae grew 0.8 cm with barley and sweet corn, 1.1 cm with oat and wheat, 1.4 cm with sugarbeet, and 1.5 cm with fallow soil. Exposure of *A. cochlioides* for 48 hr to root extracts of sugarbeet resulted in germination of zoospores and production of abundant oogonia, which all had antheridia. In comparison, oat root extracts resulted in lysis of zoospores and oogonia had few or no antheridia; wheat root extracts and water controls resulted in motile zoospores and reduced numbers of oogonia with antheridia. In conclusion, effectiveness of a green oat precrop is affected by soil moisture; some precrops directly reduce growth of *A. cochlioides*.

FORNSTROM, K. JAMES, STEPHEN D. MILLER and LARRY J. HELD, Civil Engineering, Plant, Soil and Insect Sciences and Agricultural Economics Departments, respectively, University of Wyoming, University Station Box 3295, Laramie, WY 82071. - Economics of weed management systems in sugarbeets.

Studies were conducted at four Wyoming locations in 1994 to compare economic benefits of preplant, complementary preplant and postemergence or total postemergence weed management systems in sugarbeets. The treatments with the lowest herbicide plus labor costs varied with location, according to weed populations present. Hoeing labor costs were directly related to weed population. The lowest weed populations were at Torrington and Wheatland (7,600 and 10,800 weeds/A, respectively) and the least cost treatment was to apply full preplant with no postemergence herbicide. The highest weed populations were at Worland and Powell (38,900 and 26,200 weeds/A, respectively) and the least cost treatments for both locations were those which included 3 herbicide applications (no preplant with 3 split postemergence applications and 1/2 preplant or full preplant with 2 split postemergence applications). Generally, the total weed control cost differences for each location were not large but the composition of total costs between herbicide and labor was markedly different, i.e. the cost of more herbicide was generally offset by reduced hoeing costs.

FRANC, GARY D. [1] *, COLETTE M-S BEAUPRE [1], ERIC D. KERR [2] and JAMES E. DUFFUS [3]. [1] University of Wyoming, P.O. Box 3354, Laramie, WY 82071, [2] University of Nebraska, 4502 Ave. I, Scottsbluff, NE 69361 and [3] USDA-ARS, 1636 E. Alisal St., Salinas, CA 93905. - Movement of the rhizomania vector in surface water and wind-blown soil.

Surveys were done in eastern Wyoming and western Nebraska to determine the potential for movement of *Polymyxa betae*, the vector of the rhizomania virus and other sugarbeet viruses, in flowing surface water and wind-blown soil. Monthly water collections were made from the North Platte River during a 1 year survey period. Five sites, representing locations on the river upstream from agricultural areas to downstream sites, were repeatedly sampled. Particulates in water samples were concentrated by filtration through celite which, in turn, was tested in a greenhouse bioassay for *P. betae*. Results showed that *P. betae* could be detected throughout the survey period. However, the two upstream sites had detectable levels of *P. betae* present only 33% of the time while the three downstream sites had detectable levels present ca. 75% of the time. Aerosol samples, which included wind-blown particulates, were collected on cellulose air filters with the aid of high volume aerosol samplers. Samples were collected over a 12 month period at two sample sites. After exposure, filters were aseptically cut into ca. 2.5 cm squares, which were then used to amend previously steamed sand. The resulting sand-filter mixture was tested via a greenhouse bioassay. Results showed that 42% (38/90) and 59% (20/34) of the filter samples had detectable levels of *P. betae* present for western Nebraska and eastern Wyoming collection sites, respectively. Results showed that resting spores of *P. betae* were readily detected in both flowing surface water and wind-blown particulates.

FRANZEN, P., Dorr-Oliver, Inc., 612 Wheeler's Farm Road, Milford, CT 06460-8719 - Design of batch-type centrifuges ... many possibilities but only one optimal solution.

Due to economic reasons, sugar factories prefer to operate with the least possible number of centrifuges. It can be proved that the most economic processing capacity of white sugar centrifuges is in the range of 29 to 39 mtph of massecuite, and thus the optimal number of white sugar centrifuges per factory is determined. Centrifuges with processing capacities higher than 40 mtph or lower than 29 mtph result in increased production costs. Considering all requirements in terms of process technology, as well as available data for construction materials, design rules, and up-to-date prices for mechanical and electrical equipment, an optimal centrifuge design is isolated: this centrifuge is equipped with a basket of 60" diameter, a length of 48", and a massecuite layer of 10", which correlates to a basket capacity of 2,000 kg (4,400 lbs). With drives in the range of 300 to 500 HP, this centrifuge achieves most satisfactorily massecuite throughputs of 31 to 39 mtph if a G-force factor of Z = 1,250 is used. Larger basket diameters, and consequently larger massecuite capacities, are senseless under the given conditions.

GILES, J.F.*, A.W. CATTANACH and N.R. CATTANACH, Dept. of Soil Science, North Dakota State Univ., Fargo, ND 58105. Effect of deep tillage (subsoiling) on sugarbeet yield and quality.

In recent years the amount of subsoiling by farmers has increased in eastern North Dakota and western Minnesota. The crop response reported has been varied and in may cases not quantified. Considering the disadvantages of deep tillage: the use of high power and time requirements,; the possibility of short lived effects, particularly on highly compactive soil; and in some instances, the undesirable mixing of soil horizons,; the objective of this study was to determine the potential benefits in a sugarbeet-small grain rotation. Tillage studies were initiated on silty clay and silt loam soils in the fall of 1991 and 1992 with a Blue Jet straight shank ripper and Tye Paratill implements. Depth of tillage was 17 inches. Soil conditions at the time of tillage were dry and moist in 1991 and 1992, respectively. A conventional fall chisel plow tillage treatment was included as a check. Sugarbeets and hard red spring wheat were planted perpendicular to the direction of deep tillage following seedbed preparation with a field cultivator in the spring. The two crops were rotated on the tillage treatments the year following initial deep tillage. Although a large amount of fracturing of the soil profile occurred during deep tillage operations both years, the soil loosening did not significantly change soil bulk density or crop production on either soil type during either year.

GILES, J.F.*, A.W. CATTANACH and N.R. CATTANACH, Dept. of Soil Science, North Dakota State Univ., Fargo, ND 58105. Effect of seedbed moisture management on sugarbeet stand establishment, yield and quality.

Adequate sugarbeet population resulting from vigorous seedling emergence is important for optimum crop production. Seedling emergence is usually influenced by soil water potential and other environmental factors. The objective of this study was to evaluate seedling emergence and sugar production from fall ridges established at the location of beet rows the following spring. In the spring, before planting, the dry soil on the ridge is moved into the ridge valleys, which results in a level field and exposes the moist soil beneath.
Seedbed studies were established on silt loam and silty clay loam soils in 1993 and 1994. Main treatments included fall ridging with Alloway and Sukup equipment following tillage of small grain residue with a chisel plow, and conventional fall tillage with secondary spring tillage with a Alloway RTS seedbedder prior to planting. Soil moisture prior to spring tillage was similar for all treatments. Following deridging, the surface inch of soil contained 0.1 to 0.2 inches more available water than in the conventional prepared seedbed. Sugarbeet root yield, sucrose percentage and recoverable sugar production were significantly greater in the fall ridge tillage treatments. The increase in production can be attributed to the advanced emergence of the seedlings caused by the increased soil moisture in the seeding depth at planting time.

GILES, J.F.* and N.R. CATTANACH, Dept. of Soil Science, North Dakota State Univ., Fargo, ND 58105. Ten years of improvement of planter performance and sugarbeet stand establishment.

The sugarbeet industry in eastern North Dakota and western Minnesota has made substantial progress in sugarbeet stand establishment over the past ten years. This improvement has come about because of cooperation and commitment from the sugarbeet growers and others involved in the sugarbeet industry. Improvements in stand establishments have been the result of improved seedbed preparation, seed quality, and planter precision and performance. A program designed to allow growers to evaluate the performance of their planter units on test stands designed to simulate ground speed and seed spacing has developed during this time period. Making adjustments, modifications and/or corrections to improve the performance of the planter has increased the confidence of the grower prior to actual field planting and eliminated the number of seed related field calls for seed suppliers in the spring. Plant population counts prior to harvest and harvested beet counts have increased during this time period and are well correlated with increased recoverable sugar yields.

GODFREY, LARRY D.[1]* and PEGGY A. MAUK[2], [1]Dept. of Entomology, Univ. of California, Davis, CA 95616 and [2]Cooperative Extension, Univ. of California, Sacramento, CA 95827. - Interaction of black bean aphids and beet yellows virus on sugarbeet development and yield at several intervals following plant emergence.

The individual and combined effects of black bean aphid (Aphis fabae) infestation and beet yellows virus infection on sugarbeet growth, development, and yield were examined in a 2-year field study near Davis, CA. Stresses from aphids and virus disease were initiated at three plant growth stages (3, 6, and 9 weeks after seedling emergence) within a spring plant (late April) / fall harvest (October) field. Either viruliferous or nonviruliferous aphids, as appropriate for the treatment, were transferred from laboratory colonies to plots (1 row x 25 feet) delineated with floating row cover. Aphid density per plant, virus incidence, plant leaf area, leaf, petiole, and root dry weights and photosynthetic rate were quantified about every 3 weeks. Beet yield and sucrose content were determined at harvest. Black bean aphid densities peaked at >7000 per plant in infested plots compared with ~100 aphids per plant in uninfested plots. Virus incidence averaged more than 80% in plots infested with viruliferous aphids and <15% in "nonvirus" plots. A low background level of aphids and virus occurred in all plots. Leaf area was significantly reduced by all treatments by up to 83.3%; the most severe reductions were in the aphids and aphids + virus treatments at the 3-week timing. Beet yield was reduced by an average of 44% by aphids, virus, or both stresses at the 3-week timing in 1993; yield losses were 3-10% within the 6 and 9-week timings. In 1994, significant yield losses occurred from both pests in the 3- and 6-week timings; however, in the 9-week timing, yield losses were noted in only the aphids + virus treatment. Percentage sucrose values were not affected by any treatment during either year.

ABSTRACT

GODSHALL, MARY A. and XAVIER M. MIRANDA, Sugar Processing Research Institute, Inc., 1100 Robert E. Lee Blvd., New Orleans, LA 70124. - Analysis of Moisture in Sugar Products: Comparison of Two Rapid Moisture Analyzers.

The official ICUMSA (International Commission for Uniform Methods of Sugar Analysis) method for determining moisture in sugar products by loss-on-drying requires 3 hours of oven-drying followed by an extended cooling period to a temperature 2°C above ambient. Recently, instrumentation has become available that is capable of accurately measuring the small amounts of moisture in white sugar. This presentation reports on the evaluation of two of these. Both utilize the loss-on-drying method and both have a balance resolution of 0.1 mg. The Arizona Instruments Computrac MAX-2000 Moisture Analyzer uses a small convection air oven to effect drying. The Omnimark Instrument Corporation Mark I High Performance Moisture Analyzer utilizes four quartz infrared heaters. Ranges and combinations of drying parameterss have been studied for both the new instruments on several types of sugars. The choice of optimal drying parameters plays a critical role in successful moisture determination in white, raw, powdered and soft brown sugars. This report presents the results of the study. Both instruments give results comparable to the oven, with a great savings in time. Precision of measurement using the instrumental methods is at least doubled for white and powdered sugars and approximately the same for raw and soft sugar compared to the standard oven procedure.

Hafez, Saad L.[1]*, Kikuye Hara[1] and E. Mousa[2]. Parma R&E Center, 29603 U of I Lane, Parma, ID 83660; [2]Menoufiya, Egypt. - The impact of green manure crops growing in sugarbeet rotation on sugarbeet cyst nematode and sugarbeet yields.

Four varieties of oil radish, *Raphanus sativus* var. *oleifera* (Adagio, Pegletta, Ultimo, Remonta), and three varieties of white mustard, *Sinapis alba* (Metex, Maxi, Martigena), were planted following wheat in a sugarbeet cyst nematode infested field in the fall of 1993 in Parma, Idaho. Each variety was replicated four times in a randomized complete block design, and a fallow treatment was included as a control for comparison. All varieties were mechanically chopped and incorporated 3 months after planting. Soil samples before planting in the fall, and in the following spring, were collected for nematode assay. All varieties reduced the total number of eggs and larvae significantly. Oil radish (var. Adagio) caused the highest percent reduction comparison to fallow (51%). White mustard (var. Martigena) caused the lowest percent of reduction (21%). The following spring, sugarbeet (var. HM-WS-90) was planted following the oil radish and mustard varieties. Sugarbeet yield increased significantly following Adagio, Ultimo, Maxi and Metex in comparison with the fallow treatment.

Hafez, Saad L.[1]*, Robert F. Rynk[2], Kikuye Hara[1], M. Seyedbagheri[3]. [1]Parma R&E Center, 29603 U of I Lane, Parma ID 83660; [2]Ag Eng., University of Idaho, Moscow ID 83844-2040; [3]Elmore County Extension, Courthouse, Mt. Home ID 83647. - The effect of composting sugarbeet tare dirt, cow manure and cull onions on the viability of sugarbeet cyst nematode.

Heterodera schachtii is a serious disease problem for the sugarbeet industry. Poor sanitation practices and returning tare dirt (TD) back to the field is considered the major means of nematode spread and reinfestation. Cull onions (CO) are treated as a waste product, and disposal methods for these culls present environmental and pest problems. The objective of this was to study the possibility of controlling sugarbeet cyst nematode in the TD by composting the TD alone or along with cow manure (CM) and CO. Three experiments were conducted over a three year period during 1990-94. In the first experiment, wooden boxes (4' x 4' x 8') were filled with TD infested with cyst nematodes. In the second experiment, nematode infested TD was collected and piled in two 8" x 20' x 200' piles. In the third experiment, nine windrows have been established with varying combinations of TD, CO and CM. To assess the effect of turning, three windrows are static (no turning), and the other were turned regularly. TD samples were taken before and after composting for nematode and nutrient analysis. The results of these studies indicated that no stage of sugarbeet cyst nematode survived the composting process in redwood boxes. Composting of sugarbeet TD in open field piles killed 98% of sugarbeet cyst nematodes. Sugarbeet TD, after adequate composting may be used as a soil amendment of potting mix.

HALLOIN, JOHN M[1]*. and CARL A. ELLIGER[2]. ARS, USDA, [1]Sugarbeet and Bean Research Unit, Department of Botany and Plant Pathology, Michigan State University, East Lansing, MI 48824, and [2]WRRC, Plant Development-Productivity Research, 800 Buchanan St., Albany, CA 94710. Characterization, localization and biological activity of phytoalexins associated with *Rhizoctonia* root rot lesions.

