X:\ENGLISH\RECORDER\93\DEC

*Where X = the drive letter of the CD-ROM

dec1	Introduction
dec2	International Conference on Organic Cotton
dec3	New Trends in Cotton Breeding in Uzbekistan
dec4	Foliar Feeding of Cotton with Potassium
dec5	Short Notes
dec6	Information Network on Exotic Gossypium Germplasm Call for Active Participants
dec7	A DIALOG Search from the AGRICOLA Database on Wild and Diploid Cotton

Introduction

The International Federation of Organic Agriculture Movement, in cooperation with the Bio-Foundation and the IMO Institute of Marketecology from Switzerland and SEKEM Farms of Egypt, organized an International Conference on Organic Cotton in Cairo, Egypt, September 23-25, 1993. The Conference was attended by over 60 delegates from outside Egypt and a similar number of local researchers. The Conference discussed production, consumption and marketing aspects of organic cotton. The participants of the Conference agreed that there is a need to develop international cooperation on organic cotton. The Center of Organic Agriculture in Egypt accepted the responsibility to serve as a platform for the exchange of information and to coordinate research. The participants also agreed to form an International Organic Textile Manufacture Standards Committee with the mandate to develop standards for textiles so that organic cotton products could be promoted under uniform standards. A report with further details is a part of this issue of *THE ICAC RECORDER*.

Uzbekistan is not only facing political and economic changes, but also cotton breeders face a new challenge to develop varieties for the changed agro-climatic conditions. The Aral Sea is drying up and 500-700,000 tons of sulphate and chloride salts are drifted by winds from the dry base of the sea each year. The area affected by the salinity problem is increasing. In three decades, the Aral Sea has contracted to one-half of its area in 1960 and has lost 75% of its volume. Climatic conditions have also been greatly affected. The cotton growing season has become shorter with a milder summer. Moreover, the government has fixed targets to replace cotton with grain crops for which new cropping systems have to be found and adopted. The changes which have occurred and how breeders will meet the challenge is given in the second article.

Nitrogen, phosphorous and potassium are needed by the cotton plant for normal growth. Foliar use of nitrogen has become common among farmers interested in high yield levels. In the last 15-20 years, there has been a drastic change in the morphology of cultivated varieties. In most countries, the presently grown commercial varieties have short durations. They enter into the fruiting phase early, form fruit at a higher rate and, hence, mature early. Such varieties have less vegetative mass and accordingly less abil-

ity to store nutrients for redistribution and are thus more prone to K deficiencies at the boll maturing stage. Foliar feeding of cotton with potassium nitrate has been tried extensively in the last 4-5 years. The work on foliar fertilization of cotton done in the USA has been reviewed in the third article.

In addition to the Short Notes, a DIALOG search of the AGRICOLA database on use of uncultivated species is also a part of the issue. The key words used in the DIALOG search are Cotton and Wild or Diploid.

At the 52nd Plenary Meeting of the ICAC, the Committee on Cotton Production Research of the ICAC had its Meeting and Technical Seminar on October 14, 1993. The seminar was held on the topic "Yield Constraints in Cotton and Producing Quality Cotton Under Rainfed Conditions;" seven papers were presented from six countries. The papers have been published for the benefit of researchers. The publication also contains two more papers on the subject, one from Pakistan and the other from Uzbekistan, which were not presented in the seminar. The publication has been mailed along with this issue of *THE ICAC RECORDER*. A limited number of additional copies are available from the Secretariat of the ICAC upon request. The Committee on Cotton Production Research of the ICAC decided to

hold the 1994 Technical Seminar on the topic "Fiber Characteristics and the Spinners' Perspective: A Look into the Future."

The Committee on Cotton Production Research of the ICAC also reviewed the preparations for the World Cotton Research Conference-1 to be held in Australia from February 13-17, 1994. The Conference will be followed by two field trips, one for two days and the other for four days. As of the end of November 1993, *paid registrations* to the Conference numbered 288. An additional 100 late registrations or on the spot registrations are expected. If you are interested in attending the Conference, there is still time to register and have your accommodations booked. For details, contact the ICAC, Dr. S. Barbosa at the Plant Production and Protection Division of the FAO Headquarters, Rome (Phone 39-6-57976269, Fax 39-6-57973152), or Dr. Greg Constable, Chairman of the Conference Committee, in Australia (Phone 61-67-991500, Fax 61-67-931186).

The 22nd International Cotton Conference Bremen will be held in Bremen, Germany, March 3-4, 1994. The International Committee on Cotton Testing Methods of the International Textile Manufacturers Federation will hold its meeting in Bremen March 1-2, 1994. The Committee has five Working

Groups on Fiber Length, Dust and Trash, Maturity, High Volume Instrument Testing and Honeydew. The Working Groups will consider cotton testing problems in their respective areas and also recommend new testing methods for standardization.

The fourth review article in the series of the *ICAC's Review Articles on Cotton Production Research* has been published. The title of the review article is "Short Fiber Content and Uniformity Index in Cotton" which will be mailed by the publisher in December 1993 to all on the mailing list of *THE ICAC RECORDER* and laboratories and researchers engaged in technological research available on the database of the ICAC. Additional copies may be ordered from the publisher at the following address:

CAB INTERNATIONAL
Wallingford, Oxon OX10 8DE
United Kingdom
Phone 0491-832111 Fax 0491-833508

Meister Publications has published a book entitled *WEED CONTROL MANUAL 1994* which covers details on weed control, rotation restrictions

and herbicide use. Extensive information is given in the book on herbicides, their time of application, toxicity, persistence and ground water contamination hazards. The book covers over 75 crops and also provides information on how to use herbicides in no-till and reduced tillage farming systems. The book can be purchased at a prepublication price of US$39.00 (US$ 3.00 handling charges for the USA and Canada and US$ 5.00 for international orders) from

Meister Publications
37733 Euclid Avenue
Willoughby, OH 44094-5992 USA
Phone 1-800-572-7740 & 216-942-2000
Fax 216-942-0662

International Conference on Organic Cotton

An International Conference on Organic Cotton was held in Cairo, Egypt from September 23-25, 1993. The Conference was held under the auspices of the International Federation of Organic Agriculture Movements, Germany, and supported by the IMO Institute of Marketecology, Switzerland, and the Bio-Foundation of Switzerland. In Egypt, the Conference was hosted by SEKEM Farms - a private enterprise engaged in farming in general and organic cotton in particular. The Conference was attended by over 60 participants from outside Egypt and a similar number of local participants. The Food and Agriculture Organization of the United Nations and the International Cotton Advisory Committee were also represented at the Conference as observers.

The International Federation of Organic Agriculture Movements (IFOAM) is an association of over 500 organizations and individuals engaged in biologically, economically and socially sustainable agriculture. The IFOAM, which is 20 years old, has members in 80 countries. The members include

producers, processors, traders and consultants as well as institutions involved in research, training and information about organic farming. The IFOAM's Technical Committee has formulated "Basic Standards of Organic Agriculture" for the guidance of producers. The standards are a general framework applicable to all farming and include inspection and certification guidelines. These guidelines are continuously updated to harmonize with international demands. Individual companies and associations are permitted to develop their own more precise standards and certification rules.

The International Conference on Organic Cotton discussed all important aspects of organic cotton production, consumption and marketing. While organic cotton has emerged from the pioneering stage to a sizable production, there are still many aspects of organic cotton which demand immediate attention of researchers. Organic cotton is available at a comparably higher price. The ways and means to produce organic cotton at a comparably lower price should be found so that raw material is available to the industry at a reasonable price. Now there is a need to develop international cooperation among producers and consumers of organic cotton so that organic cotton can be promoted under uniform standards and labels. In this

report, important aspects of the papers presented and discussion held are discussed.

Organic Cotton Programs in Some Countries

Cotton is an important strategic crop in Egypt. It is attacked by crickets, aphids, jassids, thrips and mites at the seedling stage and by *Spodoptera littoralis* (Egyptian cotton leafworm), *Earias insulana* (spiny bollworm) and whiteflies at the vegetative stage. At peak fruit formation stage, the crop is attacked by *Pectinophora gossypiella* (pink bollworm) and *Heliothis armigera* (American bollworm) in addition to Egyptian cotton leafworm and whitefly. Aphids also appear at the mature boll stage in addition to Egyptian cotton leafworm and whitefly. Aphids also appear at the mature boll stage in addition to bollworms. A complete biological control program has been established in Egypt.

Early stage insects such as aphids and whiteflies are kept under control by adopting various non-chemical measures including yellow sticks and traps. Egyptian cotton leafworm and American bollworm are controlled by collect-

ing egg masses and pheromone traps in addition to chemical control. Pink bollworm is controlled by confusion technique. Whiteflies, which appeared in 1988 for the first time, have spread very rapidly. 1991 was the first year that it became necessary to use insecticides for the control of whiteflies. However, various Integrated Pest Management (IPM) techniques, including egg collection of Egyptian bollworm, keep the average number of sprays at 3-4 per season. Even then, cotton consumes more than 50% of the total pesticides used in Egypt. Vast use of pheromone traps, egg collection and built-in genetic resistance to fusarium wilt, coupled with various agronomic IPM components, enabled farmers to grow 46,000 acres without the use of any insecticides during 1993. This makes organic cotton production much easier than with the heavy pressure of insects and diseases. Still SEKEM Farms is the only large set-up undertaking organic cotton production in Egypt, though there is a lot of promise for it.

In Turkey, 65 acres of organic cotton were grown during 1993 in the Rapunzel Organic Cotton Project in Izmir. Local certification procedures do not exist so it was certified by the IMO Institute of Marketecology in Switzerland. Careful water management in the absence of a regular supply of irrigation water and insect control, especially against *Heliothis*, is very impor-

tant for growing organic cotton in Turkey. Similar reports narrating organic cotton producing conditions were also presented from Argentina, Greece, India and Brazil.

On September 24, 1993, the participants of the Conference were taken to one of the locations of SEKEM Farms where organic cotton had been grown. First picking was in progress with about 70% of the bolls open. Total estimated yield would be around half of the full potential of a variety under conventional cultivation.

