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# BioOptions

Newsletter of the Center for Alternative Plant and Animal Products

Volume 1, Number 2 Fall 1989

## Last Free Issue of "BioOptions"

This is the second and last issue of "BioOptions" that will be distributed free to those on our mailing lists. If you wish to keep receiving the newsletter, and have not yet sent in your subscription, use the form on page 7.

## Fugitives Wanted

Last year, the Center began collecting fact sheets, bulletins, manuals, etc. pertaining to the production and/or marketing of alternative horticultural and agronomic crops and livestock. Thus far, over 1000 publications have been received and entered into a bibliographic database. The collection is being supported by the USDA-ES, and is in cooperation with the National Agricultural Library, which will receive copies of the materials. The compiled database will also be made available on floppy disks to contributors and other interested persons.

The Center is continuing its efforts to seek out "fugitive" literature, such as conference proceedings, research reports, out-of-print or newly printed materials, etc., that have previously been available only to a limited audience. If you have materials you would like to contribute or know of items that you would recommend for inclusion, please contact Rhoda Burrows, Center for Alternative Plant and Animal Products, 340 Alderman Hall, University of Minnesota, St. Paul, MN 55108; Phone (612)-625-5747.

## Anatomy of a Specialty Crop - The Adzuki Bean Experience

Bill Breene, Professor, Dept. of Food Science and Nutrition  
Lee Hardman, Professor, Dept. of Agronomy and Plant Genetics

The adzuki bean (*Vigna angularis*) has been grown and used for many centuries in the Orient. It was introduced to Japan from China about 1000 years ago. Its principal use throughout the Far East is as a confectionery item. It is cooked and combined with varying proportions of sugar and other ingredients, and consumed as such or in combination with other foods. The single largest use of these so-called "ann" products is as filling for bread (ann-pan), steamed breads or dumplings and sweet cakes. At least 50 other beans and legumes are also used to make these pastes, but the adzuki bean is the most prized.

Although Dr. Bob Robinson of the University of Minnesota, Department of Agronomy had been working with adzuki beans since 1962, our story really begins in 1977. A bean growers association was encouraged to produce adzuki beans by a Japanese trading company, Tokyo Maruichi Shoji (TMS). They suggested that an attempt be made to process the beans in Minnesota because raw adzuki beans were an import quota item, whereas processed beans were not.

In February 1978, Dr. Bill Breene of the University of Minnesota, Food Science and Nutrition Department was contacted about the possibility of making "ann" products in the United States by Jim Sutherland, a Marketing Specialist for the Minnesota Extension Service. Breene replied that it would be essential to have a native Japanese

food scientist working on any such pilot project because it is impossible to judge the quality of a totally unfamiliar product and most of the scientific literature was in Japanese. Dr. Isao Hayakawa had written him in June 1977 expressing a desire to spend a sabbatical year at Minnesota.

A three-year demonstration project proposal was submitted to the Governor's Rural Development Council (GRDC) in May 1978. First year funding was approved in July 1978 and Dr. Hayakawa arrived in September. A loose consortium of the Minnesota Department of Agriculture, the University of Minnesota, the edible bean growers organization, the GRDC and others began to form.

Dr. Breene visited Japan in September, 1978. Mr. Yasufuku, a food industry consultant in Japan, arranged meetings with researchers and adzuki bean processors.

About this time, articles on the romance between Minnesota and the adzuki bean appeared in *The Farmer* and *The Wall Street Journal*. They caught the attention of growers, prospective growers, the food industry, venture capitalists, opportunists, entrepreneurs, fast-buck artists, and even some snake oil dealers.

In February 1979, Mr. Yasufuku, and Mr. Hashimoto and Mr. Kuwahara, (See *Adzuki* page 2)



*Adzuki from page 1* both ann manufacturers, visited Minnesota. It became obvious that an agronomist was needed for discussions with the Japanese. Dr. Hardman of the Department of Agronomy and Plant Genetics joined the project.

