American Society of Sugar Beet Technologists

ABSTRACTS

Papers presented at the 26th General Meeting

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ANVIK, TERRY W.* Holly Sugar Corporation, Agriculture Department, 2 North Cascade Avenue, Colorado Springs, CO 80901 - Holly Sugar's Comprehensive Computerized Agricultural Information System
The Agricultural Information System has been designed to meet the varied informational needs of Holly's eight unique production areas. A standardized database supplies all the information needed to replace many manually generated reports. The system also interfaces with local Farmers Ledger Systems for a reduction of manual entry and duplication. Being designed wholly on IBM compatible personal computers, AIS is able to accommodate locally designed reports through user friendly software, such as Lotus 1-2-3. This gives the system flexibility in customizing present and future reporting needs to individual locations. Grower practice information is captured by agriculturalists throughout the growing season on either field data sheets or by entering coded information directly into laptop computers. This information is then used to provide the agricultural staffs with documentation of overall trends in local production practices. It also provides feedback to the grower as a personal summary of production and agronomic practices for the year.

ARENTSEN, JOHN O.* Industria Azucarera Nacional S.A. (IANSA), Casilla 4-D, Curicó, Chile. - Evaluation of hymexazol in control of damping-off in sugarbeet seedlings.
One of the most important diseases of sugarbeet in Chile is damping-off of seedlings caused by soil-borne fungi. These fungi are *Aphanomyces cochlioides*, *Pythium* spp., and *Rhizoctonia solani*. Two trials were conducted under greenhouse conditions to evaluate three application rates of hymexazol at 0.3, 0.6, 1.2 kg a.i./ha in relation with a check and the standard treatment fenaminosulf at 1.4 kg a.i./ha. Treatments were mixed with phosphate fertilizer and applied next to the seed. The main fungus observed in both trials was *A. cochlioides*. Hymexazol provided excellent control of disease and was less phytotoxic than fenaminosulf. The check had 79 and 57% dead plants after 40 days in each trial, respectively. The highest application rate of hymexazol showed 6 and 0% dead plants and fenaminosulf 13 and 2%, respectively. Mean emergence period was significantly higher for fenaminosulf than for all rates of hymexazol and the check.

BABB, T. A.*, J. L. KIMMELL, J. S. GERIK, and R. P. HEIMFORTH. Spreckels Sugar Co., P. O. Box 2240, Woodland, CA 95695; USDA-ARS, 1636 E. Alisal St., Salinas, CA 93905. - Evaluation of 1,3-dichloropropene soil fumigation and tolerant varieties on California sugarbeet production in rhizomania-infested soils.
The production of sugarbeets (*Beta vulgaris* L.) is limited in California by the presence of rhizomania, a viral disease (beet necrotic yellow vein virus) transmitted by a fungus, *Polymyxa betae* Keskin. Trials in 1989 and 1990 evaluated the effect of tolerant varieties in combination with soil fumigation on sugarbeet yield in rhizomania-infested fields. A split-plot experimental design was used with main plots of 0, 9 & 12 gallons per acre (gpa) fumigation rates using 1,3-dichloropropene. Subplots were varieties with a range of tolerance to rhizomania. An attempt was made to quantify the inoculum density in each of three fields and relate it to subsequent yields. Main plots were applied in either October or April, and plots were planted in February or April. Yields varied between locations, with unfumigated plots ranging from 0.45 tons of sugar per acre (TS/A) for a susceptible variety to 1.16 TS/A for a tolerant variety. The highest yielding tolerant variety yielded 3.3 TS/A in 1989 with 12 gpa of 1,3-dichloropropene. Results suggest varietal tolerance presently available is not sufficient to profitably produce sugarbeets in fields infested with rhizomania without soil fumigation. The success of a tolerant variety in combination with soil fumigation may be dependent on the original inoculum density in a field. A technique to rapidly assay soil for disease inoculum levels would aid California growers in determining which fields will produce economic returns when combined with soil fumigation and an adapted, rhizomania tolerant variety.

BAKER, JOHN R., JR. Empire Coke Company, 1917 first Avenue North, Suite 900, Birmingham, AL 35203. - Foundry Coke, the process of producing foundry coke.
A slide presentation submitted by the American Coke and Coal Chemicals Institute will be presented, which outlines a step-by-step process of the production of foundry coke, the screenings from which are purchased by the sugar beet industry for the production of sugar.

BERGEN, PETER. Alberta Sugar Company, P.O. Box 1209, Taber, Alberta, Canada TOK 2GO. - Effect of Sequential Herbicide Treatments on Sugarbeet Performance and Weed Control.

Efficacy of the herbicides, Nortron (ethofumesate) and Pyramin (pyrazon) applied preemergence was enhanced with the application of overhead irrigation. In the absence of rain or overhead irrigation preemergence applied herbicides had only modest effects on weed control. However, the preemergence treatments, even in the absence of subsequent moisture, enhanced the weed control from sequential postemergence applications of Betamix (desmedipham + phenmedipham). Although the second postemergence application of Betamix consistently increased weed control, it frequently failed to result in increased yields of sugar per acre.

BIANCARDI, ENRICO*, and G. GRASSI. Istituto Sperimentale per le Colture Industriali, Viale Amendola 82, 45100 Rovigo, (Italy). - Selection for resistance to rhizomania in sugar beet based upon local lesion numbers

When breeding for resistance to rhizomania caused by beet necrotic yellow vein virus (BNYVV), numerous problems are encountered in obtaining a uniform infection and a precise assessment of the effects of disease (Lewellen, Biancardi, Proc. IIRB, 53:69-87, 1990). To overcome some of these difficulties, we investigated a method based on mechanical inoculation of leaves with BNYVV obtained from infected Chenopodium quinoa. After approximately 10 days under controlled conditions, characteristic chlorotic lesions appear on inoculated leaves. In a previous study there was a good correlation between the number of the lesions and the susceptibility to rhizomania of the varieties tested (Grassi et al., Phitopath. Medit., 28:131-139, 1989). The efficacy of the method for breeding purposes was assessed by divergent selection within a diploid pollinator named '401' that has good resistance to rhizomania. Two cycle 1 (C1) synthetic populations were produced in 1989 based upon the fewest and the greatest number of lesions among 401 plants. Simultaneously, test-cross seed from a cytoplasmic male sterile tester was obtained. In 1990 a field trial was grown to compare test-crosses of the divergent C1 synthetics. The trial was grown in homogeneously infested soil and developed moderately severe disease conditions. After harvest, the testcrosses of divergent synthetics were significantly different for extractable polarimetric degrees, potassium and thick juice purity. All of the other production and quality variables showed trends in the direction of selection. These results demonstrated the possibility of using local lesion numbers as a criterion for resistance breeding.

BOSSE, DIETRICH. BMA, Braunschweigische Maschinenbauanstalt AG, 3300 Braunschweig, Germany. - A new apparatus for drying and cooling of crystal sugar operating by the fluidized-bed principle.

To optimize a sugar dryer and cooler, it previously has been difficult to calculate the drying and cooling process. Therefore, a new physically founded mathematical model to compute a sugar drying and cooling plant was developed. This model allowed the determination of sugar temperature and sugar moisture profiles over the length of the dryer. This allowed for development of a new sugar dryer/cooler, which is divided into three fundamentally different zones. These zones are: (1) drying zone, (2) temperature-swing zone, (3) cooling zone. This configuration, especially that of the temperature swing, prevents the sugar from being overheated, without having to endure substantial losses of propulsive force due to too low a temperature of the ingoing air. Thus, energy input for drying is lower. Consequently, the newly developed dryer/cooler, as compared with the drum-drying technology, means substantially less use of mechanical equipment, along with equivalent or even better energy parameters. Also, a higher quality sugar is produced due to the gentle treatment of the crystals in the fluidized bed.

BOWERS, DON*, DEL TRAVELLER, DENNIS SEARLE, CHARLES L. PETERSON, JOE THOMPSON, and R. V. WITHERS. First three authors, the Amalgamated Sugar Co., P.O. Box 1766, Nyssa, OR 97913; latter three authors, Agricultural Engineering, University of Idaho, Moscow, ID 83843. - Low cost pile covering.

The method for maintaining quality sugar beets in the storage pile has been an ongoing concern. In the fall of 1985, a pilot program was started by the Amalgamated Sugar Company under the direction of company agronomist Del Traveller and Charles L. Peterson, University of Idaho Agricultural Engineering Department. In 1988, the pilot program was extended to covering an entire pile with a silver-colored plastic, and a row of fans was placed down the center of the pile to exhaust the warm air out of the pile. The skirting of the pile was left up 4 feet to allow cool air to be circulated into the pile and out the top through the exhaust fans. We have worked with this method and feel that the results have been beneficial, even with the short storage period (47 days) that we have had for the past 2 years. The factory data for the 1988-89 crop computed to a savings of 133,000 lb of sugar, with a value of $29,300.00, or $1.17 per ton on the 25,000 ton test pile.

BRIGGS, STEPHEN P.*, and R. W. WHITMORE. American Cyanamid Company, Quakerbridge Executive Center, Grovers Mill Road, Room 100, Lawrenceville, NJ 08543. - New COUNTER® 20CR™ systemic insecticide-nematicide for sugar beet growers.
A new and innovative formulation of terbufos (COUNTER 20CR) has been developed by American Cyanamid Co. The formulation is a 20% active ingredient pellet manufactured from various inert ingredients that eliminate dust and increase user safety. All the pellets are of uniform shape and size, with a high density which allows the applicator to make a more precise application. This formulation also is controlled-release, and tests throughout the Northwest and Red River Valley continue to demonstrate superior control of the sugarbeet root maggot, leafhoppers, and other pests of sugar beets.

BUGBEE, WILLIAM M. USDA, Agricultural Research Service, P.O. Box 5677 - University Station, Fargo, ND 58105 - A pectin lyase inhibitor from sugar beet.
Pectin lyase (PNL), produced by Rhizoctonia solani, is a major factor in causing crown and root rot. A constitutive inhibitor of PNL was extracted from healthy sugar beet roots. The pectin lyase inhibitor protein (PNLIP) was purified and partially characterized. Inhibitory activity was most effective at pH 6.5 to 7.5. The average PNLIP content (83 U/mg dry wt) for crown, hypocotyl and root tissue was 4% higher in a root rot resistant germplasm line than in a susceptible cultivar and was higher in the root than the crown of the resistant cultivar. PNLIP partially protected 8 mm root disks from damage caused by PNL in an in vitro test. Antibodies to PNLIP will be used to assay individual plants for PNLIP by enzyme-linked immunosorbant assay.

BULGIN, ED*. The Amalgamated Sugar Company, P.O. Box 250, Nampa, ID 83653. - Lime kiln operation improvements.
Improvements in lime kiln operation have contributed to increases in company slicing capacity from 25,000 tons/day to 37,000 tons/day over the past 15 years without additional lime kiln installation. Results of steps taken to improve operation are presented. Equipment modifications, operating procedures and quality parameters are presented.

BURNS, LAURA K.*, and L. W. CLARK. Dorr-Oliver, Inc., 1200 Harger Rd., Oakbrook, IL 60521, and 612 Wheeler's Farm Rd., Milford, CT 06460, respectively. - FluoSolids calcining of lime mud for the sugar beet industry.
The fluidized bed calciner has been successfully used for calcining lime mud in the paper and water treatment industries for many years. The sugar beet industry is under increasing environmental pressure to desist the landfill of the lime mud from carbonation. A viable alternative to landfill is to reclaim the lime mud back to lime and carbon dioxide gas. This paper will explain the fluidized bed lime mud calcining process with its pelletized lime product. Schemes will be presented for integrating the calciner into the sugar beet process for recovery of the carbon dioxide gas and for producing a saleable byproduct. Budgetary sizing, utility consumption, product quality, and capital cost will be presented. Lime mud disposal is an industry problem. This paper will be an introduction to a possible solution to the problem.

CAMPBELL, L. G.*, A. W. ANDERSON, and K. A. PRODOEHL. USDA, Agricultural Research Service and North Dakota Agricultural Experiment Station, Fargo, ND 58105. - Selection for sugarbeet root maggot resistance.

Sugarbeet root maggot (Tetanops myopaeformis Röder), the major insect pest in the Red River Valley, traditionally has been controlled with insecticides applied at planting. Effective genetic resistance to this insect would reduce production costs and environmental problems associated with the use of insecticides. Attempts to identify resistant genotypes have been marginally successful. In 1989 and 1990 field trials, populations resulting from four cycles of mass selection had average damage ratings of 2.9, compared to 3.4 for five commercial hybrids (0=no damage to 5=severely damaged). The most resistant lines currently in the program were originally selected in a cooperative project between USDA (Logan, UT) and Amalgamated Sugar Co. and have since been screened in North Dakota. This material had a 2-year average damage rating of 1.9. This level of control was comparable to that obtained with insecticides at the same site. Over a 5-year period, plots with the most effective insecticide treatment had average damage ratings of 1.6, compared to 3.6 for untreated checks. Since resistance is not simply inherited, it may be of limited commercial value. Methods of utilizing this level of resistance and/or obtaining higher levels are being explored.

CATTANACH, ALLAN W.*, A. G. DEXTER and L. S. SMITH. North Dakota State University and University of Minnesota Extension Services, and Northwest Experiment Station, University of Minnesota, Box 5575, Fargo, ND 58105 and Crookston, MN 56716, respectively. - Low Input Sustainable Agriculture (LISA) and Sugarbeet Production In Minnesota and North Dakota.

Low-input farming, resource-efficient farming, organic farming, regenerative farming, and alternative agriculture are some of the labels given to LISA. In many instances Minnesota and North Dakota sugarbeet producer management systems fit well into LISA systems. Summaries of grower production records and producer survey results indicate the Minnesota-North Dakota sugarbeet industry is a leader in implementing LISA practices. Examples of cultural practice changes, soil fertility and pest management practices that fit LISA systems will be given. A study to evaluate the economic impact of pesticide input on sugarbeet yield and quality was initiated at Fargo, North Dakota and Crookston, Minnesota in 1990. Feasibility and economic impact of substitution of herbicides for hand labor was dependent on the weed population and species present. Cost of hand labor for weed control varied from $11 to $57/A. Use of a seed treatment resulted in lower plant populations and yield loss. Root maggot insecticide treatment had no effect on plant population at Fargo, but had a 90% greater stand than untreated checks at Crookston.

CATTANACH, A. W., J. A. LAMB*, and D. HILDE. North Dakota State Univ., 203 Waldron Hall, Fargo, ND 58105, NW Experiment Station, Univ. of Minnesota, Crookston, MN 56716, and American Crystal Sugar Co., Inc., Moorhead, MN 56560. - Sugarbeet nitrogen management for maximum profit and environmental protection.

Sugarbeet production practices have changed drastically in the last two decades in Minnesota and North Dakota. Changes in grower payment systems in 1980 and 1982 mandated change to production of high sugar content, low impurity sugarbeets. Development, refinement, and extensive use of the soil nitrate-N test, varietal selection, and optimal plant populations in concert with the sugar company quality payment program resulted in greatly reduced N fertilizer use (29,510,000 kg N per year) while increasing sugar yield 1771 kg per ha. The number of sugarbeet fields soil-sampled for nitrate-N increased from 28% in 1979 to 70% in 1989, while the value of one Mg of sugarbeet increased $8.28.

CHRISTENSON, DONALD R.*, AND G. M. ZINATI. Crop and Soil Sciences Department, Michigan State University, East Lansing, MI 48824. - Nitrogen uptake by sugar beets from various depths in the soil.

Sugar beets (Beta vulgaris L.) obtain N from depths of one meter or more. Formulating N recommendations based on soil tests for mineral N requires an understanding of the relative quantity of N which can be extracted by the sugar beet crop from the sub-soil. It is also important to understand at what time during the growing season the roots intercept this N. This research was undertaken to evaluate 1) at what time during the growing season sugar beets remove mineral N from various depths and 2) how much of the nitrogen taken up by the plant is removed from each depth. The experiment was designed with depth of application as the treatment. ^{15}N was placed at 30 cm intervals from the surface to 150 cm. Leaf discs were removed every 14 days after application and analyzed for the isotope. Presence of the isotope in the youngest leaf blade on a given date indicated that the root had begun to remove nitrogen from a given treatment depth. Whole plants were harvested in September and analyzed for the isotope. Preliminary results indicated that sugar beets were extracting N from 5 feet within 90 days of planting, although less than 17% of the total N supply was from depths deeper than 90 cm. The crop obtained only 20-25% of its N from applied fertilizer.

COSTESSO, DENNIS D. The Amalgamated Sugar Company, 2427 Lincoln Avenue, Ogden, UT 84401. - Comparison of concentrated separator by-product to molasses as an animal feed source.

Advances in industrial chromatographic separations of sugar from molasses will result in the replacement of molasses with concentrated separator by-product (CSB) as an animal feed source. Molasses and molasses dried beet pulp are important feed sources in today's animal feed industry. Their replacement with CSB must be considered. Studies performed for the Amalgamated Sugar Company by Dr. R. D. Weidimier of the Department of Animal, Dairy, and Veterinary Sciences of Utah State University indicate that supplementing alfalfa grass diets with CSB at practical levels will result in similar nutrient digestibility, and ruminal fermentation characteristics at similar levels to molasses. These studies currently are being repeated on high grain diets and also will be discussed. The total digestible nutrient content of CSB is 20% less than molasses. Additional studies further indicate that CSB can be substituted for molasses up to 25% DS/pulp without affecting palatability or intake. Amalgamated's experience in producing and pelletizing CSB dried beet pulp during the 1990 campaign will be discussed.

DEXTER, ALAN G.*, and JOHN L. LUECKE. Department of Crop and Weed Sciences, North Dakota State University, Fargo, ND 58105. - Simulated herbicide drift and carryover in sugarbeet.