Production of Organic Cotton

Organic cotton production means not only the absence of inorganic synthetic fertilizers, pesticides and the elimination of growth regulators and defoliants, but it involves very careful planning of the whole farming system. Though presently commercially grown varieties are used in organic cultivation, there is a need to develop varieties which could better tolerate heavy pest pressure in the absence of insecticide use. Such varieties should be developed and tested under organic conditions. Similarly, there is a need to perfect the agronomic requirements of a crop to be grown without syn-

thetic fertilizers and pesticides. There is also a need to identify suitable crop rotations so that the fertility level of the soil can be maintained for the lowest reduction in yield under organic conditions. Organic conditions will certainly result in a reduction in yield, but this loss can be minimized through various production practices including suitable varieties. Growth regulators will automatically be eliminated when the crop is grown on comparatively less fertile soil and no synthetic fertilizers are applied. Varieties having the ability to shed leaves automatically at maturity have been identified. The character is inheritable and can be inducted into the new varieties developed for organic production. If cotton is to be picked by machines, the use of defoliants will be eliminated. Trash contents are also expected to be lower in such genotypes.

Among all the pesticides used, roughly 65% of the chemicals are used against insects, 20% are herbicides, 14% are defoliants and growth regulators while fungicides and others comprise only 1% of the total toxic chemicals used on cotton. The use of synthetic pyrethroids has brought various disadvantages to producers, the most significant being resistance to insecticides which has become very serious in China (Mainland). Every year, 150,000 to 250,000 tons of active ingredients are applied to cotton so there

is a need not only to check any further increase in the use of pesticides but also to reduce the use of such chemicals for a better environment for coming generations. It was observed that, ultimately, ecological preservation and sustainability are going to attain high priority. According to one optimistic viewpoint, by the year 2000, organic cotton will comprise 10% of the total production in the world.

Organic Cotton in Use

In Europe, there is an ever increasing number of people viewing textiles from an ecological standpoint. Normally, a cotton fiber is 92% cellulose in nature while natural impurities comprise 8%, including natural oils and waxes which are useful and must remain on the fiber for easy spinning and weaving. There is a need to find alternate methods of finishing so that natural oils and waxes are not taken away along with the undesirable compounds. One of the approaches used in textiles is washing cotton fiber with water. There is a need to find better finishing methods which could also meet an international standard of 1% shrinkage. It was also emphasized that there is a need to use only certified dyes and other chemicals in the processing of organic cotton. Self-certification is also very important in

maintaining high confidence among consumers of organic products. Consumers rely on the label of the textile producer, and it is for him to guarantee that the organic raw material has been processed in a way that it can still be called an organic product.

Colored Organic Cotton

Naturally-colored cotton grown under organic conditions is also available on the market for spinning. Breeding objectives in colored cotton include improving color range, fiber quality and yield potential. Presently, only brown in various shades and green colors are available on a commercial scale. Yellow is expected to be available in the next few years. Blue color is reported to exist in Uzbekistan and other Central Asian countries, although it is in a very light shade and can hardly be marketed as blue color on commercial scale. A colored organic cotton breeding program in the USA is said to have been undertaken under organic conditions.

Colored cotton is more desirable for organic processing but has a number of disadvantages. It is often mixed with white and spoils the seed production system if grown with white cotton on the same farm. Colored cotton

also has to be ginned separately in different gins. Colored cotton varieties are said to be at least 10% lower yielding compared with commercially grown white varieties. Moreover, colored cottons are also at a disadvantage in offering a limited color choice and do not always meet the minimum requirements for spinning. Colored lint brings a premium price, but there are also problems associated with the marketing of colored cotton because of an uncertain market demand. Most of the colored cotton work is done in the private sector so many countries do not have access to seeds of improved colored cotton varieties. Such a situation will continue to prevail unless improved varieties become available to the growers as in the use of white varieties. It will not be desirable to depend on foreign companies engaged in colored cotton as their varieties may not be suitable for growing everywhere.

Whether it is colored organic cotton or white organic cotton, there is a need to have uniform standards and verification procedures. Some manufacturing standards are being developed, but most of the working groups work in isolation. The creation of an International Standards Committee to frame uniform standards for the industry was emphasized by the participants.

Biodynamic Cotton

The idea of a biodynamic agricultural method or biodynamic farming was also presented at the Conference. Biodynamic farming is a special form of ecological agriculture in which specialized preparations are applied to the soil and plant in very small quantities. Such preparations are substances which do not normally occur in the plant environment. The biodynamic preparations are made from plant and animal materials and, in one case, from a mineral. The animal and plant materials are exposed to natural actions under specific conditions. Presently, two preparations of biodynamically active substances are available. One is called Horn-manure (also called Preparation 500) which is prepared from animal manure and applied (dissolved in water) to soil at the rate of 200 gms/ha at the time of seed bed preparation. The second preparation, Horn-silca (also called Preparation 501), is prepared from animal manure and finely ground quartz and is sprayed on green leaves. Both preparations are said to boost plant growth and ultimately enhance productivity of the crop.

In Egypt, biodynamic cotton is intercropped with onions, clover or garlic. For example, if cotton has been planted in a standing crop of onions,

Preparation 500 will be applied after the onions have been harvested. Plant protection measures are taken as in the case of organic cotton. Biodynamic cotton is claimed to give higher yield than conventional growing. Many questions were posed by participants to understand the mechanism of work of these preparations, but most remained unsatisfied. Detailed information on biodynamic farming can be had from Mr. Georg Merckens, Forschungsring fur biologisch-dynamische Wirtschaftweise, Horvelinger Weg 27, D-89081 Ulm, Germany (Fax: 49-731-6020199).

Social Aspect of Organic Cotton

It was emphasized that the social component of organic cotton should not be overlooked. Organic products must have truthful labeling and meet the minimum standards set for processing. The need for a general global standards to protect the environment from chemical pollution was recognized. Material processing and treatment must not release chemicals into the environment which can be traced in the products consumed and which disrupt ecological systems. These goals can only be accomplished if producers establish long term environmental objectives and fix targets to achieve them. Secondly, chemicals and products released into the environ-

ment must be biodegradable and must not accumulate in the environment or food chains. They must not be teratogenic, mutagenic, carcinogenic or acutely toxic to humans in the concentrations occurring under field conditions. Such products must not also produce organisms which disrupt the ecological system. In the end, there must be an ecologically should solution for the disposal of unmarketable products. Energy consumption should be at the minimum and renewable energy resources should be preferred.

The need to carry out life-cycle assessment studies of all the products and by-products of cotton production, processing and the textile industry was stressed. A new Parking Lot Concept was put forward to replace the current practice of dumping waste in a manner which allows it to leach quickly into the environment. The idea of the Parking Lot Concept includes the storage of waste in such a way that will not allow spontaneous combustion or the release of gases or liquids into the ground. More details of the life-cycle assessment and the Parking Lot Concept can be acquired from the Environmental Protection Encouragement Agency, Hamburg, Germany.

Resolutions

On September 25, 1993, sufficient time was devoted to draw conclusions from the Conference. The participants of the Conference agreed on the following resolutions.

Resolution No.1

Cotton cultivation all over the world is associated with the heavy use of chemical fertilizers and pesticides. The negative impacts of these practices on human health, natural balance and our environment are clearly documented.

As a consequence, organic agricultural methods have been developed which are defined in the internationally recognized IFOAM Standards. Control and certification schemes have been put into place with the result that certified organic raw cotton is currently available on the market.

Despite the successful results of organic and biodynamic cotton growing in different parts of the world, further research in organic cotton is still needed. It is therefore proposed that an institution which might serve as an

international platform for information exchange and coordinated research be formed.

The Center of Organic Agriculture in Egypt is ready to accommodate such an institution and will request such a mandate from IFOAM.

Resolution No. 2

The existing criteria for the manufacture of raw cotton are not yet complete and sufficient. It is therefore deemed necessary to work on the development of sound ecological standards for all processing procedures of cotton, such as ginning, spinning, knitting, weaving and including all finishing methods until the final garment is produced.

Putting into account organic cotton cultivation, the criteria of the German "Arbeitskreis Naturtextile," among others, might serve as a starting point for further discussion and implementation.

It is proposed that an International Organic Textile Manufacture Standards Committee as a platform for development of standards be formed. Experts in the field of cotton cultivation and research, textile manufacturing, inspec-

tion and certification, as well as persons from environmental and consumer movements, are invited to join the committee as active members. The objectives of such a committee will be

- to develop standards for manufacturing organic textiles
- to include maximum criteria for ecological sustainability and means for life-cycle-analysis of all certified products
- to minimize all health hazards in the final product as well as for all people involved in handling these products.

Resolution No. 3

The First International IFOAM Conference on Organic Cotton herewith promotes the development of a consumer information label scheme for organic textile products.

It was recommended that convergence should be found between different existing schemes in development as to have one, worldwide-accepted label for organic textile products.

The Conference also recommended that such a label scheme should be based on independent certification according to international norms, taking into account the requirements of newly industrialized and developing economies.

New Trends in Cotton Breeding in Uzbekistan

Cotton has been grown in Uzbekistan for over 200 years. The semi-arid continental climate and irrigation facilities were favorable for growing cotton successfully. Research facilities for breeding varieties for local cultivation and determining physiological needs of the plant and a scientific approach to meet those needs were established as early as 1922. Breeders in Uzbekistan evolved high-yielding and superior varieties suitable for local cotton-growing conditions. The cotton-growing conditions have changed in the past few years so drastically that they seriously demand a shift in behavior of the cultivated varieties. Breeders realized the need for new trends in cotton breeding and accepted the challenge to meet the needs of the changing cotton-growing conditions.

Variety Development

There are three main institutes responsible for breeding superior varieties of cotton; the Uzbekistan Scientific Research Institute for Breeding and

Seed Production of Cotton, the Institute of Experimental Biology of Plants and the Central Scientific Institute for Research on Cotton. The Institute of Experimental Biology of Plants is more involved in fundamental research on all crops, but cotton gets more attention because of its role in the economy. Fundamental research led to the development of very good varieties which occupy roughly 40-45% of the total area in Uzbekistan. The Uzbekistan Scientific Research Institute for Breeding and Seed Production of Cotton has a clear mandate to evolve cotton varieties and produce their seed for commercial use. The institute, though called a cotton breeding institute, does some work on alfalfa as it is the most important crop grown in rotation with cotton. The Uzbekistan Scientific Research Institute for Breeding and Seed Production of Cotton was established in 1922 and has developed 35 *G. hirsutum* and 12 *G. barbadense* varieties so far. Some of the varieties like C-4727, developed in 1961, were so desirable that they are still grown of significant area. Presently, there are six varieties from the institute recommended for commercial cultivation which together occupy almost 50% of the total area under cotton in Uzbekistan. The varieties developed by the Central Scientific Institute for Research on Cotton are also on the list for commercial cultivation. The variety 108 F, which has been in cultivation

for a long time, was developed by the Central Scientific Institute for Research on Cotton.