The phenolic phytoalexins betagarin and betavulgarin occur in association with foliar lesions of sugarbeets (*Beta vulgaris* L.) caused by *Cercospora beticola*. We studied phytoalexins associated with disease lesions caused by *Rhizoctonia solani (AG 2-2)* on crowns and roots of sugarbeets. Freeze-dried tissues were extracted with methanol, and the phytoalexins were purified by HPLC. A phytoalexin localized within healthy tissues surrounding disease lesions, that forms colored nitroso derivatives upon reaction with dilute nitrous acid, was not extracted by methanol, apparently due to cross linking with other plant constituents. Infected tissues and surrounding, non rotted tissues contained betagarin and betavulgarin, as well as two new compounds that are a glucoside and a xyloside of betavulgarin. Only trace amounts of these compounds were isolated from healthy tissues away from disease lesions. Growth of *R. solani* on agar media containing these phytoalexins revealed that only betavulgarin caused inhibition of radial growth of the fungus. Chemical assays showed that agar medium containing betavulgarin, on which the fungus had grown, contained non inhibitory betavulgarin glycosides, demonstrating that the fungus detoxifies the phytoalexin via glycosylation. Diseased tissues fail to accumulate betavulgarin at concentrations that are highly inhibitory to the fungus, apparently due to this detoxification.

HALLOIN, JOHN M., and J. CLAIR THEURER. ARS, USDA, Sugarbeet and Bean Research Unit, MSU, East Lansing, MI 48824. Procedure modifications for operation of the *Rhizoctonia* crown and root rot nursery in East Lansing, Michigan.

Two changes have been made in the operation of the *Rhizoctonia* crown and root rot nursery at East Lansing, MI. An alternative disease rating system has been developed for scoring of disease in association with resistance breeding, and the crop rotation sequence has been changed to facilitate establishment of epiphytotics. The new rating system is non linear, providing numerical expansion of those categories exhibiting little rot. Roots are scored as follows: 0 = no evidence of disease, 1 = few isolated, superficial lesions; 2 = lesions more abundant and coalescing, to cover up to 10% of the root surface; 3 = up to 30% of the root surface rotted, with rot often extending into tissues; and 4 = crowns dead or more that 30% of the root rotted. The new system should be better for selection of disease resistant germplasms. We use a linear rating system for disease loss estimates. The site used for the disease nursery has been employed for that purpose for more than 20 years. In recent years we have had difficulty producing disease severe enough to discriminate resistant from partially resistant germplasms. The nursery employs a two year rotation between sugarbeets and alfalfa; and annually the sugarbeets are inoculated six weeks after planting, by dispensing into their crowns, millet caryopses on which the fungus has been grown. Experiments were done to determine if biological control of the pathogen was responsible for low disease severity. Highly susceptible to highly resistant sugarbeet genotypes were planted in the established *Rhizoctonia* disease nursery and in an adjacent field with no prior use as a root rot disease nursery. In two of three years, the disease was more severe at the new sites than in the established nursery. Biological control of *Rhizoctonia* seems a likely cause of the decreased disease severity in the established nursery. The crop rotation for the site is being changed to a three year rotation of sugarbeets/oats/navy beans, in an attempt to reduce the apparent effects of biological control of *Rhizoctonia*.

HARVESON, R. M.*, and C. M. RUSH, Texas Agricultural Experiment Station, P.O. Drawer 10, Bushland, TX 79012. - Studies of vegetative compatibility among isolates of *Fusarium oxysporum* f. sp. *betae* causing different disease symptoms.

Over a three-year period (1992-1994), 160 *Fusarium oxypsorum* f. sp. *betae* isolates were collected from sugar beet and pigweed plants from seven counties in Texas. All isolations were made from surface-sterilized root pieces grown on half-strength potato dextrose agar. They were separated into two groups -- those causing tip rot and those causing only vascular necrosis. They were then stored on either sterile filter paper or soil. 132 of the 160 isolates were actually used for vegetative compatibility evaluations. 28 isolates were chosen as testers. They were paired in all possible combinations to determine the number of vegetative compatibility groups (VCGs) present. Those that produced dense, aerial mycelia at point of colony intersection were considered vegetatively compatible. Those that are vegetatively compatible are considered to be genetically similar and are placed in the same VCG. Six VCGs have been identified from the 28 testers. Most of the isolates (19 of 28) fall into one group. The remaining 104 isolates are being screened against one member of each of the 6 established VCGs. To date, VCG 1 has 53 members, with VCGs 2-6 containing 2, 12, 2, 2, and 2 isolates, respectively. No relationship exists between VCG and root rot symptom or host. Results indicate that endemic populations of *F. oxysporum* have been present in Texas for some time.

HEIDEL, G. B.*, and C. M. RUSH, Texas Agricultural Experiment Station, P.O. Drawer 10, Bushland, TX 79012. - Effects on growth of two sugar beet cultivars infected by BNYVV, BSBMV, or BNYVV + BSBMV.

Beet soilborne mosaic virus (BSBMV), a rod-shaped virus transmitted by *Polymyxa betae*, closely resembles beet necrotic yellow vein virus (BNYVV), but the viruses are serologically distinct. Two studies were conducted to evaluate the effect of BSBMV on sugar beet growth. For the first study, sugar beet seedlings (cv. HH67 and Rhizosen) were vortexed in inoculum of one of three BSBMV isolates (BSBMV-1, BSBMV-2, BSBMV-3), BNYVV, or BSBMV + BNYVV. Inoculum was prepared by grinding symptomatic *Chenopodium quinoa* leaf tissue in 0.1 M potassium phosphate buffer, pH 7.4, with 0.02 M sodium sulfite and 0.45% (w:v) carborundum. Top and root dry weights of infected sugar beets in all the treatments were reduced, but the reduction was not significant compared to both mock-inoculated (buffer + carborundum) and non-inoculated controls. In the second study, seeds of HH67 or Rhizosen were planted directly over lateral beet roots infested with viruliferous *P. betae*. Top and root dry weights of sugar beets in all virus treatments were significantly reduced in comparison to those of non-viruliferous *P. betae* and non-infested control beets. Studies suggest that BSBMV is virulent, but field observations do not always support these results. Use of the vortex method to inoculate sugar beets can avoid the presence of confounding pathogens maintained in *P. betae* cultures, but the use of viruliferous *P. betae* as inoculum may better reflect field disease development.

Hein, Gary L., University of Nebraska Panhandle Research and Extension Center, 4502 Ave I, Scottsbluff, NE 69361. - Control of early season cutworms in sugarbeets.

Two species of cutworms, pale western cutworm and army cutworm, are becoming more of a problem as growers are using more fall planted small grain cover crops to reduce winter soil erosion. In 1993 and 1994 four planting time treatments and a broadcast rescue treatment were tested for cutworm control. The planting time insecticide treatments included Lorsban 15G (9 oz/1000 row feet), Counter 15G (8 oz/1000 row feet), Temik 15G (9 oz/1000 row feet), and Ammo 0.75G (9 oz/1000 row feet). A broadcast rescue treatment of Lorsban 4E (2 pt/A) and an untreated check were also included. Twenty pale western cutworms (5-6th instar) were infested into metal barriers for all insecticide treated plots and the untreated check. Stand loss for Counter and Temik were no different from the untreated check. The other two planting time treatments Ammo, a pyrethroid, and Lorsban provided good protection of the stand in this trial. The pyrethroid provided more consistent cutworm control than Lorsban 15G. In 1994 Lorsban 15G performance was likely hindered by extremely dry conditions. The rescue treatment of Lorsban 4E provided equal control to the Ammo treatment. Since Ammo is not a registered product for sugarbeets and Lorsban 15G showed variable control, the most consistent option remains the rescue treatment with Lorsban 4E. This requires that growers be prepared to scout fields to pick up the presence of cutworm problems early enough to treat.

Hein, Gary L.[1], Greg D. Binford[1], Eric D. Kerr[1], John A. Smith[1], Robert G. Wilson[1], and M. D. Culy[2], University of Nebraska Panhandle Research and Extension Center, 4502 Ave. I, Scottsbluff, NE 69361 and Dow-Elanco, 9330 Zionsville Rd., Indianapolis, IN 46268-1054. - Damage potential of rhizomania and the use of soil fumigation, varietal resistance, and planting date in the management of rhizomania.

Three studies were done to determine the effects of various cultural and chemical practices on rhizomania. Several resistant varieties where tested in both rhizomania infested and uninfested soils, and many performed well especially in the rhizomania field. However, they tended to have lower percent sugar and higher sugar loss to molasses. In the second study, planting date, starter fertilizer, Telone II, and varieties (susceptible= Monohikari; resistant=Rhizoguard) were combined to determine their effects on the severity of rhizomania. The most important findings indicated that Telone II reduced the impact of rhizomania especially on Monohikari (susceptible). Also, the effects of the fumigant were reduced for the earlier planting dates indicating the benefits of early planting in the management of this disease. The third study looked at the influence of variety (Monohikari vs. Rhizoguard) and several Telone II rates in managing rhizomania. The results from this study indicated that Telone II can have a significant impact on rhizomania with the highest rate (20 gallons/acre) giving a 65% (1993) and 19% (1994) yield increase over the non-fumigated treatments. Only at the higher rhizomania pressure did the Rhizoguard have comparable yields to the Monohikari.

HELGE, JOHN M., and LARSON, DAVID O., Nalco Chemical Company, 2415 Annapolis Lane, Suite 170, Plymouth, MN 55441.

An Update: Flume Water Management.

Longer processing campaigns, tighter maintenance budgets, and increased environmental awareness have led sugar beet processors to evaluate alternative flume water treatment approaches. This paper discusses results from 5 factories in the Red River Valley of MN and ND that have been utilizing a total system approach to flume water management. Lime reduction of at least 0.5% limerock on beets has been documented over the past 2 processing campaigns. Subsequent reduction in the volume of sludge produced has reduced the potential for odor and has reduced the solid waste handling and production from each facility. Flume water pH is maintained at a range of 6.0 - 7.0 with general corrosion rates below 5.0 mils per year. The level of lactic acid in diffusion juice at each factory appears to have a strong correlation to the ability of this total system approach to keep the lactic acid levels in the bulk flume water under statistical control.

HIEB, ALAN, The Amalgamated Sugar Company, P.O. Box 700 Paul, Idaho 83347. - Waste water minimization and utilization in land application and process systems.

In 1992, the excess condensate was separated from the main waste water system and land applied to 336 acres of contracted farm ground. A 2.3 million gallon (MG) lined pond was constructed as a surge pond for the above irrigation. The pond was intentionally kept full after the 1992-93 beet campaign in order to test condensate after 6 months of outdoor storage as feed water for the evaporators during juice run. The condensate processed with no problems. In 1993, a 42 MG aeration and storage lagoon was constructed with the option to store excess condensate in the 22 MG storage section. During the 1993 juice run, 3.7 MG of condensate was recycled to the evaporators. Juice run waste water was reduced by 21% and salt brine for softener regeneration was reduced by 36%. Approximately 18 MG will be recycled during the 1995 juice run. Eliminating salt usage is anticipated to reduce land requirements because of reduced total dissolved solids loadings by 100 acres ($350,000).

HILDE, D.J., R.E. ELLINGSON, American Crystal Sugar Co., 101 North 3rd St., Moorhead, MN 56560. A.W. ANDERSON, 269 Hultz Hall, North Dakota State University, Fargo, ND 58105. - Sugarbeet root maggot survey and IPM program - Red River Valley, 1992 - 1994.

With heavy root maggot pressure forecast for the 1992 sugarbeet crop, more precise information was needed for growers to determine the optimum period for post insecticide treatments in addition to the regular planting time treatment. There was also a need to determine the geographical extent of the root maggot problem. American Crystal Sugar Company in cooperation with North Dakota State University, conducted a broad-based survey that included all the sugarbeet growing townships in the Red River Valley, an area 175 miles long and 90 miles wide. One field per township was selected for the survey for a total of 250 fields. Eighteen field scouts were hired on a full time basis from May 1 to August 1, supervised by each of the five factory agricultural staffs. Three sticky stake traps were placed in each field and fly counts were taken 3 times per week. Daily fly counts were communicated to growers via DTN (satellite data transmission network), factory telephone recordings and personal contact. Two key dates, first fly emergence and peak fly activity became the basis for an integrated pest management program (IPM). In mid July, field scouts examined the survey fields for larval root damage using a visual scale from 0 to 5. Survey results indicated that research predictions of first fly emergence and peak fly activity were practical in field observations and useful to growers. Geographical areas with varying degrees of root maggot pressure were identified. Based on the results of the 3 year survey, an IPM program has been developed for sugarbeet growers in the heavy maggot pressure areas of the RRV.

HUBBELL, LEE*, and PAUL PFENNINGER, Monitor Sugar Company, P.O. Box 39, Bay City, MI 48707 - Comparison of variety trial results when space planting test plots at 4.5" versus 1.3" and hand thinning.

A variety approval program is important to provide the best possible varieties for the growers. The question is what seed spacing is best to use in variety testing. Should the seed be space planted at about 4.5 inches or planted thick and hand thinned. The same commercial varieties were compared in a replicated test at each seed spacing. Results: 1. When space planting it is more difficult to establish a usable stand. 2. There are more extremes in stand between tests and within tests when space planting. 3. If a variety has a thicker stand in a space planted test, it does not always result in more recoverable sugar per acre. 4. Results are less consistent from one year to the next in space planted tests. 5. The same varieties were approved and/or disapproved in both space planted and planted thick and hand thinned.

HUBBELL, LEE*, and PAUL PFENNINGER, Monitor Sugar Company, P.O. Box 39, Bay City, MI 48707 - Variety trends and Variety Approval Programs since the advent of monogerm seed for Monitor Sugar Company.

A variety approval procedure is important to provide the best possible varieties for the growers. Our program includes a requirement for Cercospora leafspot resistance, and a minimum sales requirement, before a variety can obtain full approval. Our growers have experienced several years of poor yields. Some questions were raised whether we were sacrificing yield to get a higher sugar content. When compared to USH23, the last public variety sold in our area (from 1982-1992), the varieties sold in 1994 had an increase in recoverable sugar per ton of 9.2 percent, but there was a decrease in tons per acre of 3.5 percent. When comparing a group of seven varieties soon to be sold, the tons per acre has increased to be equal to USH23, and the sugar per ton increases another 2.8 percent. Our varieties have improved a great deal, but at this time we need continued improvements in vigor and tons per acre.

Jacobsen, B.J.* and Andrea Braun, Department of Plant Pathology, Montana State University, Bozeman, MT 59717-0286. - Cercospora leafspot of sugarbeet: sensitivity to benomyl of Montana isolates and biological control.

Thirty-seven field isolates were collected from the Sidney, MT sugar district in July-August 1994 to determine whether benzimidazole fungicide resistance was present. All isolates proved to be sensitive to 1,10, and 100 ppm benomyl in agar assays. Based on this survey producers should find benzimidazole fungicides effective. Bacillus sp. were selectively isolated from the phyllosphere of Cercospora infected leaves and were assayed for in-vitro and in-vivo antagonism. In-vivo experiments were done in a growth chamber at 24-25C with 3 *Bacillus cereus* isolates, 5 cultivars and 1% chitin or 1% beta-glucan food base foliar habitat modifiers. There was a significant isolate x food base x cultivar interaction. Isolate BAC-B provided 0-93% control with 80% on Monohikari, 48% on M403, 66% on B-1996, 93% on HH82 and 54% on HH88 with the 1% chitin food base. Isolate BAC-J provided 23-95% control with these same cultivars. When all cultivars were considered BAC-B provided the best control (68.2%) with the chitin food base and BAC-J gave the best control with the beta-glucan (72.3%) followed by chitin (62.3%) followed by water (49.7%). HH82 plants sprayed with maneb @ 200 ppm had 98% control. Biological control with Bacillus sp was found to vary with cultivar and food base carrier system.