Sugarbeet is susceptible to drift or carryover of many herbicides used in rotational crops in North Dakota and Minnesota. The objective of these experiments was to evaluate sugarbeet injury from direct application and from carryover of several recently labelled herbicides. Carryover experiments were established in 1987 and 1989 near Fargo, ND. Sugarbeet was seeded the year after initiation and thereafter. Imazamethabenz, imazamethapyr, fomesafen, metribuzin, DPX-V9360, CGA-136872, and DPX-V9360 plus DPX-E9636 caused sugarbeet injury one year after application. Thifensulfuron, tribenuron, lactofen, and acifluorfen did not injure sugarbeet one year after application. Imazethapyr applied at 0.06 lb/A in 1987 caused severe sugarbeet injury in 1988 and 1989 and at 0.12 lb/A caused sugarbeet injury in 1988, 1989 and 1990. Imazamethabenz and fomesafen did not injure sugarbeet two years after application. Other herbicides that caused injury one year after application will be tested in 1991 for injury two years after application. Simulated drift experiments were conducted at Amenia, ND in 1988 and 1989 and Casselton, ND in 1990 by direct application of low herbicide rates to sugarbeet. Thifensulfuron, thifensulfuron plus tribenuron and imazethapyr were relatively more toxic to sugarbeet than imazamethabenz, 2,4-D, bromoxynil, or bentazon. Visible injury symptoms from thifensulfuron, thifensulfuron plus tribenuron, imazethapyr, and imazamethabenz were identical.

DOLEY, WILLIAM P.*, and JOSEPH W. SAUNDERS. American Crystal Sugar Company, P.O. Box 1227, Moorhead, MN 56561-1227 (formerly Department of Crop and Soil Sciences, Michigan State University, East Lansing, MI 48824) and USDA-ARS, P.O. Box 1633, East Lansing, MI 48826. - Effects of genotype, subculture interval and growth regulators on shoot regeneration from serially-subcultured hormone-autonomous sugarbeet (*Beta vulgaris* L) callus.

Shoot regeneration rapidly declines when hormone-autonomous sugarbeet callus is serially subcultured. We investigated the effects of genotype, subculture interval, BA concentration and TIBA on regeneration from calli up to 18 wk old. Calli of three genotypes were initiated from leaf disks on B1 medium (MS + 1 mg/L BA) and subcultured to various media after 3 wk growth. When calli were subcultured every 3 wk on B1, genotypes differed in rate of decline in shoot regeneration. After 15 wk on B1, more than half of EL 45/2-108 calli were still regenerating, while regeneration by calli of REL-1 and FC 607-O-20 was approaching zero. Subculture interval did not effect subsequent shoot regeneration. Regeneration from calli maintained on B1 was increased after subculture to B3 medium (MS + 3 mg/L BA). The frequency of regenerating calli and the number of shoots per callus were both enhanced by doubling the BA concentration at each subculture or by maintenance on B1 + 1 mg/L TIBA. Calli of REL-1 were more responsive than calli of FC 607-O-20 to maintenance on TIBA. Increases in shoot regeneration were greater when concentrations of both BA and TIBA were higher in subsequent medium. Calli maintained in a non-regenerating state on hormone-free medium were induced to regenerate by transfer to B3. Manipulation of shoot regeneration with BA and TIBA appears to be compatible with a model involving auxin/cytokinin ratio.

DONEY, DEVON L. USDA, Agricultural Research Service, P.O. Box 5677 - University Station, Fargo, ND 58105 - Beta germplasm evaluation.

The collection and maintenance of Beta germplasm are major responsibilities of the Sugarbeet Crop Advisory Committee (CAC). Since the establishment of the Sugarbeet CAC in 1983, the Beta collection maintained at Ames, Iowa has experienced significant growth. It is now considered one of the most complete Beta collections in the world. This extremely valuable collection has little use or impact unless specific information and knowledge about its content is available. Evaluations for specific priority descriptors have been conducted by experts at five locations since 1987. This is a continuing effort largely funded by the USDA-ARS, with significant contributions by the Beet Sugar Development Foundation, American Crystal Sugar Co., and Betaseed, Inc. Although much of the work is considered characterization, specific germplasms for tolerance or resistance to Rhizomania, Erwinia root rot, powdery mildew, and sugarbeet root maggot have been identified. Evaluation data are entered in the USDA Germplasm Resources Information Network (GRIN) where they are made available to the user community throughout the world.

DUFFUS, JAMES E.*, and R. T. LEWELLEN. USDA-ARS, 1636 E. Alisal St., Salinas, CA 93905. - Planting and harvesting alterations for the control of lettuce infectious yellows virus.

Lettuce infectious yellows virus (LIYV) has become a major disease inducing agent of sugarbeet in the southwest desert region of U.S A. Losses as high as 20-30% have been reported. Monitoring of whitefly (*Bemisia tabaci*) populations and LIYV incidence indicate that they peak in August through October. The effects of altering planting and harvesting dates on whitefly incidence, LIYV incidence and sugarbeet yield were studied in an effort to design an agronomic control for the disease. Young plants at each observation had significantly higher whitefly numbers. There was a significant decrease in whitefly populations as the season progressed. This resulted in progressively less infection at the later planting dates. The cultivar US H11 had a higher infection rate than HH 41. The percentage of infection on US H11 was 45% at the late August planting date and was 12% at the late October planting date. Gross sugar yields under these relatively light infection rates were greater with increased growing periods indicating that delayed planting under relatively light LIYV infection pressure is of no value.

DUFFUS, JAMES E., and H. Y. LIU*. USDA-ARS, 1636 E. Alisal St., Salinas, CA 93905. - Unique beet western yellows virus isolates from California and Texas.

Yellowing virus isolates collected in California and Texas have been shown to have unique biological properties. They are very similar to "mild isolates" of the beet yellows virus (BYV) as reported in the late 1940's and early 1950's from Europe and U.S.A. The mild yellowing isolates produce only mild interveinal reddening symptoms on the BYV indicator *Chenopodium capitatum*, they have a host range which includes common indicator species of BYV, they are not mechanically transmitted as are severe BYV isolates, they do not cross protect against subsequent inoculation by severe BYV isolates, and they are serologically unrelated to severe BYV isolates. Insect transmission, host range studies, virus purification and serology have shown that these isolates are not mild isolates of BYV but are unique isolates of beet western yellows virus (BWYV). Most commonly found BWYV isolates from beet have a wide host range and are readily distinguished from BYV by "diagnostic" infection of *Capsella bursa-pastoris* and lack of infection of *Chenopodium capitatum*. These newly described isolates of BWYV do not affect *Capsella* but cause symptoms on *Chenopodium*. These "new" biological types may be more damaging to sugarbeet but may be more readily controlled by host-free periods than conventional BWYV strains.

DUFFUS, JAMES E.*, R. PERRY, H. Y. LIU, and C. WATSON. USDA-ARS, 1636 E. Alisal St., Salinas, CA 93905 and University of Arizona, Tucson, AZ 85706-6985. - Susceptibility of *Atriplex* sp. to beet curly top virus.

Atriplex sp. are being evaluated in California by several government groups as a forage crop when irrigated with saline drainage water. *Atriplex*, a salt loving plant, has an affinity for selenium. Perennial species are used as a multi-clipped forage crop and fed to selenium deficient cattle. Most *Atriplex* sp., reported in the literature of the 1920's, have been susceptible to beet curly top virus (BCTV) and may act as virus and vector (beet leafhopper) reservoirs. *Atriplex* sp. found to be most promising (productivity, forage quality and agronomic characteristics) were evaluated as beet leafhopper hosts and for BCTV susceptibility. *A. barclayana*, *A. camarones*, *A. canescens*, *A. canescens* subsp. *macropoda*, *A. cinera*, *A. desertícola*, *A. halimus*, *A. nummularia*, and *A. sagittifolia* were all found to be poor hosts of the beet leafhopper and were not hosts of BCTV. The utilization of these species should not be considered as threats to curly top control efforts. A reevaluation of the host range of BCTV is probably justified.

ECKHOFF, J.L.A.* Montana State University, Eastern Agricultural Research Center, PO Box 1350, Sidney, MT 59270. - Split application of N on sugarbeets.

N management practices may increase sucrose yield. Applying N in the fall and again after emergence is one practice used by growers in the irrigated Yellowstone River valley. For four years, split applications of N were applied to Monohikari and Monoricca at a rate for a root yield goal of 25 T/ac to determine optimum management practices for early and late harvests. In the fall prior to planting, N was applied at rates of 0%, 25%, 50%, 75% and 100% of the total amount and the rest was applied 4-5 weeks after emergence, so that all plots ultimately received the same amount of N. Half of each plot was harvested about Sep 10 and the other half was harvested three weeks later. At the early harvest, there was no difference in sucrose yield among treatments of Monoricca in three years, and no difference among treatments of Monohikari in two years. When differences did occur, sucrose yields were greatest when 75% or 100% of the N was applied in the fall. Across years, there was no difference in sucrose yields among treatments of either variety. At the late harvest date, root yields and sucrose contents varied from year to year, so that different treatments had the greatest sucrose yield in different years. Across years, sucrose contents of both varieties at both harvest dates tended to increase as the percent of N applied in the fall increased. There was no difference in impurity contents among treatments, but amino-N contents tended to be greater when all the N was applied after emergence. This study suggests that splitting the application of N does not increase yield or quality of sugarbeets in the irrigated Yellowstone River valley.

EIDE, J. D.*, G. A. SMITH, and C. A. WOZNIAK. USDA, Agricultural Research Service, P.O. Box 5677 - University Station, Fargo, ND 58105 - Isolation of Agrobacterium tumefaciens from Beta vulgaris for enhanced transformation of sugarbeet.

Transformation of sugarbeet, Beta vulgaris L., with Agrobacterium tumefaciens is the most promising method for insertion of foreign genes into the sugarbeet genome. The number of virulent strains of Agrobacteria for use in sugarbeet is limited. In a search for compatible gene vectors, Agrobacteria were isolated from homogenized sugarbeet crown galls. Samples of serial dilutions were plated on selective media D1 or New and Kerr with or without 65 units ml^{-1} bacitracin and 30 $\mu g/ml$ streptomycin. Isolates that tested positive for 3-ketolactose were tested for virulence on sugarbeet seedlings and petiole sections. Those strains showing the greatest virulence will be candidates for disarmament and incorporation into our sugarbeet transformation program.

EKERN, ERIC. Spreckels Sugar Company, P. O. Box 1287, Manteca, CA 95336. - Thin juice softening using the Gryllus process.

Spreckels Sugar installed thin juice softening at the Manteca, CA, factory in 1989. Use of evaporator antiscalents had reduced the frequency of evaporator boilouts required; but, because boilouts still were necessary, softening offered potential savings from boilout chemicals and antiscalents. In order to save chemical expenses and avoid disposal problems, the Gryllus process was uniquely suited to our needs. By regenerating the softening resin with intermediate machine syrup, a chemical-free and waste-free process bypasses the calcium that remains in solution after carbonation around the evaporators and the white and intermediate boilings and returns it to the raw boiling so there is no increase in melassigenic potential. The first year in service showed a direct savings of $107,000 in chemicals.

EMEK, DOUGLAS J. Alberta Sugar Company, P.O. Box 1209, Taber, Alberta, Canada TOK 2GO. - A description of the new sugarbeet tare laboratory at Taber, Alberta.

Until 1989, sugarbeet growers in southern Alberta were paid on the basis of tonnage only. Declining beet quality in the early 1980's finally led to payment based on sugar content. A new tare laboratory was constructed in 1989 using state-of-the-art equipment from Italy and Germany. At the same time, operations at the six beet receiving stations were computerized, using bar-coded grower ID cards and tare sample cards. The new tare laboratory consists of two independent PLC-controlled lines, each capable of processing up to 120 samples per hour. Computers interfaced to each line record the gross and net weights of each sample, together with other pertinent information (presence of rocks, trash, mud etc). A second computer controls the operation of the analytical instruments. Sucrose content, amino-nitrogen, sodium and potassium levels are determined on each sample. In addition, the alkalinity coefficient, extraction and sugar loss to molasses are calculated and provided to growers on a daily basis. Construction of the facility began in early 1989 and was completed in time for the 1989 harvest. The equipment has performed as expected, processing between 2500 and 3000 samples daily during the peak harvest period. After only two years of operation, the new payment method has resulted in noticeable improvements in beet quaility.

FAIL, GAIL L.*, AND L. L. HOEFERT. USDA, Agricultural Research Service, 1636 E. Alisal St., Salinas, CA 93905. - Electron microscopy of sugarbeet leaves infected with Beet Distortion Mosaic Virus.

Beet Distortion Mosaic Virus (BDMV), a soil-transmitted virus from the Texas panhandle, causes mosaic symptoms and hyperplasia of leaf mesophyll cells that externally appear as leaf distortions. Particles are flexuous rods which range in length from 650 nm (in leaf dips) to 2,000 nm (in purified samples). BDMV can be mechanically transmitted to several species in the Chenopodiaceae, and to *Gomphrena globosa*, in the Amaranthaceae. Infections may be limited to local lesions, or may be systemic. The development of virus inclusions has been studied in systemic infections of sugar beet, spinach, and *G. globosa*. Initial examinations used light microscopy of unfixed tissues stained with Azure A. Infected plant tissues contained inclusion bodies in mesophyll and phloem. Electron microscopy showed that the inclusion bodies were composed of tightly packed bundles of virus particles, which commonly attached to the outer membranes of chloroplasts. Vesicles similar to those described in closterovirus infections were present in advanced infections.

FISCHER, BILL B.*, T. A. BABB, and K. J. HEMBREE. University of California Cooperative Extension, 1720 S. Maple Avenue, Fresno, CA 93702. - Evaluation of clopyralid for weed control in California sugar beet fields.

Numerous species of weeds that infest sugar beet fields in California are not controlled adequately with presently used herbicides. In replicated applied research trials, clopyralid in combination with phenmedipham plus desmedipham effectively controlled a broader spectrum of weeds than either herbicide used singly. Fewer treatments and less herbicide were required to control weed species such as *Xanthium*, *Helianthus*, *Polygonum*, *Trifolium*, and weeds beyond the seedling stage in the Compositae and Amaranthaceae families. The combinations of clopyralid, phenmedipham and desmedipham plus ethofumesate provided effective control of *Abutilon theophrasti*. Reduced rates (0.5 lb a.i./A) of phenmedipham plus desmedipham in combination with clopyralid at 0.0625 and 0.125 lb a.i./A provided very effective weed control, with minimal short-lived injury to the beet seedlings. The compatibility of sethoxydim added to the above combinations also was investigated, with promising results. The registration and labeling of clopyralid for use in California would greatly benefit sugar beet growers and could reduce the total amount of herbicides presently used for postemergence control of weeds in sugar beets.

FORNSTROM, K. JAMES*, STEPHEN D. MILLER, LARRY HELD, and PAUL BURGENER. Univ. of Wyo, Agri. Engr. Dept., Univ. Station Box 3295, Laramie, WY 82071. - Management options for sugarbeet stand establishment.

Careful selection and application of herbicide and plant to stand can reduce the cost of obtaining an adequate stand of weed-free sugarbeets. This study was conducted at two locations near Powell, WY and two locations near Torrington, WY to demonstrate the economics of planting to stand and complementary herbicide treatments. Seven management options from no labor (plant to stand, preplant herbicide, postemergence herbicide and wick application of herbicides) to full labor (overseeding, no herbicides, thinning and hoeing as needed) were included in the study. Weed densities varied considerably between sites and treatments and ranged from no weeds to 164,000 weeds/A. Regression analysis indicated that 7.4 hours/A were required to walk a sugarbeet field two times, weeding required 0.27 hours/A for each 1000 weeds and thinning required 6 hours/A. Data were summarized with a computerized budget generator to develop an enterprise budget for each management option at each location. Considering the management options at all locations, economic outcomes ranged from a high net return of $295/A ($936 gross minus $412 variable and $229 fixed cost), to a low of $-258/A ($608 gross minus $648 variable and $218 fixed cost). Labor requirements explained a large portion of the difference in observed variable costs among management options.

FORNSTROM, K. JAMES*, STEPHEN D. MILLER, and JAMES M. KRALL. University of Wyoming, Agricultural Engineering Department, University Station Box 3295, Laramie, WY 82071. - In-furrow cover crops for sugarbeet protection from wind erosion.

This paper describes a sugarbeet production system that utilizes a cover crop as a living mulch for wind erosion protection during establishment. Type of cover crop, timing of cover crop and beet planting to provide erosion protection, and the timing of mulch removal to limit competition with sugarbeets were studied. Barley, oats, and winter wheat were planted and compared with no cover crop at Torrington, WY. Two rows of grain were planted in the furrow between sugarbeet rows. Sugarbeets were planted after the cover crop emerged and was later sprayed with sethoxydim. Two cover crops, four beet planting dates and three spray dates were compared in 1989. Sugarbeet populations were significantly influenced by all three factors. Delayed beet seeding and/or delayed mulch removal reduced soil moisture and limited sugarbeet emergence. Sugarbeet yields with a cover crop were equal to those with no cover crop if sugarbeets were planted and mulch removed at the correct time. In 1990, three cover crops were compared at one sugarbeet planting date and one spray date. Winter wheat reduced sugarbeet emergence and yield when compared with barley or no cover crop. Relationships for barley dry matter and height as a function of heat units were developed. Planting beets when approximately 200 heat units have accumulated and spraying barley when approximately 400 heat units have accumulated will provide erosion protection without reducing sugarbeet population or yield.

FOX, J. GARY. American Crystal Sugar Company, Research Center, P.O. Box 1227, Moorhead, MN 56561-1227. - Development and benefits of DuoFiber.