The variety approval process is well established. All candidate varieties are tested by the Ministry of Agriculture at 40 locations throughout the cotton belt for three years. The varieties performing better than commercial varieties are recommended for large scale cultivation. The zoning of varieties, which is determined from the multi-location trials of the Ministry of Agriculture, also applies. Though seed production is the responsibility of the respective breeders, seed certification is done at the gins. There seems to be a gap between the breeders of the varieties and seed certification which is done by a separate agency. There are chances of misuse of the certification standards. Breeders have used all means of breeding varieties, but radiation breeding probably has a better reputation in Uzbekistan than anywhere else.

Need for New Trends

Salinity Problem

The ambient conditions of the cotton plant have changed significantly in the past few years, the most drastically changed being the soil conditions. In the 1950s, the government decided to divert water from the Aral Sea in order to irrigate areas already in cotton and also to vacate land for the purpose of growing cotton in the desert. The value of cotton was estimated to be greater than the loss of the fish collected from the Aral Sea. The water depletion was so fast that the Aral Sea started drying up quickly. In 1960, the Aral Sea covered approximately 25,800 square miles. In about 30 years, the sea has shrunk into sections totaling 13,000 square miles and has lost 75% of its volume. It is estimated that now, on the average, winds cause 500-700 thousand tons of sulphate and chloride salts to drift from the dried Aral Sea base to the cultivated lands each year. The drift affects Uzbekistan, Karakalpakstan and some parts of Kazakhstan. If the drying up of the sea continues at this rate, estimates indicate that the movement of salts will increase 10 times by the year 2000. Approximately 25-30 cubic kilometers of water need to reach the Aral Sea each year just to maintain

its current level. This much water is not available unless cotton is left dry in the fields and water from Amu and Syr Rivers is diverted to the Aral Sea. Otherwise, the salinity problem will continue to increase every year, necessitating the development of varieties suitable for growth under saline conditions.

The cotton plant is comparatively tolerant to salinity, but germination remains a problem. Early stage seedlings are highly sensitive and are liable to be burnt by a high salt concentration. The seeds germinate, but a percentage of seedlings fail to emerge from the soil and are lost. Others grow for a few days and ultimately die much before entering into the fruiting phase. If the plant is able to sustain the first few weeks, normal flowers and bolls can develop. The plants under high salt conditions often remain short in stature and do not require growth regulators to check excessive growth. Such conditions usually result in a higher fruiting index.

Cotton breeders in Uzbekistan realized the need and tried various approaches for developing salt-tolerant varieties. They have been able to select suitable lines from segregating generations of radiated material. Varieties like Samarkand-3, Okoltin and Juldus have been developed by ra-

diomutagenesis. Radiation effects sometimes cause changes at the DNA level that result in genetically unstable genotypes. Such genotypes continuously segregate, giving rise to slightly deviated genotypes. This deviation could be due to the weakening of some of the hydrogen bonds which continue breading in the following generations, giving rise to a new arrangement of bases and thus new phenotypes. Cotton breeders noted similar segregation and considered that higher adaptability of the varieties developed through ultraviolet rays may be due to the heterogeneous makeup of the population. However, further genetic studies proved that it is not necessary for a heterozygous population derived from radiation to always confer better tolerance to salinity. They found that some homogeneous non-segregating genotypes were even more tolerant to adverse salinity conditions. The genetic and physiological mechanism of tolerance to salinity is now better understood, providing better opportunities to develop varieties for the changing needs of Uzbekistan agriculture.

Wilt Tolerance

Wilt, noted to cause significant losses in yield in Central Asian Republics of the former Soviet Union, is not a new disease to cotton in Uzbekistan. Both

Verticillium dahliae and *Fusarium oxysporium* had been a problem until the early 1970s. Wild genotypes carrying wilt resistant genes were identified and extensively used in crossing. Local varieties were crossed with *G. hirsutum* spp. *mexicanum nervosum* to incorporate tolerance.

Resistant varieties like Tashkent-1, Tashkent-2 and Tashkent-3 were released for commercial adoption and proved very successful against wilt. In more than 10 years, more new varieties were released with better fiber quality characteristics but without the genes tolerant to wilt acquired form the wild species. Now once again, wilt has appeared as a major disease causing significant losses in yield. The losses are even worse because of virulent races of *Verticillium dahliae*. Once again, the precious breeding approach of incorporating wilt tolerance from uncultivated species is needed. A more effective way of utilizing the remote technology is to attempt hybridization between the best local varieties and new wilt tolerant donors, wild and semi-wild tetraploid and diploid cotton species. More than 10 promising wilt-tolerant lines are at advanced stages of testing. They were developed from parents involving *G. hirsutum* spp. *purpurscens*. Some diploid spp. *G. harknessii*, *G. thurberii*, *G. asridum* and tetraploid *G. barbadense*

spp. *darwinii*, *G. barbadense* spp. *latifolium* have also been used in the hybridization.

Short Season Varieties

Climatic Changes

The Aral Sea's shrinkage also caused major changes in weather conditions. In the summer, the temperature reaches up to 40°C, and there are salt storms in areas like Muynak, about 35 kilometers to the south of the Aral Sea base. There is now a milder and shorter summer. The change has further squeezed the cotton growing period. The effects of low temperatures on fiber characteristics are well known. An early drop in temperature when the plant has full mature bolls usually hastens boll opening. Forced premature opening results in low micronaire and immature fibers. Various varieties react differently to the milder temperatures and t he early onset of winter. The lint from early maturing varieties is sold at a higher price compared to the late maturing varieties, possibly because late maturing varieties do not produce the same quality of fiber as early maturing varieties.

Government Plan

Uzbekistan produced over 1.6 million metric tons of cotton in 1989 and 1990. It has a potential to produce more cotton but at the cost of food crops. The Government of Uzbekistan has decided to attain self-sufficiency in food crops and to decrease the area under cotton to 1.5 million hectares and maintain it at this level. The 1991/92 production level of 1.5 million tons of fiber will be maintained by increasing yield per unit area. The area vacated of cotton will be used to grow grain crops (wheat, rice, barley and maize), mainly wheat. According to the government plan, grain crops will be grown on 750,000 hectares which have irrigation facilities and 250,000 hectares in non-irrigated areas. Cotton has been grown in a mono-cropping system for years. Presently, cotton-alfalfa is the main rotation followed. The increase in grain crops will significantly affect the area under alfalfa.

Implementation of the above mentioned government decision demands a big change in the cropping system as a whole. While there is a need to identify more profitable crop rotations, early maturing varieties have to be developed which could fit into the changed cropping system on the one

hand and escape from the cold weather conditions on the other hand. The cotton growing period has to be shortened without sacrificing either yield or fiber quality.

Breeders faced an enormous challenge to release varieties which could mature before the onset of the frost and still have the same yield potential and fiber parameters. The priorities of the breeding programs had to be re-arranged. In fact, breeders had material in the breeding stocks which was not considered desirable due to one reason or another. Now this need has provided the foundation for the entire variety development program. Conventional varieties under normal conditions had a growing period of 160-170 days. Tashkent-6 normally takes 125-130 days to mature. Varieties like Uldus with faster growth rates have been developed. According to breeders at the Institute of Experimental Biology of Plants, Tashkent Uldus takes 110-120 days to mature, which is one of the main reasons that the variety has become so popular among the growers and is estimated to be grown on about 70,000 hectares. Breeders in Uzbekistan have also succeeded in developing *G. barbadense* varieties which mature in 115-120 days.

Commercial Cotton Hybrids

In India, commercial cotton hybrids are grown on over two million hectares, i.e., 28% of the total area under cotton in the country. Hybrid vigor has not been exploited in other countries in spite of possessing the know-how to produce hybrid seed for various reasons. Most of the problems are associated with the cost of hybrid seed which is not compensated for by the increase in production. In Uzbekistan, breeders tried to develop interspecific hybrids which were superior in yield and quality. The limitations of interspecific hybridization encountered in Uzbekistan are

- Undesirable vegetative growth resulting in tall, bushy and inefficient plants. A very undesirable feature of the plant under high input conditions of cotton growing (300 kg N per hectare) in Uzbekistan.
- Late maturation. The short cotton growing season in Uzbekistan puts an upper limit to the formation of bolls which can open and be picked before the onset of the frost. The interspecific hybrids were very late maturing and many bolls were lost to frost.

Recently, cotton breeders at the Tashkent State Agrarian University have overcome these problems. They have identified interspecific combiners which when crossed give a short stature and early maturing F_1 generation like commercially cultivated upland varieties. The *G. hirsutum* parent which is very short and carries a marker gene for red color has played a greater role. Of course, the combining ability of the parents has to be determined. However, the experiments showed that the identified *G. hirsutum* parent can be crossed with most *G. barbadense* varieties. The high-yield potential and superior quality of the *G. barbadense* parent must be kept in view in order to have higher heterotic effect on yield and quality in the resulting hybrid. Resistance to verticillium wilt should be carried from the *G. barbadense* parent. Interestingly, the resulting F_1 generation does not show any heterosis for the height of the plant.

For the sake of production of hybrid seed, a technique has been developed whereby hand emasculation is not required. A paper tube is pushed onto the stigma of the female parent which separates the anthers from the style. According to Dr. Nataliya G. Simongulyan of the Tashkent State Agrarian University, it is more convenient to use the paper technique on the *G. barbadense* parent. Breeders have also found that paper tube emas-

culation is not equivalent to cyplasmic or genetic male sterility and gives rise to 5-10% female parent plants in the F_1 generation. As the male parent carries a dominant gene for red color, the self-pollinated plants can easily be recognized in the F_1 generation and eliminated at early stages. The specific combiners are secret. The superiority of the hybrids both for yield and quality has been confirmed, but the seed is not available for commercial planting. Identification of suitable combiners, especially in the case of interspecific hybrids and for growing conditions like those in Uzbekistan, is very important. The hybrids are expected to be available to growers if bulk seed production is undertaken by the government.