KAFFKA, STEPHEN R.* and GARY A. PETERSON, Department of Agronomy and Range Science, University of California, Davis CA 95616. The performance of rhizomania susceptible and resistant sugarbeet cultivars in fall and spring plantings in California's Sacramento Valley.

Rhizomania is an increasingly widespread problem for sugarbeet producers in California's central valley. Mild winter temperatures allow crops to be overwintered. To evaluate whether fall-planting under lower soil temperatures would reduce losses to rhizomania compared to spring planting, trials were carried out at two sites in the Sacramento Valley under conditions of moderate to severe rhizomania infection pressure. Root and sugar yields and plant populations were compared from beets established at three planting dates in autumn (10-1-93, 10-19-93, and 11-1-93) and one in early spring (1-19-94). Three cultivars, one susceptible (SSNB3) and two resistant (SS595R and Rhizosen Plus), were established at each planting date. Plots were harvested four times beginning in late May and ending in late August. By early summer, most plants exhibited symptoms of rhizomania. Under severe rhizomania conditions, the combination of fall planting and resistant cultivar improved yields significantly compared to spring planting, but the highest yields were 30 % lower than from uninfected nearby fields. Highest root and sucrose yields were achieved with the November planting date (52.6 Mg ha^{-1} and 6.3 Mg ha^{-1})and the lowest average yields resulted from the early spring planting date (36.1 Mg ha^{-1} and 3.8 Mg ha^{-1}) . When planted in autumn, the susceptible cultivar had root yields comparable to the resistant cultivars, but lower sucrose concentrations. When planted in spring, the susceptible cultivar was severely infected and had reduced yields. Plant populations declined with each harvest date. By August plant losses were greater than 50% of May populations in some treatments.

MICHAEL A. KARAGODIN, DEAN DELOREY, STEPHEN COE, AND ED BULGIN, The Amalgamated Sugar company, P.O. Box 87, Nampa, Idaho 83687- Air Pollution Modeling Studies.

In order to gain a better understanding of the ambient air quality impacts from the boilers and pulp dryers at the beet processing facilities, preliminary air dispersion modeling was conducted using EPA's ISC2 air dispersion model. This included a system of statistical and material balance equations. Pollutants included nitrogen oxides, sulfur dioxides and carbon monoxides. The model takes information about the pollutant source, calculates how the pollutant is transported and dispersed based on meteorological data, and calculates the resultant concentrations that are expected at specified locations. The dispersion model calculates and prints out the average concentration values of a particular pollution component in all directions from the source, in 10° degree increments and with a distance from 100 to 3000 (or more) meters. The information is given for different averaging times (maximum hourly, 3 hours, daily and annual). Examples of utilization of the Dispersion Model are presented.

ABSTRACT

KARAGODIN, MICHAEL A., Ph.D.*, LEAVITT, KELLY and COWGER, TIM D., The Amalgamated Sugar Company, P.O. Box 87, Nampa, Idaho 83653-0087 - Fully Automatic Seeding System For Vacuum Pans.

One of the major factors in getting uniform sugar crystals in the Vacuum-Pan crystallization process is proper seeding procedure. The effect of manual seeding with alcohol slurry depends greatly upon the experience of the operator and has the following drawbacks: non uniform amounts of slurry, improper moment of seeding and sucking air during opening of the seeding valve. All of this leads to an uneven number and size of crystals. The objective in this work was to create a reliable system capable of accomplishing of proper seeding without operator involvement. For this purpose a Fully Automatic Seeding System was developed, which included: a seeding slurry circulation loop, a measuring device, a complex of automatic valves and a computer. A computer program controls the following sequence of operations: automatic charging of the seeding cylinder with a measured amount of slurry, pulling the slurry into the pan at the proper moment of the process, cleaning the lines with flushing liquid, and pulling in the proper quantities of anti-scalant and defoamer. The main feature of the seeding device is a sealed plunger which does not allow any air to the slurry area. The Seeding System showed a good performance and reliability.

KEARNEY, MIKE*, VADIM KOCHERGIN, KEN PETERSEN, LARRY VELASQUEZ AND BILL JACOB, The Amalgamated Sugar Company Research Laboratory, 2320 Orchard Drive East, P.O. Box 127, Twin Falls, Idaho 83303. - The Amalgamated Sugar Company raw juice chromatography separation process.

The raw juice chromatographic separation process has been developed by The Amalgamated Sugar Company with several goals in mind. These goals include: elimination of liming and carbonation, elevation of extraction levels, alleviation of pollution concerns, reduction of sugar end handling requirements and an overall simplification of the beet sugar production process.

In general, the new process consists of preparing raw juice for use as a separator feed, treating the prepared raw juice through a chromatographic separator and crystallizing sugar from the separator extract. Products from the process include crystallized sucrose, a concentrated nonsucrose material, and molasses.

Nonsucrose removal with the process is about 75-85% prior to crystallization. Overall extraction is therefore very high. The small quantity of nonsugars to the sugar end results in relatively small quantities of low purity fillmass and final molasses.

KERR, E. D.[1*], J. A. SMITH[1], G. L. HEIN[1], and M. D. CULY[2], [1]University of Nebraska Panhandle Research and Extension Center, 4502 Ave. I, Scottsbluff, NE 69361, and [2]Dow-Elanco, 9330 Zionsville Rd., Indianapolis, IN 46268-1054. - A comparison of soil surface sealing methods following 1,3-D soil fumigation for control of Heterodera schachtii and Nacobbus aberrans on sugar beet.

Effective sealing of the soil surface following soil fumigation with Telone II (1,3-D) nematicide is necessary for successful control of Heterodera schachtii and Nacobbus aberrans. This study compares roller harrowing to disking + roller harrowing as auxiliary sealing methods following conventional presswheel sealing. 1,3-D was applied at a rate of 147 L/ha at 25 cm depth with 46 cm spacing. Soil temperature was 4 C at 20 cm. Infection severity is the number of H. schachtii adult females or N. aberrans galls per 50 cm of tap root and attached side roots. In a fall application study, 21, 28, and 14 H. schachtii females and 1.5, 3.8, and 1.4 N. aberrans galls for presswheel only, auxiliary roller harrow, and auxiliary roller harrow + disk, respectively, were not significantly ($P = 0.05$) different, and in a spring study, 28, 19, and 35 H. schachtii females and 1.5, .8, and.3 N. aberrans galls,respectively, were not significantly different. There were no significant differences among treatments for final emergence, root and sugar yield, sugar content, or root tare. Favorable soil tilth, moisture, and temperatures enhanced nematode control following all sealing treatments.

KERR, ERIC D.*, ROBERT G. WILSON, and DAVID D. BALTENSPERGER, University of Nebraska Panhandle Research and Extension Center, 4502 Ave. I, Scottsbluff, NE 69361. - Comparison of several trap crop species on soil populations of Heterodera schachtii.

Certain host and nonhost crop species and specialized trap crop species modify the population level of the sugar beet nematode, Heterodera schachtii. Corn, GN dry bean, sugar beet, crambe, oil radish, and Sudan grass were grown in Heterodera schachtii infested soil in western Nebraska over a four month period beginning 14 June and ending 14 October 1994. The initial nematode population was 12.7 eggs/cm^3 of soil. Plot size was one row (.56 M spacing) x 1.2 M long. A randomized complete block design utilized 3 replications. Plots were furrow irrigated with surface water. Final nematode populations in soil were 36.2, 18.1, 12.0, and 10.4 egg/cm^3 following crambe 'NM 2', sugar beet 'SX-1', corn 'NK 3639', and bean 'Harris', respectively. Egg density decreased following oil radish to 3.6., 3.7, and 7.5, for oil radish varieties 'Pegletta', Adagio', and 'Nemex', respectively, but only to 11.1, 9.6, and 8.9/cm^3 following Sudan grass 'Trudan 8', 'Sordan 79', and 'Hidan 36', respectively. In an associated test, 22 genetically diverse varieties of crambe were followed by egg populations ranging from 30.2 to 71.3 eggs/cm^3. The 49.1 mean was a 3 fold increase over the initial population of 15.7 eggs/cm^3

Abstract

Knolle, Jürgen C., SUET Saat- und Erntetechnik GmbH, Sudetenlandstr. 26, D - 37269 Eschwege, Germany.

- RTF, a new technology of precise fungicide and insecticide application as a part of a quality assurance concept in sugarbeet incrusting (filmcoating)

Fungicide & Insecticide Seed Treatments reduce costs, risks and environmental impact of chemicals on farmland, and the same seed and seedling protection with only 5 % and less of the acreage concentration by spraying or granules. Seed applications must therefore fulfill requirements in treatment quality, which the traditional dressings could not provide. The innovative RTF filmcoating system is based on a Rotor-Stator mixing machine, which is equipped with a special spinning-disk atomizer and integrated drying facilities. Adaequate control units allow the multi-layer application of high pesticide concentrations. The formulation concepts are based on water, pre-mixed with special binders and other material for controlled release purposes of the pesticides. Programmable suspension dosages provide exact and even distribution of the protective substances to the single grain; the complete process is governed by a low constant temperature-humidity regime. Chromatography analyses from RTF-treated seeds enlighten the process quality. Naked Beetseed coated with Thiram at a target of 12 g a.i./U showed av. dosages of 11.8 g/a.i.U. With 50 grains analyzed individually, the variation of results was only 7.90%. Onion seeds coated with 13.6 g a.i. of Benfuracarb per seed Unit (100.000 grains) had concentrations of 13.4 g in all samples, and a variation coeff. CV of 10.40% between 50 individual seeds. Besides for this high quality, RTF systems are designed for operational and users safety.

Abstract of paper for
1995 ASSBT meeting

Condensate Polishing by Ion-Exchange

V. Kochergin, T. Henscheid, L. Velasquez

Operation problems of the ion-exchange condensate polisher, such as high pressure drop, copper and iron leakage, etc. are discussed. The presence of ammonia in the condensate was found to reduce efficiency of ion-exchange copper and iron removal. The ratio of suspended to dissolved copper and iron in the backwash samples is determined. Significant amount of suspended copper and iron hydroxides may possibly provide a continuous supply of metal ions into the solutions. Recommendations are given for condensate polisher optimization.

KOCHERGIN, VADIM*, MIKE KEARNEY; The Amalgamated Sugar Company Research Laboratory, 2320 Orchard Drive East, P.O. Box 127, Twin Falls, Idaho 83303.

Chromatographic separator optimization.

Chromatographic separators are presently used by most of the U.S. beet sugar companies for molasses desugarization. The importance of monitoring the chromatographic separator operation is emphasized by analysis showing the effect of small fluctuations in separator parameters on sugar production. Insufficiency of existing optimization criteria is demonstrated. A convenient criterion (Z-factor) is proposed, allowing for the separator performance evaluation. The Z-factor basically represents efficiency of a process including molasses desugarization with further crystallization of the extract. It is shown that multiple combinations of extract purities and recoveries result in the same amount of crystalline sugar production. An example is given illustrating the convenience of the Z-factor application for comparison of various modes of the chromatographic separator operation.

KURANOUCHI, TOSHIKAZU, Hokkaido Natl. Agric. Exp. Stn., Hitsujigaoka, Toyohira-ku, Sapporo 062, JAPAN. - Development of high sugar and high quality sugarbeet varieties in Japan.

In Japan, the purchasing system of sugarbeet was improved to the new one in 1986. In the system, a standard sugar content is determined. Sugarbeet roots of which sugar contents are higher(/lower) than standard, are purchased higher (/lower). Hence the cultivation area of high sugar or moderately high sugar varieties widely increased. And recently, the content of harmful non-sugars in roots, which disturb the crystallization of sucrose, became to be taken serious.y. For that, several varieties with high sugar and high quality have been bred in Hokkaido Natl. Agric. Exp. Stn.. Sinultaneously individual selection methods of quality, adding to high sugar, have been developed. "Mono hikari" is a variety with high yield and moderately high sugar. Greatest merit of it is high quality, and the content of non-sugars are lowest among varieties in Japan. "Mono white" is a variety with moderately high yield and high sugar. It was bred in international joint research. The content of non-sugars are low, but higher than "Mono hikari".
In Hokkaido Natl. Agric. Exp. Stn., breeding for new varieties with high quality as "Mono hikari", with high sugar content as "Mono white", and with high root yield is going on.

KURANOUCHI, TOSHIKAZU, and MASAKATSU TANAKA, Hokkaido Natl. Agric. Exp. Stn., Hitsujigaoka, Toyohira-ku, Sapporo 062, JAPAN. - Breeding of sugarbeet F1 hybrid lines for high processing quality.

Constituents relative to sugarbeet quality, namely, amino-nitrogen, potassium and sodium, are generally called as harmful non-sugars, and they disturb the crystallization of sucrose in manufacture. Using an auto-analyzer and an electric conductivity meter, individual selection for low content of harmfu non-sugars carried out, and some promising CMS maintainer (O type) lines have been bred. These lines were crossed with other CMS lines, and F1 hybrid seed parent lines were obtained. Then, the productivity and quality of selected O type lines and F1 hybrids derived from them were examined.
Selection effects on harmful non-sugars were different between lines, but generally high. When selection were performed in the direction of two ways, namely, either low or high content of harmful non-sugars, content of non-sugars differed greatly between two progenies. It was generally recognized that, when selection was performed in the direction of low content of harmful non-sugars, yield of progeny decreased and sugar content increased. Some hybrids of high quality selected lines are higher in productivity and lower in harmful non-sugars, as compared with hybrids of their parent lines. Therefore, the effective breeding of high quality variety, in addition to high yield and high sugar content, will be prospective.

LANGNER, PHILIPPE and STEPHEN R. KAFFKA*, Department of Agronomy and Range Science, Univ. of California, Davis CA 95616. Consumptive water use and yield of fall-planted sugarbeets in California's San Joaquin Valley.

A line-source irrigation trial was carried out during two years to quantify water use, biomass accumulation and sugar yields of an October-planted sugarbeet crop in the San Joaquin Valley of California, at a site with low winter rainfall. Irrigation water was applied at rates varying from approximately 85% to less than 10% of estimated crop ET. Measurements with a neutron access probe were used to schedule irrigations and estimate water recovery from the soil to a depth of 2.75 m. Harvests were made in May, June, and July each year. In the first year, winter rainfall was twice the long-term average, and sugarbeet root yields failed to respond to irrigation water gradients until the final harvest in July. In the second year, rainfall was below average and root yields responded to the irrigation gradient at all three harvests, with response increasing with successive harvests. Total biomass (DM) increased with increasing irrigation levels, but root and sucrose yields reached a maximum at irrigation levels between 50% to 60% of crop ET. Water use efficiency values (Q_a : 0.0036 Mg DM cm^{-1} and S_a : 0.0017 Mg sucrose cm^{-1}) were approximately one-third higher than those reported for comparable studies for spring-planted beets in California. In deficit treatments, sugarbeets recovered water from depths greater than 2.75 m. Sucrose concentration was increased by deficit irrigation but decreased at the most severe deficit levels. A decrease in sugar concentration under extreme deficit was correlated with increased amino-N levels in those treatments.