Food grade sugarbeet fiber has only been recently developed as an important new dietary fiber. The talk will cover:

- The historical use of sugarbeets
- The composition of sugarbeet dietary fiber (DuoFiber)
- The physiological benefits
- Functional properties in comparison to other dietary fibers

FRATE, C. A.*, B. B. FISCHER, T. A. BABB, and T. R. JOHNSON. U.C. Cooperative Extension, Ag Bldg., County Civic Center, Visalia, CA 93291-4584; U.C. Cooperative Extension, 1720 S. Maple Ave , Fresno, CA 93702; Spreckels Sugar Company, Inc., P. O. Box 2240, Woodland, CA 95695; Spreckels Sugar Company, Inc., P. O. Box 68, Mendota, CA 93640. - Sugarbeet response to the plant growth regulator TRIGGRR in the San Joaquin Valley of California.

TRIGGRR, a cytokinin-containing plant growth regulator, was reported to increase sugarbeet root yields, sucrose percent, and purity in trials conducted in the Red River Valley in 1988. In 1989, TRIGGRR was evaluated in three trials in the San Joaquin Valley. The trials were designed as randomized complete blocks having from four to eight replications depending on location. Treatments varied in each experiment. Foliar TRIGGRR was evaluated at rates ranging from 4 oz/A to 16 oz/A (0.3-1.2 L/ha) of the formulated material. Repeat applications at predetermined growth stages were compared with a single application. The spray solution, which also included a surfactant, was buffered at 6.0-6.5 pH. Soil TRIGGRR also was applied at planting and at lay-by at a rate of 1 oz/1000 ft (29 ml/300 m) of row. Root yield, percent sucrose, and purity were determined for one of the trials. In another trial, root rot problems prevented yield determination, but healthy roots were sampled randomly for percent sucrose and purity analysis. For the third trial, only yield and percent sucrose were determined. There were no differences among TRIGGRR treatments or the untreated check for the parameters measured in any of the three trials.

GERIK, J. S.*, and T. A. BABB. USDA, Agricultural Research Service, 1636 E. Alisal St., Salinas, CA 93905, and Spreckels Sugar Co., Inc., Road 18C, P.O. Box 2240, Woodland, CA 95695. - Inoculum density of *Polymyxa betae* and beet necrotic yellow vein virus in soils from California sugarbeet fields fumigated and not fumigated with 1,3-dichloropropene.

Soil was collected from several sugarbeet fields in California and were assayed for the number of infecting units of *Polymyxa betae* and beet necrotic yellow vein virus (BNYVV) using a most probable number (MPN) technique. This technique requires that the soils be diluted, in a systematic manner, with sterile soil, past a point were the pathogens can no longer be detected. The soil dilutions required for the MPN technique were made using aliquots of the soil to be assayed which had been sterilized in an autoclave. The culture of bait plants in the diluted soils was accomplished in 24 well tissue culture plates, as described by Ciafardini and Marotta (Appl. Environ. Microbiol.: 1273-1278, 1989). Roots of the bait plants were assayed visually for *P. betae* and tested by ELISA for infection by BNYVV. These assays provide information as to the inoculum density in sugarbeet fields known to be heavily infested with *P. betae* and BNYVV. Additional studies were conducted with soil collected from 2 field plots fumigated with 0, 9 or 12 gallons/acre of 1,3-dichloropropene. These plots were designed as randomized complete blocks, and random soil samples were collected from each plot. Soil samples were assayed for number of infecting units of *P. betae* and BNYVV using the MPN technique. These assays provide information as to the effect of 1,3-dichloropropene on the population of *P. betae* and BNYVV.

GERIK, J. S.*, and STEVEN R. TEMPLE. USDA, Agricultural Research Service, 1636 E. Alisal St., Salinas, CA 93905. and Agronomy and Range Science, University of California, Davis, CA 95616. - Comparison of direct seeding and seedling transplanting on yield loss in sugarbeet due to rhizomania.

Fumigation with 1,3-dichloropropene has been a successful control strategy for rhizomania in the spring plant - spring harvest area of California. The fumigant apparently reduces the soil population of *Polymyxa betae* to low levels, thereby protecting the taproot until the time when this tissue is no longer susceptible. Only primary tissues, the epidermal and cortical cells, are susceptible to infection by *P. betae*. As the sugar beet tap root emerges from the seed and grows through the soil it is susceptible and may be killed, until the cortex is sloughed and secondary growth commences. By the end of the summer feeder roots may be nearly 100% infected, but as the soil temperature drops in the fall of the year, infection is much reduced and the infected sugarbeets will recover and produce a near normal crop the following spring. Experiments were conducted to determine the effect of seedling transplanting on yield loss caused by rhizomania. Four sugarbeet varieties, susceptible or tolerant, were planted or transplanted in a split plot in a field known to be heavily infested with the rhizomania pathogens. Observations made during the growing season indicated that the transplanted sugarbeets remained healthier than the direct seeded ones. The experiment implies that transplanting sugarbeets may diminish the amount of damage caused by rhizomania and that transplanting could be a substitute for soil fumigation in an integrated control strategy.

GHOLSON, LARRY E.*, W. WIMMER, and B. FINGER. Western Sugar Company, 1700 Broadway, Suite 1600, Denver, CO 80290. - Computerization of the sugarbeet field crop record.

Collection of agronomic, pest and crop management data on a field-by-field basis is essential to producing a high-quality sugarbeet crop. Unfortunately, this information, when it exists only in field notebooks, is difficult to consolidate for optimalizing information utilization on a factory or corporate basis. Since 1988, Western has been developing a computerized system for fieldman use to place all field crop record information in an easily accessible database and to attach production measurements so that specific practices can be evaluated. This process has entailed the selection of appropriate hardware and development of software to encourage regular usage by field staff. The result is a powerful database that can generate individual field reports for growers and overall reports for corporate managers.

GILES, J.F.*, A.W. CATTANACH and N.R. CATTANACH, Dept. of Soil Science, North Dakota State Univ., Fargo, ND 58105. - Application of Post-Planting Fertilizer Material to Growing Sugarbeets.

Research was undertaken to evaluate the potential for placing N fertilizer material adjacent to sugarbeets (Beta vulgaris L.) shortly after emergence or during cultivation operations. Applicators used were a spoke wheel for punching liquid fertilizer (28-0-0), a coulter nozzle injector and a drop tube with a straight nozzle mounted on the cut-away disc cultivator. These methods were compared with a surface broadcast application of urea granules followed with a cultivation for incorporation and a no fertilizer check treatment. The post-emergence applications were compared with a soil test recommended fall and spring applied incorporated fertilizer treatment. Root and recoverable sugar yields were increased with the application of post-planting fertilizer material. Application methods were not significantly different, except during very dry growing seasons.

GILES, J. F.*, A. W. CATTANACH, and N. R. CATTANACH. Dept. of Soil Science, North Dakota State Univ., Fargo, ND 58105. - Planting depth, time of planting and secondary tillage interactions on sugarbeet emergence.

Adequate sugarbeet stands resulting from vigorous seedling emergence are important for optimum crop production. Seedling emergence is usually influenced by soil water potential and seedling depth as well as other environmental factors. Often these environmental conditions are interacting with the secondary tillage depth and type to produce seedbeds of varying suitability for germination and emergence. The objective of this study was to evaluate seedling emergence in seedbeds prepared by three secondary tillage implements in combination with a grain drill. Sugarbeet seed was drilled at three depths and at six planting times following tillage. Changes in water content due to tillage treatment were observed to the depth of tillage at each planting time. Seedling emergence was significantly affected by seeding depth and tillage treatment.

GODBY, STEVEN, Western Sugar Company, 20th and East Overland, Scottsbluff, NE 69361 and VERONICA GRUPPO, Seed Testing of America, 950 Boston Avenue, Longmont, CO 80501. - Variety determination by differential isozyme responses using electrophoretic starch gels.

Hybrid varieties of the sugarbeet, Beta vulgaris L., are thought to have a large population variability. Pure parental genetic lines cannot be attained by self-pollination as is done in grains. The purpose of this research was to determine whether genetic variability is as great as believed or stable enough within a variety to use polymorphism at isozyme alleles to identify specific varieties. Thirteen varieties were studied in order to identify a wide range of characters. Thirty-six individual seeds/lot from three lots of each variety were used to monitor seed lot variability. Extracted isozymes from seedlings or imbibed seeds were collected on filter paper wicks, inserted into starch gels and electrophoresed. The resulting migration patterns were then recorded for nine isozymes. The thirteen varieties appeared to be stable enough between lots to be readily identified by at least two specific patterns. There were two sets of two varieties each that appeared to be very closely related or possibly the same varieties. Additional tests and refinements will be needed to define these varieties.

GRIFFIN, G. D. USDA, Agricultural Research Service. Forage and Range Research. Utah State University, Logan, UT 84322-6300. - Effect of injection spacing and population density on nematicidal control of *Heterodera schachtii*.

Heterodera schachtii initial soil nematode densities (Pi) of 3.8-16.8 eggs/cm^3 soil were effectively controlled with application of the soil fumigant 1,3-dichloropropene (1,3-D) injected on 56-cm row centers. The poorest nematode control and lowest sugarbeet, *Beta vulgaris* L., yields resulted from fumigation of a Pi of 16.8 eggs/cm^3 soil with 90 kg/ha of 1,3-D injected on 30-cm broadcast centers. The best nematode control resulted from fumigation of a Pi of 3.8 eggs/cm^3 soil with 225 kg/ha of 1,3-D injected on 56-cm row centers. Chemical rates of 90, 135, 180, and 225 kg/ha of 1,3-D injected on 56-cm row centers resulted in sugarbeet yields of 62, 69, 72, and 82 metric tons/ha at a Pi of 3.8 eggs/cm^3, 57, 62, 69, and 77 metric tons/ha at a Pi of 7.7 eggs/cm^3 soil, and 37, 44, 57, and 69 metric tons/ha at a Pi of 16.8 eggs/cm^3 soil. The same rates of chemicals injected on 30-cm broadcast centers resulted in sugarbeet yields of 49, 54, 67, and 74 metric tons/ha at a Pi of 3.8 eggs/cm^3 soil, 36, 47, 54, and 65 metric tons/ha at a Pi of 7.7 eggs/cm^3 soil, and 20, 31, 40, and 47 metric tons/ha at a Pi of 16.8 eggs/cm^3 soil. Soil fumigant 1,3-D, at a rate of 135 kg/ha injected on 90-cm row centers was as effective in controlling *H. schachtii* as were 180 and 225 kg/ha injected on 56-cm row and 30-cm broadcast centers.

GRIFFIN, G. D. USDA, Agricultural Research Service, Forage and Range Research, Utah State University, Logan, UT 84322-6300. - Efficacy of single and combined applications of aldicarb and ethoprop to control *Heterodera schachtii*.

Split applications of aldicarb at preplant and ethoprop at post plant were effective in controlling *Heterodera schachtii*, as observed by nematode invasion of sugarbeet, *Beta vulgaris* L., seedlings and sugarbeet yields. Because the greatest inhibition of sugarbeet growth by *H. schachtii* occurs at soil temperatures over 20 C, the initial nematode population density (Pi) and soil temperature at planting affects nematicidal control of *H. schachtii*. A split application of 2.24 + 2.24 kg a.i./ha of aldicarb plus ethoprop was as effective as a preplant treatment of 4.48 kg a.i./ha of aldicarb in controlling Pi of 4.2-6.8 eggs/cm^3 at a soil planting temperature of 8 C, but not at a soil planting temperature over 12 C. A split application treatment of 3.36 + 3.36 kg a.i./ha of aldicarb and ethoprop was as effective as a preplant treatment of 5.6 kg a.i./ha of aldicarb in controlling *H. schachtii* Pi of 8.4-11.4 eggs/cm^3 at a soil planting temperature of 8 C, but not at a soil planting temperature over 12 C. Phytotoxicity from post plant treatments of ethoprop was minimal, whereas preplant treatments of 4.48 and 5.60 kg a.i./ha of ethoprop were highly phytotoxic and adversely affected sugarbeet yields.

GUO, DEDONG*, JIZHI WANG, YUHUA MAN, and SHUBIAO JIA. Institute of Biology, Heilongjiang University, Harbin 150080, People's Republic of China. Preliminary investigations of *Beta cicla* L. China.

Beta cicla L. China, as a winter vegetable used by farmers, is widely distributed in China, from the Yellow River in the north to the Pearl River in the south. This type of leaf beet in China has been cultivated for more than 1600 years. It has undergone acclimatization in many parts of the country, and local types may have evolved. Fourteen specimens of *B. cicla* L. China, collected from Huaiyin, Wuxi, Hangzhou, Hengyang, Zhenzhou, Yicang, Chengdu, and Jianyang, were grown and observed in Harbin. Preliminary observations suggested that these specimens are different from *B. cicla* L. Turkey. Each of the specimens seemed to be from a population with different variations, e.g., annual/biennial growing habits and their intertypes; fertile and sterile pollen; sugar content; root and leaf types; disease resistance; etc. Investigations showed *B. cicla* L. China to be a primary material of high potential in its utility that needs further study.

HAFEZ, SAAD L. University of Idaho, SW Idaho R & E Center, Parma, ID 83660. - The effect of nematode resistant sugarbeet hybrids and oil radish varieties on sugarbeet cyst nematode (*Heterodera schachtii*) populations in soil.

Sugarbeet cyst nematode (SCN) is one of the most serious and important limiting factors for sugarbeet (*Beta vulgaris*) production. In Idaho and eastern Oregon, more than 50% of the sugarbeet acreage is infested with this nematode at levels where control of SCN is needed to obtain economical yield. In this study, several nematode-resistant sugarbeet hybrids and oil radish varieties were tested in the greenhouse and commercial field to evaluate their potential for SCN control. Results showed that the percent reduction in cyct nematode population among different hybrids ranged from 50-89%. In a different study, three nematode-resistant oil radish varieties planted after wheat in the fall of 1989 in sugarbeet fields heavily infested with SCN indicated that Pagletta varieties and R-184 significantly reduced the number of eggs by 62 and 61%, respectively. Fallow, the untreated control, reduced SCN by 39%.

HECKER, R. J.*, and M. E. McClintock. USDA, Agricultural Research Service, 1701 Center Ave., Fort Collins, CO 80523. - Use of sugarbeet pollen for genetic assay and selection.

Pollen is a unique plant tissue that is potentially useful for genetic assay and selection. Methods were explored with sugarbeet pollen to assay for disease resistance and heterosis, and to select for tolerance to cold, salinity, and aluminum. Several pectolytic and cellulosic enzymes known to be produced by *Rhizoctonia solani* had no consistent differential effect on in vitro germination and K^+ leakage of pollen from root rot resistant and susceptible sugarbeets. Pectin lyase produced by a root rotting strain of *R. solani* had a potent negative effect on pollen germination but no resistance differentiating power. Cercosporin toxin reduced pollen germination and generally increased K^+ leakage, but did not discriminate between leaf spot resistant and susceptible pollen sources. Four cycles of low temperature challenge of pollen during fertilization showed evidence of genetic gain for cold tolerance. Three cycles of a more intense in vitro cold challenge of pollen gave a modest genetic gain in one of two separate lines, the gain being detected by measurements in both pollen and seedlings. Pollen challenged by salinity for 3 cycles resulted in more salt tolerant pollen but no change in plants. Challenge of pollen for aluminum tolerance is in the first cycle. Pollen-stigma complementation vs. heterosis for root yield showed a positive relation, but, if used, would result in the discard of some lines potentially good as parents for hybrids. Pollen size and variance were unrelated to sporophytic heterozygosity, hybrid vigor, and combining ability. Cryopreserved pollen appears to have lost 69% of its original viability after 5 years.

HENSCHEID, THOMAS H.*. The Amalgamated Sugar Company, P. O. Box 127, Twin Falls, ID 83303. - Five years' experience with weak cation softening on thin juice.

Thin juice softening has been carried out on a factory scale using a weak cation exchanger in the hydrogen form. The resin is regenerated with sulfuric acid forming a solution of calcium sulfate which is added back to diffusion as a pulp pressing aid. Therefore no waste disposal problems are created. Critical operating conditions are described which make this method of softening unique and a distinct advantage over other methods of thin juice softening. The overall effects of soft thin juice on factory operation are also described.

HIEB, ALAN W.*, and JOHN CHRONIC. The Amalgamated Sugar Co., Mini-Cassia Factory, 50 South 500 West, Paul, ID 83347. - Mechanical vapor recompression for evaporation requirements of chromatographic separator by-product streams.

Chromatographic separators are becoming an important factor in the success and profit of sugar producers. One significant capital and operating cost associated with separators is the increased evaporation requirement. A mechanical vapor recompression (MVR) station was installed during the 1989-90 season at the Twin Falls facility. The MVR evaporators are currently concentrating raffinate from 6% to 45% dissolved solids with essentially no feed steam.

HOBBS, GEORGE R. The Amalgamated Sugar Company, P. O. Box 250, Nampa, ID 83651. - Better handling and cleaning of sugar beets to reduce damage and enhance factory operations.

The Amalgamated Sugar Company has been interested in altering and developing equipment to reduce damage in handling beets, and to produce cleaner beets delivered to the slicers. Why? Better storage, reduced tailings or beet chips, produces better cossettes, which enhance diffusion, purification, and extraction. Because our factories are in Idaho and eastern Oregon (a high quality potato-producting area), we are conducting research and experimentation with the potato industry to accomplish this. As we know, handling and cleaning is important to the potato industry, because the market price is very sensitive to a clean, undamaged product. We have found many of their procedures very adaptable and better than the beet sugar industry techniques. We feel we should share this with the industry. We will illustrate what we have learned and the possible enhancements it could make to our present sugar beet handling and cleaning practices.

HOEFERT, L. L.*, AND S. S. MARTIN. USDA, Agricultural Research Service, 1636 E. Alisal St., Salinas, CA 93905 and Agricultural Research Service, 1701 Center Ave., Fort Collins CO 80523. - Trap crops for the sugarbeet cyst nematode (*Heterodera schachtii*). I. Structure.