Commercial Cotton Varieties of Uzbekistan

Variety	Origin	Earliness (days)	Boll wt. (gm)	Lint %	Staple (mm)	Strength (g/tex)	Release year
Medium-long staple							
C-4727	137F x C-1470	- 10-12 (108F)	6.3-6.8	37.0-39.0	26.6	26.0	1961
Chimbai-3010	Selection fromC-4727	±1-2 (C-4727)	6.3-6.8	36.0-37.0	26.2	25.0	1976
Kizal-Ravat	Selection fromTash.-1	±2 (108Φ)	6.3-6.5		26.2	26.9	1976
175 F	(156F x 2795) x (L204 x M. Nervozum)	-4 (Tashkent-1)	5.2-5.6	33.0-34.0	28.6	26.4-27.9	1980
Tashkent-6	Complex back cross	- 6-10 (Tashkent-1)	6.0-6.5	35.5-36.5	28.6	27.0-28.2	1981
AH-Bayuant-2		125-128 days	5.5-6.0	32.0-33.0	26.2	26.7	1983
Kirgiz-3		121-129 days	4.7-5.0	31.9-32.7	27.4	26.5	1986
C-6524	159F x 5152 (hirsutum)	- 2-3 (Tashkent-1)	5.9-6.0	33.0-34.0	28.0	29.2	1986
C-9070	L-5197 x L-8541	- 10 (175F)	6.5-6.8	34.0-34.5	27.5	27.6	1990
Bukhara-6	Tashkent-1 x 9647-E	+3 (Tashkent-1)	5.8	35.6	27.0	28.3	1990
Uldus	AH-Samarkand & Samarkand-3	115-120 days	6.3-7.5	39.0-40.0	26.6	26.9	1992
AH-415		112-115 days	5.1	40.6	26.6		1992
AH-510	AH-505 x L-2366	123-129 days	5.0-6.0	34.0-35.0	28.4	27.4	1992
C-6530	Selection from C-6526	-2 (C-6526)	5.9-6.1	37.5	27.4	27.6	1993
Fine-staple							
C- 6037	C-6002 x C-6015	- 8 (5904E)	3.8-4.0	31.0-32.0	33.0	35.5	1977
9883-E	9709-E x 9647-E	129-135 days	3.6-3.9	32.0-32.5	33.3	33-34	1983
Karshee-8	ML 104 x ML-107	- 5 (C-6037)	3.4-3.6	32.0-33.0	31.4	32.2	1992

Foliar Feeding of Cotton With Potassium

All major nutrients are needed by the cotton plant throughout the growing period, but the amount needed varies with the stage of growth. At the peak fruit formation stage, the plant needs the maximum amount of nitrogen. The requirement for phosphorous is more stable compared with the other two major nutrients. Potassium needs are at their peak at the boll filling stage. Bolls carry more K than any other part of the plant. A higher concentration of K in the bolls may be because K is needed to maintain sufficient turgor pressure for fiber elongation. K is also involved in enzyme activiation and pH balance in the cells, critical for healthy plants and disease suppression. K supply also affects seed maturity. When K uptake is higher than its use at the early stages of growth, excess K is stored in the leaves for reuse by the young bolls at a later stage. A heavy boll load enables the maturing bolls to strip K from the nearby leaves. The need for K is so high at boll maturing stage that plant requirements may exceed the supply from the soil and the reserve in the leaves, so much so that young leaves at the top may be deprived of any supply of K from the soil, all of which is di-

verted toward the young bolls. Heavy stripping of K from leaves results in deficiency symptoms. Modern short stature varieties are more prone to this phenomenon.

Where Does the Potassium Go?

Soils in many countries are rich in K and do not require the addition of potassic fertilizers for an average or even a good yield level. If cotton is grown in rotation with crops which receive potassic fertilizer, K stays in the soil for cotton. K is not lost in the soil in large quantities as it can move only slowly in the soil, better than phosphorous but not as quickly as nitrogen. K is then taken away by the plant. According to Oosterhuis et al (1991), 27.7 kg of K is picked up by the plant from the soil to produce one bale (217.7 kg) of lint.

Nutrient Analysis for One Bale of Cotton (in kgs)

Nutrient	All Above Ground Parts	Seed Cotton	Lint
Oxygen	952.6	317.5	113.4
Carbon	748.4	249.5	86.2
Hydrogen	163.3	54.4	15.9
Nitrogen	28.1	16-18	0.5
Potash (K_2O)	27.7	6.8	1.4
Phosphate (P_2O_5)	10.0	6-9	0.2
Calcium	12-28	0.5	0.1
Magnesium	5-12	2.3	0.2

If it is a crop of three bales/ha, the total K uptake by all above ground parts of the plant will be three times 27.7 kg. Carbon, hydrogen and oxygen are available to the plant in abundance from the atmosphere and ground water, but N, P and K must be returned to the soil for normal growth.

According to Malik, (1988), an analysis of the different parts of the plant showed the following constitution:

Nutrient Analysis of Cotton Plant Parts (in percent)

Plant Part	N	P	K	Ca	Mg	S
Roots	0.82	0.12	1.06	0.45	0.25	0.06
Stems and Branches	1.06	0.08	1.60	0.69	0.25	0.05
Leaves	2.30	0.15	2.49	3.15	0.52	0.42
Burs	1.08	0.18	3.50	1.28	0.26	0.17
Seed	3.13	0.43	2.10	0.18	0.33	0.33

It is again seen that K is found in a much higher quantity in most plant parts, particularly in the lint and burs.

Symptoms of Potassium Deficiency

Potassium deficiency symptoms in cotton are characterized by bronzing, which fall into two categories, symptoms occurring at the bottom of the plant on the lower mature leaves at the top of the main terminal. Young growing leaves on the branches may also show deficiency symptoms. Deficiency symptoms on the mature leaves appear as yellow-white mottling which soon progresses to the leaf tip, and margin and specks in between the veins. The leaf tip and margins curl downwards as the tissue break-

down continues. Finally, the whole leaf becomes yellow-colored and ultimately sheds. The late-season symptoms appear in young leaves at the top and progress downward. Such symptoms may not be due to non-availability of K in the soil but due to internal stripping of the plant.

Foliar Feeding

Early crop growth is generally not affected by K supply, however, at the end of the season, the total accumulation of K is closely related to the total K supply. 65% of the total plant K is found in fruit, with about 45% of the boll K found in lint and seed. Foliar fertilization would provide an efficient supply of nutrients in case there was a need to provide a particular nutrient or nutrients for maximum growth or to escape any stress. Nitrogen is more frequently applied as foliar fertilizer at stages when it is considered not important to irrigate but the plant needs nitrogen to maintain normal growth. Foliar feeding with any fertilizer is not a substitute for soil application but can be used to meet deficiencies arising at a very critical stage of growth. Foliar fertilizers should be applied when both soil and tissue tests show that there is a need for a particular nutrient. Folia applications should not be made when the plant is in water stress. Faster fruiting cultivars with

higher fruiting indices have increased the need to use K as a foliar fertilizer. Foliar application on K appears to be a viable cotton production practice under certain circumstances which can restore the plant supply and thus increase productivity and preserve quality.

Mechanism of Foliar Fertilizer Absorption

Potassium is absorbed into the leaves by the diffusion process. The absorption rate depends on the rate of application, temperature and condition of the cuticle. A higher concentration of K on the leaf surface accelerates the absorption process. Temperature has a strong effect on uptake. The leaf cuticle is a waxy layer on the outside of the leaves that protects the leaves from evaporation losses and other environmental adversities. A thin layer allows better diffusion. Warm temperatures soften the cuticle and also enhance diffusion. Leaf exposure to dry, hot and water deficit conditions thicken the cuticle, composed of harder waxes. A thick cuticle layer provides better protection against adverse environmental conditions but, due to this poor ability to soften, has diminishing effect on the diffusion rate. A 33% increase in the thickness of the cuticle results in a decrease of one-third in the uptake of the leaf. The thickness of the cuticle, once at-

tained, is maintained by the leaf for the rest of its life. Expanded leaves during a period of water stress decrease the diffusion rate. Likewise, the application of foliar K should be made either early in the day or in the evening. Diffusion is affected by many factors, but, once absorbed, K is highly mobile within the plant and easily pulled in by bolls.

If the concentration of K in the leaves drops below 2.0%, the ability of the leaves to function properly declines. At 1.0% K, the leaves almost cease to function. Leaves start shedding when the K concentration in the leaves drops to 0.2%. Many commercial products are available to correct K deficiencies, but potassium nitrate (KNO_3) is used most often. It is applied at the rate of 4.5 kg of material dissolved in 45.5 l of water and applied 3 to 4 times starting from the first bloom.

Effect of Potassium Application

Potassium deficiencies affect yield and the quality of the fiber. A lack of K results in a lower number of bolls, smaller bolls with shorter fiber length, lower micronaire value, less uniformity of fiber length and an increase in white specks on fabrics. The requirements of some of the present highly ef-

ficient and short-season varieties of cotton have been shown. Cassman et al (1990) have shown that high application of K to SJ-2 and Acala GC 510 resulted in an increase in yield. The increase was more pronounce in SJ-2. In other experiments, Stoneville 213 and DES 24 also showed a positive interaction with K. In this experiment, three levels of K were tried and, at all levels, Stoneville 213 showed higher response compared with DES 24. Minton (Meredith, 1992) tested 20 varieties at zero and 120 kg/ha of K and noticed an increase in yield with the addition of potassium fertilizer. However, he did not find variety-K interaction. He noticed a lower incidence of wilt disease both in the tolerant and susceptible varieties.

Oosterhuis et al (1991) conducted experiments for two years to evaluate the beneficial effects of foliar-applied KNO_3 on yield and quality of cotton. Potassium was applied at the rate of 0, 3, 5, 10, 15, and 20 kg/ha in the form of KNO_3. Petiole analysis indicated that the K level increased in all the treated plots compared with the control plots. Yield improvement was noticed when the plants were fertilized with soil and foliar application of KNO_3 or only foliar application of KNO_3 compared with no application of KNO_3. Fiber uniformity and strength improved in one year but not in the second year.

Potash effects on the quality of spun yarn are also prominent. Work done at the Potash and Phosphorous Institute in Starkville, Mississippi, has shown that thick defects decreased in yarn spun from cotton applied with potassic fertilizer. Potash application also decreased the number of breaks per 1,000 hours of rotor spinning from 322 to only 60 breaks (Thompson, 1992).