The key to launching a new or alternative crop is to identify markets, preferably by contract, and then to identify individuals in the production/processing/marketing chain who are trustworthy, solvent and willing to grow gradually with the markets. The participants must be in the private sector. The difficulty is in finding participants who are neither too big or too small. General Mills and Mitsubishi could afford to team up and handle an adzuki bean/ann venture, but they are too big to consider such small initial markets. On the other end, companies (or individuals) having a sense of adventure and willing to take risks in hope of hitting the jackpot, are usually too small. They are understaffed and undercapitalized. Companies close to being the right size probably got there the hard way and are too smart to take another dip in the quicksand. This creates a vacuum into which a very interesting mixed bag of politicians, opportunists, adventurers, pirates, brigands and blackguards is plummeted.

As the GRDC project developed, various individuals and groups in the U.S. and Japan inquired and many jumped in. Mr. Yasufuku wisely cautioned against forming joint processing ventures with Japanese trading companies because they are accustomed to dealing with raw products and could probably not properly judge the quality of ann.

Two major obstacles became apparent. The first was the import quota on raw adzuki beans, even though imports were required to meet demand. The way around this was to ship ann to Japan. This brought up the second obstacle:

transportation costs. Even at the cheapest possible cost, Taiwan, the Philippines, and China were much more favorably situated than Minnesota. Another way to attack the freight cost problem would be to produce a good quality dried ann which could be rehydrated in Japan. Attempts were made to spray dry ann in the Coulter and Niro pilot model spray dryers in the Food Science Department. Because of the high sugar content, the dried product was sticky and hard to collect. Further, the Coulter dryer with its pressure atomizer, severely damaged the starch granules. The Niro centrifugal atomizer separated the adzuki bean starch from the sugar/water phase in the drying system.

Several hundred pounds of ann produced in the U. of M. pilot plant by Dr. Hayakawa in 1979 were taken to Fond du Lac, Wisconsin and dried by DEC, International in their Filtermat Spray dryer which was equipped with a two fluid atomizer. This was an excellent product. Samples were sent to Japan and Mr. Hashimoto got so excited that he immediately flew to Minnesota along with Mr. Yasufuku. The Filtermat equipment worked ideally, but represented a hefty capital investment and was not easily accessible on a custom basis. Some acceptable products were produced in the Niro pilot plant at Hudson, Wisconsin using conventional dryers.

In 1981, three food technologists purchased a defunct dairy plant near Rochester and formed a company called Innovative Food Processors, Inc. (IFP). Equipment in the plant included a functional Bufflovak spray dryer. After about a year of discussions, an agreement was signed by the IFP partners and Mr. Hashimoto. Mr. Hashimoto would furnish specialized equipment and instruction about how to make ann. IFP would purchase beans, produce dried ann, and ship it to Japan. This was the closest shot at the establishment of an adzuki bean processing operation in Minnesota.

A major unforeseen problem was that the old Bufflovak dryer did not have sufficient capacity. Production got underway during July; high humidity of the drying air along with low dryer capacity caused the manufactured ann to ferment before it could be dried.

(See *Adzuki*, page 3)

## BioOptions

is the quarterly newsletter of the Center for Alternative Plant and Animal Products. The Center was created to aid in the development of new and alternative crop and livestock enterprises.

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### *Adzuki from page 2*

The relationship between IFP and Hashimoto ended in a lawsuit and counter-suit which was eventually settled amicably. However, it should not have been entered into in the first place. This is an example of a company that was too small.

Dr. Hardman worked to obtain herbicide labeling and clearance for adzuki beans. He made recommendations as to the proper soil type for growing the crop. They do not grow well on heavy, poorly drained, high pH soils. Despite the fact that adzuki bean production advice was available from Dr. Hardman, some farmers with no experience in growing dry, edible beans, let alone adzuki beans, got into the act. Some adzuki beans were planted on the wrong type of soil in Southeastern Minnesota resulting in a total crop failure. Guess who got blamed? The local news media were informed that the University of Minnesota was encouraging the production of a crop that was not suitable to be grown in Minnesota.

In 1981, a farmer/director of a sugar beet cooperative contracted with Toyomenka, a trading company, to grow adzuki beans. The grower received \$50 per acre up front. A major problem was that the beans were planted on the wrong type of soil.

Dr. Hardman learned about the problem and told Dr. Brene who immediately informed Mr. Yasufuku that this crop was likely to fail and that the word would spread in Japan that adzuki beans cannot be grown in Minnesota. By this time, Toyomenka had already sent someone to Minnesota to inspect the crop. He reported "all of the trees are dead," and, "Minnesota is unsuitable for adzuki bean production".