Nematodes are attracted to some members of the Brassicaceae, notably species of Radish, and *Sinapis*. These plants have been widely planted in Europe as cover crops to aid in the attraction and removal of nematodes from sugarbeet fields. The techniques have met with considerable success abroad. Our approach has been to look at the seeds and seedlings of the trap crops to see if any structural anomalies may exist that could explain the attraction of nematodes to the cover crops. We have begun the investigation into the distribution of specialized cells in seedlings and dry seeds during hydration. Quantitative data have been collected that indicate higher numbers of specialized cells occur in non-trap crop Brassicaceae species but that the size of the specialized cells is greater in trap crop species. Electron microscopy during development shows that the specialized cells differentiate in a manner similar to laticifers in latex-bearing plants, but that the cell content differs. In the specialized cells, glucosinolates or their precursors accumulate via endoplasmic reticulum cisternae that fuse with the central vacuole to produce a cell lumen filled with the glucosinolate materials.

HUBBARD, J. C.*, and J. S. GERIK. USDA, Agricultural Research Service, 1636 E. Alisal St., Salinas, CA 93905. Temperature optima of California isolates of *Polymyxa betae*.

Isolates of *Polymyxa betae* were collected from sugarbeet production fields in California. Cultures of these isolates were initiated using multiple resting spore clusters collected with a micromanipulator and added to pots of sterile sand in which sugarbeet seedlings were grown. Dried root tissue from these plants, containing resting spores of *P. betae*, was used to inoculate sugarbeet seedlings growing in 4" pots. Inoculated plants were grown in growth chambers for 8 weeks at 16, 20, 24, or 28 C, and root samples taken from the pots were assayed for the amount of infection by *P. betae* using a modification of the procedure developed for quantification of vesicular-arbuscular mycorrhizae. The data indicate that the highest infection rate for *P. betae* occurs near 24 C, but one isolate from the Imperial Valley in California showed bimodal temperature optima, suggesting a mixed population of *P. betae* in that isolate. Further studies were conducted using single resting spore isolates of the above cultures established by the agar disk method and maintained on sugarbeets growing in sterile sand in a growth chamber. Zoospores collected from these cultures were used to inoculate further temperature experiments. The data from these studies will be discussed in conjunction with environmental data collected from areas of California where rhizomania is and is not a serious problem.

HUBBELL, LEE A. Research Manager, Monitor Sugar Company, 2600 S. Euclid Ave., Bay City, MI 48706. - Determining the effect of planting date on beet quality and yield.

Every spring, a decision must be made concerning time of planting. There is much discussion about the advantages and disadvantages of being the first grower to plant. Planting dates for some growers are considerably later than for others. Planting later offers less potential for top production than earlier planting. This test was designed to plant beets four different dates, each 7-10 days apart, with the first planting as early as possible. Populations of 110 and 150 beets per 100 feet also were included. The results indicate an advantage to earlier planting and thicker populations.

HUBBELL, LEE A.*, Research Manager, Monitor Sugar Company, 2600 S. Euclid Avenue, Bay City, MI 48706. - The impact of higher populations in 28" and 30" rows on recoverable white sugar per acre.

The study was implemented because growers were not achieving what was thought to be desired beet populations. Our previous eight years of hand dug pre-harvest samples averaged less than 109 beets per 100 feet and our average grower seed spacing at planting was 6.4 inches. The row width in Michigan is 28" and 30" with very few in 22" rows. In this study beets were thinned to stands of 60, 80, 100, 120, 140 and 160 per 100 feet of row or 10,455 to 29,870 beets per acre. Results have produced significantly better sucrose content, yield, and recoverable white sugar per acre with the higher populations.

JARO, VICTOR J.*. The Amalgamated Sugar Company, P. O. Box 127, Twin Falls, ID 83303. - Chromatographic separator extract processing.
The Amalgamated Sugar Company chromatographic separation process became operational at the Twin Falls Factory in December of 1988. With diluted beet molasses as a feed syrup, the process separates the sugar and non-sugar components, producing a sugar-rich extract and a non-sugar raffinate. The separator operates approximately 330 days per year, with concentrated extract stored during the intercampaign period for processing during an extract campaign just prior to the start of beet slice. There have been two successful extract campaigns to date, and they will be discussed and compared to a typical thick juice run.

JONGENS, JOHAN*, California and Hawaiian Sugar Company, 830 Loring Ave., Crockett, CA 94525, Mechanical Engineer. Installation of three new automatic bagging machines to package granulated and confectioners type sugars at C&H Refinery.
Three new fully automatic net-weigh packers have been installed to replace four old 50/100 lbs. valve bag packers and one old 25 lb. open mouth packer. The new packers are equipped with automatic bag feeding, opening and positioning for filling bags. A duplex scale consisting of two modules which are coupled to electronic loadcells provide for accurate weighing and a wide range of products. An automatic pinch top sealer seals the bags after the bag has been filled with product. Operational control for the packer, scales and sealer are provided by a microcomputer control system. The installation has reduced labor and material cost considerably. Greater accuracy of the modern scales have reduced sugar giveaway. Pinch top sealed bags provide for a tamper proof sealed bag and also eliminates sugar leakage from the valve bags on the warehouse conveyors.

JURY, DAVID EARL. Holly Sugar Corporation, P. O. Box 517, Hamilton City, CA 95951. - The advantages of thick juice filtration over standard liquor filtration at Hamilton City.
We have lowered our cost of operation and increased our filter capacity by filtering thick juice. This simple modification has also allowed us to decrease steam consumption on the white pans by increasing the brix of the stand liquor. These benefits have been achieved with no apparent loss in sugar quality.

KEARNEY, MICHAEL*, KATHY HIEB, BEVERLY CROTHERS, AND DEL TRAVELLER. The Amalgamated Sugar Company, P. O. Box 127, Twin Falls, ID 83303. - Forecasting yield with neural networks.
Neural networks are models that simulate the biological neural structure of the brain. Unlike familiar computers and software which operate in a serial manner and follow programmed rules, neural networks are massively parallel and learn appropriate rules on their own. Following training, neural networks can exhibit useful generalizing abilities. Several neural networks were constructed for the purpose of forecasting crop yield. Initial results indicate that neural networks may be quite useful for this application.

KERR, ERIC D.*, JAMES G. ROBB, and DARYL E. ELLIS. University of Nebraska Panhandle Research and Extension Center, 4502 Ave. I, Scottsbluff, NE 69361. - Factors affecting the economic threshold for *Heterodera schachtii* control in sugar beet.
Economic threshold levels for the sugar beet nematode, *Heterodera schachtii* Schm., on sugar beet, *Beta vulgaris* L., varies significantly among geographic areas that differ in average soil temperatures. Field studies were conducted in the North Platte Valley of Nebraska during 1988 and 1989 to establish relationships between preplant nematode egg and larva concentration (eggs/cm^3 of soil) and final sugar beet yield. For the response function that most closely represented the average field conditions in the North Platte Valley, the sensitivity of results to changes in percent sugar, percent nematode control, cost of control, and sugar price coefficients were evaluated. For typical production costs and grower contracts, economic threshold levels were influenced by each of these coefficients. The economic threshold (eggs/cm^3) dropped from about 3.0 at 15% sugar to about 2.3 at 18% sugar. At 80% nematode control the threshold was 3.1, in contrast with 2.5 at 100% nematode control. Cost of control is a major determinant of the economic threshold. With a $60/acre cost of control the threshold level was 1.8; increasing the cost of control to $100/acre increased the threshold to 3.1; at $160/acre control cost the threshold increased to 4.9. Price of sugar also influenced the economic threshold, at $20/cwt the calculated threshold was 3.3, at $28/cwt the threshold declined to 2.3.

KIENZLE, WILLIAM B. Holly Sugar Corporation, Betteravia Factory, 2820 W. Betteravia Rd., Santa Maria, CA 92227. - Investigations on the use of near infrared (NIR) spectroscopy for on-line juice analyses.
Process juice samples were analyzed by three NIR instrument suppliers using scanning wavelength instruments capable of on-line installation and fiber optic information transfer. Diffusion juice and thin juice samples collected over a 4-day period were analyzed for solids (refractometric and sand-dried) and sugar (polarization and gas chromatography) in our control laboratory. A duplicate set of these samples was sent to three instrument suppliers for NIR evaluation. Instruments from two suppliers achieved correlation coefficients of 0.98 or higher. Better correlations were observed with polarization (0.95, 0.99, 0.999+ for the three instruments) than with GC sucrose (0.97, 0.98, 0.99, respectively).

KNOLLE, JUERGEN C. SUET Saat- und Erntetechnik GmbH, Industriehof, D-3440 Eschwege, FRG. - Studies and expectations of sugar beet seed pretreatments.
Pretreatments of sugar (and fodder) beet seeds are claimed to improve germination rate and velocity, the emergence and population, as well as the yield of the crop. SUET has tested a broad range of varieties by steeping in water, in addition with the fungicide thiram, and by damp storage, also followed by pelleting exclusively for the field tests. Results obtained in the laboratory show highest increase of germination velocity with raw seed pretreated, also after pelleting. Previously processed seeds (polishing, cleaning, grading) already develop high quality level so that further increase from pretreatment is minimized. After pelleting, the effects of pretreatment are marginal and cannot be saved in the field tests. The loss can be a result from multiple wetting and drying while pelleting. But from leaching tests of pre- and nontreated seeds, the cation concentrations (Na, K, Ca, Mg) do not correlate with respective germination rate or velocity or emergence results. Addition of thiram infused by steeping does not influence the fungal diseases, as analyzed active ingredient on/in the seeds is only in ppm range, compared to protection by several grams per kg of seed from standard application.

KNUDSEN, THOMAS D.* MINN-DAK FARMERS COOPERATIVE, 7525 Red River Road, Wahpeton, North Dakota, 58075. The Use of Satellite Technology For Grower Information Dissemination.
The need for instant access to information is common in today's highly technological society. The sugarbeet grower also requires a much more up to date and timely information source on how to not only produce the best possible crop, but is keenly interested in the day to day operation of the company. This has been accomplished in the past through use of mobile telephones, company newsletters, mailings and commercial radio broadcasts. While the aforementioned sources did improve management-producer communication, there still existed a gap that needed to be filled. This has been partially accomplished at Minn-Dak Farmers Cooperative through the use of satellite technology. Information is generated at a computer terminal at the main office and sent via a phone modem to a satellite uplink station in Ames, Iowa. From there the information is downlinked to a grower's satellite and is displayed on his monitor in a matter of minutes. There are three pages of information available and the Cooperative controls access to the Minn-Dak segment. A brief rundown of some of the topics generated would include crop progress, Cercospora advisories, soil and root temperatures, harvest schedules and progress, factory process and hauling schedules and upcoming informational meetings. This information is only part of a market information package offered by the Data Transmission Network of Omaha, Nebraska. This system has been in use at the Cooperative since September of 1989. Currently 75% of the Cooperative's acreage has access to the information. This information can be updated 24 hours a day, seven days a week. Potential use of this system is only limited by ones imagination.

KUSTERER, JAMES E., JR., MSc., Ch.E.*. The Amalgamated Sugar Company, P.O. Box 250, Nampa, ID 83653. - A novel method of handling filter aid.
Topic includes a description of the pneumatic conveyance of filter aid from returnable, one-ton tote bags to eliminate bag handling, bag disposal, the potential of back injuries and crystalline silica ingestion. Conveyance employs the use of an air-actuated diaphragm pump commonly employed in pumping high solids sludge. The advantages, disadvantages, method of installation, remote operation, and system limitations will also be reported.

LAMB, J.A.*, and A.W. CATTANACH. University of Minnesota, Northwest Experiment Station, Crookston, MN 56716 and North Dakota State University, 203 Waldron Hall, Fargo, ND 58105. - Zinc Fertilizer for Sugarbeet Grown in Minnesota and North Dakota.

The question about the use of zinc fertilizer in sugarbeet production has routinely surfaced in the sugarbeet growing areas of Minnesota and North Dakota. Reasons for questions include that of the results of 75% of the zinc soil tests submitted by producers are below the adequate level and sugarbeet production practices such as planting date, variety, and applications of other nutrients have changed dramatically in the past 20 years. From 1988 to 1990, a study to determine zinc needs of sugarbeet was conducted at 9 locations with below adequate soil test levels (0.3 to 0.6 ug/g) on the glacial lake sediment and glacial till soils of Minnesota and North Dakota. In 1988 zinc rates of 0, 4, 8 and 16 kg Zn ha^{-1} were applied. The 1989 and 1990 rates were 0, 2.8, 5.6, 8.4 and 11.2 kg Zn ha^{-1}. Zinc sulfate was broadcast applied and incorporated at all locations. Zinc uptake of the tops at row closer, root yield, recoverable sucrose, root amino N, and root Na were measured. The use of zinc did not significantly effect root yield, sucrose concentration, recoverable sucrose or the impurities measured even though the soil test values were at levels where zinc fertilizer response is expected for other zinc responsive crops grown in the same area such as corn and dry edible beans. At this time, zinc fertilizer is not necessary for optimum sucrose production in Minnesota and North Dakota.

LANCRENON, XAVIER. Applexion, 15700 Lathrop Avenue, Harvey, IL 60426. - The NRS for sugar juice deliming: Renewed interest due to recent developments in the U.S. beet sugar industry.

There is renewed interest in the deliming of beet sugar juice in the U.S. sugar industry, where presently certain trends are noted: (1) The quality of beet sugar juice has lowered in recent years, and we find higher lime salts, which creates an unusual amount of scaling of the evaporators. (2) The increase in the cost of energy is pushing the industry toward technologies that increase evaporator efficiency. Deliming, for example, is becoming a profitable operation. (3) The NRS (New Regeneration System) is an effluent-free deliming system, which produces soft molasses suitable for further processing by ion exclusion. Therefore, a company that is considering the integration of ion exclusion in its operation can bypass molasses deliming if NRS deliming is applied in the beet sugar factory.

LARSON, DAVID O.*, and JOHN M. HELGE. Nalco Chemical Company, One Nalco Center, Naperville, IL 60566. - A unique method to control settling of first carbonation juice.

Operational control of the separation of carbonation juice typically varies widely from factory-to-factory, even from shift-to-shift. Traditionally, control has relied on a simple timed settleability test and visual observation of overflow juice. Lime addition and alkalinity adjustment were set to achieve optimum removal of non-sugars. Addition of an organic flocculant is typically used to compensate for short hydraulic retention in the thickener or to achieve rapid recovery in an upset condition. Our field work has developed unique control software tied to a sensitive optical sensor that continuously optimizes polymer feed and alerts operating personnel when juice clarity cannot be controlled by polymer. This enables them to optimize alkalinity, lime addition, and temperature to achieve juice clarity and reduce variability.

Lauer, Joseph G.* University of Wyoming, UW-REC, 747 Road 9, Powell, WY 82435. Plant population and N rate effects on sugar beet (*Beta vulgaris* L.) harvest timing.

The sugar beet industry has recently adopted an early harvest option in the grower-processor contract. Management adjustments may be necessary for early harvested fields. The objectives of this study were: 1) To describe sugar beet yield and quality response to harvest timing, and 2) To determine optimum soil N and sugar beet plant populations for early versus late harvest. In 1989 and 1990, experiments were conducted at Powell, WY on a Garland clay loam (fine, mixed, mesic Typic Haplargid). Ammonium nitrate (34-0-0) was applied at rates of 0, 112, 168, 224, 280 and 336 kg N ha^{-1}. Sugar beet populations of 37 100, 61 800, 86 500, and 111 200 plants ha^{-1} were established. Harvests were at two or three week intervals, beginning 13 September and ending 25 October. In both years linear and quadratic responses to applied N and harvest date were observed for root yield and sucrose concentration. Plant population effects on sugar beet yield and quality were usually not significant. In 1989, increasing applied N increased root yield (29.9 to 50.1 Mg ha^{-1}), brei impurities (Na, K, amino-N), loss to molasses (6.48 to 7.97 g kg^{-1}), and recoverable sucrose (4.79 to 7.85 Mg ha^{-1}). Applied N did not affect sucrose concentration (165 to 164 g kg^{-1}). Later harvest increased root yield (39.9 to 48.2 Mg ha^{-1}), sucrose concentration (149 to 181 g kg^{-1}), brei amino-N (88 to 142 mg kg^{-1}), and recoverable sucrose (5.64 to 8.36 Mg ha^{-1}). Later harvest decreased brei Na (213 to 167 mg kg^{-1}) and brei K (1451 to 1367 mg kg^{-1}). Later harvest only slightly increased loss to molasses (7.11 to 7.30 g kg^{-1}). Later harvest increased recoverable sucrose which greatly affected grower return, while small changes in brei impurities and loss to molasses only slightly affected processing costs.

LEWELLEN, R. T.*, and I. O. SKOYEN. USDA-ARS, 1636 E. Alisal St., Salinas, CA 93905. - Improvement and performance of populations of sugarbeet x *Beta maritima*.

As a consequence of its rather narrow genetic base, sugarbeet (*Beta vulgaris* L.) has been highly vulnerable to endemic diseases and pests, particularly in warmer and/or more humid environments. *B. maritima* is believed to be its ancestral species and should be an important and useful germplasm resource. An advanced sugarbeet breeding line was crossed to 59 accessions of *B. maritima* from the pre-1980 USDA collection. Individual F_1 and F_2 lines from each *B. maritima* accession were produced. Mother roots from the F_2 lines grown in a field plot were selected based upon nonbolting and agronomic type and composited to produce an F_3 population. The F_3 source and cycle 1 and 2 synthetics from it were evaluated in comparison to the sugarbeet parental line. Genetic variability was obvious in the sugarbeet x *B. maritima* populations for most traits examined. Selections for resistance to beet yellows virus and rhizomania based upon individual plant performance for sugar yield and root conformation significantly increased the performance of the respective synthetic when grown under diseased conditions. Even under mild disease exposure, the selected synthetics were superior to the F_3 source. The data suggested that an improvement for root and sugar yield also occurred. Compared to the sugarbeet parental line, root and sugar yield was higher but sucrose content and quality traits were poorer.