Wilhm and Searles (1993) conducted trials with foliar K fertilizer "SURE-K" at three different locations in the USA. The soil was given the normal dose of N and a sufficient supply of K, the general recommendation for the area where the trials were conducted. SURE-K was sprayed four times during the season at the rate of 22.7 l/ha starting form the boll formation stage. They observed an increase in K concentration in petiole analysis. Foliar spraying of K also slightly increased yield in addition to improving the fiber length and micronaire value; fiber strength, however, decreased.

Oosterhuis (1992) conducted replicated trials for three years on foliar application of K to cotton. In addition to the normal production practices, the treatments included: checking with no soil or foliar K, preplanting soil application of KCl, foliar application of KNO_3 at 2, 4, 6 and 8 weeks after the

first flower and preplanting soil application, and foliar application at 2, 4, 6 and 8 weeks after the first flower. The soil rates varied from 33.5 to 67.3 kg/ha, depending upon the soil needs. The foliar dose was 11.2 kg/ha of KNO_3 in 112 l/ha of water. Foliar application coupled with preplanting soil application gave on the average a 78.5 kg higher lint yield per hectare compared to only soil application. Foliar feeding also improved fiber quality, particularly in respect to length uniformity and strength.

Weir et al (1992) studied the effects of foliar N and K on cotton petiole levels and lint yield. The experiments were conducted in soils which had a known history of cotton showing deficiency symptoms at the peak fruit formation stage. The petiole K was significantly different due to soil application of K fertilizers. Weir et al (1992) did not note any difference in petiole analyses on any one sampling date. However, the experiments showed that applying KCl and KNO_3 resulted in significantly higher yield compared with the check group. Though the increase in yield was not consistent, they found KNO_3 produced a higher increase in yield than KCl.

Miley et al (1992) tried KNO_3 in various doses and concentrations to study leaf burn effects. KNO_3 was applied to cotton in the first week of flowering;

4.5 kg in 22.7 l, 4.5 kg in 34 l, 4.5 kg in 45.5 l, 9 kg in 681 and 9 kg in 901 of water. Soil application of 68 kg/ha of K was given before sowing in addition to 56 kg/ha N, 33 kg/ha P_2O_5 and 1.1 kg/ha Boron. There was no serious leaf burn injury from any of the doses. Various mixtures of N, P, K and Boron were also tried, but all the tested doses were safe to use. Foliar application of KNO_3 did show a trend toward increases in yield from some of the treatments, but none of the differences were statistically significant. Boll weight also did not increase in any of the treatments of KNO_3. Why foliar application of K in various doses did not have an impact on yield or boll weight could be due to two reasons. First, the soil was rich in the case of the supply of K as petiole analyses showed above 4% K throughout the season. Secondly, the varieties grown and yield level could affect the plant need for K. If the variety is a conventional type and a very high yield is not expected or targeted, there may not be a need to apply foliar K.

Foliar fertilization of seedlings, applying one, two and three applications of 12-48-8, did not produce any increase in plant height and yield (Edmisten et al, 1993).

Sources of Foliar Potassium

Potassium is available for soil application mainly in the form of potassium sulphate (sulphate of potash) and potassium chloride (muriate of potash). Potassium magnesium sulphate is also used on a small scale for soil application. Potassium nitrate is the main product for foliar application.

Miley (1992) tried various K salts for foliar treatment which included sulfate, chloride, thiosulfate, nitrate and carbonate. The studies showed that KCl (at a much lower price) is as good as KNO_3. In the absence of any impact of foliar use of K on yield or boll weight, differentiating the usefulness of one product over another may not be justified. Studies which followed in 1992 confirmed that only KNO_3 gave a significantly higher yield compared with other compounds.

KNO_3 must be dissolved in hot water at concentrations above 5.0% K, an expensive process. KCl has been tried by Pettiet (1993) as an alternative to KNO_3. The KCl and KNO_3 were dissolved in water at the rate of 5.0%, 8.8% and 11.7% K and sprayed on the crop to see their effects of K level of the leaf and burning effects, if any. The solutions were applied at 45

l/ha, 90 l/ha and 135 l/ha rates. Leaf concentration was measured after 24 hours of application while leaf burn was graded after 72 hours . It was observed that both fertilizers dissolved readily at 5.0% concentration, while the KCl dissolved five times faster than KNO_3 at 8.8% and eight times faster at 11.7% concentration. The KCl showed traces of leaf burn damage at 5.0% concentration at 45 l/ha which increased with the increase in concentration and dose. The KNO_3 showed traces of leaf burn only at 11.7% concentration when applied at the rate of 135 l/ha. When measured after 24 hours of application, the leaf concentration of K was higher in the case of KCl applications, at all rates. Potassium uptake was almost equivalent at 5.0% concentration of KCl or 11.7% concentration of KNO_3. Pettiet regarded muriate of potash (KCl, 62.5% K) a better source of K than KNO_3 for foliar fertilization. Chloride effects on the soil were not discussed.

Testing the Potassium Level

In order to decide whether a crop needs foliar application of K or not, knowing the quantity of vegetative growth, the demand of K by the fruit (yield level) and the quantity of K stored in the plant parts for redistribution is important. The modern trend in the plant type of varieties has decreased the

quantity of vegetative growth. Whatever quantity of K may be applied to the soil, it is simply not possible to keep the same quantity of K stored for redistribution. Stripping by the developing fruit from the young growing leaves can be avoided if K is supplied by foliar application.

The potassium status of the plant can be tested from the cotton leaf blade or leaf petiole. Leaf blade analysis involves drying, grinding and digesting selected leaf tissues. Full mature leaves are the most sensitive indicator of K status of the plant. K concentration in the leaves generally declines with age and the appearance of squares, flowers and bolls. According to Baker et al (1992), the critical level of K will occur between 1.2 to 0.9%. Petiole analysis is more commonly used to assess the K status of the plant. The petiole K percentage also decreases with the age of the petiole; the decline is more sharp compared with leaf blade analysis. A level below 1% showed leaf defoliation. Bassett and MacKenzie (in Baker et al 1992) showed that Acala cotton should contain a minimum of 4.0% K at first bloom, 3.0% K during peak bloom, 2.% K by the first boll opening and 1.0% during just prior to harvest. Low soil moisture also affects K concentration in the plant parts.

There is a need to identify quicker methods to test the level of K in the plant leaves so that deficiency could be compensated for before any losses occur. In this regard, the "K Meter" has shown promise. The selective ion meter cannot be used as a substitute for petiole analysis but has been proved to be a useful tool when coupled with petiole analysis. More work is probably needed to confirm the accuracy of results and bring them in agreement with petiole analysis.

The work conducted in the USA so far shows that, with the advent of faster fruiting varieties having higher fruiting indices, plant requirements for K have changed. High yield expectations from such varieties have increased the K needs at the boll formation stage which cannot be met from the soil. Meeting this requirement with foliar fertilization of K is an option. More research is needed to confirm the usefulness of foliar application of K; recommendations will probably be specific to the type of variety grown and the target yield to be obtained.

References

Baker, W.H., McConnell, J. S., Maples, R. L. and Varvil, J. J. 1992. Soil and plant methods for diagnosing K deficiency in cotton. *Proceedings of the Beltwide Cotton Conferences*, National Cotton Council of America, PO Box 12285, Memphis, Tennessee 38182.

Edmisten, L. K., Wood, C. W., Burmestar, C. H. and Mitchell, C. C. 1993. Foliar fertilization of seedling cotton. *Proceedings of the Beltwide Cotton Conferences,* National Cotton Council of America, PO Box 12285, Memphis, Tennessee 38182.

Hake, K., Cassman, K. and Ebelhar, W. 1991. Cotton nutrition. *Cotton Physiology*, Volume 2, Number 3, National Cotton Council of America, PO Box 12285, Memphis, Tennessee 38182.

Kerby, T. A. 1992. Potassium uptake and utilization by the plant. *Proceedings of the Beltwide Cotton Conferences,* National Cotton Council of America, PO Box 12285, Memphis, Tennessee 38182.

Malik, M. N. 1988. Cotton soils and fertilizers. *Cotton in Pakistan*, Pakistan Central Cotton Committee, Moulvi Tamizuddin Khan Road, Karachi, Pakistan.

Meredith, Jr. W. R. 1992. Solving potassium problems on the farm: Variety selection. *Proceedings of the Beltwide Cotton Conferences,* National Cotton Council of America, PO Box 12285, Memphis, Tennessee 38182.

Miley, W.N. Oosterhuis, D. M., Baker, W. H., Varvil, J. J. and Batchelor, J. T. 1992. Effects of foliar application of Potassium fertilizers on cotton yield, boll weight and leaf-

burn. *Proceedings of the Beltwide Cotton Conferences,* National Cotton Council of America, PO Box 12285, Memphis, Tennessee 38182.

Oosterhuis, D. M., Hake, K. and Burmester, C. 1991. *Cotton Physiology*. Volume 2, Number 8, National Cotton Council of America, PO Box 12285, Memphis, Tennessee 38182.

Oosterhuis, D. M. 1992. Foliar feeding with Potassium nitrate in cotton. *Proceedings of the Beltwide Cotton Conferences,* National Cotton Council of America, PO Box 12285, Memphis, Tennessee 38182.

Pettiet, J. V. 1993. Potassium chloride as a source of foliar fertilizer for cotton. *Proceedings of the Beltwide Cotton Conferences,* National Cotton Council of America, PO Box 12285, Memphis, Tennessee 38182.

Thomson Jr. W.R. 1992. Effect of potash on quality and utilization of cotton. *Proceedings of the Beltwide Cotton Conferences,* National Cotton Council of America, PO Box 12285, Memphis, Tennessee 38182.

Weir, B.L. Roberts, B. A. and Kerby, T. A. 1992 Effects of foliar N and K on cotton petiole levels and lint yields. *Proceedings of the Beltwide Cotton Conferences,* National Cotton Council of America, PO Box 12285, Memphis, Tennessee 38182.

Wilhm, J. L. and Searles, G. V. 1993. Foliar SURE-K (Potassium foliar fertilizer). *Proceedings of the Beltwide Cotton Conferences,* National Cotton Council of America, PO Box 12285, Memphis, Tennessee 38182.