LEWELLEN, R. T. USDA-ARS, Agric. Res. Stn., 1636 E. Alisal St., Salinas, CA 93905. - Breeding for dual resistance in sugarbeet to cyst nematode and rhizomania.

The homozygous, sugarbeet cyst nematode (SBCN) (*Heterodera schachtii*) resistant line B883 from the Netherlands was used as the source of nematode resistance (NR). B883 had been developed from Savitsky's 19 chromosome alien addition line with NR from *Beta procumbens*. B883 and C603 and C604 developed at Salinas from B883 are true breeding for NR, but they do not possess other requirements for disease resistance and productivity; they are very low in sucrose content. In addition, hybridization reinstates heterozygosity for NR that creates lower than normal transmission rates making recovery of new, useful, true-breeding NR lines difficult. NR genotypes have retarded flowering and pollen development and a tight linkage with crown galling and shoot proliferation. This linkage to galling is very useful to identify NR plants in segregating populations. Ultimately, galling is potentially deleterious, but field tests under high plant populations suggest that it will be mostly benign. Resistance to rhizomania using the Holly gene was incorporated into the NR breeding program. All recent scoring, selection, and performance testing was done under field conditions with infestations to both rhizomania and SBCN. Segregating lines through backcross four have been developed with dual resistance. Each succeeding backcross has given expected root yields and improved sucrose content; within the backcross populations, the nematode susceptible segregates approach the level of the recurrent parent as expected but the NR counterparts remain 1-3% points lower in sucrose content. Reciprocal backcrosses had different rates of NR transmission. Among different backcross lines, transmission rates through the male ranged from 1-16% and 3-26% through the female rather than the theoretical 50% rate. A modified backcross procedure using homozygous NR pollinators in parallel to conventional backcrossing should greatly increase the rate of recovering new homozygous NR lines and synthetics useful for parental line development and population improvement.

LIU, HSING-YEH*, GAIL C. WISLER, and JAMES E. DUFFUS, USDA, Agricultural Research Service, 1636 E. Alisal St., Salinas, CA 93905. - Occurrence of vascular necrosis of sugarbeet in the Imperial Valley of California.

Since about 1981, a vascular necrosis syndrome (VNS) of sugarbeet has been observed in the Imperial Valley of California. Two soil-borne viruses have been isolated and identified. One of these viruses is isometric and approximately 26 nm in diameter. The particle morphology, protein coat subunits, and nucleic acid size are similar to those of tobacco necrosis virus (TNV). The serological relationship to TNV has also been demonstrated in agar double diffusion tests. Another spherical virus isolated from necrotic sugarbeet roots was serologically related to tomato bushy stunt virus. Random sampling of 50 beet fields conducted during 1994 indicated that 80% of the fields tested had VNS. Biological assays indicated that virus was recovered from 68% of the fields tested. The isolated viruses were TNV(6%), TMV(24%), TBSV(36%), and 34% were not identified. The etiology, economic impact, and the relationship of these viruses to the increasing vascular necrosis syndrome in the Imperial Valley is not known.

LUECKE, JOHN L., ALLAN W. CATTANACH, and ALAN G. DEXTER, Department of Plant Sciences and Soil Sciences, North Dakota State University and the University of Minnesota, Fargo, ND 58105.-Fertilizer effect on sugarbeet.

Fall ridging of fields previously broadcast treated with herbicide and fertilizer will concentrate the herbicide and fertilizer in the ridge. Leaching of the herbicide or fertilizer may occur between ridging and planting causing a concentration of the chemicals in a zone just below the ridge. Sugarbeet seeded into this zone after spring deridging may be directly exposed to the concentrated chemicals. Stand losses observed in eastern Montana were suspected to be caused from this potential problem. Early fall application appeared more injurious than late fall application in commercial field observations. Field and greenhouse experiments were conducted to investigate the effect of Ro-Neet, dry nitrogen fertilizer, soil temperature and time of fertilizer application on sugarbeet population and yield. Soil treated with urea at 200 and 400 lb/A of nitrogen caused more sugarbeet injury than soil treated with Ro-Neet at 2 and 4 lb ai/A. The interaction between Ro-Neet and fertilizer was not significant. In general, soil treated with high rates of urea caused more sugarbeet injury and more stand loss than soil treated with high rates of ammonium nitrate in the greenhouse. No difference between urea and ammonium nitrate was observed in field experiments. Soil treated with fertilizer and stored at 40F or 120F for 30 days caused more sugarbeet injury and reduced sugarbeet stand more than soil stored at 70 to 90F. Sugarbeet treated with nitrogen fertilizer at 2 or 3 times the recommended rate had lower sugarbeet population, percent sucrose, and extractable sucrose compared to sugarbeet with the recommended or half the recommended amount of nitrogen.

McGuinness, Thomas J., Environmental Engineer, Spreckels Sugar Company, P.O. Box 8025, Pleasanton, CA 94588- Emission Reduction Credits in the Beet Sugar Industry

The Clean Air Act of 1977 created two programs, Prevention of Significant Deterioration and New Source Review, which can require new sources to offset proposed emission increases with corresponding reductions from the existing emission inventory. This has led to the development of emissions banking and trading systems in some areas of the country, particularly California. Key elements of emissions banking are presented along with case histories of transactions at the factories of the Spreckels Sugar Company.

McGuinness, Thomas J., Environmental Engineer, Spreckels Sugar Company, P.O. Box 8025, Pleasanton, CA 94588.- Groundwater Quality Issues in the Beet Sugar Industry

Potential sources of concern at factory sites with respect to groundwater impact are identified. A workplan for assessment of source impact on groundwater is outlined. Characterization of sources, evaluation of site geology, construction and sampling of a monitor well network are the work plan elements described.

MARTIN, SUSAN S. USDA, Agricultural Research Service, 1701 Center Avenue, Fort Collins CO 80526. - Sugarbeet organic acids: distribution and post-harvest changes.

Organic acids, some important intermediary metabolites and others characteristically accumulated by sugarbeet (*Beta vulgaris* L.), comprise about one-fifth of the non-sucrose components of typical sugarbeet extracts. I report the distribution of the major organic acids in the roots and peel (surface layers) of four diverse sugarbeet cultivars, and their changes through eight weeks of high-quality storage at 4°C. Aqueous extracts of frozen tissue were analyzed by HPLC on an HPX-87H ion exclusion column (4.6 X 300 mm) at 60°C, eluting with 0.01N H_2SO_4 at 0.5 ml/min; organic acids were detected by UV absorbance at 220 nm. Major organic acids present at harvest were oxalic, citric, malic, and succinic. Lactic, formic, and acetic acids, which can accumulate during storage as a result of monosaccharide degradation, remained at trace or very low concentrations under the constant-temperature, high quality storage used for this study. Pyrrolidone carboxylic was present at low levels at harvest and increased slightly in storage. Per gram of sucrose, the sugarbeet peel contains about 5X-10X the organic acid concentration of the whole root. The relative importance of each of these compound as an impurity in processing is related to the solubility of its calcium salt, which determines the effectiveness of removal by liming.

MAUK, P.A.[1]*, L.D. GODFREY[2], K.W. RUSHING[3], C.A. WEBER[1], J.S. GERIK[4], AND T.A. BABB[5]. [1]Univ. of Calif. Coop. Ext., 4145 Branch Center Road, Sacramento, 95827, [2]Dept. Entomology, Univ. of Calif., Davis, [3]Gustafson Incorp., Dallas, TX, [4]Holly Sugar Co., Tracy, CA, and [5]Spreckels Sugar Corp., Woodland, CA. - Effect of rate and seed application technique on performance of imidacloprid on sugar beets in California.

It has been estimated that 12% of the potential sugar yield in the US are lost due to insect pests. Several insects, including wireworms, cut worms, seed corn maggots, beet armyworm, flea beetles, cucumber beetle larvae, and symphylans are pests of seedling sugar beets and make stand establishment difficult. Another important pest group is the sucking insects, such as aphids, leafhoppers, and whiteflies. These pests can reduce yield from direct feeding and from transmission of virus diseases. Yield losses due to insect problems and associated virus diseases can be limiting to sugar beet production in California. The systemic insecticide imidacloprid can be applied as a seed treatment to control soil-borne and sucking insects. The objective of this study was to determine if rates of 30, 60, or 90 g a.i./seed unit can be applied as either a film coat (fc) or a pellet (p) to control aphids and whiteflies without reducing plant stands. Sugar beet seed (USH-11) was treated by Beta Seed (fc), Holly Sugar Co. (fc), Incotec (fc and p), and Seed Systems (fc and p). Seed was planted at 3 field sites in the fall of 1994 in 3 distinct regions of California: Imperial Valley (Brawley), Central Valley (Fresno), and Sacramento Valley (Davis). Plant stands were evaluated at 2 and 3 wk after planting. In the Imperial Valley, whitefly adults, nymphs, and feeding injury were evaluated weekly for the first 4 wk of growth. Both the 60 and 90 g rates significantly reduced feeding injury from whiteflies. The effects of imidaclopnd on whitefly populations were variable. Higher rates (60 and 90 g) tended to suppress whitefly nymphs on leaves. At the Davis and Fresno sites, aphid control was measured using a laboratory assay with black bean aphids. In the field, under optimum soil conditions, the 90 g film coat reduced stands by 15-25%. Under poor soil conditions, the 90 g film coat reduced stands by 25-42%. Pelleted seed increased stands as compared with film coated seed under all conditions and rates of imidacloprid. In fall planted sugar beets, where temperatures are mild (40-70 F), laboratory assays indicated that all rates (30, 60, and 90 g) of imidacloprid significantly suppressed aphid colonization four months after planting.

MECHELKE, W.[1], J.R. STANDER[2], E. BARZEN[3] and E. SCHULTE-KAPPERT[4]. [1] KWS, P.O. Box 1463, D-37555 Einbeck, [2] BETASEED, INC., P.O. Box 858, Kimberly, ID 83341, [3] MPI, Carl-von-Linne-Weg 10, D-50829 Köln, [4] PLANTA, Grimsehlstr. 31, D-37574 Einbeck. - New tools in Rhizomania resistance breeding.

Requirements are increasing for rhizomania resistant varieties with higher performance under both infected and non-infected conditions, and which also combine resistances to other diseases. The foundations for rapid gain from selection are simply inherited resistances, efficient disease screening techniques, and short breeding cycles. "C39", "RIZOR" and "HOLLY" are the sources of moderate to high resistance used in most of today's varieties. In the long-term breeders will also utilize resistance derived from *Beta maritima*. Rhizomania greenhouse tests which measure the virus content in seedlings are very efficient for the selection of high resistance. There is a strong correlation between a low greenhouse virus content and a high sugar yield in the field under infection. Selection for resistance based upon RFLP- or PCR-markers which are closely linked to rhizomania resistance genes may in the long-term replace the greenhouse test. Data from proprietary and official trials demonstrate the potential of using these techniques to develop highly tolerant varieties which perform competitively with normal varieties under non-infected conditions.

MILLER, STEPHEN D. and K. JAMES FORNSTROM, Plant, Soil, and Insect Sciences and Civil Engineering Departments, respectively, University of Wyoming, University Station Box 3354, Laramie, WY 82071. - Weed control in sugar beets with fall herbicide applications in a fall cover crop.

Fall application of preplant incorporated herbicides eliminates the need for spring tillage and allows an earlier start for sugar beets in the spring. Fall herbicide applications; however; increase the risk of soil erosion. Studies were conducted at Torrington, Wyoming in 1993 and 1994 on a light textured sandy loam soil (79% sand, 11% silt, 10% clay with 1.1% organic matter) to compare the efficacy of fall and spring herbicide applications in sugar beets established in a living winter wheat mulch. Weed control was similar to slightly better and sugar beet injury less with fall compared to spring preplant herbicide applications. To compensate for herbicide loss in fall treatments during the winter months application rates were increased 25 to 33%. Early preplant herbicide applications (21 to 28 days prior to seeding sugar beets) caused 2 to 5% less injury than planting time applications while maintaining similar levels of weed control at comparable rates. Combining fall herbicide applications with the living mulch concept on light textured soils is a feasible means for maintaining adequate crop residue and minimizing soil erosion during the winter months.

MITCHELL, ROBERT W., PPG Specialty Chemicals, 905 Wootten Dr., Kerman, Ca., 93630. - Slope diffuser operation optimizing temperatures.

The Slope diffuser with external heating may be operated at excessive center temperatures when processing lower quality or degraded beets which can cause negative results. They are reduced elimination, increased pressed pulp moisture and increased fuel cost. An alternative to this high temperature profile would be a lower flat profile with extended diffusion time. This profile gives reduction of energy usage at the diffuser and pulp drying, improved elimination, better pH control, less plug-ups and a higher slice rate.

MORAGHAN, JOHN T.[1*], and LARRY J. SMITH[2], [1]North Dakota State University, Walster 131, Fargo, ND 58105, and [2]University of Minnesota, Northwest Experiment Station, Crookston, MN 56716. - Mineralization of nitrogen from sugarbeet tops and the growth of a subsequent wheat crop.

Sugarbeet tops, because of their N content, can influence the yield of subsequent crops. Sugarbeet tops were removed prior to the root harvest from experimental areas in two Red River Valley fields in 1992 and 1993. The influence of fall-applied urea and high (3.48 and 2.58 % N in 1992 and 1993, respectively) and low N (1.48 and 1.26% N in 1992 and 1993, respectively) sugarbeet tops on growth of wheat in 1993 and 1994 was studied. Urea increased yields by up to 31 bu/acre in 1993 and 28 bu/acre in 1994; the optimal urea rate was 120 pounds N/acre. High N sugarbeet tops, containing 216 pounds N/acre in 1992 and 189 pounds N/acre in 1993, increased wheat yields by 36 bu/acre in 1993 and by 29 bu/acre in 1994. The corresponding increases from low N tops, containing 58 pounds N/acre in 1992 and 77 pounds N/acre in 1993, were 7 bu/acre in both years. Separate field experiments indicated that high N sugarbeet tops mineralized appreciable quantities of nitrate in the spring. Most of this mineralized NO_3, but only part of the Cl added in sugarbeet tops, was found in the upper 12 inches of soil. Sugarbeet tops can reduce the N-fertilizer requirement of subsequent crops, and must be considered in relation to nitrate pollution.

MORISHITA, DON W. and ROBERT W. DOWNARD, University of Idaho, Twin Falls Research and Extension Center, P.O. Box 1827, Twin Falls, ID 83303. - Economics of chemical and hand weed control in sugarbeets.