LEWELLEN, R. T.*, and I. O. SKOYEN. USDA-ARS, 1636 E. Alisal St., Salinas, CA 93905. - Screening for bolting tendency within sugarbeet populations.

It may be feasible to use a nonbolting, annual (*bb*), CMS inbred line of sugarbeet (*Beta vulgaris* L.) as a tester to evaluate and screen genotypes for bolting tendency. Based upon tests involving lines with known but extremes in bolting tendency, a good association occurred between the lines in overwintered tests and their corresponding annual testcrosses under long-day greenhouse conditions. It remained uncertain whether this evaluation procedure would be critical enough to sort genotypes within a breeding line. Plants from two lines were randomly selected, selfed to produce S_1 lines and crossed to annual C600CMS. S_2 lines were obtained from some S_1 lines. Annual testcrosses were evaluated for bolting in greenhouse and field tests under long-day conditions. Biennial S_1 and S_2 lines were evaluated for bolting in conventional fall planted field trials. Testcrosses evaluated in the greenhouse showed wide dispersion for bolting but not when tested under long-day field conditions. S_1 lines in an over-wintered test ranged from 0 to 91% bolted. Bolting tendency of S_2 lines had good association with their S_1 source but continued to show wide differences within sets from a common S_1 line. The testcrosses evaluated in the greenhouse showed agreement with their corresponding S_1 and S_2 lines evaluated under overwintered conditions, but there were some major discrepancies. Usually though, the very slow bolting testcrosses identified the very nonbolting S_1 lines and S_2 lines that showed little additional segregation for bolting.

LEWELLEN, R. T.*, and S. R. TEMPLE. USDA-ARS, 1636 E. Alisal St., Salinas, CA 93905 and Agronomy and Range Science, University of California, Davis, CA 95616. - Response of sugarbeet line C31/6 to selection for resistance to beet yellows virus.

Beet yellows virus (BYV) continues to plague sugarbeet growers and processors in the Central Valley of California. Partially resistant or tolerant breeding lines that have been developed at Salinas over the past 35 years reduce the losses caused by BYV; however, higher levels of resistance in more productive backgrounds would be highly desirable. From moderately resistant breeding line C31/6, 100 half-sib families were evaluated for yield under BYV infected conditions at Davis and Salinas to determine if additional progress for resistance or performance under BYV conditions could be made. A wide dispersion for sugar yield occurred at both Davis and Salinas, but the rank correlation was poor. Six half-sib families were selected and individually advanced. Based upon data from each site, separate cycle 1 (C1) synthetics from a 10% selection intensity were made. Corresponding hybrids were produced with the source, C1 synthetics, and advanced lines. These were evaluated at Salinas and Davis in 1990 under BYV infected and noninfected conditions. The performance and resistance (% loss) of the source and C1 synthetics were not significantly different. Differences did occur among the six lines and their hybrids. The relative performance of the progenies and lines at Davis and Salinas suggested that location effects were important.

LI, Y. F., and Y. Q. WANG. Institute of Sugarbeet and Sugar, The Ministry of Light Industry, 111 Xue Fu Road, 150086 Harbin, People's Republic of China. - Genetic transformation of sugarbeet using *Agrobacterium* and analysis of T-DNA products in tumor-cell lines.

Strains C58, T37, and B3/73 of *Agrobacterium tumefaciens* were used for infection of 106 varieties and lines of *Beta vulgaris* and *B. maritima*, and crown galls were induced in 102 varieties. Among them, two teratomes were obtained on *B. vulgaris* and one on a hybrid of *B. maritima* X *B. vulgaris*. Bacteria-free calli containing T-DNA were isolated on auxin-free MS medium. Data from paper electrophoresis verified that the nopaline synthetase gene was integrated into the genome of *B. vulgaris* and was fully expressed. Thus, the Ti plasmid can be used as a vector in genetic engineering of *B. vulgaris*.

LIAN, Y. Y., and Y. F. LI*. Institute of Sugarbeet and Sugar, The Ministry of Light Industry, 111 Xue Fu Road, 150086 Harbin, People's Republic of China. - Sugar been improvement in China.

Sugar beet genetics, breeding, and culture in China will be reviewed to include the following: (1) History of sugar beet culture in China; (2) Genetic research of sugar beet breeding; (3) Breeding methods – the character and effect of breeding new varieties in China; (4) Germplasm, variety, distribution, and adaption; (5) Sugar beet genetic manipulation in China; (6) National sugar policy and seed market; and (7) Organization of sugar beet research and production.

MARTIN, SUSAN S. USDA, Agricultural Research Service, 1701 Center Ave., Fort Collins CO 80526. - Trap crops for the sugarbeet cyst nematode (*Heterodera schachtii*). II. Biochemistry.

Root exudates of plants of the Brassicaceae are uniquely effective in attracting the sugarbeet cyst nematode. Members of this plant family also produce a unique group of biologically active chemicals, the **glucosinolates** (abbreviated GSL), which might be involved in the effect. I analyzed the GSLs in radish (*Raphanus sativus*) and mustard (*Sinapis alba*) trap crop cultivars, and determined their concentrations in seeds, developing seedlings, and leaves and roots of mature plants. Samples were extracted in boiling 75% methanol (8 min.), evaporated to remove methanol, made to known volume with distilled water, filtered (0.2μ), and analyzed by HPLC (C_{18}-column; gradient elution with 3% (aq.) acetic acid and acetonitrile mixtures; diode array UV detection; electronic integration). All samples of *S. alba* contained one predominant GSL, 4-hydroxybenzylglucosinolate (glucosinalbin); three others were present in trace amounts. Glucosinalbin increased rapidly in early development, and was greater in the epicotyl than in the hypocotyl. Seed of *R. sativus* 'Maxi' contained 4-methylsulfinylbut-3-enylglucosinolate (glucoraphenin) as its predominant GSL, but germinating seedlings (including both hypocotyls and epicotyls) rapidly synthesized the unoxidized analog, glucoraphasatin (4-methylthiobut-3-enylglucosinolate), its content equaling or exceeding that of glucoraphenin by 72-96 hr. Small amounts of glucosinalbin and 4-hydroxy-3-indolylmethylglucosinolate also occurred in *R. sativus*. Roots and tops of mature radish plants differed in GSLs.

MARTYN, R. D.*, E. A. DILLARD, and C. M. RUSH. Dept. of Plant Pathology and Microbiology, Texas A&M University, College Station, TX 77843. - Host specific and nonhost specific isolates of *Fusarium oxysporum* recovered from sugar beet, spinach, and red-root pigweed.

Sugar beet (*Beta vulgaris* L.) and spinach (*Spinacia oleracea* L.) are members of the Chenopodiaceae plant family. Red-root pigweed (*Amaranthus retroflexus*) is a cosmopolitan weed pest in the Amaranthaceae family. A wilt disease caused by formae speciales of *Fusarium oxysporum* has been described on each of these plants. In this study, 20 isolates of *F. oxysporum* recovered from diseased plants were cross-inoculated onto each of the three species by three different inoculation procedures in an attempt to determine host specificity of the isolates. Analysis of the inoculation tests defined several levels of host specificity and aggressiveness among the isolates; however, the inoculation method had little effect on the results. Isolates specific to sugar beet and to spinach were identified as well as isolates that were pathogenic to both hosts. In addition, pigweed isolates were highly aggressive to sugar beet, but not to spinach. Of the three plant species tested, pigweed was the most tolerant to Fusarium wilt. That there are isolates of *F. oxysporum* pathogenic to more than one plant species suggests that there is a continuum of pathogenicity within a given forma specialis.

MARTYN, R. D.*, D. H. KIM, E. A. DILLARD, and C. M. RUSH. Dept. of Plant Pathology and Microbiology, Texas A&M University, College Station, TX 77843. - Isozyme relatedness and mtDNA RFPL groups of *Fusarium oxysporum* from sugar beet, spinach, and red-root pigweed.

Twenty isolates of *Fusarium oxysporum* recovered from diseased sugar beet, spinach, and red-root pigweed plants were examined by isozyme profiles and mtDNA RFLP patterns to determine their relatedness. Five enzymes (G-6-PD, MDH, CAD, PGI, and ADH) were electrophoresed in polyacrylamide gels. Isozyme bands were scored as binomial data and subjected to a cluster analysis program to generate matching distances between isolates. When analyzed individually, each enzyme separated the isolates into three main groups that correlated with host specificity. When all five enzymes were analyzed together, each main group separated into subgroups that corresponded to aggressiveness of the isolates. Genomic DNA from each isolate was probed with an mtDNA PstI polyprobe (pFON-1-pFON9) constructed from *F. o.* f. sp. *niveum* and examined for polymorphisms. Six RFLP groups were identified. Group I contained the crossover isolates, group II contained host-specific sugar beet isolates, and group III contained host-specific spinach isolates. The remaining three groups separated out on the basis of reduced aggressiveness.

Miller, J.*, A. Quinn, J. R. Stander and R. Jansen. Betaseed, Inc., P.O. Box 195, Shakopee, MN 55379. - Use of partially enclosed plastic structures for controlled matings in sugarbeets.

Various types of plastic barriers are used in our sugarbeet breeding program to facilitate controlled matings. Plastic barriers consist of two types: "partitions" and "sleeves". Partitions are portable crosswalls modified from an earlier KWS design. Each consists of various types of plastic sheeting stretched over a 2 m X 3.8 m metal frame. Partitions are placed parallel to each other and 1.4 m apart. Sleeves consist of various rectangular and hexagonal sizes surrounded by 1.8 m high plastic tubes held rigidly upright by a system of 1.2 cm metal posts. Posts within and between sleeves are held in place by a system of triangles constructed from metal bars. Both structures are economical. The sleeves have lower initial costs, but are more labor intensive. For both structures, the vernalized plants to be mated are planted in precise patterns, but are treated as a row crop until the plastic structures are erected. Outcross contamination levels for these structures have been 5 to 10%.

MILLER, STEPHEN D.*, and K. JAMES FORNSTROM. University of Wyoming, Department of Plant, Soil and Insect Sciences, University Station Box 3354, Laramie, WY 82071. - Postemergence Canada thistle and green foxtail control in sugarbeets.

A mixture of desmedipham plus phenmedipham is the most widely used postemergence herbicide in sugarbeets in Wyoming. However, seedling grasses and Canada thistle are not effectively controlled with this treatment. Trials have been conducted at the Research and Extension Centers at Torrington and Powell, WY, since 1985 to evaluate the efficacy of several postemergence weed management systems for control of these weed species in sugarbeets. Canada thistle control has been good (91 to 94%) with clopyralid at 0.19 lb/A, and green foxtail control excellent (95 to 100%) with sethoxydim at 0.2 lb/A. Canada thistle control with clopyralid has been similar whether applied as a single or split treatment alone, or in combination with desmedipham plus phenmedipham. Slight antagonism of foxtail control (5 to 8%) with sethoxydim has been observed on only a few occasions with combinations with desmedipham plus phenmedipham or clopyralid. Regression analysis has indicated sugarbeet yields are reduced 0.4 T/A (R^2 = 0.87) and 0.2 T/A (R^2 = 0.53) for each 1000 Canada thistle or green foxtail plants per acre, respectively.

MONCLIN, JEAN-PIERRE. Manager of Technical Services, Southern Minnesota Beet Sugar Cooperative, P. O. Box 500, Renville, MN 56284. - Continuous pan for boiling beet syrup.

A continuous pan for boiling beet syrup, installed at SMSC near Renville, MN, for the 1990 beet campaign, will be described and discussed. Controls concept and results of MA, CV, and magma quality requirements are indicated. Also, a mathematical study is intended in order to define the kind of flow through the pan and the number of equivalent "theoretical stages."

MONCLIN, JEAN-PIERRE. Manager of Technical Services, Southern Minnesota Beet Sugar Cooperative, P. O. Box 500, Renville, MN 56284. - Fully automaic pan boiling system.

A true fully automatic total boiling system in successful operation at SMSC near Renville, MN, will be described and discussed. This system controls all boil stems (7 batch pans and 1 contiuous pan). Algorithms for control of supersaturation (in function of purity, brix, and temperature) and results in terms of quality, savings (labor and steam), and capacity increase are indicated.

MORAGHAN, JOHN T.*, and K. HORSAGER. Dept. of Soil Science, North Dakota State University, Fargo, ND 58105. Nitrogen fertilizer experiments with sugarbeet in the Red River Valley.
Sugarbeet, Beta vulgaris L., is grown under dryland conditions in the Red River Valley, a region of limited and erratic growing-season precipitation. The success of the industry is dependent upon sugarbeet's deep rooting system and the storage of up to 10 to 12 inches of available soil water in the rooting zone. Twenty four nitrogen fertilizer experiments were conducted in the region between 1985 and 1990 on soils with various levels of soil nitrate-N in the rooting zone. Important findings from this research included: (1) high levels of soil nitrate-N within the rooting zone, in general, had a more detrimental effect on sugar yields and root quality than comparable levels of fertilizer N placed in the topsoil; (2) approximately 75-90 pounds of soil nitrate-N or fertilizer N at certain yield levels needed to be present in the upper 2 feet of soil to insure optimal early-season growth and optimal sugar yields; (3) return of sugarbeet tops resulted in the addition of approximately 50 to 200 pounds of organic N to the soil; (4) sugarbeets were very effective at removing soil nitrate-N from the rooting zone; (5) relatively low levels of petiole nitrate-N can be present from late July on without affecting adversely sugar yields; and (6) recovery of fertilizer N in tops and storage roots was generally less than 50% of the applied quantity.

MORRISON, CHRIS D.*. Nalco Chemical Company, 395 Taylor Blvd., Suite 115, Pleasant Hill, CA 94523. - Performance monitoring of biocides in mill water systems used to minimize corrosion and microbiological fouling.
Sugar mill cooling system performance can dramatically affect the efficiency and reliability of the mill's operation. Uncontrolled microbiological growth can limit crystalizer cooling capacity and/or shut down vital plant equipment due to corrosion, scale, or under-deposit/slime corrosion by sulfate-reducing bacteria. Control agents for these applications are limited by FDA registrations. The most common biocide, gaseous chlorine, has difficulty acting in mill water systems due to the very high levels of ammonia found in these systems. Ammonia readily reacts with chlorine to form a less-toxic coproduct called "chlor-amines." The use of biodispersants has proved effective in improving the cleanliness of mill water systems. Recently, Nalco's Acti-Brom chemistry has shown to be very cost-effective in mill water microbiological control. This has been further compared to chlorine dioxide and ozone and believed to be still the most cost-effective choice. Further investigations into biocide use in the flume and diffuser areas of the plant are being compared to the allowable FDA uses of biocides. This study will be completed by February, 1991, and will be ready to be discussed then.

NARUM, JUDY A.[1]*, SUSAN S. MARTIN,[2] and KENNETH H. CHAMBERS.[3] [1]Beet Sugar Development Foundation, and [2]USDA-ARS, 1701 Center Ave., Fort Collins CO 80526; and [3]Holly Sugar Corporation, P.O. Box 1052, Colorado Springs CO 80901. - Sugars and impurities in *Beta vulgaris* cultivars after pile storage.
Differences among sugarbeet cultivars in ability to maintain high quality during storage are of interest to growers and processors. We followed biochemical changes in sugarbeets grown and pile stored at three factory locations, which had different environmental conditions. Six varieties were held for 110 days at location #1, five varieties were held for 90 days at location #2, and two varieties were held for 49 days at location #3. Samples collected at harvest and after pile storage were analyzed for pol sucrose; amino-N (ninhydrin); sodium and potassium (flame photometer); and "true" sucrose, raffinose, glucose, fructose and betaine by HPLC. Pol sucrose was higher in all samples than "true" sucrose. Significant differences were found among varieties for ability to retain sucrose during storage. After storage, "true" sucrose decreased by 1.94 to 5.18 (% of fresh weight) in the varieties tested at location #1, and 0.11 to 0.86 in those at location #2. Small or no sucrose losses were found under the short-term storage at location #3. Post-storage raffinose, glucose, and fructose levels (g/100g LC sucrose) increased in all cultivars at all locations.

NARUM, JUDY A.[1]*, and SUSAN S. MARTIN.[2] [1]Beet Sugar Development Foundation, and [2]USDA-ARS; 1701 Center Ave., Fort Collins CO 80526. - Sugars and impurities in peel and interior of *Beta vulgaris*: changes under high-quality storage.

Two major factors are important in loss of sucrose from sugarbeets during pile storage: respiration, and biochemical conversions to compounds such as invert sugar and raffinose. As part of a broader investigation of peel biochemistry, our objective in this study was to determine the rate of loss of sucrose and changes in other impurities in the peel *versus* peeled interior of sugarbeets harvested and held under nearly ideal conditions. Sugarbeets from commercial, smooth root, and experimental varieties were stored at 4°C and nearly 100% humidity. Whole root (RT), interior (IN), and peel (PL) samples were collected at harvest and after 8, 16, and 24 weeks of storage. Biochemical changes were monitored by analyzing aluminum-clarified sucrose filtrate samples for pol sucrose; sodium and potassium (flame photometer); amino-N (ninhydrin); weight loss on drying; and "true" sucrose, glucose, fructose, raffinose, and betaine (HPLC). At harvest, "true" sucrose comprised 14.71%, 14.78%, and 3.01% of RT, IN, and PL fresh weight, respectively; these levels decreased to 12.33% (RT), 12.82% (IN), and 2.22% (PL) after 24 weeks. During high quality storage, mean raffinose content (g/100 g LC sucrose) approximately doubled in RT and IN, but increased 3½-fold in the peel.

OWENS, LOWELL D.*, and C. A. WOZNIAK. USDA, Agricultural Research Service, Plant Molecular Biology Laboratory, Beltsville, MD 20705 (Present address of second author: USDA-ARS, P.O. Box 5677, Univ. Stn., Fargo, ND 58105. - Measurement and effect of gel water potential on growth of sugarbeet leaf disks and production of morphogenic callus.