Short Notes

- **Aphid response to various temperatures and granules**
  Aphids are a worldwide pest of cotton, found most often on young growing leaves during the first eight weeks after sowing. At an early stage, natural biological control and adverse weather conditions usually decrease the population to a low level of non-economic importance, but aphids can reappear as a major pest if conditions become favorable at any stage of the crop, most commonly at the end of the season. Normally, aphids can live for a period of four weeks, but their life span is greatly affected by temperature. The experiments done at the Plant Protection Institute in Zhengzhou, China (Mainland), have shown that aphids can live for a longer period of time at 18°C. The survival rate of aphids was studied in the laboratory at 14°C, 18°C, 20°C, 22°C, 24°C, 26°C and 30°C. Aphids were allowed to feed on young cotton seedlings. There was no mortality at any temperature under study for almost two days. The survival rate decreased with the increase in temperature. The decrease was more rapid in the cages kept at 30°C where there was no survival after 14 days. A small percentage of aphids could live even up to 39 days when dept at 18°C.

There was no survival after 22 days at 14°C.

The body size measured at different temperatures also showed that the maximum size was developed at 18°C. At 18°C on average, the aphids were 1.470.07 mm in length and 0.910.03 mm in width. Length and width decreased with the increase in temperature. Length and width were at a minimum at 30°C, i.e., 0.640.05 mm and 0.360.02 mm, respectively. Fertility rate was highest at 20°C.

At the Cotton Research Institute, Anyang, China (Mainland), eight different granule products were tried to control aphids. Granules were applied after 20, 25, 30 and 35 days of planting. The results showed that applying granules after 20 days of planting is most desirable, instead of applying them at a later date. Although all the products were effective even when applied after 35 days of planting, their effectiveness in controlling aphids decreased many times in most cases. Application of all the products, with the exception of one, also decreased the mite population by 53-94%. Granule application, though it affected germination, had a positive effect

on the height of the plant and the number of fruiting branches, flowers and squares (Source: *Acta Gossypii Sinica*, Vol. 4, No. 1, 1992).

- **Ethanol from cotton stalks**
  On average, a good cotton field produces four tons of cotton stalks after the final crop pick. Total vegetative mass of the plant is greatly affected by varieties, fertilizer doses, irrigation, soil conditions and even weed control and pest attack. It is an important component of IPM that stalks should be removed from the field after a specific date to minimize carryover of insects, particularly those responsible for causing direct damage to fruiting parts. Similar recommendations are made about ginning waste. The industry still does not have an economical and popular solution for the disposal of cotton leftovers, i.e., stalks and ginning waste. Returning waste to the soil and use as fuel still remain the commonly adopted practices.

  Researches in Australia have investigated the possibility of using cotton sticks and ginning waste for the purpose of extracting ethanol. Ethanol is an alcohol widely used as fuel for internal combustion engines in many countries around the world. In the USA, mixing ethanol with petrol for the sake of reducing pollution is recommended. In Brazil, using ethanol in the

transport sector is encouraged because it is locally produced and reduces reliance on imported petroleum. The ethanol produced in the USA and Brazil comes form fermentation of plant sugars and starches. Work recently published in Australia has shown that about 300 liters of ethanol can be produced from one ton of dry mass of cotton plants in addition to 180 kgs of lignin. Lignin is recovered from recycling the water component and has its own commercial value. A fungus producing an enzyme which breaks down the lignin surrounding the cell walls, allows access to the sugars within the cell wall and helps to double ethanol recovery from the same amount of material. Recovery is not equivalent to high-yielding sugars and starches, but the technology has a promise to further enhance ethanol recovery from cotton and other woody materials.

The cost of ethanol extracted from cotton stalks greatly depends on the cost of the sticks, i.e., price, pulling, collection, packing and transportation. It is claimed that blending ethanol with diesel has numerous advantages; a mix of 20% ethanol and 80% diesel does not require any modification in the engine. It is economical to produce ethanol compared with importing diesel. Ethanol mixed with diesel also produces fewer combustion pollut-

ants compared with diesel alone. For more information, contact Kim Fraser, NSW Agriculture Research Economist, Agricultural Research Center, Triangie, NSW 2823, Australia.

- **World cotton production and consumption estimates**
  According to *COTTON: Review of the World Situation*, Volume 47, Number 2, November/December 1993 of the International Cotton Advisory Committee, world cotton production estimates for the year 1993/94 are placed at 17.9 million metric tons. India and the USA are expected to maintain their production level of 1992, i.e., 2.38 and 3.53 million metric tons, respectively. In Pakistan once again, the crop has had a serious setback from the leaf curl virus, and production is estimated at 1.61 million metric tons, which is 4.5% higher than 1992. Farmers in Pakistan tackled the leaf curl virus in a better way compared with last year, and production estimates were encouraging. However, an unexpected heavy attack of whitefly at the end of September, coupled with aphids, affected the late formed bolls. Production from China (Mainland) is estimated at 4.2 million metric tons against 4.508 million tons last year. Uzbekistan is expected to produce over 100,000 metric tons more cotton in 1993/94 over 1992/93 on account of higher yield.

World cotton consumption is estimated at 18.9 million metric tons in 1993/94, 200,000 tons greater than last year and almost one million tons greater than production. Among the five major cotton producing counties, India and Pakistan are expected to show higher consumption than in 1992/93. The expected increase will be 100,000 tons (5%) in India and 44,000 tons (3% in Pakistan. Consumption in China (Mainland) is also expected to rise by 50,000 tons over 1992/93. In the USA, an increase of 8,000 tons in local consumption is expected. Consumption in Japan, China (Taiwan), Hong Kong, the Republic of Korea and Singapore is forecast to fall by more than 60,000 tons of cotton over 1992/93. European countries and Southeast Asian countries are expected to increase the use of cotton during 1993/94.

Due to greater consumption than production during 1993/94, prices are expected to rise. The current forecast for the Cotlook A Index for the year 1993/94 is 68 cents per pound, plus or minus 7 cents.

INFORMATION NETWORK ON EXOTIC *GOSSYPIUM* GERMPLASM
CALL FOR ACTIVE PARTICIPANTS

The diploid species of *Gossypium* are widely recognized as potential sources of genes useful for improvement of the tetraploid species. Over the years a few groups and individuals have worked with some of the species and have introgressed new genetic material into commercial lines. However, the over-all efforts have not matched the potential of the exotic germplasm base.

Because research programs utilizing diploid species for tetraploid cotton improvement are widely scattered in the world, scientists working in this area could be well served by an information exchange network. For each individual scientist, such a network should increase awareness of and access to recent results, new techniques and germplasm resources. In addition, the network could be used as an outlet to increase professional recognition and interaction between programs and help alleviate the sense of isolation experienced by many investigators.

James McD. Stewart at the University of Arkansas is taking initial steps to organize a network among cotton researchers who utilize diploid *Gossypium* species for cotton improvement. Because of the limited knowledge on most of the *Gossypium*

species, the scope of the network should include all disciplines contributing data on any of the diploid species. Investigators working with one or more of the species, who are interested in being affiliated with an information exchange network, are encouraged to establish that affiliation by sending their name, institution, address, telephone and facsimile, along with a brief description of their research roster of investigators will be developed and distributed to all respondents. Initial plans are to have a yearly newsletter composed of contributions from the participants.

Dr. James McD. Stewart
Professor, Altheimer Chair for Cotton
Agronomy Department
University of Arkansas
Fayetteville, AR 72710 USA
Telephone: (501) 575-5722
Facsimile: (501) 575-7465

A DIALOG Search from the AGRICOLA Database on Wild and Diploid Cottons

A DIALOG search of the AGRICOLA database was conducted on the work published from 1980 to 1993 on wild species. The key words used are **Cotton** and **Wild** or **Diploid**. 51 references are given here which include work on various useful aspects of diploid cotton.

91108950 93044237 Holding Library: AGL
Abscisic acid-insensitive mutations provide evidence for stage-specific signal pathways regulating expression of an Arabidopsis late embryogenesis-abundant (lea) gene
Finkelstein, R.R.;
University of California, Santa Barbara, CA
Molecular and General Genetics. Apr 1993. v. 238 (3) p. 401-408.
Berlin, W. Germany: Springer International.
ISSN: 0026-8925
CODEN: MGGEAE
Language: English
Includes references.
Subfile: OTHER FOREIGN
Document Type: Article

91102483 93039125 Holding Library: AGL

Copia-like retrotransposable element evolution in diploid and polypliod cotton (Gossypium L.)

Vander Wiel, P.L.; Voytas, D.F.; Wendel, J.F.

Iowa State University, Ames, IA

Journal of molecular evolution. May 1993. v. 36 (5) p. 429-447.

New York, NY: Springer-Verlag.

ISSN: 0022-2844

DNAL CALL NO: QH359.J6

Language: English

Includes references.

Subfile: OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);

Document Type: Article

91093132 93031352 Holding Library: AGL

Regulation of photsynthesis by end-product accumulation in leaves of plants storing starch, sucrose, and hexose sugars

Goldschmidt, E.E.; Huber, S.C.

The Hebrew University of Jerusalem, Rehovot, Israel

Plant physiology. Aug 1992. v. 99 (4) p. 1443-1448.

Rockville, Md.: American Society of Plant Physiologists.

ISSN: 0032-0889 CODEN: PLPHA

DNAL CALL NO: 450 P692

Language: English

Includes references.
Subfile: OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article

91066173 93991678 Holding Library: AGL

Ovule culture of interspecific hybrids from diploid wild cotton x tetraploid cultivars and the embryo and seedling development

Hu, S.A. and X.L. Li
11 leaves (some folded); 27 cm.
Karachi, Pakistan : Muhammad Ali Society, 1988.
DNAL CALL NO: TRANSL 39142
Language: English
Translated from Chinese for the OICD, ARS, USDA by Mrs. Geti Saad, Ag TT 85-1-0010.; Translated from: I Chuan Hsueh Pao = Acta Genetica Sinica, vol. 9, no. 1:57-62, 1982.
Includes bibliographical references (leaves 10-11).
Place of Publication: Pakistan
Document Type: Monograph; Bibliographies; Translation

91039286 92069042 Holding Library: AGL

Ovipositional response of three Heliothis species (Lepidoptera: Noctuidae) to allelochemicals from cultivated and wild host plants

Mitchell, E.R.; Tingle, F.C.; Heath, R.R.