Idaho sugarbeet production relies on herbicides and cultivation for weed control although many growers continue to use hand labor as a part of their weed management program. Field studies were conducted in 1993 and 1994 to evaluate herbicide combinations and hand weeding for weed control and economic return in sugarbeets. The experiment was established as a randomized complete block design with four replications. Plots were 4 rows wide by 30 feet long. All herbicides were band-applied with a plot sprayer. Economic analysis included herbicide cost, which was based on a University of Idaho Cost Inputs Survey, and $4.90/acre for each application. Hand labor costs were based on the hoeing time of each plot multiplied by $5.50/hour. All other cost inputs were fixed. Ethofumesate was applied preemergence (PRE), phenmedipham + desmedipham was applied postemergence (POST), and EPTC and trifluralin were applied as lay-by herbicides. The most expensive weed control treatments in both years were POST applications plus hand weeding with or without lay-by herbicides. Kochia, common lambsquarters, redroot pigweed, and hairy nightshade were the weeds evaluated. Redroot pigweed and hairy nightshade were controlled effectively with most treatments. Kochia and common lambsquarters control was most consistent with PRE and POST combinations with and without hand weeding. These combinations with and without hand weeding also provided the highest yields and net return. In 1993, hand weed only had a net return equal to other weed control treatment combinations. In 1994 however, hand weed only was not economical due to hand weeding when the weeds were larger.

NOBLE, DAVID C., Monitor Sugar Company, 2600 South Euclid, Bay City, MI 48707-0917. - The Application of New Technologies at Monitor Sugar.

New equipment was installed in six specific stations over the past two years. Richter tubes installed in precarbonation and 1st carbonation increased gas utilization from 70% to 85%, and reduced scaling in heat exchangers allowing a 150-day Campaign without cleaning. Membrane presses reduced lime losses from 0.25% to 0.07% on beet, whilst reducing wash water usage to 3% on beet. A 4,200 m^2 (45,212 ft^2) falling film evaporator used as the 4th body, a concentrator, increased the average standard liquor brix by 4.1°, and provided a high grade vapor for use in the continuous, low raw pan. Six new G1250 white centrifugals increased station capacity, with tests showing water consumption reduced by 32% over the old P1000 models. Two further additions to the sugar end were a 4 - compartment continuous, low raw pan and a 475 m^3 (16,777 ft^3) vertical crystallizer. The system handled brixes upto 96°, and produced true molasses purities down to 55 during the 1993/94 Campaign.

NOVOSEL, KAREN M.*, and KAREN A. RENNER, Michigan State University, Dept. Crop and Soil Sciences, East Lansing, MI 48824. - Nicosulfuron and primisulfuron root uptake, translocation, and inhibition of acetolactate synthase by sugarbeet.

Inherent differences in sugarbeet sensitivity to nicosulfuron and primisulfuron have been noted in field and greenhouse work. with primisulfuron being more detrimental to sugarbeet growth. Radiolabled herbicide experiments were initiated to determine if the cause of differential sugarbeet sensitivity was due to differences in uptake, translocation, and/or ALS site sensitivity. Sugarbeet uptake of primisulfuron was double that of nicosulfuron in a hydroponic environment. When herbicide rates were increased from 5 to 25 ppb ai, uptake did not increase five times as would be expected if these herbicides were taken up passively. Transpiration was decreased by 41% upon the addition of a herbicide to the nutrient solution indicating that these compounds interfere with xylem transport in sugarbeet. Discrepancies in herbicide uptake could be due to this fact supporting research indicating passive uptake of these compounds. Nicosulfuron moved to the site of action more rapidly compared to primisulfuron but the percentage of herbicide translocated was not significantly different six days after treatment. Solution concentration did not effect translocation patterns. ALS enzyme activity, as determined by acetoin production in greenhouse grown sugarbeets, was decreased more rapidly by primisulfuron. Nicosulfuron increased ALS activity at low concentrations (0.5 and 5.0 nm). This appears to be an expression of the process of a toxin acting as a growth stimulant at low levels of plant exposure on an enzymatic level. ALS activity plateaued between 0.5 and 5.0 nm with primisulfuron. This type of curve is indicative of two isozymes with varied sensitivity to primisulfuron, though this is conjectural until the isozymes are isolated. There was a minimum of a fifteen fold difference in ALS sensitivity with primisulfuron decreasing activity to a greater extent. Uptake and translocation play a minimal role in sugarbeet response to these two herbicides. While metabolism could be a factor, differences in ALS site sensitivity can account for differential sugarbeet tolerance to nicosulfuron and primisulfuron.

OLSON, JOHN L.[1], PATRICIA R. FULLER-PRATT[2], and RANDOLPH A. MIELKE[3], [1]Huntingdon Engineering and Environmental, Inc., 600 South 25th Street, Billings, MT 59107, [2]Western Sugar Company, 1700 Broadway, Suite 1600, Denver, CO 80290, [3]Western Sugar Company, 3020 State Street, Billings, MT 59107. - Lime pile management as a bioreactor to decrease groundwater impacts.

The Western Sugar Company sugar beet processing plant in Billings, Montana transports spent lime from the sugar purification process to an on-site lime pile storage area. The slurry of spent lime and flume water contains organic matter removed during juice purification and is a relatively high strength organic and nitrogen-bearing wastewater. Groundwater monitoring data collected at the facility indicated that the slurry infiltration to the shallow alluvial aquifer below the pile had resulted in groundwater mounding and downgradient water quality impacts. Initially, WSC considered constructing an expensive anaerobic and nitrification/denitrification wastewater treatment system. However, further investigation of the lime pile revealed that it was already serving as an efficient filter and anaerobic reactor. BOD_5, COD, and TOC concentrations were observed to decrease by 98% to 99.9% and the TKN was observed to decrease by 60% before infiltrating to the groundwater. Comparison of the slurry application with other wastewater land application systems suggested that nitrogen removal could be enhanced and groundwater mounding impacts diminished through improved process and slurry management practices. The resultant system required low capitol costs and minimal maintenance cost. The system includes downgradient extraction and reapplication, alternation of lime slurry application into 11 small basins for more even distribution and better surface aeration, and process improvements to reduce organic and hydraulic loading. WSC implemented the slurry application changes beginning with the 1994/1995 campaign season. The immediate effect was to substantially decrease the groundwater mound. Initial groundwater chemistry data are promising. Evaluation of effects of the changes on the groundwater quality will continue.

OWENS, LOWELL D.*, JOHN C. INGERSOLL and THOMAS M. HEUTTE, USDA, Agricultural Research Service, Plant Molecular Biology Laboratory, Building 006, Beltsville, MD 20705. - Genetic engineering studies in sugarbeet: Promoter analysis in transiently transformed suspension cells and degradation of antibacterial polypeptides in leaf intercellular fluids.

The rational design of gene constructs for introduction into sugarbeet necessitated development of a transient assay for assessing promoter activity in sugarbeet cells. Inducible promoters from tobacco osmotin and PR-S genes and a potato proteinase inhibitor 2 (PIN2) gene were fused to the β-glucuronidase (*uidA*) coding region and compared with a construct carrying the constitutive 35S promoter from cauliflower mosaic virus. An optimized protocol consisted of preincubating suspension cells 4 h on medium supplemented with equal proportions of sorbitol and mannitol (250 mM total) prior to bombarding with DNA-coated microparticles. At 24 h the osmotin promoter displayed activity 2.5 times that of the 35S promoter. Activities of the PR-S and PIN2 promoters were intermediate. To investigate degradation of the secreted polypeptide products of engineered genes, antibacterial cecropins were incubated with leaf intercellular fluid (ICF) from various crops. Modified cecropin MB39 had a half-life of 5.8 h in sugarbeet ICF, while that for authentic cecropin B was 4.6 h. This influence of structure on stability was observed in ICFs from other crops as well.

PALM, KAREN L., and JOHN A. SMITH, University of Nebraska, 4502 Avenue I, Scottsbluff, NE 69361. - A survey of sugarbeet plant spacings in grower fields in western Nebraska.

More growers in western Nebraska are planting-to-stand rather than overseeding and thinning their sugarbeet fields. The desired plant population and plant spacing accuracy result from the performance of the planting system and associated emergence, and are not "corrected" by thinning. The goal of this survey was to determine the level of accuracy of plant spacings in fields planted-to-stand and in fields before and after thinning. Plant spacing measurements were made in a total of 54 sugarbeet fields in western Nebraska over a four year period. A total of 500 spacings were measured in random locations within each field. ISO defined spacing accuracy parameters were calculated. Simple parameters of "accurate" spacings (within ± 1 in. of mode spacing), "narrow" spacing (< 1 in.), and "wide" spacings (> 18 in.) were also calculated to provide easily visualized descriptions of plant spacing accuracy. The mode spacing was assumed to be the actual spacing delivered by the planter or the target spacing if the field was thinned. In the fields planted-to-stand, an average of 38% of the plant spacings were rated as accurate spacings, (ranging from of 26% to 58%), 4% narrow spacings and 2% wide spacings. This suggests that improvement in plant spacing accuracy is needed. For the fields with both before and after thinning measurements, an average of 35% of spacings measured accurate (ranging from 27% to 57%), 8% narrow, and 2% wide before thinning. In these same fields after thinning, 22% of spacings measured accurate (ranging from 15% to 37%), 4% were narrow, and 6% were wide. Thinning was detrimental to plant spacing accuracy.

PANELLA, LEE[1]* and Mary K. Hjort[2], USDA, Agricultural Research Service, 1701 Center Ave., Fort Collins, CO 80526 and Colorado State University, Department of Physiology, Fort Collins, CO 80523. - Genetic diversity among isolates of Rhizoctonia root rot pathogenic to sugarbeet.

Currently, it is possible to assay the pathogenicity to sugarbeet of an isolate of *Rhizoctonia solani* through a greenhouse bioassay only, which may take 12 to 16 weeks. Recent work done on the phylogenetics of this pathogen has not been well correlated with the host specificity of the fungus. Whether the pathogenicity to sugarbeet has evolved once or more than once in this fungus could substantially influence its interaction(s) with the sugarbeet plant. *R. solani* is divided into anastomosis groups (AGs) based on the ability of the hyphae to fuse and exchange genetic material, or, more recently, into intraspecific groups (ISGs) based on molecular markers. The polymerase Chain Reaction (PCR) was used with the ITS1 and ITS4 primers to amplify the DNA of *R. solani* coding for the 5.8S ribosomal RNA gene (rDNA) as well as the two flanking ITS regions. Five restriction enzymes, Alu I, Hae III, Hha I, Hinf I, Hpa II, and Rsa I, were used to create restriction fragment length polymorphisms (RFLPs) from the amplified DNA fragments. Data from 92 isolates of *R. solani* were analyzed using the SIMQUAL program (NTSYS-pc from Exter Software) based on Jaccard's coefficient. The resulting similarity matrix was used to create a phenogram. There was good discrimination between AG-2-2 (causal agent of sugarbeet crown and root rot) and the other AGs, but not adequate discrimination within this AG or among the other AGs. More genetic markers are needed to discriminate adequately. Isozyme markers from four enzyme systems (α- Acid phosphatase (α-ACP), Phosphoglucomutase (PGM), Glucose-6-Phosphate-dehydrogenase (G6PDH), and Malate dehydrogenase (MDH)) are being screened to further distinguish among isolates. Greenhouse tests will be used to determine the pathogenicity of the isolates of *R. solani* to sugarbeet. These data will be correlated with the phylogenetic information to genetically "fingerprint" those isolates pathogenic to sugarbeet.

PRINCE, JOHN W.F., British Sugar plc, Oundle Road, Peterborough, PE2 9QU, UK - Quality criteria for sugar beet seed treatment.

Increasingly the seeds used to produce root crop production are being asked to carry higher levels of agrochemicals to protect not only the emerging seedling, but the maturing plant during the mid-season growing period. Procedures have to be in place to ensure both the quality of seed and the levels of agrochemicals applied to the pellet. Risk assessments on each agrochemical have been conducted leading to tolerance levels being agreed for each. In the UK, 13% of the crop is at risk from soil pests, and following mild winters, 100% can be at risk from Virus Yellow. For growers to have confidence in the treatments applied, quality systems need to be robust and open. The registered rate for tefluthrin is 10g ai/unit for which limits of between a minimum of 9.3g ai/unit and a maximum of 10.7g ai/unit have been set for the UK. Similarly, imidacloprid has a registered rate of 90g ai/unit and limits between a minimum of 83g ai/unit and 94g ai unit. These targets are to be continuously reviewed and improved.

D. EUGENE REARICK*, The Amalgamated Sugar Company, P.O. Box 127, Twin Falls ID 83303. - Non-sugar removal in the molasses and raw juice chromatographic separation processes.

During extended investigations of the application of simulated moving bed ion exclusion technology to the recovery of sucrose from sugarbeet molasses and concentrated diffusion juice, information on the elimination of various individual non-sugars has been collected. Ash constituents including inorganic anions and cations are removed at over 95% efficiency. Nitrogen compounds vary considerably with some removed very readily while betaine (at 65% removal) is one of the major components more difficult to separate from sucrose. Invert and raffinose are removed from molasses at 60% and 80% levels respectively and the separation acts as a very efficient remover of dextran (99% removal). A comparison of ion exclusion separation with liming and carbonation of diffusion juice shows the chromatographic system to give a much better removal of non-sugars particularly those which are not made insoluble by calcium oxide treatment (chloride, sulfate, potassium, sodium, raffinose, etc.).

REARICK, E., M. LAMBREGTS, C. MCKAY, J. OLMSTEAD, S. OLMSTEAD, and D. PATTERSON. The Amalgamated Sugar Company, 2320 Orchard Drive East, P.O. Box 127, Twin Falls, ID 83303. Distribution of components in sugarbeet roots.

ABSTRACT

The distribution of various components in sugarbeet was determined by slicing whole sugarbeets into a crown, a "slice" of ¼" to ⅜" thickness containing all remaining leaf scars, and a root portion (free of leaf scars). The three portions were weighed, analyzed, and the percent of each component in each beet portion was calculated based on total weight of component in whole beet. Most sucrose (92%) was found to be contained in the root portion while only 60-70% of some non-sucroses (α-amino nitrogen, sodium, chloride, nitrate, sulfate, and invert) are concentrated in the root. Several non-sucroses show distributions nearer to that of sucrose with 81.6% of potassium, 81.5% of phosphate, 86.9% of malate and 92.5% of oxalate present in the root portion.

ABSTRACT

RHOTEN, CHRISTOPHER D., Spreckels Sugar Company, P.O. Box 68, Mendota Ca. 93640. - Operating performance of a NRS "two-stage" polishing Thin Juice deliming system.

The thin juice deliming system described produces high efficiency of calcium removal from thin juice having relatively high and varying concentrations of calcium hardness. Calcium removal efficiency of the strong cation based system is proportional to the log of the feed calcium concentration. Analysis of the decalcification efficiency of the system defines the calcium loading parameters and the regenerate requirements of the lead column as a function of the juice hardness being fed to the system. System control parameters based on the efficiency regression allows precise calcium loading of the lead column as a function of the juice fed to the system preventing excess calcium bleed to the polishing unit and optimization of the deliming efficiency. Maximum and consistent deliming performance is achieved when the lead column calcium loading is properly managed. Statistical evaluation of the polished effluent juice hardness serves as an overall indicator of system performance.