During studies to optimize the production of regenerable callus from cultured leaf disks of sugarbeet (*Beta vulgaris*, line REL-1), we observed large differences associated with the gelling agent employed. The water potential of the gel was found to be a major determining factor. A simple method was devised to measure the relative matric potential of different gels. A precisely moistened filter-paper disk is placed on the gel surface, allowed to equilibrate, removed, and weighed. The relative gain or loss of water from the paper disk is a measure of the matric potential of the gel and varied with both gel type and concentration. Water availability also was affected by the ease with whith water is expressed from gels in response to localized pressure caused by expansion and contortion of the leaf disk during growth. Water expressibility was measured with a weight and capillary pipette and shown to also vary with gel type and concentration. By optimizing water availability, more than 150 callus-derived embryos and shoots were produced in a single dish of cultured sugarbeet leaf disks.

PFENNINGER, PAUL D.*, Monitor Sugar Company, 2600 S. Euclid, Bay City, MI 48706. - A decade of growth and expansion for both company and growers.

Monitor Sugar Company and its' growers have experienced a tremendous growth period during the last decade. Acreage has increased from 26,800 acres to 59,000 acres during that 10 year period. Not only has the factory been modernized to handle the increases, but the growers involved have increased in numbers and size as well. The drastic changes from four row planters and two row harvesters to twelve row planters and six row harvesters indicates the growers' dedication to the beet industry. The average grower operation has increased in size over 30% bringing along with it larger equipment, better management practices, and a successful community. Along with the larger equipment comes larger vehicles to transport the crop. Grower owned semi's transporting 30 - 35 tons per load have increased from 148 in 1980 to nearly 500 in 1990. The Bay City location will receive over 3,000 loads in two eight hour shifts. Comparisons are made regarding our growers and the advances they have made during the decade of the 80's.

PYNNONEN, BRUCE W.*, Dow Chemical U.S.A., Larkin Laboratory, Midland, MI 48674 - Analysis of Sucrose, Raffinose, and Betaine in Beet Molasses and the Extract and Raffinate Obtained from Ion Exclusion

In conventional analysis of factory process streams, sucrose purity is determined by refractometry and polarimetry. Brix measurements by refractometry do not give the true weight percent dissolved solids except for pure sucrose solutions. In addition, it is well known that raffinose, invert, amino acids, and other optically active compounds affect the polarimetric measurement. This error is normally accepted since it is relatively small with high purity streams. For very accurate sugar accounting, (especially with low purity streams such as those involved in recovery of sucrose from beet molasses via ion exclusion) high performance liquid chromatography (HPLC) offers an improved technique. The development and validation of an HPLC analytical procedure for determining raffinose, sucrose, invert, and betaine in these types of samples will be discussed. Precision, recovery, and specificity of the measurements allow process analysis and control of the ion exclusion process.

GOURD, T. R.*, and R. W. WHITMORE. American Cyanamid Company, Ft. Collins, CO 80521. - Closed handling system for COUNTER® systemic insecticide-nematicide.
An innovative, closed handling system specifically for the granular insecticide, COUNTER, has been developed in a joint effort by American Cyanamid and Deere and Company. Use of the system greatly minimizes grower exposure to the chemical while improving handling convenience over that of the conventional system currently used. The container is constructed of durable 6-mm clear plastic that is returnable and refillable, and will address the pesticide container disposal issue. On-farm testing in Iowa indicates high grower acceptance because of the ease of use and the protection the system provides against wind, spillage, and human exposure.

GREENFIELD, SCOTT D.*, R. W. WHITMORE, and S. P. BRIGGS. American Cyanamid Company, One Cyanamid Plaza, Wayne, NJ 07470. - Red River Valley, ND sugar beet root maggot control using terbufos in heavy pressure situations.
The sugar beet root maggot, *Tetanops myopaeformis* (Roder) is the most destructive insect pest of sugar beets in the Red River Valley, ND. Trials were established on eight fields to determine the economic benefit of using terbufos in heavy population areas. Terbufos was applied modified-in-furrow, and rates used were commensurate with field location and condition. Stand counts and root ratings were conducted throughout the season, and yields were recorded. Sugar content was analyzed by the American Crystal Sugar Company. All fields had an increased yield from terbufos treatment, with one being eight times that of the untreated. Sugar content was increased significantly in all terbufos treatments.

RAINS, DOUGLAS*, ALAN G. DEXTER, PHILIP BRIMHALL, and STEPHEN D. MILLER. American Crystal Sugar Company, P. O. Box 600, Crookston, MN 56716. - A comprehensive approach to weed control can be cost effective.
Yield, sugar percent and percent sugar loss to molasses data were drawn from American Crystal's grower practice data base for the years 1986, 1987, 1988 and 1989. The information drawn was from the Crookston Factory District and included only representative fields. Over the 4 years, this represented over 195,000 acres of commercial sugarbeet fields. The yields were grouped by preplant herbicides, postemergence herbicides, labor, and all combinations of the above. Preplant herbicides included: Avadex, Eptam, Ro-Neet, Nortron and Antor. Postemergence herbicides included: Betanex, Betamix, Herbicide 273, Poast and Treflan. Dollar per acre returns were calculated on the yields, using the actual numbers from the American Crystal sugarbeet payment for each year's data. American Crystal's data base does not include the rates at which the herbicides were used. To supply comparative costs for different herbicide treatments, data is drawn from Alan Dexter's 1985 Crookston and 1989 Hillsboro herbicide trials. Yield trends from these studies support American Crystal grower practice data results. Costs for labor are drawn from Steve Miller's study on weed population per acre versus cost per acre. The effects of weed population on sugarbeet yields are from Phil Brimhall's Michigan study. Results showed that using a combined approach to weed control increased yields sufficiently to cover increased cost and, in some years, returns exceeded costs by $75.00 per acre.

REARICK, D. EUGENE*. The Amalgamated Sugar Company, P. O. Box 127, Twin Falls, ID 83303. - Sugar industry applications of Fourier transform infrared spectroscopy. Identification of fiber samples.
Unlike older dispersive instruments, modern Fourier transform infrared (FTIR) spectrophotometers with their higher beam power and spectrum averaging capabilities can give high-quality infrared (IR) spectra of small fiber samples directly. This is especially useful for very flexible fibers that cannot be analyzed by other IR techniques. FTIR spectroscopy has been applied in two principal areas: (1) Identification of contaminant fibers in white sugar, (2) Analysis of factory insulating materials for the presence of asbestos.

RENNER, KAREN A., and GARY E. POWELL*. Crop and Soil Sciences Dept., Michigan State University, East Lansing, MI 48824. - Response of sugarbeet (*Beta vulgaris*) to soybean (*Glycine max*) herbicide residues in soil.
Clomazone, imazaquin, imazethapyr, and chlorimuron are soybean herbicides with lengthy soil persistence. When sugarbeets are planted in rotation, yield loss may occur. Research was initiated in 1986 to examine the effect of these herbicides on sugarbeets planted 1 (6 locations) and 2 (2 locations) years following application. Residues from preplant incorporated clomazone at 2.0 and 1.0 lb ai/A did not reduce sugarbeet yield 1 and 2 years following application at any location. Yield losses in sugarbeets planted 1 year following preemergence imazaquin at 0.25 and 0.125 lb ai/A were detected at 5 of 5 and 1 of 5 locations, respectively. Sugarbeet yield losses were not detected 2 years after imazaquin application. At the location where imazaquin was preplant incorporated, sugarbeet yield reductions were detected for both application rates 1 year but not 2 years following application. Residues from preemergence imazethapyr applications at 0.125 lb ai/A reduced yield of sugarbeets planted 1 year after application at all locations. Sugarbeet yield losses were detected at only 1 location from imazethapyr applications of 0.063 lb ai/A 1 year after application. Where imazethapyr was preplant incorporated at 0.078 lb/A, sugarbeet yield loss occurred for 1 and 2 years following application. Residues from preemergence chlorimuron applications of 0.02 to 0.08 lb ai/A reduced sugarbeet yield severely at all locations, regardless of soil pH (range 6.0-8.0). Sugarbeet yield losses were still detected 2 years after application at the single location (pH 7.6) where chlorimuron was applied and sugarbeets planted for 2 years following application.

RUPPEL, E. G. USDA, Agricultural Research Service, 1701 Center Ave., Fort Collins, CO 80523. - Trap crops for the sugarbeet cyst nematode (*Heterodera schachtii*). III. Susceptibility to fungal pathogens of sugarbeet.
Three cultivars of the mustard *Sinapis alba* (3-9001, 3-9002, & 'Maxi') and one radish (*Raphanus sativus* 'Nemex') were planted in pathogen-infested soil or inoculated in the greenhouse with sugarbeet fungal pathogens and evaluated for disease 21 or 30 days later. *Aphanomyces cochlioides* induced 20-26% seedling damping-off in mustards, 50% in radish, and 87% in sugarbeet. Damping-off caused by *Pythium ultimum* ranged from 0-47% in mustards, 22-35% in 'Nemex,' and 37-45% in sugarbeet, whereas *P. aphanidermatum* induced 35-100% damping-off across the trap crops and sugarbeet, stand loss being dependent on environmental conditions. *Rhizoctonia solani* AG-4 caused 45-67% damping-off in trap crops and 92% in sugarbeet. *R. solani* AG-2-2 induced 34-68% seedling loss in the trap crops and 97% in sugarbeet. *Fusarium oxysporum* var. *betae* caused 100% seedling loss in sugarbeet, 19% in 'Maxi,' 8% in 3-9001, and no loss in 3-9002 or 'Nemex.' *F. avenaceum* reduced stands in sugarbeet, 'Maxi,' and 3-9001 by 86, 5, and 8%, respectively; 'Nemex' was not susceptible. *Cercospora beticola* induced a few leaf spots in the cotyledons and older leaves of the trap crops. Powdery mildew, *Erysiphe polygoni* (= *E. betae*), failed to infect the trap crops. Susceptible trap crops, incorporated as green manure, may serve as inoculum reservoirs for subsequent sugarbeet crops.

RUSH, C. M.*, K. M. VAUGHN, and J. E. WARNER. TAES, 6500 Amarillo Blvd. W, Amarillo, TX 79106. - Reduction in Aphanomyces seedling disease of sugar beet by management of soil moisture.
Aphanomyces is the most common seedling pathogen of sugar beets grown in the Texas Panhandle. Since the infective unit of this pathogen is the zoospore, we hypothesized that disease control could be achieved by planting seed into a soil wet enough for seed germination but too dry for zoospore movement. In a laboratory study, sugar beet seed, cv. Tx-9, were untreated, solid matrix primed (SMP) or SMP and mixed with a fluid for fluid seeding. Seed were then planted into soils with matric water potentials adjusted to -1 through -9 bars, all of which are too dry for zoospore movement. Neither seed treatment nor soil matrix potential affected overall seed germination, but SMP treated seed and SMP+fluid both germinated faster and had better radicle growth at all matric potentials than the control. Seed with the same treatments were also planted in the greenhouse in boxes containing soil artificially infested with oospores of Aphanomyces cochlioides. Ten boxes were pre-irrigated and allowed to dry down to approximately -1.5 bar before planting. After planting, five of the boxes received a second irrigation. Seed treated with SMP or SMP+fluid emerged faster than non-treated seed in all boxes, but after six days no significant differences existed. After six days, seedling emergence in boxes irrigated post-plant was only slightly better than in pre-irrigated boxes, 100 vs. 97% respectively, but the difference was significant. However, the average disease in boxes irrigated post-plant was 56% and only 5% in pre-irrigated boxes.

RUSSELL, L. DOUGLAS*. The Amalgamated Sugar Company, P.O. Box 1766, Nyssa, OR 97913. -Improved factory operation through optimized juice purification.

Juice purification improvements installed in conjunction with a factory expansion have been integrated with existing equipment providing excellent results. The non-sugar elimination has increased by 36% expressed as a percent on beets. The results were obtained using existing carbonation and filtration equipment and adding a pre-limer, cold limer and hot limer. Four years of evolution in the allocation of equipment and operational methods have provided an excellent system.

SAILSBERY, R. L.*, and G. S. PETTYGROVE. University of California Cooperative Extension, P. O. Box 697, Orland, CA 95963 and LAWR, University of California, Davis, CA 95616. - Fertilizer N response of sugarbeets irrigated with high-nitrate water.

The sugarbeet, Beta vulgaris L., is nitrogen sensitive. High plant N levels near harvest can result in low sucrose levels. In field studies fertilizer N rates were evaluated where irrigation waters contained 21.4 to 27.6 lb N/acre-ft. Based on estimations of the amount of irrigation water applied and an assumed 65% furrow irrigation efficiency, N supplied to sugarbeets was calculated to range from 60 to 74 lb/acre in the four trials conducted and was sufficient to give maximum tons/acre and sugar/acre without additional fertilizer N. Root yields at the zero N fertilizer treatment were 31.3, 31.7, 53.2 and 30.7 tons/A during the three year evaluation period. Early season residual soil NO_3-N was 100, 127, 117 and 138 lbs/acre to a depth of 3 feet in the four trials. Sugarbeet growers with significant levels of nitrate N in irrigation water for use on sugarbeets should carefully evaluate the N program selected for sugarbeets.

SAMARAWEERA, INDRANI S. R.*, and D. L. BERG. American Crystal Sugar Company, Research Center, P.O. Box 1227, Moorhead, MN 56561-1227. - A comparison of three techniques used in the assessment of the efficacy of biocides and sanitizers for microorganism control in factory diffusers.

Loss of sugar in factory diffusers due to microbial action is a problem that has continued to plague the sugar industry for many years. A preliminary survey to assess the efficacy of biocides and sanitizers for microorganism control in factory diffusers was carried out by us previously (ASSBT 1989). This assessment has been further evaluated by use of three techniques; namely, 1) a "disc diffusion assay - modified Kirby Bauer technique," 2) a shaker technique with use of diffusion juice, & 3) a microbial count. All three techniques were conducted simultaneously either for mesophiles or thermophiles. These techniques used in evaluation will be discussed.

SAMARAWEERA, UPASIRI, and LARRY BATTERMAN. American Crystal Sugar Company, Research Center, P.O. Box 1227, Moorhead, MN 56561-1227. - Alternate methods for sucrose analysis.

Several methods are in use for sucrose analysis both at the factory and Research level. Although many new methods have been developed and shown to be accurate, the older methods are still in use at the factories. In this study we will compare Polarimetry, High Pressure Liquid Chromatography (HPLC), Ion Chromatography, and Enzymatic Analysis and evaluate them on the basis of 1) ease of sample preparation, 2) time required for analysis, 3) cost of operation, 4) accuracy of method, and 5) limits of detection.

SAUNDERS, JOSEPH W.*, WILLIAM P. DOLEY, GEORGE ACQUAAH, and M. H. YU. USDA, Agricultural Research Service, Crop and Soil Science Department, Michigan State University, East Lansing, MI 58824 and USDA-ARS, 1636 E. Alisal St., Salinas, CA 93905. - Isoenzyme fingerprinting and in vitro shoot multiplication in *Beta lomatogona* Fisc. et Mey.

The apomixis existing within *Beta lomatogona* Fisc. et Mey. might be useful in development of true-breeding high-performance hybrid sugarbeet cultivars if it can be transferred into *B. vulgaris* L. and harnessed in breeding programs. We studied isoenzyme fingerprinting and in vitro propagation as tools to identify apomictic and interspecific progeny and to clone individual genotypes, respectively. Variation among six accessions was seen with malate dehydrogenase (MDH), isocitrate dehydrogenase, shikimate dehydrogenase, phosphoglucomutase, and phosphoglucoisomerase, but not with 6-phosphoglucose dehydrogenase. One accession had a unique MDH pattern. Some patterns were different from those found in sugarbeet. In vitro multiplication of shoots of three accessions was achieved, starting with floral stalk axillary buds and using 6-benzyladenine as the sole growth regulator. 3.0 mg/L was the optimum concentration for overall shoot enlargement and multiplication. This is 10-fold higher than routinely found for sugarbeet. This research indicated that isoenzyme fingerprinting and in vitro shoot multiplication could be used in genetic studies with *B. lomatogona* and, presumably, with interspecific hybridization derivatives with sugarbeet.

SAUNDERS, JOSEPH W.*, STEPHEN E. HART, and DONALD PENNER. USDA, Agricultural Research Service, Crop and Soil Science Dept., Michigan State University, East Lansing, MI 48824. - Physiological and genetic basis of sulfonylurea herbicide resistance obtained from somatic cell selection.

Publically released clone CR1-B is a direct selection via somatic cell culture for resistance to the sulfonylurea herbicide chlorsulfuron. CR1-B was found to be 300- to 1000-fold more resistant to chlorsulfuron than source clone REL-1 in in vitro shoot culture tests. Greenhouse tests found CR1-B resistant as well to the other sulfonylurea herbicides primisulfuron and thifensulfuron, but not to imidazolinone herbicides. Both CR1-B and REL-1 exhibited similar low (10%) rates of metabolism of primisulfuron. CR1-B had acetolactate synthase (ALS) activity at least eight-fold less sensitive to inhibition by chlorsulfuron than REL-1. CR1-B is heterozygous for the resistance factor, which has been transmitted and expressed in a 1:1 fashion for four successive outcrosses in a stable manner. These results indicate that this sulfonylurea resistance is encoded by a dominant allele (designated *Sur*) that conditions an altered ALS enzyme, which is less sensitive to inhibition by the sulfonylurea herbicides.

SCHEPERS, J.S.*, J. KRALL, R. FULLMER, J. POORE, K. DAVIS, and M. SCHEFCIK. USDA, Agricultural Research Service, 113 Keim Hall, Lincoln, NE 68583-0915, University of Wyoming, Torrington, WY, Holy Sugar, Torrington, WY, Servi-tech Inc., Dodge City, KS. Comparison of leaf petiole and chlorophyll meter techniques to evaluate N status of sugarbeet.