Insect Attractants Behavior, and Basic Biology Research Laboratory, ARS, USDA, Gainesville, FL
Journal of chemical ecology. June 1990. v. 16 (6) p. 1817-1827.
New York, N.Y. : Plenum Press. ISSN: 0098-0331 CODEN: JCECD
DNAL CALL NO: QD415.A1J6
Language: English
Includes references.
Subfile: OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article

91017903 92054694 Holding Library: AGL
Haploid and diploid callus from cotton anthers
Barrow, J.; Katterman, F.; Williams, D.
SEA, USDA, New Mexico State University, Las Cruces, NM
Crop Science. July/Aug 1978. V. 18 (4) p. 619-622.
Madison, Wis. : Crop Science Society of America.
ISSN: 0011-183X
CODEN: CRPSAY
DNAL CALL NO: 64.8 C883
Language: English
Includes references.
Subfile: OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article

90107859 92012389 Holding Library: AGL

Phylogenetics of the cotton genus (Gossypium): character-state weighted parsimony analysis of chloroplast-DNA restriction site data and its systematic and biogeographic implications

Wendel, J.F.; Albert, V.A.

Iowa State University, Ames, IA

Systematic botany. Jan/Mar 1992. v. 17 (1) p. 115-143.

Lawrence, Kan.: American Society of Plant Taxonomists.

ISSN: 0363-6445 CODEN: SYBOD

DNAL CALL NO: QK95.S97

Language: English

Includes references.

Subfile: OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);

Document Type: Article

90084936 91053600 Holding Library: AGL

Terpenoids of Asiatic and Western Hemisphere diploid and tetraploid cottons

Altman, D.W.; Stipanovic, R.D.; Bell, A.A.

USDA-ARS Southern Crops Research Laboratory, Texas A&M University, College Station, TX

Proceedings - Beltwide Cotton Conferences. 1991. v. 1 p. 534-537.

Memphis, Tenn. : National Cotton Council of America.

CODEN: BCOPB

DNAL CALL NO: SC249.N6

Language: English
Paper presented at the "Cotton Improvement Conference, " 1991, San Antonio, Texas.
Includes references.
Subfile: OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article

90018059 91010900 Holding Library: AGL
Comparative study of seed proteins of wild cotton species
Khashimov, D.A.; Dzhalilov, B.D.; Yuldashev, P.Kh.; Alikhodzhaeva, S.S.; Egamberdiev, A.E.; Shoakhmedova, G.S.; Sozinov, A.A.
Academy of Sciences of the Uzbek SSR, Tashkent
Cytology and Genetics. 1990. v. 24 (1) p. 60-64.
New York, N.Y. : Allerton Press.
ISSN: 0095-4527 CODEN: CYGED
DNAL CALL NO: QH573.C92
Language: English; Russian
Translated from: Tsitologiia i genetika, v. 24 (1), 1990, p. 56-61. (QH573.T75).
Includes references.
Subfile: OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article

89138360 90052579 Holding Library: AGL
Dormancy in southwestern cotton boll weevils: a comparative physiological study of Anthonomus grandis in wild and domesticated cotton bolls

Rojas, R.R.; Leggett, J.E.; Leopold, R.A.
Biosciences Research Laboratory, ARS-USDA, Fargo, ND
Journal of insect physiology. 1990. v. 36 (8) p. 601-606.
Devon : Pergamon Press.
ISSN: 0022-1910 CODEN: JIPHA
DNAL CALL NO: 421 J825
Language: English
Includes references.
Subfile: OTHER FOREIGN;
Document Type: Article

89133672 90049982 Holding Library: AGL
Pollen fertility of some simple and compound translocations of cotton
Stelly, D.M.; Kautz, K.C.; Rooney, W.L.
Texas A&M Univ., College Station, TX
Crop Science. July/Aug 1990. v. 30 (4) p. 952-955.
Madison, Wis. : Crop Science Society of America. ISSN: 0011-183X
CODEN: CRPSAY
DNAL CALL NO: 64.8 C883
Language: English
Includes references.
Subfile: OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article

89080357 90021579 Holding Library: AGL

Behaviour of cotton leafperforator (Lepidoptera: Lyonetiidae) on wild and cultivated cotton

Wilson, F.D.; Szaro, J.L.

USDA, ARS, Western Cotton Research Laboratory, Phoenix, AZ

Journal of the Arizona-Nevada Academy of Science. 1989. v. 23 (1) p. 45-48.

Tempe, Ariz. : The Academy.

ISSN: 0193-8509 CODEN: JAZAA

DNAL CALL NO: 500 AR44

Language: English

Includes references.

Subfile: OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);

Document Type: Article

89077253 90008429 Holding Library: AGL

Phenology and ecology of wild cotton (Malvales: Malvacceae) and the boll weevil (Coleoptera: Curculionidae) in Tamaulipas, Mexico

Jones, R.W.; Cate, J.R.; Burke, H.R.

Texas A&M University, College Station, TX

Journal of Economic Entomology. Dec 1989. v. 82 (6) p. 1626-1632. ill.

Lanham, Md. : Entomological Society of America.

ISSN: 0022-0493 CODEN: JEENAI

DNAL CALL NO: 421 J822

Language: English

Includes references.
Subfile: OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article

89062099 89243078 Holding Library: VXG; AGL
Distribution of Arizona wild cotton (Thurberia thespesioides)
Herbert C. Hanson
1991; p. 49-59 : ill.; 23 cm.
Tucson, Arizona : University of Arizona,
Bulletin/University of Arizona, Agricultural Experiment Station; no. 3
DNAL CALL NO: 100 Ar4 (2) no. 3
Language: English
Cover title. Bibliography: p. 59.
Place of Publication: Arizona
Government Source: State/Provincial
Subfile: UIU; EXP STN (STATE EXPER. STN); AZ;
Document Type: Monograph; Bibliographies

88123116 88902783 Holding Library: AGL
Development of the generative sphere in interspecific and intraspecific hybrids of wild cotton species - O razvitii generativnoi sfery u vnutri-i mezhvidovogo gibri-dov dikikh vidov khlopchatnika
Rumi, V.A.
7 p. : ill. ; 27 cm.

Karachi, Pakistan : Muhammad Ali Society, 1986.
DNAL CALL NO: TRANSL 34773
Language: English
Translated from Russian for the OICD, ARS, USDA by Mrs. Geti Saad, TT 85-1-0992.; Translated from: Uzbekskii Biologicheskii Zhurnal, no. 2:74-77, 1978.
Bibliography: p. 6-7.
Place of Publication: Pakistan
Document Type: Monograph; Bibliographies; Translation

88107805 88037400 Holding Library: AGL
Isozyme Polymorphism among diploid and tetraploid species of cotton
Saha, S.; Stelly, D.M.; Percival, A.E.
Proceedings - Beltwide Cotton Production Research Conferences. 1988. p. 97-98.
Memphis, Tennessee : National Cotton Council and The Cotton Foundation.
CODEN: BCOPB
DNAL CALL NO: SB249.N6
Language: English
Conference held on January 3-8, 1988, New Orleans, Louisiana; Includes abstract.
Subfile: OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article; Abstracts

88090946 88902771 Holding Library: AGL
Genome analysis of a diploid cotton hybrid = Genomnyi analiz diploidnogo gibrida khlopchatnika

Abdullaev, A.A., S.M. Rizaeva and O.N. Lazareva
3 p.; 27 cm.
Karachi, Pakistan : Muhammad Ali Society, 1985.
DNAL CALL NO: TRANSL 34785
Language: English
Translated from Russian for the OICD, ARS, USDA by Mrs. Geti Saad, TT 85-1-0979.; Translated from: Uzbekskii biologicheskii Zhurnal, no. 1:66-67, 1980.
Place of Publication: Pakistan
Document Type: Monograph; Translation

88066838 88025555 Holding Library: AGL
Evolution of the cultivated species of cotton
La evolucion de las especies cultivadas de algodon
Fryxell, P.A.;
Ceiba. Dec 1984. v. 25(2) p. 156-163.
Tegucigalpa : Escuela Agricola Panamericana.
ISSN: 0008-8692
CODEN: CEIBA
DNAL CALL NO: 475 C32
Language: Spanish
Includes references.
Subfile: OTHER FOREIGN;
Document Type: Article

87133305 87077212 Holding Library: AGL

Establishment of embryonic suspension cultures of a wild relative of cotton (Gossypium/klotzschianum Anderss.)

Finer, J.J.; Reilley, A.A.; Smith, R.H.

In vitro cellular & Developmental Biology : Journal of the Tissue Culture Association. Oct 1987. v. 23 (10) p. 717-722. ill.

Gaithersburg, Md. : The Association.

ISSN: 0883-8364 CODEN: ITCSA

DNAL CALL NO: QH585.A1I58

Language: English

Includes references.

Subfile: OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);

Document Type: Article

87065119 87025331 Holding Library: AGL

Radiosensitivity of some wild species of cotton with different numbers of chromosomes

Nazirov, N.N.; Arslanova, S.V.

Soviet Agricultural Sciences. 1986. (2) p. 38-41.

New York, N.Y. : Allerton Press.

DNAL CALL NO S1.S68

Language: English; Russian

Translated from: Vsesoiuznaia akademia selskokhoziaistvennykh nauk, Doklady, (2), 1986, p. 25-27. (20 AK1).