RUSH, C. M., and R. M. HARVESON*, Texas Agricultural Experiment Station, P.O. Drawer 10, Bushland, TX 79012. - Reduction of sugar beet root diseases by cultivar selection and fumigation management.

A study was begun in 1994 to evaluate the efficacy of irrigation frequency and cultivar mixtures to control multiple soilborne pathogens. Four cultivars and four blend combinations were planted 13 April in a randomized complete block, split plot design with six replications. The main plots were irrigation levels and cultivars were the split treatment. Each plot consisted of four 100 ft rows. They were irrigated for emergence 15 April, followed by bi-monthly irrigations for the wet plots and one irrigation a month for the dry plots. Disease counts were made seven times during the season at 2-week intervals by destructively sampling infected plants from one row of each plot. All cultivars in the test were chosen because they are currently being used commercially in Texas. Ranger is a new cultivar that is a high sucrose producer, whereas MH9155 was bred for high root yields. Rhizosen is a rhizomania-resistant cultivar, and HH67 has good tolerance to *R. solani*. Entries that included MH9155 tended to produce the better results for most yield parameters. High irrigation levels were correlated with high disease incidence and ratings. Few significant differences were seen from yield components between irrigation treatments. Results indicate that reduced irrigations could be beneficial for growers who are forced to plant into pathogen-infested soils.

RUSH, C. M., and G. B. HEIDEL*, Texas Agricultural Experiment Station, P.O. Drawer 10, Bushland, TX 79012. - Variation in symptomatology and serotype among furoviruses infecting sugar beet.

Beet soilborne mosaic virus (BSBMV) is a multiparticulate rod-shaped virus transmitted by *Polymyxa betae*. It is similar to beet necrotic yellow vein virus (BNYVV), but the viruses are serologically different. BSBMV capsid molecular weight has been estimated at 22.5 kDa, and the genome is comprised of three to four RNA species. Sugar beets exhibiting typical BSBMV-like foliar symptoms were collected from fields in Colorado. Leaf samples were tested by ELISA. Two isolates (Neal, Amen) were positive for BSBMV. Three isolates (RC, LC, Schaeffer) repeatedly tested negative for BSBMV or had absorbance values that were higher than those of healthy controls but lower than those typically recorded for positive samples. A single 22-23 kDa protein species from each isolate was visualized in denaturing polyacrylamide gels. Using BSBMV-specific PCR primers, a single 700 bp product was amplified from RNA extracted from each isolate. Gel electrophoresis of RNA extracted from LC and RC virus preparations indicated the presence of four RNA species with a banding pattern similar to that of BSBMV. Virus isolates serologically different from BSBMV but similar in terms of symptom expression, capsid protein, RNA banding pattern and PCR products amplified using BSBMV-specific primers may comprise a serotype of BSBMV. Along with serological variation among BSBMV isolates, variation in foliar and root symptomatology has been observed.

SAMARAWEERA, INDRANI S.*, UPASIRI SAMARAWEERA, DIANE L. RHEAULT, and RICHARD C. MONT, American Crystal Sugar Company, Research Center, P.O. Box 1227, Moorhead, MN 56561-1227. - An unusual occurrence: is L-lactic acid a true indicator of microbial infection?

Sugar loss due to microbial infection has been a problem encountered by the sugar industry since its inception. Therefore monitoring of microbial populations and keeping infections in check becomes very important. However, conventional culture methods for estimates of microbes takes a minimum of 48 hours. Therefore chemical estimates of bacterial metabolites such as L-lactic acid and nitrites have been used in preference to culturing methods for routine analysis. These chemical estimates, though suitable in most cases, will not hold true in all cases and was found to be the case at one of American Crystal Sugar Company's factories. Here L-lactic acid numbers and microbial counts obtained by culturing methods gave conflicting results. In this case L-lactic acid numbers were low and pointed to no signs of infection, but bacterial counts were high. In addition organic acid analysis of samples by HPLC gave very high total lactic acid numbers (sum of D and L-lactic acid) which were 20 times that of L-lactic acid. The presence of high levels of D-lactic acid and low levels of L-lactic acid was further confirmed by an enzyme kit method as well. Additional investigation of frozen samples for specific microbial types indicated the presence of Leuconostoc in fairly high numbers. Leuconostoc mesenteroides is a predominant D-lactic acid producer and was a probable causative agent of this unusual phenomenon. This unusual formation of D-lactic acid in preference to L-lactic acid in sugar factory process streams is the first reported incidence to our knowledge.

SAMARAWEERA, UPASIRI, American Crystal Sugar Company, Research Center, P.O. Box 1227, Moorhead, MN 56561-1227. - SO_2 interference in enzymatic L-lactate determination (YSI) and a method to prevent this interference.

Sulfur dioxide has been known to interfere in YSI L-lactate determination. The mechanism of interference or the level of interference was not known. It was believed that the integrity of the enzyme was destroyed by SO_2. Therefore this study was done to address those issues and find a method to remove such an interference. This study revealed that SO_2 interfered in the YSI L-lactate determination and was proportional to SO_2 concentration. The interference was particularly important above 500 ppm of SO_2. In addition the enzyme was found to be still active after experimentation and hence indicated that the integrity of the enzyme is retained. It was also found that the interference was chemical in nature in that SO_2 when injected on a blank membrane did not produce a current. Instead SO_2 was found responsible for the reaction with the L-lactate oxidation product, hydrogen peroxide before it reached the electrode surface resulting in low L-lactate readings. In order to remove this interference, several methods were evaluated and oxidation with potassium chlorate was found to be the most successful. Results showed that 0.32 M acidic $KClO_3$ removed most of the interference that is caused below 1000 ppm of SO_2 in approximately 2 minutes.

Scoresby, J. Rene, Dale Comer, Matt Ehlhardt, Gerald Hora, Terry Mayberry, and Kevin Thorsness, AgrEvo USA Company, Little Falls Centre One, 2711 Centerville Road, Wilmington, DE 19808. - Betamix Progress - a New Herbicide for sugarbeets.

Betamix Progress is a new product that is a combination of the herbicides desmedipham, phenmedipham, and ethofumesate. The three active ingredients are a 1:1:1 ratio for a total of 1.8 lb. active ingredient per gallon. Eighteen field trials were conducted in 1994 with small plot research equipment. Seventeen broadleaf weeds and four grasses were evaluated for control with Betamix Progress. Betamix Progress was applied at 0.22 to 0.29 lb. ai/A three times starting at the cotyledon stage, five to ten days later, and again five to ten days later. Betamix Progress was also applied at 0.25 to 0.5 lb. ai/A two times at cotyledon to 2 leaf and again at 2 to 4 leaf. Betamix Progress applied at a season total of 0.66 lb. ai/A gave good to excellent control of most weeds with very little crop injury. For hard to control weeds higher herbicide rates gave higher control. Betamix Progress gave better weed control than did Betamix. Farmers will have flexibility in application timing and herbicide rates when using Betamix Progress. Widespread farmer demonstrations during 1994 affirm good weed control and farmer acceptance.

SHOCK, CLINTON C.*, JOHN G. MILLER [2], LAMONT D. SAUNDERS[1], and TIMOTHY D. STIEBER[3], [1]Malheur Experiment station, Oregon State University, 595 Onion Ave., Ontario, OR 97914, [2] National Soil Tilth Lab., Ames, IA, [3] University of Idaho, Payette, ID. Sugar beet performance and nitrogen recovery following onions.

Sugar beets grown following onions and potatoes can have high tonnage yield, excessive levels of pulp nitrate, and depressed sugar content. Sugar beets were grown in three separate trials on silt loam soils at the Malheur Experiment Station, Ontario, Oregon following onions. Onions had been fertilized with 0, 56, 112, 224, and 448 kg N per hectare. Depending on the N fertilizer rate to onions, residual soil nitrate and ammonium for sugar beet production averaged 98 to 265 kg/ha in the top 1.8 m of soil. Beet yield increased with N rate on the onions from 87.4 to 104.8 Mg/ha. Plant dry weight yield, plant N content, beet pulp nitrate, and conductivity also increased with onion N rate. Sucrose content declined from 17.6 % at 0 N to 15.4 % at 448 kg N/ha. Recoverable sugar was highest (16.0 Mg/ha) following 224 kg N/ha applied to the preceding onion crop. Soil organic matter mineralization was estimated to contribute 194 kg/ha of available -N.

SMIGOCKI, ANN[1]*, SUNGGI HEU[1], IRIS McCANNA[1] and GEORGE BUTA[2], [1]USDA, ARS, Plant Molecular Biology Laboratory, and [2]Horticultural Crops Quality Laboratory, Beltsville, MD 20705. - Insecticidal compound(s) induced by regulated expression of a cytokinin biosynthesis gene in transgenic plants.

Cytokinins as well as other plant hormones have commercial applications as bioregulators and in combination with endogenous hormones have been shown to affect natural plant defense mechanisms. Since current interests are focusing on combined effects of natural defense mechanisms of plants and biotechnology for crop improvement, we evaluated cytokinin's role as a modulator of insect resistance in transgenic plants carrying a cytokinin biosynthesis gene that was engineered for leaf expression by mechanical wounding or insect feeding. We were able to demonstrate that the herbivorous *Manduca sexta* larvae consumed up to 70% less of the leaf material from transgenic plants expressing the cytokinin gene as compared to control plants. The effect on newly hatched *Myzus persicae* (green peach aphid) nymphs feeding on transgenic plant material was more dramatic in that only about 35% of the nymphs matured and of those only about 60% were able to reproduce. The green peach aphid is an efficient vector for transmission of viruses causing beet yellows, western yellows, and mosaic diseases in sugar beet Insecticidal activity was associated with the leaf surface extracts of transgenic plants and upon further fractionation yielded high molecular weight compounds that are in the process of purification. The activity in the extracts is stable at 4 C for more than 2 months in water but appears to be light sensitive. Coating of normal leaf disks with 0.1% solutions of the partially pure extracts completely retards insect feeding and, in most cases, kills the hornworm within two hours of exposure. The insecticidal activity may only be specific for certain orders of insects such as Lepidoptera and Homoptera but not Coleoptera since it appeared not to have an affect on the alfalfa weevil.

Smith, Garry A.*, and John D.Eide, USDA, Agricultural Research Service, Northern Crop Science Laboratory, P.O. Box 5677, State University Station, Fargo N.D. 58105
Biocontrol of sugarbeet root maggot via entomopathogenic fungi.

Entomopathogenic (insect disease causing) fungi are unique among insect pathogens because they infect by penetrating the external cuticle instead of the gut. A great diversity of fungal species have the ability to infect insects. There are two major taxonomic groups of fungal entomopathogens; Hyphomycetes are not obligate pathogens in nature and many have a broad host range ; by contrast, the Entomophthorales, are naturally obligate pathogens of generally limited host range. We have identified at least two pathogenic fungi which may become part of the arsenal for biological control of the sugarbeet root maggot. As with parasites and predators, introducing biotypes of pathogens adapted to the climate of the target area of introduction can be crucial to successful establishment. Development of entomopathogenic fungi for control of insects is only feasible if these organisms are safe. We are investigating the entomopathogenic fungi *Beauveria bassiana* and *Metarhizium anisopliae* for pathogenicity and virulence to the root maggot. These two fungi are not obligate pathogens and are soil born. Based on studies with laboratory animals, neither species is considered infective or toxic to humans. We have found that both of these fungi infect and kill at several insect developmental stages including the adult fly. We have found infection in eggs, second instar, third instar and adults. Infection and mortalities for the important third instar stage of the insect after seven days exposure was about 15 % for both fungi. But after 15 days and beyond, infection by *Beauvaria* resulted in 30-46% mortality and infection by *Metarhizium* resulted in 94-100% mortality. Spore concentration of inoculum was critical to successful infection and mortality.

SMITH, J. A., University of Nebraska, 4502 Ave. I, Scottsbluff, NE 69361. - Sugarbeet plant spacing performance of seven sugarbeet planter models.

Accurate spacing of sugarbeet plants within the row can be a factor in effective weed control, in efficient harvest, and in sugar yield. As a result, growers are seeking better performance from their planters, examining different models, accessories, and operating practices, to achieve more accurate plant spacing. The objectives of this study were to examine plant spacing accuracy of common sugarbeet planters and one new planter; compare laboratory seed spacing accuracy with field plant spacing accuracy; and evaluate new components introduced for the MaxEmerge 2 planter. A total of 500 spacings were measured for each planter model. Planter models evaluated were the Deere 71, Milton, Deere MaxEmerge 2, Monosem, Stanhay-Webb 590, WIC and Kleine. There were both field plant spacing and laboratory seed spacing accuracy differences among planter models. The Kleine planter provided the most accurate plant spacing, followed by the Milton and Stanhay-Webb 590 planters. The new components for the MaxEmerge 2 planter did not substantially improve plant spacing, but they did improve seed depth control. Accuracy of seed spacing in the laboratory was much better than plant spacing accuracy in the field, with most planters. The reason was movement of the seed within the seed furrow. Seed spacing accuracy on a grease belt test stand did not consistently represent plant spacing accuracy in the field. Seedbed conditions, seed coating type, and field speed influenced plant spacing accuracy.

SMITH, J. A., K. L. PALM, and C. D. YONTS, University of Nebraska, 4502 Ave. I, Scottsbluff, NE 69361. - Field loss from sugarbeet harvest.

There is little data available which documents the amount of sugarbeet root left in grower's fields after harvest. Does field loss represent a significant economic loss to the grower, and is it of sufficient magnitude to warrant attention by the sugarbeet industry? The objective of this study was to determine the field loss from sugarbeet harvest operations in grower fields. Field loss was measured in a total of 45 grower fields during three harvest seasons. Roots and root parts were collected from 8 sites at random within each field and categorized as large whole roots, small whole roots, sliced root parts, large tails, small tails, and miscellaneous root parts. Average harvest loss, including all categories of root parts, was 0.9 ton/A, ranging from 0.1 to 4.0 ton/A. Average harvest loss, excluding the categories of small roots and small tails, was 0.7 ton/A, ranging from 0.1 to 3.9 ton/A. Averaged over all fields, 40% of the total field loss was from large tails, caused primarily by insufficient depth of the lifter wheels. Eighteen fields had less than 0.5 ton/A total field loss. Five fields had harvest loss greater than 1.5 ton/A. Thirty percent of the loss in these five fields was large tails and another 30% was sliced roots. The sliced roots were often caused when the sugarbeet row was not centered in the soil ridge. The digger wheels registered on the soil ridge and sliced the sugarbeet roots. Most growers had an acceptable level of harvest loss. However, an educational effort is needed to reduce excessive field loss in approximately 20% of the fields.

SMITH, JOEL C., American Crystal Sugar company, 101 North Third Street, Moorhead, MN 56560. - Environmental awareness training.