Nitrogen status of sugarbeet (*Beta vulgaris* L.) is frequently monitored by analyzing leaf petioles for nitrate concentration. Petiole sampling is time consuming and interpretation of results is delayed until after laboratory analyses. Recently, hand-held chlorophyll meters have been used to evaluate N status of rice, corn, wheat, and sorghum crops. The objective of this study was to compare chlorophyll meter data with petiole nitrate concentrations of sugarbeet for several dates during the 1990 growing season in Colorado, Nebraska, and Wyoming. Petiole nitrate concentrations declined throughout the growing season, but varied substantially between fields. Chlorophyll meter readings generally remained high across a wide range of petiole nitrate concentrations and declined at low petiole nitrate levels. Preliminary data indicates that the chlorophyll meter technique can be used to identify fields with low petiole nitrate concentrations, however additional research will be required to calibrate chlorophyll meter readings with crop N status across varieties, growth stage, and climatic conditions.

SCHMALZ, CHARLES L.*, and J.W. STEINMEYER. THE AMALGAMATED SUGAR COMPANY, 2427 Lincoln Avenue, Ogden, Utah 84401. - Inter-Laboratory Precision of Sugar Analysis.

Precision of analytical results, particularly between different laboratories is a subject of concern to all chemists. Under the auspices of the United States National Committee for Uniform Methods of Sugar Analysis, a test was conducted to evaluate inter-laboratory precision in the sugar industry. Replicates of two sugar samples were submitted to a number of sugar testing laboratories. Color, ash, and moisture were determined using USNC standard suggestions for future studies.

SCHMIDT, WALTER H. Ohio Agricultural Research and Development Center, 952 Lima Ave., Box C, Findlay, OH 45840. - Influence of nitrogen rate on soil nitrate level and sugar production in Ohio.

Soil nitrate levels in 1989 ranged from 14 lb/A in April to less than 5 in October with no added N. Applying 110 lb N at planting resulted in a June nitrate level of 32 lb/A and an October level of 5. Nitrate levels in 1990 ranged from 10 lb in April to 5 lb in October. The 1989 clear juice purities ranged from 92.21% for 120 lb of applied N to 93.85% for no applied N. The raw white sugar produced per acre was 6,019 and 5,509 lb/A, respectively.

SEARLE, DENNIS W. The Amalgamated Sugar Company, P.O. Box 250, Nampa, ID 83653. - An automatic tare sampler for sugarbeets.

Taking a fair and equitable tare sample is of great importance to both the Amalgamated Sugar Company and the growers, since the ultimate grower payment and, consequently, economic return from the crop is based on these samples. On one series of pilers, called the 48-inch piler, because of the width of the boom belts and the mechanical design of the piler, it has been impossible to take a fair and equitable sample. As a solution to the problem, the University of Idaho Department of Agricultural Engineering, in cooperation with the Amalgamated Sugar Company, developed an automatic, hydraulically activated, programmable process-controlled tare sampler to be used on the 48-inch sugarbeet piler. This mechanism has been used through two harvest seasons and has proven to be effective in accomplishing the desired goal of fair tare.

SEILER, GERALD J.*, and D. L. DONEY. USDA-ARS, Northern Crop Science Lab., Fargo, ND 58105. - Collection of wild sugarbeet species (*Beta* spp.) from Europe.

Preservation of wild sugarbeet germplasm is imperative because of the continued loss of native habitats. Cultivated sugarbeet (*Beta vulgaris* L.) is presently based on a narrow genetic base. Wild *Beta* spp. have the potential of contributing unique genes for insect and disease resistance to cultivated sugarbeet. Since 1988, sugarbeet explorations have been undertaken in five European countries: France, Denmark, Belgium, Channel Islands (Guernsey and Jersey), and the Soviet Union. Seeds from 120 populations of *B. vulgaris L. ssp. maritima* (L.) Thell. (sea beet) were collected from France, 19 from Denmark, five from Belgium, five from Guernsey Island , and three from Jersey Island. The addition of the sea beet populations to the USDA-ARS *Beta* collection makes it the most complete in the world. Seeds from three populations of *B. corolliflora* Zoss., one population of *B. lomatogona* Fisch. et Mayer, and two populations of *B. macrorrhiza* Stev. were collected from the Soviet Union. The germplasm collected from the Soviet Union is the first seed of these wild species obtained in over 50 years. The wild sugarbeet germplasm collection is a valuable genetic resource. It's potential will be realized through systematic evaluation for specific characters.

SHIPPEN. WAYNE R.*., The Amalgamated Sugar Company, Mini-Cassia Factory, 50 South 500 West, Paul, Idaho 83347. - Design and Conetruction of a Thin Juice Softener System at the Mini-Cassia Factory.

To allow sugar to be removed from molasses using the TASCO separator, it is necessary to provide a molasses feed stock free of calcium and magnesium ions. A softening process to remove these ions from thin juice using a hydrogen form resin with affinity for divalent cations was installed during 1989. This resin is regenerated using sulfuric acid producing calcium sulfate that is returned to the diffuser supply as a pressing aid. In addition to producing suitable feed stock molasses, benefits include clean evaporators, extended filter cycles, improved pulp pressing, and elimination of pan boil outs, leading to increased slice of approximately 300-400 tons per day in the 1989-90 campaign. Detrimental effects observed included increased corrosion to carbon steel evaporator shells and piping.

SHOAEE, NASSER*. The Amalgamated Sugar Company, P.O. Box 1766, Nyssa, OR 97913. - Operation and sterilization of an 8,000 tons per day tower diffuser with counter-current mixer.

During 1987, an 8,000 tons/day BMA tower diffuser was installed at the Nyssa factory of The Amalgamated Sugar Company. Draft of 114 and 0.30 pulp loss were obtained at nominal capacity. The average slice rate for the 1989 campaign was increased to 9,044 tons/day with 0.29 pulp loss and 118 draft. The counter-current mixer produced raw juice with temperatures of 10-15° C above beet temperature. Sulfur dioxide is being used as the bacteriacide in the mixer and press water. Direct bacteria count, lactic acid, invert analysis, clarifier and filter operation in the beet and the sugar end point to successful control of infection in the diffuser.

SLOTH JENSEN, ARNE, and VISTI ANDERSSON *. DDS Engineering A/S, Gladsaxevej 305, DK-2860 Søborg, Denmark. - Drying of beet pulp in superheated steam under pressure.

A new method for drying beet pulp has been developed in Denmark, and full-scale plants are now operating in Denmark and France. The pressed pulp is conveyed into a modified cellular fluid bed under pressure. The particles are carried by a vertical superheated steam flow circulated within a closed vessel. In the cells intimate contact is achieved between the particles and the superheated steam, and at the same time the particles are conveyed from the first to the last cell in such a way that the small particles with the shortest drying time reach the last cell before the large ones. The steam developed by evaporation from the particles is discharged from the closed system. This steam of e.g. 3 bar gauge is used for juice evaporation. The method offers 3 major advantages: 1) Energy saving: The energy supplied leaves the drier as steam in an applicable form. By using this steam, you recover much of the energy and may save more than 90% compared to the amount of fuel used by other drying plants, e.g. drum driers. 2) No pollution: Contrary to other drying methods, there is no emission as the system is closed. 3) Improved product quality: As the drying takes place without admission of air, there is no oxidation and material loss. No impurities from flue gas can mix with the dried pulp. Further the heat treatment of the beet pulp when dried under pressure improves its digestible qualities.

SMITH, GARRY A. USDA, Agricultural Research Service, P.O. Box 5677 - University Station, Fargo, ND 58105 - Development of a biopesticide targeting the sugarbeet root maggot.

The development of a biopesticide for control of the sugarbeet root maggot (Tetanops myopaeformis Röder) is a major project of the USDA-ARS Fargo sugarbeet unit. Three basic phases of the project have begun at the laboratory: 1) development of a bioassay, 2) identification of appropriate bacterial gene vectors, and 3) identification and isolation of the gene for use in transformation. Associated with phase 1 is the development of a laboratory rearing method for the root maggot to complete the life cycle under controlled conditions. Phase 2 includes identification and characterization of endophytic and rhizospheric bacteria. Phase 3 involves the insertion of entomocidal genes into a vector such as Agrobacterium for transfer to the plant genome or the transformation of endophytic or rhizospheric bacteria for introduction to the plant and ingestion by the insect larvae. Gene products of interest are being selected for expression of high insecticidal activity with low mammalian and plant toxicities.

SMUCKER, A. J. M., and J. C. Theurer*. Department of Crop and Soil Sciences, Michigan State University, and USDA, Agricultural Research Service, East Lansing, MI 48824-1325. - Dynamics of fibrous root growth for selected sugarbeet germplasms.

Knowledge of the growth dynamics of fibrous root systems of sugarbeet, Beta vulgaris L., could be an important factor for enhancing production. Root activities of selected sugarbeet germplasms were quantified by the minirhizotron and micro-video camera techniques in field experiments in central Michigan. Root activities are expressed as the number of roots at the surface of minirhizotron tubes to a depth of 130 cm. Genotypes tended to show the greatest variability at approximately 55 days growth. Growth rates of the fibrous roots were greatest for the high yielding cultivar Mono-Hy-E4 and lowest for the high taproot to leaf weight ratio (TLWR) line EL-46 and the smooth root line 85700. The greatest accumulation of fibrous roots on Mono-Hy-E4 moves down through the soil profile with the growing season. In the smooth root line, the greatest number of fibrous roots tended to stay in the top 50 cm of soil. Duration (growth vs. death) was similar over years for both Mono-Hy-E4 and the smooth root line.

SNODGRASS, GARY*, and OLSON, OWEN (PETE)*. AMERICAN CRYSTAL SUGAR COMPANY, 101 North 3rd Street, Moorhead, MN 56560. - Boiling and centrifuging of white sugar using a distributed control system.

Traditionally, sugar boiling has been an art with the "sugar boiler", the master of its operation. Automation of this process has evolved over the years through the use of analog controllers, conductivity sensors, boiling point rise sensors, etc. With digital electronic controls coming of age and the use of distributed control systems, the sugar boiling process may now be controlled directly from screens used by operators to monitor multiple pans. Fillmass density and temperature, pan level and vacuum are used to bring the pan under control for repeatable seed points, growth rate, and dropping point producing a more consistent mean aperture crystal size and coefficient of variation of crystals throughout the massecuite. As an example, the average MA went from 15.69 to 13.8 with the control range of the MA going from 7.3 to 2.7 - a reduction of 63%; while the average CV went from 29.18 to 27.1 with the control range going from 22.35 to 3.8 for a reduction of 83%. The white centrifugal machines were previously controlled by relay logic and mechanical timers which caused large amounts of down time to "troubleshoot" when problems occurred. It was decided to place the "battery" of machines on a distributed system to alleviate this problem and give a more uniform station operation. By using speed and flow information plus on line diagnostics, the down time of the battery has greatly been reduced, which in turn, produces a more uniform flow to the granulator/cooler. There has also been an increase in the drying (spin) time of the machines from 40-50 sec/cycle to 70-90 sec/cycle without causing any slow down in production.

SPETTOLI, PAOLO[1]*, G. PASINI[1], G. VACCARI[2], and G. MANTOVANI[2]. [1]University of Padova, 35100, Padova, Italy, and [2]University of Ferrara, 44100 Ferrara, Italy. - Enzyme activities and total amino acid content in rhizomania susceptible, tolerant and partially resistant sugar beet varieties at different nitrogen levels.

Rhizomania is one of Italy's most virulent diseases of sugar beet (*Beta vulgaris* L.), causing proliferation of shorter roots and reduced sucrose content. One rhizomania susceptible cultivar (NZ type), one tolerant (NZ-Z type), and one partially resistant (EN type) grown at different nitrogen levels (0, 80, 160 kg/ha) in a soil affected by rhizomania were compared. The effect of nitrogen fertilization on beet technological quality by means of enzyme activities and total amino acid content was evaluated. Samples of beet roots harvested at three different times were analyzed. Acid and neutral invertase, sucrose synthetase, and aminopeptidase specific activities were determined on the cold extraction juice of the "brei," whereas total amino acid content was carried out on the hot extraction juice. The values of enzyme activities versus sugar beet varieties, harvest time, and nitrogen fertilization, measured by a three-way analysis of variance and Tukey test, showed significant differences ($P < 0.05$). The tolerant cultivar displayed acid and neutral invertase and reducing sugars (% polarization) significantly lower than the susceptible and partially resistant cultivars. Harvest time X N, harvest time X cultivar, and N X cultivar interactions on the enzymatic activities also were found. The partially resistant sugar beet generally revealed higher levels of enzyme and total amino acid content, the latter increasing with nitrogen supply.

Stallknecht, G. F.*, and L. N. Thompson. MSU, Southern Agricultural Research Center, Huntley, MT 59037. - Fall managements for weed control in sugar beets.

Fall management practices for herbicide applications included, fall ridged for spring herbicide application, fall ridged/fall band applied herbicides and fall broadcast applied herbicides followed by ridging. The fall practices were compared to conventional spring tillage management. Results indicate that herbicides applied in the fall can effect weed control equal to or better than spring applied herbicides, dependent upon available spring moisture. Sugar beet emergence and seedling vigor were higher in the fall applied, as compared to the spring herbicide treatments when spring moisture was limiting, while no differences were noted when adequate spring moisture was available. Data, to date indicate that the fall broadcast/fall ridged practice effected better weed control as compared to fall ridged/band applications, particularly when wind erosion caused the ridge depressions to fill with soil. Our overall results indicate that fall herbicide application managments are effective methods for weed control in sugar beets.

STORDAHL, JAMES B., ALLAN W. CATTANACH*, and ALAN G. DEXTER. Dept. of Crop and Weed Sciences, North Dakota State University and University of Minnesota, P. O. Box 5575, Fargo, ND 58105. - Production of sugarbeets in living cover crops.

Seeding sugarbeet in living cover crops will reduce soil erosion and may prevent stand loss due to strong spring winds in Minnesota and North Dakota. Numerous cover cropping options may be used in the fall or spring that fit different sugarbeet production systems. Sugarbeets were planted into winter wheat, winter rye, fall barley, fall flax, and spring barley cover cropping systems in the spring of 1989 and 1990. Winter rye was planted at 15, 30, 45, and 60 lb/A. Sugarbeets were planted into each cover crop with no spring tillage, light tillage, or moderate tillage. Sugarbeet yielded 2.5-5.0 tons/A less in winter rye cover cropping systems. Yields were not significantly different for other cover crop systems. Sugarbeet plant population was significantly reduced with no-till planting. Sugarbeets planted into winter rye plots seeded at 15, 30, 45, and 60 lb/A yielded an average of 5,000, 4,200, 3,800, and 3,650 lb/A of extractable sugar, respectively. Higher winter rye cover crop seeding rates significantly reduced sugarbeet plant population.

STORDAHL, JAMES B., ALAN G. DEXTER*, and ALLAN W. CATTANACH. Department of Crop and Weed Sciences, North Dakota State University, Fargo, ND 58105. - Control of living cover crop in sugarbeet.

Seeding sugarbeet into a living cover crop reduces soil erosion and death of sugarbeet seedlings caused by frequent strong winds in North Dakota and Minnesota. The success of this technique is dependent on methods to completely kill the cover crop to prevent sugarbeet yield loss from competition. Winter rye was seeded in September 1989 and sugarbeet was seeded into the winter rye in May 1990. The winter rye was treated with glyphosate at planting or with sethoxydim, fluazifop-P, or quizalofop at 1,2, or 4 weeks after planting. Sugarbeet from plots treated 4,2,1, and 0 weeks after planting yielded an average of 2500, 5900, 6500, and 7000 lb/A of extractable sucrose, respectively. When the cover crop was treated with glyphosate at planting plus sethoxydim at 1,2, or 4 weeks after planting, sugarbeet yield averaged 7400 lb/A of extractable sucrose. The earliest control of the winter rye resulted in the greatest sugarbeet yield. Winter wheat and winter rye were seeded in strips across the plots in September 1989. Sugarbeet was seeded in May 1990 in the living cover crop. Glyphosate at 0.75 lb/A, clethodim at 0.18 lb/A, and quizalofop at 0.18 lb/A applied at planting controled winter rye better than sethoxydim at 0.4 lb/A or fluazifop-P at 0.4 lb/A. Sugarbeet was seeded into non-tilled and lightly-tilled winter rye. Tilled winter rye was much more tolerant to glyphosate applied at planting than non-tilled winter rye. Applying glyphosate three or more days before tillage eliminated the tillage effect.

SWENSON, ALAN M. The Amalgamated Sugar Company, Mini-Cassia Factory, 50 South 500 West, Paul, ID 83347. - Long-term thick juice storage.

The Mini-Cassia Factory thick juice production exceeds the sugar-end capacity. The excess thick juice is stored for an 11-month period and is processed just prior to the next beet campaign. Several parameters must be maintained to successfully store juice for extended periods of time. Included are thick juice RDS, ph, temperature and purity. Storage conditioners must be maintained to minimize temperature rise and bacterial contamination.

TERRY, NORMAN*, A. R. ARULANANTHAM, and I. M. RAO. Dept. of Plant Biology, University of California, Berkeley, CA 94720. - Photochemical capacity limits photosynthesis of sugar beets under field conditions by decreasing the CO_2-acceptor, ribulose bisphosphate.

Research from this laboratory has shown that the rate of photosynthesis of sugar beets is limited by the capacity of the leaf to do photochemistry. Photochemical capacity limits photosynthesis at high or low levels of ambient CO_2 concentration (e.g., field levels). In this paper, I present data showing that photochemical capacity limits photosynthesis through a reduction in the amount of the CO_2-acceptor, ribulose 1,5-bisphosphate (RuBP), rather than through the activity of the CO_2-fixing enzyme, rubisco. The reduction in photochemical capacity of leaves was obtained experimentally by using iron deficiency, which has been shown to specifically diminish the thylakoid content of chloroplasts. The reduction in RuBP regeneration in iron deficient leaves was not due to a decrease in the formation of the photochemical products, ATP and NADPH. This view is based on measurements of ATP and NADPH, and on triose phosphate/3-phosphoglycerate ratios, which were high in iron deficient leaves. RuBP regeneration may have been limited by the modulation of the enzyme that forms RuBP, ribulose-5-phosphate kinase.