Timely discussions turned a potential catastrophe into an advantage; Toyomenka contracted,

U.S. style, with experienced growers for 200 acres of adzuki beans in 1982. The U.S. style contract called for payment at a specified price based on grade upon delivery of the product.

It first appeared that adzuki beans had few if any disease problems. However, several years into their expanded production a disease began to show up, caused by a bacterium *Pseudomonas adzukiola*. Since growers planted seed from their own crop, seed-borne disease became more of a problem. For acreage to continue to grow, even if there were assured markets, the seed industry would have to initiate a disease-free seed program which requires both time and money. We are faced with a circular problem: there isn't enough adzuki bean volume for the seed industry to get involved and the crop cannot be grown in large volume if the seed is not available.

Much more could be related in order to illustrate problems on the production side when a new crop is struggling to establish itself. But technology appears to be the least important facet in the development of a specialty crop. The market is the engine that drives any new crop. The bottom line in specialty crop endeavors is that the private sector has to make it go. There is very little control over private entrepreneurs and their individual or collective activities. Practically all of the failures, and we have mentioned only some of them, were caused by hasty starts and short cuts on the path to fame, glory, and riches.

Despite all of these frustrations, the adzuki bean still has potential as a specialty or alternative crop for Minnesota and elsewhere. Fortunately, perhaps because of an alert team of fire fighters, the adzuki bean did not suffer the sort of ignominious death which struck down the Jerusalem artichoke.

## **Amaranth Research in Minnesota**

Amaranth is an ancient pseudo-cereal that originated in the Americas. It was grown extensively during the height of the Aztec civilization in Mexico in the fifteenth century. It can be used as a high-protein grain or as a leafy vegetable, and has potential as a forage crop.

The most common use for grain amaranth is to grind the grain into a flour for use in breads, noodles, pancakes, cereals, cookies, etc. The grain can be popped like popcorn or flaked like oatmeal. More than 40 products containing amaranth are currently on the market in the United States.

Amaranth has several nutritional qualities which contribute to its use by the health food market. The grain has 12-17% protein, and is high in lysine, an essential amino acid in which cereal crops are low. The grain is high in fiber and low in saturated fats. Recent studies have linked amaranth to a reduction in cholesterol levels in laboratory animals. Amaranth contains tocotrienals which have cholesterol-lowering activity in humans.

The two species of grain amaranth commonly grown in the U.S. are *Amaranthus cruentus* and *Amaranthus hypochondriacus*. They are related to redroot pigweed, but are different species and have not become weeds in fields where they have been grown. The grain amaranths have large colorful seed heads and can yield over 1000 pounds of grain per acre in the upper Midwest. The plants are about five to seven feet tall when mature. The tiny, lens-shaped seeds are one millimeter in diameter and are usually white to cream colored.

(See *Amaranth* page 4)



### *Amaranth from page 3*

Research on amaranth by U.S. agronomists began in the 1970's, so optimum production guidelines and uniform, adapted varieties have not yet been fully developed.

Amaranth can be grown throughout the Midwestern and Western U.S. It is reportedly drought-tolerant, similar to sorghum, provided there is sufficient moisture to establish the crop. Amaranth responds well to high sunlight and warm temperatures. It is usually sown in late May or early June when the soil temperature is at least 65°F. It does not mature completely in the upper Midwest's short growing season, so a frost is necessary to kill the crop so it will be dry enough to harvest.

No herbicides are labeled for use with amaranth so weeds must be controlled by cultivation. Researchers and growers have not seen major disease problems. Damping off of young seedlings and stem canker may occur. Further problems may develop as the acreage of amaranth increases. Tarnished plant bug, flea beetle, and amaranth weevil are potentially significant insect pests of amaranth.

Markets for amaranth are small and fragile. The primary market is the food industry. Growers should identify a market, or have a contract before planting amaranth.

In 1988 the Minnesota Legislature allocated money to the Minnesota Department of Agriculture to fund a research project to evaluate the marketing, processing and production feasibility of grain amaranth for Minnesota. The Grain Amaranth Feasibility Project is being conducted by the University of Minnesota and the Institute for the Development of Amaranth Products, Inc. (IDAP), a non-profit organization located in Bricelyn, Minnesota.