An environmental awareness training will help ensure that employees understand their responsibility to comply with environmental laws, regulations and permits. The training has to be specific to the company's needs. It must include an identification of responsibilities. Once employees are trained, they can be held accountable for meeting the environmental goal of the training. Next, determine how the training will be developed and delivered. Conducting a current analysis of environmental awareness and a needs assessment is the next step. From this information, the conceptual draft of proposed training materials and the delivery system can be presented to management. Final training materials and methods can be presented to management. Final training materials and methods can be prepared based on the comments of management. The training materials should target specific groups, such as managers, supervisors, employees in specific jobs and the general staff of the company. Supervisors and managers need to be responsible for identifying those who need training and the type of training needed. Management support of the program is essential to its success.

SMITH, LARRY J.[1], and ALBIN W. ANDERSON [2]. [1]NW Expt. Stat., Univ. Minnesota, Crookston 56716 and [2]Dept. Entomology, North Dakota State Univ. Fargo 58105. - Post-emergence insecticide application for sugarbeet root maggot (*Tetanops myopaeformis*) control in the Red River Valley.

The sugarbeet root maggot (SBRM) is the most significant economic insect pest on sugarbeet in northwest Minnesota and eastern North Dakota. Inadequate performance by registered at-plant insecticides, due to drought conditions in much of the region (1988-92), lead to recommendations for a post emergence application of Chlorpyrifos (4E) in combination with the at-plant insecticide in 1992. Subsequent research on rates, timing and the affect of moisture on the performance of Chlorpyrifos (4E) has supported and refined these recommendations and may result in the use of post emergence only treatments for areas of low or moderate SBRM pressure in the region. Increasing the rate of Chlorpyrifos (4E) from 1.0 to 3.0 lb a.i./acre, broadcast equivalent, increased recoverable sucrose 300-455 lb/acre in separate trials and extended the window of control. Application of the higher rate 17 days before peak adult fly activity increased recoverable sucrose 1526 lb/acre over the control, and gave control equal to the recommended at-plant application of Terbufos (15G). One inch of moisture within 24 hours of application of 1.0 lb a.i./acre Chlorpyrifos (4E) alone, or in combination with at-plant Terbufos, increased recoverable sucrose 1276 and 805 lb/acre, respectively.

SNYDER, GORDON W., JOHN C. INGERSOLL, and LOWELL D. OWENS, USDA/ARS, PMBL, 10300 Baltimore Ave., Beltsville, MD 20705. - *Agrobacterium*-mediated and biolistic enhanced transformation of sugarbeet.

Molecular improvement of the sugarbeet is dependent on an efficient, reproducible method of direct gene transfer, therefore, our objective was to develop a simple method of genetic transformation. Seeds of Rel-1 were germinated in the dark at 27 °C for 3 weeks on medium containing 1.0 mg/l 6-benzylaminopurine (BA) and 0.5 mg/l 2,3,5-triiodobenzoic acid. The seedlings were then transferred to 4 °C for cold treatment and storage. After 2 months, the shoots were isolated, the leaves trimmed close to the stem, then incubated for 10 days in the dark at 27 °C on a high-auxin containing medium. Following the incubation, the shoots were cut through the longitudal axis, placed cut-side-up on medium containing osmotica, 0.3 mg/l BA, and 0.1 mg/l naphthaleneacetic acid. The tissue was bombarded with gold particles coated with a plasmid containing one of four pathogen-response genes. Half of the explants were then incubated in an *Agrobacterium* culture for 20 min. After a two-day cocultivation on the same medium supplemented with 100 μM acetosyringone, the explants were washed, placed on medium containing either 1.0 or 2.0 mg/l BA, 100 mg/l kanamycin and 300 mg/l cefotaxime and incubated in the light at 25 °C. After 4 weeks green organogenic calli appeared on the explant tissue. Only the tissue inoculated with *Agrobacterium* showed regeneration, and from 10 explants 0-5 calli were produced. Generally, regeneration was better on the medium supplemented with 2.0 mg/l BA, with the controls producing only nonorganogenic green calli.

STARKE, ROBERT J., and KAREN A. RENNER, Department of Crop and Soil Science, Michigan State University, East Lansing, MI 48824.

Velvetleaf Control with Triflusulfuron in Sugarbeet.

Triflusulfuron is a postemergence herbicide that controls velvetleaf in sugarbeet. Sugarbeet response and velvetleaf control from postemergence applications of triflusulfuron alone and in combination with desmedipham + phenmedipham, non-ionic surfactant, and 28% liquid urea ammonium nitrate were evaluated in the field. Velvetleaf control was also evaluated in greenhouse experiments. Another field experiment determined if preemergence applications of cycloate, ethofumesate, pyrazon, or pyrazon + ethofumesate followed by postemergence applications of triflusulfuron, desmedipham + phenmedipham, ethofumesate, endothall or combinations thereof influenced sugarbeet yield or quality in the absence of weeds. Sugarbeet injury was temperature dependent with greater and more persistent visual injury when there were cooler temperatures at the time of and following triflusulfuron application. Triflusulfuron controlled velvetleaf only when non-ionic surfactant was added. Desmedipham + phenmedipham increased velvetleaf control in the absence of non-ionic surfactant in the field. However, adding desmedipham + phenmedipham to triflusulfuron + non-ionic surfactant decreased velvetleaf control in the greenhouse. In the absence of weeds, all preemergence herbicides except ethofumesate reduced sugarbeet yield. All postemergence herbicide combinations reduced sugarbeet root yield by 3.4 to 5.5 Mg/ha in the absence of weed competition.

STORM, DALE W., and WENDLING, THOMAS E., Infilco Degremont Incorporated, 2924 Emerywood Parkway, Richmond, VA, 23229. - **Contact Anaerobic Treatment for Sugar Beet Wastewater.**

Contact (suspended growth) type systems are employed for anaerobic wastewater treatment in many plants. They are especially applicable in beet sugar plants. In plants where lime is used in beet washing, calcium carbonate precipitation in the wastewater creates particular problems for wastewater treatment. Loss of active biomass from the reactor is also frequently a problem encountered in anaerobic wastewater treatment.

This case study of a wastewater system at the Pfeiffer u. Langen beet sugar plant in Elsdorf, Germany, which treats 35 tons per day of COD (chemical oxygen demand) prior to discharge to a municipal sewer system, examines the effectiveness of gas mixing in the reactor, clarification/thickening, as well as other measures employed to increase the performance of the overall wastewater system.

In this plant, BOD (biochemical oxygen demand) reductions of > 95% are experienced, as well as COD reductions of > 85% at high volumetric COD loadings of 10 Kg COD/cu.m./day.

TSAI, CHIA-JUNG[1] and Joseph W. Saunders[2], [1]Crop and Soil Sciences Department, Michigan State University and [2]USDA, Agricultural Research Service, East Lansing, MI 48824. - Somatic embryos from callus of clone REL-1.

Somatic embryogenesis has been reported anecdotally several times in sugarbeet. However, development of procedures for maximum production of somatic embryos is needed if they are to used in gene transfer or even in artificial seeds. In model clone REL-1, a low frequency of somatic embryogenesis (about one embryo per ml of suspension) was elicited following a plating-out onto hormone free MS medium of fresh suspension culture cells grown with hormone free MS medium. The inclusion of 0.1 or 0.3 mg/l ABA in the plate out medium increased the number of somatic embryos in this system. The highest average somatic embryo yield achieved was 15/ml of suspension plated out on the combination of NAA (1mg/l) and ABA (0.1 mg/l). After 22 to 40 days, various stages from globular, heart, or torpedo shaped embryos to mature opaque white embryos with cotyledons and radicles were present at the surface of the callus tissue. The external morphology of several somatic embryos was examined by scanning electron microscopy. The somatic embryos developed into normal plantlets, including betalain pigmentation on hypocotyls, after being transferred onto hormone free MS medium. The conversion rate of somatic embryos of different lengths (1, 2, 3 mm) into complete plantlets was 78%, 81% and 85%, respectively. Secondary embryogenesis, helpful for the use of embryoids in gene transfer, was not observed in this study.

VAUGHN, K. M.*, and C. M. RUSH, Texas Agricultural Experiment Station, P.O. Drawer 10, Bushland, TX 79012. - A survey of *Aphanomyces cochlioides* from sugar beet production areas in the United States and Canada.

Aphanomyces cochlioides is a soilborne fungus that causes black root, a serious sugar beet seedling disease. Tachigaren, a systemic fungicide that has activity against *Aphanomyces* spp. and other seedling pathogens, is widely used in Europe and Japan. Until the forthcoming registration of Tachigaren in the USA, the only control measures available to growers in the Texas Panhandle to reduce disease caused by *A. cochlioides* are to plant early when soils are cool and use limited irrigation to establish a stand. A survey was conducted to determine the geographical distribution of *Aphanomyces* and other major sugar beet seedling pathogens throughout production areas in the USA and Canada. In greenhouse experiments, soil samples from Canada, California, Colorado, Idaho, Michigan, Montana, Nebraska, Ohio, the Red River Valley, Texas, and Wyoming were screened for *Aphanomyces*, *Rhizoctonia*, and *Pythium*. High levels of *Aphanomyces* were detected in soils from Montana, Ohio, and the Red River Valley, while *Rhizoctonia* was predominantly isolated in soils from Colorado, Idaho, and California. Also, high levels of *Pythium* were detected in California soils. Since Tachigaren is used in other countries to suppress *Aphanomyces*, a field study was conducted to evaluate the efficacy of Tachigaren as a seed treatment to control *Aphanomyces* on sugar beet seedlings in the Texas Panhandle. Tachigaren significantly reduced incidence of seedlings infected by *A. cochlioides*, but, in this study, it did not protect against infection by *Aphanomyces* the entire season.

WANG, SHAOKE, AKIO SUZUKI and DALE YEAROUS, Seedex Inc., Longmont, Co. 80501 USA -The evaluations of methods for ploidy determination in Beta Vulgaris L.

Various methods for Ploidy determination in sugar beet (Beta Vulgaris L.) were evaluated. These methods included the measurements of leaf stomatal density, stomatal size, chloroplasts number in stomatal guard cells, pollen size and somatic chromosome counting. All these methods were conducted among a diploid population and its equivalent triploid and tetraploid populations. The results indicated that the somatic chromosome counting was the most reliable and efficient method. However, good cytological technique was required. The pollen size measurement is a practical method, though the measuring time is limited. The chloroplast number in stomatal guard cells also provided useful information for ploidy determination, its simple, but lack of accuracy between triploid and tetraploid. The measurements for stomatal density and size showed quite variations and hard to be accurate for practical use. The method of using flow cytometer to measure ploidy levels was also discussed.

WILSON, ROBERT G.* and GARY L. HEIN, University of Nebraska, 4502 Ave. I, Scottsbluff, NE 69361. - Interaction of insecticides applied at planting with triflusulfuron (Upbeet) herbicide applied postemergence.

ABSTRACT

A two-year field experiment was conducted near Scottsbluff, NE, to determine the influence of aldicarb, chlorpyrifos, and terbufos applied at planting with desmedipham plus phenmedipham and triflusulfuron applied after sugarbeet emergence on crop stand, vigor, and root yield. Aldicarb, chlorpyrifos, and terbufos were applied as bands at recommended and 2x rates over the crop row. In addition chlorpyrifos was also applied postemergence when sugarbeets were in the cotyledon stage of growth. Triflusulfuron and desmedipham plus phenmedipham were applied alone or in combination as split treatments once when sugarbeets were in the cotyledon stage of growth and again 7 days later when the crop was in the 2-true-leaf stage of growth. Observations of early season sugarbeet vigor suggested there was no interaction between aldicarb applied at planting and postemergence applications of triflusulfuron or desmedipham plus phenmedipham. Sugarbeet vigor declined when the 2x rate of chlorpyrifos applied preplant or postemergence was applied to sugarbeets also receiving a postemergence application of triflusulfuron or desmedipham plus phenmedipham. One of two years sugarbeet vigor declined when the 2x rate of terbufos was applied preplant and followed by a split application of triflusulfuron postemergence. Later season observations of sugarbeet stand and root yield did not suggest there was an interaction between aldicarb, terbufos, or chlorpyrifos with triflusulfuron or desmedipham plus phenmedipham.

WILSON, ROBERT G.* and PATRICK J. SHEA, University of Nebraska, 4502 Ave. I, Scottsbluff, NE 69361. - Dinitroaniline herbicide carryover to sugarbeets.

ABSTRACT

A four-year field experiment was conducted near Scottsbluff, NE, to compare the soil degradation of ethalfluralin, pendimethalin, and trifluralin in soil. Dinitroaniline herbicides were applied preplant incorporated before planting dry edible beans at rates of 0.56, 1.12, and 2.24 kg/ha. Herbicide degradation was monitored by analyzing soil utilizing a chemical extraction and gas chromatograph analysis of the extract. Sugarbeets followed dry edible beans in the crop rotation and crop growth was related to dinitroaniline herbicide concentration. Moldboard plowing of the soil before sugarbeet planting reduced dinitroaniline herbicide concentration in the upper 0- to 8-cm zone of the soil profile by 39 and 76% in 1990 and 1992, respectively. Moldboard plowing increased the concentration of herbicide in the 15- to 30-cm zone of the soil profile. Ethalfluralin degraded faster in the soil than pendimethalin or trifluralin. Eleven months after herbicide application soil residues of 0.07 ppmw or greater of pendimethalin of trifluralin in the upper 0- to 8-cm of the soil profile reduced sugarbeet growth and stand.

WINDELS, C.E.[1]*, R.A. KUZNIA[1], and J. CALL[2]. [1]NW Expt. Stat., Univ. Minnesota, Crookston 56716 and [2]Am. Crystal Sugar Co., East Grand Forks, MN 56721. - *Thanatephorus cucumeris* (=*Rhizoctonia solani* AG-3 and AG-5) effects on sugarbeet.

In 1993, a superficial, white to gray, dusty growth observed on sugarbeet petioles was identified as hymenia of *Thanatephorus cucumeris*. Our objectives were to: 1) evaluate effects of *T. cucumeris* on sugarbeet yield and quality, 2) identify anastomosis groups (AGs) of *Rhizoctonia solani* isolated from *T. cucumeris*-infected sugarbeet, and 3) test pathogenicity of *R. solani* on sugarbeet and potatoes. There was a 20% reduction in sucrose content and a 24% reduction in recoverable sucrose compared to uninfected plants in three fields. Of *R. solani* cultures isolated from *T. cucumeris*-infected beets, AG-3 (a potato pathogen group) was identified in four fields (potatoes planted in 1992) and AG-5 was in one field (wheat planted in 1992). When soil was inoculated with *R. solani* AG-3 (27 cultures) and AG-5 (5 cultures), both AGs resulted in sugarbeet seedling stands of 83% compared to 85% in the control. Inoculation of 8-wk-old beet roots with these cultures (and in the control) resulted in root rot values of <1 (0-7 scale). When potato sprouts were inoculated with *R. solani* AG-3 (14 cultures) and incubated at two temperatures, root rot values (0-4 scale) averaged 0.8 at 10°C and 0.6 at 25°C; AG-5 (3 cultures) was mildly pathogenic only at 25°C ($\bar{X}$=0.8). Sclerotia of *R. solani* AG-3, but not of AG-5, formed on sugarbeet roots at 25°C and on potato seed pieces at 10°C. Thus, previous crops are a source of inoculum of *R. solani*, which increases on sugarbeet as *T. cucumeris*.