THEURER, J. C.* USDA, Agricultural Research Service, Department of Crop and Soil Sciences, Michigan State University, E. Lansing, MI 48824-1325. Comparison of smooth taproot sugarbeet versus standard taproot cultivars at different plant densities.

Smooth root beets have the advantage of being harvested with less soil adhering to the roots, which is primarily because of the lack of the two grooves with numerous fiberous and branched roots typical of standard root type cultivars. The question arises as to the ability of smooth root types to develop adequate fibrous root systems to maintain optimal plant growth under water stress that could occur with today's desired high plant densities. Field experiments were conducted in central Michigan over three years to compare smooth root types with commercial cultivars in 28 (standard), 22, 20, 18, and 14-inch row spacings. In all experiments, smooth root lines had typically the highest root yield, and the commercial varieties had significantly higher sugar percentage at all row spacings. Smooth root lines showed parallel response to that of the commercial cultivars and no adverse effects under high density planting.

TOTH, LASZLO, and D. L. MCFARLAND*. The Western Sugar Company, 1700 Broadway, Suite 1600, Denver, CO 80290. - A study on low raw magma.
In the Bayard, NE, factory, methods were researched to obtain even grain Low Raw massecuites. Absolute pressure, temperature, and other parameters were varied during Low Raw pan boiling while the cooling curves in the crystallizers were PLC controlled. The Affination station consisted of two groups of Western States continuous centrifugals, two magma minglers, and two massecuite pumps. In the second mingler, magma was prepared from affinated sugar and High Green or Standard liquor and used as footing in High Raw or White vacuum pans. Correlations between the quality and quantity of magma and High Raw or White massecuites were evaluated.

TUNGLAND, L. R.*, and R. H. HELMERICK. Hilleshög Mono-Hy Inc., 11939 Sugarmill Road, Longmont, CO 80501. - Environmental selection during pollinator seed increase in sugar beet.
Yield losses have been observed in sugar beet varieties when seed production shifts from experimental to commercial status. The objective of this study was to investigate potential yield loss in sugar beet hybrids resulting from environmental selection over several sequential pollinator seed increases. Three generations of three heterogeneous pollinators were used to evaluate drift during seed production. Hybrid seeds representing nine population/generation combinations were sown in a randomized complete block design with two replicates at three locations. Traits measured were white sugar yield (WSY), white sugar content (WSC), root yield (RY), sugar content (SC), and juice purity (JP). A significant positive change was observed for JP in population 1. Although nonsignificant, important negative changes were observed in all three populations for RY and WSY. These results indicate that environmental selection during a pollinator seed increase is one explanation for yield reductions in commercial sugar beet hybrids.

WAA, EVAN A. American Crystal Sugar Company, Research Center, P.O. Box 1227, Moorhead, MN 56561-1227. - Design and construction of a small scale brei sampler.
American Crystal Sugar's Idaho Research Facility was in need of a small-scale beet brei sampling system to support the sugarbeet variety development effort. This system washes a sample of fresh beets, dewaters it, prepares brei, and provides a means to quick freeze these tissue samples for later analysis at the Moorhead Quality Lab. Among the design criteria considered for this project were limited floor space, reduction of moving parts compared to a conventional system, low capital cost, use of stock components where possible, disposal of beet slabs, and packaging and identification of samples.

WANG, GUIZHI, HANQING LI*, and DEDONG GUO. Institute of Biology, Heilongjiang University, Harbin 150080, People's Republic of China. - The acquirement of four sugar beet monosomic additions and observations of their meiotic behavior.
Four monosomic additions with *B. patula* chromosomes were segregated from progenies obtained by interspecific crosses of three related species: (*B. patula* X *B. cicla*)F_1 X *B. vulgaris*. Observations were made on plant morphology, meiotic behavior, and alien chromosome characteristics of the monosomic additions. Plant PT5-1 displayed the red leaf-vein characteristic of *B. patula*. Cytological studies showed its alien chromosome to be the No. 9 chromosome of *B. patula*. The frequencies of meiotic diakinesis 9II+1I ranged from 90.30-97.69%, which were significantly different from the sugar beet primary trisomic. A few trivalents occurred. The frequency of 9II+1I at MI was somewhat higher. Frequencies of the 1+9+9 configuration at MII were 33.62-63.6%. The transmission rate of monosomic additions was rather low.

WANG, JIZHI, HANQING LI*, DEDONG GUO, and SHUBIAO JIA. Institute of Biology, Heilongjiang University, Harbin 150080, People's Republic of China. - Development of new male sterile cytoplasms of sugar beet.
Some new ms cytoplasms were obtained by the following interspecific hybridizations: *Beta patula* Ait. X *B. cicla* L. Turkey; *B. cicla* Turkey X *B. patula*; and *B. cicla* China X *B. patula*. The ms plants were segregated from hybrid progenies. Three new ms cytoplasms, named P, CT, and CC, were developed by continuous backcrossing for 7-8 generations with *B. vulgaris* Shuangfeng. Male sterility displayed maternal inheritance. Most hybrid progenies for crosses of ms plants with *B. vulgaris* were male sterile. Restoring genes exist in *B. patula* or *B. cicla*. These ms cytoplasms were different in pollen degeneration. P-type ms cytoplasm possessing good economic characteristics has been used in production. It is suggested that it could become a substitute or supplement for s-type ms cytoplasm.

WEISS, L. WARNER. Equipment Sales Company, 10129 E. Powers Ave., Englewood, CO 80111. - Investment decision using the SUGARS computer program.
The SUGARS computer program can be used to make computer simulations of process improvements for a sugar factory to determine the potential investment paybacks. SUGARS is a versatile and comprehensive computer program for sugar factory analysis that can be used to evaluate different processes by doing the heat and material balance. Several sugar end process improvements are shown with comparisons to a base process for assessment of the financial advantage of each improvement.

Wilson, Herbert C.* Holly Sugar Corporation, P. O. Box 581, Brawley, CA 92227 Separation of magnetic particles from bulk sugar flows - A review.
In the past, concerns and analyses in regard to metallic contamination of sugar have been directed toward particles which were generally visible to the naked eye. Increasingly, customers are concerned about the presence of very fine magnetic particles in the sugar they purchase. The paper reviews the development of industrial permanent magnets and magnetic separating equipment. A method of quantifying ferrous particles in sugar is offered. The installation of rare earth type magnetic grate separators is recommended as the most practical solution.

WILSON, ROBERT G.*, and G. L. HEIN. Univ. of Nebraska, Scottsbluff, NE 69361. - Effect of planting time herbicide and insecticide combinations on sugarbeet emergence, vigor, and yield.
Herbicides and insecticides applied at planting were combined and compared for their effect on sugarbeets. The results from two locations indicate that preplant applied cycloate (Ro-Neet) and ethofumesate (Nortron) can interact with aldicarb (Temik), carbofuran (Furadan), chlorpyrifos (Lorsban), fonofos (Dyfonate), and terbufos (Counter) applied at planting to reduce sugarbeet stand, vigor, and yield. The degree of injury depended upon the pesticide, rate of application, and location.

WILSON, ROBERT G.*, J. A. SMITH, and C. D. YONTS. Univ. of Nebraska, Scottsbluff, NE 69361. - Effect of seeding depth, herbicide, and variety on sugarbeet emergence, vigor, and yield.
Preplant applied herbicides were compared for their effect on three varieties of sugarbeets when seeds were planted at six depths during 1987 and 1989. More sugarbeet seedlings emerged and at a faster rate as the depth of seeding decreased from 4.5 to 1.6 cm. Herbicide injury to sugarbeet seedlings increased as depth of seeding increased from less than to greater than 2.5 cm. Under weed-free conditions herbicide treatments reduced sugarbeet stand and decreased early season sugarbeet height but had little effect on root yield or sucrose content.

WINDELS, CAROL E.* and ROGER K. JONES+. Northwest Experiment Station, University of Minnesota, Crookston 56716* and University of Minnesota, St. Paul 55108+. - A new sugar beet disorder in the Red River Valley.
This report describes the symptoms of a disorder of unknown etiology affecting sugar beet in the Red River Valley of Minnesota and North Dakota. Symptoms of the disorder begin to appear in fields in early August about 100 days after planting. Affected plants occur in areas that are oval, semi-circular or irregular in shape and vary in size from 3 to 75 m in diameter. These patches are located near edges of fields and reoccur when beets are planted. Every plant in the affected area shows symptoms and there is a sharp line of demarkation between affected and healthy plants. Aboveground symptoms include yellowed leaves that are brittle, twisted and prostrate on the soil surface; cracking of leaf petioles; and a proliferation of leaf buds at the crown. At the end of the growing season, roots of affected plants have short, swollen secondary roots that resemble galls. Beet seed was planted in soil samples from disorder and healthy areas of a field and placed in a growth chamber (30 C day/ 24 C night, 12 hr/12 hr photoperiod). Fourteen days after emergence, symptoms (chlorosis and cupping) appeared on the first set of true leaves but not on cotyledonary leaves of sugar beet seedlings in the disorder soil. There were no symptoms on seedlings growing in soil from unaffected areas of the field. Estimates of sugar beet yield and quality were made in affected and healthy areas of three fields in 1989 and in four fields in 1990. Yields (T/ha) were reduced by 1.6 to 65% in disorder areas compared to healthy areas of fields, percent sucrose was reduced by 21 to 56%, and recoverable sugar was reduced by 42 to 81%.

WINDELS, CAROL E.*, and DONNA J. NABBEN-SCHINDLER. Northwest Experiment Station, University of Minnesota, Crookston, MN 56716. - Indexing sugar beet fields for root rot potential of Aphanomyces cochlioides.

The purpose of this investigation was to determine if indexing soils for root rot potential in the greenhouse could predict Aphanomyces root rot in the field. In October-November of 1985-89, 100 field sites (that were to be planted to sugar beet the following season) were sampled and indexed for root rot caused by A. cochlioides. Each soil was screened, mixed, planted with fungicide-treated sugar beet seed (25 seeds/each of 4-5 pots), incubated at 17 ± 2 C until emergence, and then the temperature was increased to 25 C to favor damping-off. As seedlings died they were assayed for A. cochlioides and 3 wk after emergence, remaining seedlings were rated for root rot using a 0-3 visual scale. Based on these values, a disease index was calculated on a 0-100 scale (0 = all plants healthy and 100 = all plants dead). Of the 100 sites indexed, Aphanomyces was detected in 64 sites and the root rot index values for these soils ranged from 6 to 100. The following field season, 56 sites were planted to sugar beet (Aphanomyces had been detected in 42 of these fields); root rot index, yield and quality also were determined. Root rot index values and final seedling stands in the greenhouse assay correlated with yield in 1 of 5 yr ($P = 0.05$). Generally, weather conditions during the other 4 yr did not favor severe Aphanomyces root rot. Although the seedling assay detects A. cochlioides in soil, application of the root rot index to the field is confounded by environmental conditions unfavorable for disease development on sugar beet.

WINTER, S. R.* Texas Agricultural Experiment Station, P. O. Drawer 10, Bushland, TX 79012. - Nitrogen management in cropping systems of sugarbeets and grain crops.

Grain crops in rotation with sugarbeets need adequate nitrogen (N) to produce profitable yields. However, excess N applied to grain crops may accumulate in some soils and reduce sugarbeet quality. The objective of this research was to determine optimum N rates in a sugarbeet rotation considering yield and quality of all crops grown. Nitrogen rates used (0, 80, and 160 lb/A annually) on wheat grown prior to the 1989 sugarbeet crop were not high enough to provide significant accumulation of residual soil N. The combination of low residual N and about 240 lb/A of applied N resulted in sugarbeets with 16.0 to 18.1% sucrose and a yield of 30 to 38 tons/acre in 1989. Many producers in Texas apply excess N to crops grown prior to sugarbeets as evidenced by the fact that they frequently have excess residual N and seldom have 16.0% or higher sucrose. Soil sampling before applying N to any rotation crop should be standard practice to assure low residual N prior to sugarbeets. Results in 1989 indicate that high quality sugarbeets can be grown without shortchanging N on preceding crops; however, further results are needed for conclusive proof. A broader range of residual N levels was present prior to the 1990 sugarbeet crop so more conclusive results are expected.

WOZNIAK, CHRIS A.* and LOWELL D. OWENS. USDA, Agricultural Research Service, P.O. Box 5677 - University Station, Fargo, ND 58105 and Building 006, BARC-West, Beltsville, MD 20705 - Modification of basic tissue culture methods increases regenerative potential of sugarbeet leaf discs.

A comparison of media gelling agents and preparation methods was performed in an effort to enhance the yield of reproductive structures from in vitro leaf disc cultures. Regenerative structures represent plant formation through both organogenesis and somatic embryogenesis from callus produced at the disc periphery. Bacto-agar (0.9%), HGT Agarose (0.7%), ME Agarose (0.7%), Phytagar (0.3%) and Gelrite (0.3%) were used to solidify RV basal medium (Freytag et al.) medium supplemented with 1 mg/L BA. Leaf discs of 7 mm diameter were punched from shoot cultures of clone 'REL-1' and cultured 5/plate. Gelrite and the two agaroses were superior in yield of regenerative structures (300 to 500% increase) and callus dry weight (37 to 155% increase) when compared to Phytagar and Bacto-agar at the given concentrations. Preliminary experiments comparing filter sterilized vs. autoclaved media indicate increases in organogenic callus formation of >70% for filtered medium when culturing leaf discs.

XU, DECHANG. Sugar Beet and Sugar Industry Research Institute, 111 Xue Fu Rd., Harbin, People's Republic of China. - Nutrient balance and sugarbeet yield.

The Diagnosis and Recommendation Integrated System (DRIS) has been demonstrated to be an effective tool for detecting plant nutrient deficiencies. In sugarbeet, the possibility was examined for using DRIS to predict nutrient deficiencies at any growth stage at which sugarbeet leaves are analyzed. For this purpose, a data bank comprising over 500 observations was used to explain the results of two field experiments and was compared with the concentration of nutrients in leaves and soils. Results indicated that DRIS could predict sugarbeet nutrient imbalances and the principal limiting nutrient at an early growth stage, which would allow sufficient time for correcting the deficiency in the field. A BASIC program was developed on a SHARP PC-1501.

YU, M. H.* USDA, Agricultural Research Service, 1636 East Alisal St., Salinas, CA 93905. - Observations on the occurrence and inheritance of some induced variations in sugarbeet.

Explants of certain sugarbeet (*Beta vulgaris* L.) genotypes were induced to generate new plants through an in vitro process. When leaf sections from plants with monosomic additions that were descendents of sugarbeet and *B. procumbens* Chr. Sm. interspecific hybrids were cultured, the majority of regenerants expressed similar phenotypes and growth profiles to the donors. Nonetheless, over 20% of regenerated plants had leaf intumescence, chromosomal, or both, variations. In diploid sugarbeet, on the other hand, variations in derivatives from leaf cubes and unpollinated ovules were primarily chromosomal. In either case, the majority of karyotypic variation was chromosome doubling. Transverse sections of the intumescent leaves exhibited multi-layered epidermis with proliferated cells that formed wart-like protrusions and occasional trichomes, especially beneath the vascular bundles of minor veins. The malformed leaf traits were transmitted to progeny when intumescent diploid and tetraploid monosomic additions were crossed to normal sugarbeet pollinators. From these crosses, additional aneuploid classes of progeny with chromosomes ranging from 9 to 39 occurred. Leaf intumescence was inherited as dominant character and was associated with the addition chromosome.

YONTS, C. DEAN*, J. A. SMITH, KAREN L. PALM, and ROBERT G. WILSON. University of Nebraska, Panhandle Research and Extension Center, 4502 Ave. I, Scottsbluff, NE 69361. - Sugarbeet yield comparison of 14, 22, 30, and 38-inch row width and optimization of the in-row spacing for each row width.

Producers in the Nebraska Panhandle traditionally have grown sugarbeets in 22-inch rows and corn and dry beans in 30-inch rows. The use of two row widths necessitates two sets of implements and tractors, which increases production cost and decreases equipment flexibility. Many producers have switched to growing sugarbeets in 30-inch rows. Is there a reduction in potential yield compared with 22-inch rows, and what is the optimum plant population? Do other combinations of row spacing and plant population have more potential for these growers? A 3-year study addressed these questions by comparing four row widths, 14, 22, 30, and 38 inches, and five target plant populations, 10,000, 16,000, 26,000, 41,000, and 60,000 plants per acre within each row width. Yield response curves were developed for all row widths and final plant populations at harvest time. Maximum sugar yield was attained with a 22-inch row width and a harvest plant population of 30,500 plants per acre. These results may not reflect optimum economic production levels because of other factors, such as equipment and labor, which influence production costs and the final net profit.

ZAMORA, DAVID L., R. W. WHITMORE*, and S. P. BRIGGS. American Cyanamid Company, One Cyanamid Plaza, Wayne, NJ 07470. - Methods of applying COUNTER® at planting.

COUNTER is applied at planting to control early infestations of sugar beet root maggot. The modified-in-furrow method of applying the insecticide at planting is effective and safe to the crop and environment. This technique involves applying the chemical in the furrow behind the seed drop zone, after soil covers the seed. It is important to prevent direct contact of the chemical with the seed. Contact can be prevented by installing a drag chain between the seed drop zone and the insecticide drop zone so that soil is moved over the seed before the insecticide is placed in the furrow. By placing the insecticide-drop tube immediately in front of the press wheel, most planters will have sufficient space for a drag chain. If sufficient space is not available to install a drag chain between the seed drop zone and the insecticide drop zone, or if the soil is wet and will not cover the seed even with a drag chain, then the insecticide can be placed in a narrow band behind the press wheel and lightly incorporated with a drag chain or mechanical fingers.