Dr. Jim Lehmann of IDAP, a recent graduate of the plant breeding program at Iowa State

University, is coordinator for the project. It has been his job to pull together the many facets of the development of this crop, and to identify key missing links from production agronomy to the functionality and nutritional value of the grain, to marketing of specialty products.

Dr. Daniel Putnam, of the Department of Agronomy and Plant Genetics is conducting the agronomic portions of the study. In 1988 and 1989, various amaranth lines were tested at six locations in Minnesota and amaranth has been found to produce respectable yields, ranging from 300 to 2000 lbs/acre. Some of the semi-dwarf lines show particular promise. The fertilizer requirements and optimum plant density of amaranth is also being examined. Amaranth is particularly responsive to nitrogen, with yields doubling in some trials due to fertilizer applications. Amaranth performed quite well in the drought conditions of 1988. In 1989, stand establishment was a problem in two locations due to dry conditions at planting time.

The forage potential of amaranth has been examined as a component of this study. Jim Stordahl, a graduate student in the Department of Animal Science, has been examining time of harvest and variety effects on forage yield and quality. He has found that amaranth may be quite acceptable as a late planted forage, and, if cut early, has a crude protein level similar to that of alfalfa. It also has the capacity for regrowth, and could fulfill a role similar to that of other late planted summer annual forages.

Dr. Breene of the University's Department of Food Science and Nutrition studied amaranth product feasibility. A production scale twin-screw extruder cooker (Buhler Miag Co.) was used to process approximately 100-lb. batches of whole amaranth grain or amaranth flour alone or in combination with other ingredients.

The whole grain particles underwent popping in the extruder and were then agglomerated to form larger ones, making them easier to handle. This process will be studied further to determine whether it affects the nutritional value and functional properties of the amaranth.

It was possible to manipulate operating conditions to produce puffed or expanded texturized products from 100% amaranth flour. However, it was easier to produce such products when other cereal ingredients were included at about 20% of the infeed material. Amaranth flour will probably be used in such products to boost nutritional value, but these trials have shown that it is possible to make whole amaranth products. The added ingredients included up to 12% modified corn starch and up to 8% soft wheat flour. Sugar and/or salt were added for flavor. Two basic product types were produced: a "salty" snack or crouton and a "sweet" cereal.

Work is underway to determine whether and in what way extrusion processing has altered the viscosity and pasting characteristics and such chemical properties as tocotrienol, trypsin inhibitor and dietary fiber contents.

*Portions of this article were excerpted from "Amaranth" by D.H. Putnam, E.S. Oplinger, J.D. Doll, and E.M. Schulte in the Alternative Field Crops Manual published by the Univ. of Wisconsin - Extension, and the Univ. of Minnesota, Center for Alternative Plant and Animal Products, and Minnesota Extension Service. Daniel Putnam and William Breene also contributed to this article. Further information on amaranth is available in the "Amaranth Grain Production Guide" listed in the Publications section.*



## News Briefs

**U.S. Corporations finally strike oil - canola, that is** was the title of a recent article in the Star Tribune (Minneapolis, November 12, 1989). Dick Youngblood listed several major corporations such as Cargill, ADM, and Piper, Jaffray & Hopwood, that "are starting to bet serious resources that canola will one day be an important crop". Roy Johnson of Cargill projected that American farmers will be growing 1 to 3 million acres of canola within five years.

**Evaluation of Vegetable Amaranth** HortScience (October, 1989) reported research at Alcorn State Univ. in Mississippi that compared field adaptation and consumer acceptance of four varieties of amaranth. In 1987, fresh weight yields ranged from 2230 to 11,690 lbs/acre. Mineral contents of the amaranths were similar to collards and kale, and the texture was similar to spinach.

**Nigerian Dwarf Goats** have great potential, according to an article in a recent issue of "Missouri Farm" (September/October, 1989). They were originally imported from West Africa to American zoos. There are only a few hundred in the U.S. and Canada and since their popularity is growing, the price of breeding stock is high, \$200 - \$500 per animal. They are easy to care for and produce 1 to 2 quarts of milk per day.

## Publications

**Wheat is Unique: Structure, Composition, Processing, End-use Properties, and Products** edited by Yeshajahu Pomeranz, Washington State University. This new book is the Proceedings of the Wheat Industry Utilization Conference held in San Diego, California in October, 1988. It includes state-of-the-art information on processing and utilization and also projects the most promising future developments in the wheat industry. It includes 43 edited papers, over 700 pages of research. The cost is \$68, including domestic postage. For ordering information, contact AACC Books, 3340 Pilot Knob Road, St. Paul, MN 55121.