WINTER, STEVEN, Texas Agricultural Experiment Station, P. O. Drawer 10, Bushland, TX 79012. - Sugarbeet response to nitrogen in Texas.

The average sugar content in Texas is only 14 to 15%. Excess residual nitrogen (N) is the major quality inhibiting problem. A wide range of N rates were applied to crops grown prior to sugarbeets to provide a range of residual N levels for beet production. At each residual level, a range of N rates were applied to sugarbeets. Thus, residual levels were main plots and applied rates were subplots in six factorial experiments completed in 1990 and 1991. The average increase in net return for optimizing applied N was 72, 13, 5, and 0 percent when 0-4 ft residual N was < 30, 31-90, 91-150, and > 150 lbs/acre, respectively. The recommended total of residual plus applied N is 8 lbs/ton if residual is < 30 lbs/acre and 5 to 7 lbs/ton if residual is greater than 30 lbs/acre. Maximum net return occurred at 88 lbs/acre residual N plus 167 lbs/acre applied N (6.6 lbs/ton) which produced 38.9 tons/acre, 16.22% sugar, 1.34% loss to molasses, and 11,080 lbs/acre recoverable sugar. At 26 lbs/acre residual N, return was maximized with 290 lbs/acre applied N (8.3 lbs/ton) and the 6-experiment means were: 38.0 tons/acre, 16.31% sugar, 1.34% loss to molasses, and 10,931 lbs/acre recoverable sugar. At 260 lbs/acre residual N plus 0 applied N (6.5 lbs/ton), yield was 40.0 tons/acre, 15.02% sugar, 1.67% loss to molasses, and 10,187 lbs/acre recoverable sugar. Reducing residual N prior to sugarbeets allows the producer to maximize beet quality and return.

WISLER, GAIL C., J.E. DUFFUS, H.-Y. LIU[1], E.D. KERR[2], and J.J. GALLIAN[3]. USDA-ARS, Salinas, CA 93905[1], Univ. of Nebraska, Scottsbluff, NE 69361[2], Univ. of Idaho, Twin Falls, ID 83303[3]. Incidence of two soil borne viruses of sugar beet in the USA.

Soil tests conducted in cooperation with the USDA-ARS in Salinas, CA for beet necrotic yellow vein virus (BNYVV) and a partially characterized virus termed beet soil borne mosaic virus (BSBMV) in the sugar beet growing areas of the USA were summarized for 1992-1995. BNYVV was found in two counties in Nebraska, with 5.7% incidence, whereas 29% of samples were found to be infested with BSBMV. In 1994, BNYVV incidence in Idaho was restricted to a 5.6 km radius of southeastern Idaho, but by 1995, BNYVV had been confirmed in several beet growing areas along the Snake River, extending into eastern Oregon (personal comm., J.J. Gallian and D. Traveler). Samples from Colorado had a 6.4% and 39% incidence of BNYVV and BSBMV, respectively. BNYVV was not detected in samples from Wyoming or Michigan, but BSBMV was present in both states (9.1 and 6.1%, respectively). BNYVV was not dectected in samples from Ohio or Montana. BNYVV was detected in 13.8% of samples from California, but to date, no BSBMV has been detected or isolated by tests performed at the USDA.

WISLER, GAIL C., H.-Y. LIU, J.E. DUFFUS. USDA-ARS, Salinas, CA 93905. Genomic comparisons among several furo-like viruses of sugar beet.

The degree of relationship among five beet necrotic yellow vein virus (BNYVV) isolates and eight other furo-like viruses termed beet soil borne mosaic virus (BSBMV) from sugar beet in the United States was evaluated by serology of both structural and nonstructural proteins, particle morphology, host range, fungal transmission, and analysis of the RNA genomes. Polyclonal antisera to the C-terminal 60 amino acids of the BNYVV coat protein (CP), the 14- and 75-kDa nonstructural proteins, and seven monoclonal antibodies were specific to BNYVV in Western blots. Antisera to the BNYVV CP and to its cloned CP reacted strongly with the 22-kDa CP of the BNYVV isolates but weakly to the 24-kDa CP of the BSBMV related isolates. Antisera to the 42-kDa BNYVV movement protein reacted with a 42-kDa protein of the BNYVV isolates, and also with a ca. 44-kDa protein of all but one BSBMV-related isolate. The eight non-BNYVV isolates all gave reactions of identity in Western blots using antisera to the CP of the two original BSBMV isolates from Texas, with a molecular mass of ca. 24-kDa, which is distinct from the 22-kDa for the CP of all BNYVV isolates. No cross-reactivity was observed in reciprocal immunodiffusion tests between the CP of BNYVV or the BSBMV isolates, whereas all BNYVV gave reactions of identity to each other and likewise, all BSBMV-related isolates gave reactions of identity to one another. Three BSBMV-like isolates were tested and shown to be transmitted by Polymyxa betae. The symptoms of BSBMV isolates were different from those of BNYVV on indicator plants. Three BSBMV-related isolates were analyzed for polyadenylation of the RNA's, and for the size and number of their RNA's in comparison to BNYVV. Like BNYVV, all RNA's of BSBMV-related isolates were polyadenylated, but the size and number of RNA's differed from BNYVV. Based on the various parameters evaluated here, the eight BSBMV isolates appear to be furoviruses, but are distinct from BNYVV.

WOZNIAK, CHRIS A., USDA, Agricultural Research Service, Northern Crop Science Laboratory, P.O. Box 5677, Fargo, ND 58105. - Nutrition and mediation of larval development of the sugarbeet root maggot by bacteria.

Tetanops myopaeformis Roder, the sugarbeet root maggot (SBRM), maintains an internal population of gut-associated microbes. Identification of these insect-endogenous bacteria (IEB) on selective and non-selective media from third instar larvae from four geographic locations and on root feeding sites resulted in a total of 53 species characterized. Isolation of bacteria from the sugarbeet rhizoplane in the absence of SBRM, revealed a subset of 8 species common to both SBRM and sugarbeet roots. *Stenotrophomonas maltophilia* was the only species ubiquitously encountered from all sources tested. Surface disinfestation of SBRM eggs yielded gnotobiotic larvae which were co-cultured with axenic sugarbeet cells. First instars were observed to feed on cells growing on plant culture medium (MS), but moulted to the second instar at low levels; no third instars were produced. Addition of S. maltophilia inoculum provided for development to the third and final instar. Three other species, *E. coli* JM109, *Serratia liquefaciens*, and *Pseudomonas syringae* pv. *aptata*, were also found capable of supplying a moulting factor which resulted in enhanced larval development. Amendment of gnotobiotic cultures with cell-free culture filtrate of *S. maltophilia* resulted in the production of third instar SBRM also, indicating the presence of a soluble factor needed for development. Consumption of sugarbeet tissues was facilitated by the presence of bacteria.

WRONA, ANNE F.[1]*, and ROBERT T. LEWELLEN[2], [1]University of California Cooperative Extension, 1050 East Holton Road, Holtville, CA 92250, and [2]USDA, Agricultural Research Service, 1636 East Alisal Street, Salinas, CA 93905. - Effectiveness of soil solarization, fumigation, and sugarbeet varieties in controlling rhizomania in California's Imperial Valley.

Rhizomania, a disease that significantly reduces sugar yield of sugarbeet, was first identified in fields in California's Imperial Valley in 1992. A soil-borne fungus, *Polymyxa betae*, vectors the causal agent, beet necrotic yellow vein virus (BNYVV). Resting spores remain viable in the soil for more than 20 years. Our primary objective was to evaluate different soil treatments with potential to control rhizomania. We evaluated the performance of four varieties of sugarbeet (both susceptible and partially resistant varieties) in four soil treatments applied to rhizomania-infested soil before planting: 1) solarization (plastic in place for 6 weeks during summer fallow period between crops), 2) fumigation with metam sodium applied at a rate of 60 gal/acre with a three-tiered spray shank, 3) tarped fumigation with methyl bromide/ chloropicrin at a rate of 350 lb/acre (chemical control), or 4) untreated control. Each treatment was replicated four times in a completely randomized split plot at the USDA Irrigated Desert Research Station, Brawley, CA. Individual plots were two rows wide by 30 feet long. Beds were on 30" centers and all irrigation was by sprinklers. Differences between soil treatments were highly significant (CI=95%). Yield expressed as pounds of sugar per acre was 10,386, 9636, 2676, and 2260 for methyl bromide, solarization, metam sodium and control plots, respectively. Beet tonnage per acre was 33.22, 29.52, 9.49 and 7.99, and percent sucrose was 15.75, 16.37, 13.66, and 13.52 for the respective treatments. Although the resistant varieties yielded more sugar, tonnage, and percent sucrose than the susceptible check, the differences were not significant. The performance of the resistant hybrids may have been reduced because the resistant lines were developed to show resistance specifically to BNYVV, and not to additional edaphic/biotic agents that would have accumulated during the repeated beet cropping done at the site to saturate the ground with viruliferous *Polymyxa betae*.

WUNSCH, HANSJOACHIM*, and AVRAM; PEDRO, IPRO Industrieprojekt GmbH, Celler Str. 67, D-38114 Braunschweig, GERMANY. - Report about the new beet sugar factories in east Germany: conception and applied process technology.

Following reunification of the two Germanies in 1990, an unprecedented rationalization process from formerly 43 factories to presently 9 took place. The paper concentrates on both "green field" factories, Könnern with 16,500 mt/d slicing capacity and Klein Wanzleben with 8,000 mt/d. The equipment layout and civil engineering concept of Könnern is explained and illustrated with drawings and photographs. Salient points are outside location of diffusion towers, pulp presses, juice purification vessels, evaporators, continuous vacuum pans, and vertical crystallizers. The factory has only one main operating floor at 10 m which comunicates with outside platforms and all auxiliary buildings by bridges. As the capacity of the sugar end is 8,000 mt/d, surplus thick juice produced during the campaign is stored in 3 large tanks and processed to sugar during a thick-juice campaign. Total investment costs for the Könnern factory were approx. 330 million US$. Meanwhile the factory has operated for 2 full campaigns with good success. The process technology employed in the Klein Wanzleben factory encompasses several absolute novelties in the sugar industry. All products are boiled in vertical continuous pans, whereby the vapours of the intermediate and afterproduct pans are employed to heat the white pans, leading to a steam demand in the sugar end of only 6.5 % on beet. Pulp drying is effected in steam dryers and the dryer vapours at 3 bar are directed via a steam transformer together with turbine exhaust steam to the evaporator station. In order to be able to generate the necessary electrical power with a reduced total process steam requirement of 16 - 17 % on beet, a gas turbine generating 4.5 MW has been installed. Its flue gases are used in a 100 mt/h high pressure steam boiler. The balance of the electrical power is generated in a back-pressure extraction turbine rated at 14.5 MW maximum. As a result total energy consumption including pulp drying is only 150 kWh/mt as compared to 270 kWh/mt for a conventional factory employing high-temperature pulp driers. Total investment costs amounted to approx. 265 million US$. Klein Wanzleben has also completed its first campaign with good results.

YONTS, C. DEAN[1], ROBERT G. WILSON[2], and JOHN A. SMITH[3], [1]Associate Professor, [2]Professor, and [3]Associate Professor, University of Nebraska, Panhandle Research and Extension Center, 4502 Avenue I, Scottsbluff, NE 69361. - Influence of planting and replanting date on stand, yield and quality of sugarbeets

Soil moisture and temperature, key factors for emergence, are not always favorable in the spring. The result is variation of planting date and effective emergence date, and occasional replanting. The decision to plant early must compare the risk of freezing temperatures and replanting with the potential for increasing the growing season. To assist in this decision making process, a study was initiated with the primary objective of determining how date of planting affects stand, yield, and quality of sugarbeets. Over a three year period, field studies were conducted at four locations and included five planting dates beginning in April. Other factors included in the study were: (1) two varieties, and (2) two planting methods. At harvest, plant density, root yield, percent sugar and tare were determined for each treatment. Planting methods, plant-to-stand and thin-to-stand had no effect on sugarbeet yield. The two varieties responded differently to the five planting dates. The Monohikari variety provided greatest yield with the first and last planting dates. The second variety produced similar yields from the first three planting dates and had less variation among planting dates. Overall, yields tended to be similar for the planting dates during April and declined by as much as 12 tons/acre for the last planting date in May.

YU, M. H., USDA, Agricultural Research Service, 1636 East Alisal St., Salinas, CA 93905. - Sugarbeet root-knot nematode and approaches taken to develop resistant varieties.

Sugarbeet is one of the favored hosts of root-knot nematodes. In areas where *Meloidogyne* spp. occur, they can be a serious problem, and in some cases result in a complete crop failure. Observations on nematode life cycles and screening for host plant resistance were conducted in the laboratory and greenhouse. Development of root-knot nematode is marked by the occurrence of four molts and five stages. Nematode feeding stimulated formation of giant cells in host tissues, resulting in root galls and protuberances, thus hindering sugarbeet growth and limiting production. The rate of nematode reproduction was positively associated with the number of root galls formed. Resistance to root-knot nematode is rare; nevertheless, resistance has been identified in *Beta maritima* germplasm. Hybrid crosses were made between the resistant sea beets and sugarbeet. Nematode resistance was transmitted to both the outcrossed and selfed progenies through pollination. Derivative plants with desirable traits are being selected for breeding sugarbeet resistant to root-knot nematode.

Zielke, Richard C., Michigan Sugar Company, P. O. Box 247, Carrollton, MI 48724 - Genotype X Environment Interactions for Cercospora Leafspot.

The warm, humid areas east of the Mississippi River are especially prone to the development of the foliar disease Cercospora beticola on sugarbeet. Since 1919, severe epiphytotics occurred about every 20 years, according to the literature, with the last one in 1959. (Another could have occurred in 1979 except that new, more resistant cultivars were introduced).

Germplasm resistant to the disease has been developed by public and private company breeders over the last 35 years at various locations. Also, standards for acceptance of commercial cultivars in official trials now specify a limit as to the susceptibility to the disease. The question arises concerning location(s) of test nurseries to adequately evaluate trial entries, especially since correlation coefficients of readings between locations is seldom ever higher than 0.75. In 1990 and again in 1994, correlations between Ohio (Old Fort) and 2 locations east of Saginaw, Michigan (Reese and Caro) were 0.59 and 0.67 for $n=26$ and 35, respectively. This means that given 3-year averages for certain cultivars would preclude their approval in one state or the other if readings were only available or used from one location (state).

As stated by Dr. Hogaboam in 1965, and found again from my experiences in the last 10 years, "test nursery results must be used from localized trials where the results will be utilized".