**The Directory for Small-Scale Agriculture**, developed by the USDA Office for Small-Scale Agriculture, enables users to quickly access nearly 500 key state and federal government employees who can address questions about small-scale, diversified agriculture. To obtain your copy of the directory (Stock Number 001-000-04539-3), send a check for \$5.50 to "Superintendent of Documents", U.S. Government Printing Office, North Capitol Street NW, Washington, DC 20402.

**The 1989 Amaranth Grain Production Guide** is now available from the Amaranth Institute, P.O. Box 216, Bricelyn, MN 56014. It is co-authored by the Rodale Research Center and the Amaranth Institute. It is the most complete publication on amaranth production available to date. The guide is included with your annual membership fee of \$30.00. Membership in the Amaranth Institute also includes a subscription to their bi-monthly newsletter, "Legacy". Individual copies of the guide are available for \$5.00.

**Alternative Agriculture** is the name of a recent publication of the National Research Council. The report states that "Alternative farming methods are a practical and economical way to maintain yields, conserve soil, maintain water quality, and lower operating costs through improved farm management and reduced use of fertilizers and pesticides". The authors maintain that these methods have not been widely adopted due to a lack of research on alternative agricultural systems, and the fact that the federal farm programs discourage their implementation. Eleven case studies of farms using alternative production

systems are included. The cost is \$19.95 paperback and \$29.95 hardbound. For information on how to order, contact National Academy Press, 2101 Constitution Ave., NW, Washington, DC 20418.

**Journal of Applied Rabbit Research** is published quarterly by the Rabbit Research Center at Oregon State University. The journal has been in existence since 1978. Its purpose is to convey current research information to those with an interest in commercial rabbit production. The Journal includes not only research conducted at the OSU Rabbit Research Center, but also research reports from other rabbit programs throughout the world. Reviews of experimental studies reported elsewhere are also published. The Journal is distributed to supporters of the Rabbit Research Center. Active membership fees are \$15 in the United States, and \$20 (U.S.) for all other countries. Make checks payable to OSU Rabbit Research Center and send to OSU Rabbit Research Center, Oregon State University, Corvallis, OR 97331.

(See *Publications* page 6)



### *Publications from page 5*

**Rabbit Production** is a useful reference for all those interested in raising rabbits, from the novice rabbit raiser to those with many years of experience. This book is well illustrated and includes 32 color pictures of major breeds of rabbits. It contains the latest scientific information on all aspects of rabbit production. The authors are P.R. Cheeke and N.M. Patton from Oregon State University, S.D. Lukefahr from Alabama A&M University, and J.I. McNitt from Southern University at Baton Rouge, Louisiana. The cost is \$19.95; in the U.S., you may order from the OSU Rabbit Research Center. Outside the U.S., order directly from Interstate Printers and Publishers, P.O. Box 50, Danville, IL 61834.

**The Herb, Spice, and Medicinal Plant Digest** is a newsletter published by the Department of Plant and Soil Sciences at the University of Massachusetts - Amherst. It includes contributed articles, summaries of research reported in other publications, lists of publications related to herbs, spices and medicinal plants, and information on upcoming events. A one year subscription costs \$8.00. Checks should be made out to Dr. Lyle Craker and sent to him at the Dept. of Plant and Soil Sciences, Univ. of Massachusetts, Amherst, MA, 01003.

**Missouri Farm** is a magazine dedicated to preserving and promoting small farming, rural living, community and agripreneurship. It includes feature articles on alternative agricultural enterprises such as bees, pawpaws (North America's largest edible native fruit), and chinchillas, to name only a few covered in the most recent issue. It is published six times per year and the subscription rate is \$18 per year. For more information, write to Missouri Farm Magazine, Rt. 1, Box 237, Clark, MO 65243.

**Lost Crops of the Incas** is the name of a recent research report published by the National Research Council. At the time of the Spanish conquest in the early 1500's, the Incas cultivated almost as many species of plants as the farmers of Asia and Europe. The Spanish conquistadors considered the native foods inferior and forced the Indians of the Andes to grow European crops such as wheat, barley, and carrots. Of the Inca foods, only the potato is widely known today; the rest have remained hidden in the Andes for almost five centuries. This new report describes over 30 of the most promising "lost" crops. Many of these food crops have the potential to become important contributors to the world's food supply. Some of these overlooked foods offer special advantages for developing nations, such as high nutritional quality and excellent yields. For example, quinoa is a grain with up to twice the protein in the standard cereal grains, and a better amino acid balance. Cherimoya has a creamy, custard-like white flesh that tastes like a blend of papaya, pineapple, and banana. Arracacha is a root that combines the flavors of cabbage, celery, and roasted chestnuts. Copies of the report are available for \$20.00 from the National Academy Press, 2101 Constitution Avenue, N.W., Washington, D.C. 20418.

**Strategies for Alternative Crop Development: Case Histories** is the title of the proceedings of a symposium that was held in conjunction with the Crop Science Society of America's annual meeting last November and organized by the Center for Alternative Plant and Animal Products. The publication includes case histories for five crops that are in various stages of commercial development: amaranth, canola, lupine, meadowfoam, and kenaf. Each chapter covers the origin and history of the crop; impediments to production and marketing; the role of scientific advances, politics, crop champions,

and funding in its development; and future prospects for the crop. Cost of the 72 page publication is \$10, including domestic postage. Checks, made payable to the University of Minnesota, should be sent to Cathie Bergum, Educational Development System, 405 Coffey Hall, University of Minnesota, St. Paul, MN 55108.

**North American Dairy Sheep Symposium** proceedings are now available. The symposium was held July 25-28, 1989 in St. Paul and was sponsored by the Dept. of Animal Science, the Center for Alternative Plant and Animal Products, and the Minnesota Extension Service. Experts from Europe and North America presented information on producing sheep milk, care and feeding of dairy sheep, manufacturing of sheep milk products, and strategies for starting a new business. Cost of the 192 page volume is \$17 including postage. Overseas orders add \$2 U.S. for airmail delivery. Checks, made payable to the University of Minnesota, should be sent to Cathie Bergum, Educational Development System, 405 Coffey Hall, University of Minnesota, St. Paul, MN 55108.

**Deer Farming** is the title of a symposium that was held September 16, 1989 in St. Paul and was sponsored by the Minnesota Family Farm Institute, the Center for Alternative Plant and Animal Products, and the Minnesota Extension Service. Topics covered include profit potential, health, reproduction, nutrition, and deer handling and equipment requirements. The featured speaker was Dr. Geoff Asher of the Ruakura Agricultural Center in Hamilton, New Zealand. The 47 page proceedings are available for \$11 U.S. postage paid. Checks, made payable to the University of Minnesota, should be sent to Cathie Bergum, Educational Development System, 405 Coffey Hall, University of Minnesota, St. Paul, MN 55108.



## Calendar of Events

**January 11-14, 1990 - Combined 5th National Direct Marketing and 30th Annual Ohio Roadside Marketing Conference** Toledo, Ohio. Contact Kelso Wessel, ORMC Coordinator, 2120 Fyffe Road, Columbus, OH 43210; (614) 292-6413.

**January 20-21, 1990 - I.D.E.A.S - 1990.** Hamilton, Ontario. Innovation, Diversification, Entrepreneurship in the Agricultural Sector. Sponsored by the Transition Crop Team and the Ridgetown Agricultural College. Call Linda at (519) 674-5456.

**February 8-10, 1990 - Special Products from Northwest Forests** Portland, Oregon. Sponsored by the World Forestry Center, the U.S. Forest Service, and other trade, professional, educational, and governmental organizations. Contact World Forestry Center, 4033 SW Canyon Road, Portland, OR 97221; (503) 228-1367.

**February 10, 1990 - Cut Flower Production in Wisconsin** Madison, Wisconsin. Co-sponsored by the Assn. of Specialty Cut Flower Growers and the Univ. of Wisc. Contact John Zehrer, Star Valley Flowers, Route 1, Box 65, Soldier's Grove, WI 54655; (608) 624-3325.

**February 12, 1990 - 5th Annual Illinois Asparagus School** Moline, Illinois. Contact Carl Cantaluppi, Univ. of Illinois Cooperative Extension Service, 1188 John Deere Road, East Moline, IL 61244; (309) 706-0512.

**February 14-16, 1990 - 3rd North American Strawberry Conference: The Strawberry into the 21st Century** Houston, Texas. Sponsored by the North American Strawberry Growers Assn., USDA, Univ. of Minnesota Extension Service, Texas A&M University and the Horticulture Research Inst., Ontario. Contact Cathie Bergum, Extension Special Programs,

405 Coffey Hall, Univ. of Minnesota, St. Paul, MN 55108; (612) 625-3775 or (800) 367-0286.

**February 15-18, 1990 - Farm Conference '90** Visalia Convention Center, Visalia, California. Sponsored by California Assn. of Family Farmers. Contact Univ. of California, Davis, Small Farm Center, Davis, CA 95616-9989; (916) 445-5294.

**February 17, 1990 - Minnesota Rabbit Seminar and Judging Conference** St. Paul, Minnesota. Contact Gerald Wagner, 405 Coffey Hall, 1420 Eckles Ave., University of Minnesota, St. Paul, MN 55108; (800) 367-5363.

**April 2-5, 1990 - International Canola Conference** Atlanta, Georgia. Sponsored by ASA, CSSA, SSSA, USDA-ARS, Canola Council of Canada, Foundation for Agronomic Research, Nat'l  
(See *Calendar* page 8)

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Your comments about "BioOptions" would be most helpful to us. Please tell us what you like about our newsletter and how we could improve it. We also encourage you to send us information on upcoming events and new publications.



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Fertilizer Development Center, Potash and Phosphate Institutes of the U.S. and Canada, and the Univ. of Georgia. Contact Dr. Noble R. Usherwood, Potash and Phosphate Institute, 2801 Buford Highway, Suite 401, Atlanta, GA 30329; (404) 634-4274.

**April 4-6, 1990 - Wood Based Economic Development in the Lake States: A Symposium on Specific Forest Product Opportunities** St. Paul, Minnesota. Sponsored by the University of Minnesota, USDA Forest Service, Lake States Forestry Alliance, the Wisconsin, Michigan, and Minnesota Assns. of RC&Ds, the Wisconsin, Michigan and Minnesota Dept. of Natural Resources, the Minnesota Dept. of Trade and Economic Development, Michigan Dept. of Commerce, Wisconsin Dept. of Development, and Michigan Tech University. Contact Cathie Bergum, Extension Special Programs, 405 Coffey Hall, University of Minnesota, St. Paul, MN 55108; (612) 625-3775 or (800) 367-0286.

**June 19-20, 1990 - Corn Utilization Conference III** St. Louis, Missouri. Sponsored by the National Corn Growers Assn. and Funk Seeds International. Papers, posters and demonstrations on new chemicals from corn and biotechnical applications are being solicited. Contact Ann, National Corn Growers Assn, 1000 Executive Parkway, Suite 105, St. Louis, MO 63141-9938; (314) 275-9915.

**July 9-10, 1990 - "Organic" Meat** Minneapolis, Minnesota. Sponsored by the Center for Alternative Plant and Animal Products, and the Minnesota Extension Service. Objectives are to 1) discuss federal regulations concerning "organic" meat, 2) review conventional and organic production methods, 3) Present marketing and pricing strategies for organic meat, and 4) serve as a forum for discussion. Contact Laura McCann at 305 Alderman Hall, 1970 Folwell Ave., University of Minnesota, St. Paul, MN 55108.

**August 23-25, 1990 - 4th National Amaranth Symposium.** Minneapolis, Minnesota. Sponsored by the Center for Alternative Plant and Animal Products, Minnesota Extension Service, Rodale Press, Inc., the Amaranth Institute, and the Institute for the Development of Amaranth Products. Papers, posters, and exhibits relating to production, processing, and marketing of amaranth are encouraged. For further information contact Cathie Bergum, 405 Coffey Hall, 1420 Eckles Ave., University of Minnesota, St. Paul, MN 55108; (612) 625-2722 or (800) 367-5363.

**October 1-5, 1990 - International Triticale Symposium** Passo Fundo, Rio Grande do Sul, Brazil. Papers are being solicited; abstracts should not exceed 250 words and should be submitted by May 1, 1990 to CNPT/EMBRAPA, P.O. Box 569, 99001 Passo Fundo RS Brazil.

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