Includes references.
Subfile:OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article

87040841 87008768 Holding Library: AGL
Embryology of Australian cotton species
Kamalova, G.V.; Abukhoskaia, A.P.; Idiiatullina, D.L.
Uzbekskii biologicheskii zhurnal. 1986. (3) p. 47-50. ill.
Tashkent : "Fan".
ISSN: 0042-1685 CODEN: UZBZA
DNAL CALL NO; 442.8 UZ1
Language: Russian
Includes references.
Subfile: OTHER FOREIGN;
Document Type: Article

87040833 87008760 Holding Library: AGL
Effect of low above freezing temperature on the fraction composition of readily soluble proeins in cotton radicles
Nabiev, A.G.; Usmanov, R.M.; Zakirov, A.Z.
Uzbekskii biologicheskii zhurnal. 1986. (3) p. 21-22.
Tashkent : "Fan".
ISSN: 0042-1685 CODEN: UZBZA
DNAL CALL NO; 442.8 UZ1

Language: Russian
Includes references.
Subfile: OTHER FOREIGN;
Document Type: Article

87040607 87008532 Holding Library: AGL
Characteristics of the photosynthetic system of cotton species of different ploidy
Khodzhaev, A.S.; Igamberdieva, D.I.
Uzbekskii biologisheskii zhurnal. 1986. (4) p. 26-29.
Tashkent : "Fan".
ISSN: 0042-1685 CODEN: UZBZA
DNAL CALL NO: 442.8 UZ1
Language: Russian
Includes references.
Subfile: OTHER FOREIGN;
Document Type: Article

86133829 86050754 Holding Library: AGL
Morphogenesis of some wild species of cotton
Kliat, V.P.; Abdullaev, A.A.
Uzbekskii biologicheskii zhurnal. 1986. (2) p. 54-56.
Tashkent : "Fan".
ISSN: 0042-1685 CODEN: UZBZA
DNAL CALL NO: 442.8 UZ1

Language: Russian
Includes references.
Subfile: OTHER FOREIGN;
Document Type: Article

86133824 86050749 Holding Library: AGL
Morphological structure of the flower of wild diploid cotton species from the old world
Dariev, A.S.; Tazhibaev., A.
Uzbekskii biologicheskii zhurnal. 1986. (2) p. 36-40. ill.
Tashkent : "Fan".
ISSN: 0042-1685 CODEN: UZBZA
DNAL CALL NO: 442.8 UZ1
Language: Russian
Includes references.
Subfile: OTHER FOREIGN;
Document Type: Article

86132127 86048889 Holding Library: AGL
Cotton collecting in Continental Ecuador and Galapagos Islands
Schwendiman, J.; Ano, G.; Percival, A.E.
Plant Genetic Resources Newsletter. Dec 1985. (64) p. 33-37. maps.
Rome : Food and Agriculture Organization of the United Nations.
DNAL CALL NO: 451 F732

Language: English
Includes references.
Subfile: FAO (UNESCO FAO);
Document Type: Article

86123917 86043089 Holding Library: AGL
Field studies on the parasitoids of cotton fleahopper in its wild habitat
Rajakulendran, S.V.; Cate, J.R.
Proceedings - Beltwide Cotton Production Research Conferences. 1986. p. 241-244.
Memphis, Tennessee: National Cotton Council and The Cotton Foundation.
CODEN: BCOPB
DNAL CALL NO: SB249.N6
Language: English
Paper presented at the "Beltwide Cotton Production Research Conferences," January 4-9, 1986, Las Vegas, Nevada.
Includes 13 references.
Subfile: OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article

86104443 86026904 Holding Library: AGL
Substitution of cotton cytoplasms from wild diploid species for cotton germplasm improvement
Umbeck, P.F.; Stewart, J.M.
Crop Science. Nov/Dec 1985. v. 25 (6) p. 1015-1019.

Madison, Wis. : Crop Science Society of America.
ISSN: 0011-183X
CODEN: CRPSAY
DNAL CALL NO: 64.8 C883
Language: English
Includes references.
Subfile: OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article

86059014 85071248 Holding Library: AGL
Effect of radioactive phosphorus (32P) on the growth, development and yields of cultivated and wild cotton forms of different origin
Nazirov, N.N.; Kozubaev, Sh.S.
Uzbekskii biologicheskii zhurnal. 1983. (4) p. 14-18.
Tashkent : "Fan".
ISSN: 0042-1685 CODEN: UZBZA
DNAL CALL NO: 442.8 UZ1
Language: Russian
Includes 3 references.
Subfile: OTHER FOREIGN;
Document Type: Article

86010218 85027807 Holding Library: AGL
Cotton as a world crop

Lee, J.A.;
Agronomy. A series of monographs - American Society of Agronomy. 1984. (24) p. 1-25. ill., maps.
Madison, Wis., Soil Science Society of America.
ISSN: 0065-4663 CODEN: AGRYA
DNAL CALL NO: 4 AM392
Language: English
Includes references.
Subfile: OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article

85148980 85819814 Holding Library: AGL
Ecology of wild cotton and the boll weevil in littoral habitats in Northern Yacatan
Williams, David W. and Cate, James R.
1984, 21, 9 leaves of plates : ill.; 28 cm.
DNAL CALL NO: SB608.C8W5
Language: English
Cover title.
Bibliography: leaves 20-21.
Place of Publication: xxu
Government Source: State/Provincial
Subfile: OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Monograph; Bibliographies

85145911 85019566 Holding Library: AGL

Parasitism of Heliothis zea and Heliothis virescens (Lepidoptera: Noctuidae) larvae in wild and cultivated host plants in the Delta of Mississippi

Stadelbacher, E.A.; Powell, J.E.; King, E.G.

Environmental entomology. Oct 1984. v. 13 (5) p. 1167-1172.

College Park, MD. : Entomological Society of America.

ISSN: 0046-225X CODEN: EVETEX

DNAL CALL NO: QL461.EE532

Language: English

Includes references.

Subfile: OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);

Document Type: Article

85069784 84080090 Holding Library: AGL

Ovule culture of interspecific hybrids from diploid wild cotton X tetraploid cultivars and the embryo and seedling development.

Hu, S.A.; Li, X.L.

I ch'uan hsueh pao - Acta Genetica Sinica. v. 9 (1) 1982. p. 57-62.

Peking : , K'o hsueh ch'u pan she.

NAL: QH431.I17

Language: Chinese; English

Includes references

Subfile: OTHER FOREIGN;

Document Type: ARTICLE

85049859 84077772 Holding Library: AGL

Exotic cotton tolerates semiaridity (Wild cotton plants from Mexico as source of genes for commercial cotton cultivars in the United States)

Carriere, B.;

Agricultural Research - U.S. Department of Agriculture, Agricultural Research Service. v. 32 (1) July/Aug 1983. p. 4. ill.

Washington, D.C, : , The Administration.

ISSN: 0002-161X

NAL: 1.98 AG84

Language: English

Subfile: USDA (US DEPT. AGR);

Document Type: ARTICLE

84131209 84019894 Holding Library: AGL

Comparative studies of morphological characters of haploid and diploid plants of cotton (Gossypium ssp.)

Mehetre, S.S. IJARC; Thombre, M.V.

Indian journal of agricultural research. v. 16 (4), Dec 1982. p. 215-218.

Karnal :, Agricultural Research Communication Centre.

ISSN: 0367-8245

NAL: S3.I5

Language: English

Includes references.

Subfile: OTHER FOREIGN;
Document Type: ARTICLE

84119069 84009371 Holding Library: AGL
Combining ability analysis in Gossypium arboreum (Diploid cotton, northern India)
Duhoon, S.S. and Singh, M.
The Indian Journal of Agricultural Research.
ISSN: 0019-5022
NAL: 22AG83I
Language: English
Includes references.
Subfile: OTHER FOREIGN;
Document Type: ARTICLE

84081809 83116691 Holding Library: AGL
Comparative studies on some physiological aspects in organ forming (diploid as well as haploid) tobacco & non-organ forming cotton callus tissues (Nicotiana tabacum, Gossypium hirsutum)
Mehta, A.R.;
Plant tissue culture 1982: proceedings, 5th International Congress of Plant Tissue and Cell Culture held at Tokyo and Lake Yamanake, Japan, July 11-16, 1982, Edited by Akio Fujiwara. p. 125-126.
Tokyo : , Japanese Association for Plant Tissue Culture, (1982?).
NAL: QK725.I49 1982

Language: English
Includes references.
Subfile: OTHER FOREIGN;
Document Type: ARTICLE

84045121 83090092 Holding Library: AGL
Screening of some diploid cotton strains against Fusarium wilt (Fusarium oxysporeum, Gossypium arboreaum, Gossypium herbaceum)
Hande, Y.K. JMAUD; Padule D.N.; Lakhande, S.B.
Journal of Maharashtra agricultural universities. v. 8 (2) May 1983. p. 191-192.
Pune : , D.R. Bapat. ISSN: 0378-2395
NAL: S471.I3J6
Language: Enlish
Includes references.
Subfile: OTHER FOREIGN;
Document Type: ARTICLE

84014408 83063652 Holding Library: AGL
Some notes on the morphological and anatomical characteristics of the species Gossypium populifoliumm (Benth.) F. Muell ex Tod and Gossypium pilosum Fryx (subsection Grandicalyx Fryx) (Cotton, identification of wild Australian species)
Valicek, P. CTFTA;
Coton et fibres tropicales. v. 36 (3), 1981. p. 233-239. ill., maps.
Paris : , Institut de recherches du coton et des textiles exotiques.

ISSN: 0010-9711
NAL: 73.8 C82
Language: English; French; Spanish
Includes references.
Subfile: OTHER FOREIGN;
Document Type: ARTICLE

84014401 83063645 Holding Library: AGL
Some notes on the morphological characteristics of Gossypium ellenbeckii (Gurke) Mauer (Wild African cotton species identification)
Valicek, P. CTFTA;
Coton et fibres tropicales. v. 36 (2) 1981. p. 157-162. ill., maps.
Paris : , Institut de recherches du coton et des tetiles exotiques.
ISSN: 0010-9711
NAL: 73.8 C82
Language: English; French; Spanish
Includes references.
Subfile: OTHER FOREIGN;
Document Type: ARTICLE

84012395 83061635 Holding Library: AGL
Lipids of wild forms of cotton (Breeding for resistance to pests).
Ganieva, M. KHLOA; Badalova, M.; Nasyrova, D.
Khlopkovodstvo. Jan 1981. (1), Jan 1981. p. 36-37.

Moskva : , "Kolos".
ISSN: 0023-1231
NAL: 72.8 K522
Language: Russian
Subfile: OTHER FOREIGN;
Document Type: ARTICLE

84011850 83061090 Holding Library: AGL
Wilt resistance of chemomutants of wild cotton and their hybrids (Verticillium dahliae, Gossypium hirsutum ssp. mexicanum var nervosum).
Egamberdiev, A.E.; Paiziev, P.
Uluchshenie kul'turnykh rastenii i khimicheskii mutagenez/ (otvetstvennyi redaktor I.A. Rapoport). p. 183-188.
Moskva : , Nauka, 1982.
NAL: QH 465.C5U4
Language: Russian
Includes references.
Subfile: OTHER FOREIGN;
Document Type: ARTICLE

83060346 82093520 Holding Library: AGL
Photoperiodic reaction of wild diploid species of cotton exposed to varying high temperatures (Gossypium davidsoni, Gossypium anomalum, Gossypium sturtii, initial breeding material).

Ikramov, I.U.; Musaev, D.A.; Usmanov, S.A.; Berdiev, S.M.
Uzbekskii biologicheskii zhurnal. 1982. (3) 1982. p. 50-52.
Tashkent, U.S.S.R., "Fan".
ISSN: 0042-1685
NAL: 442.8 UZ1
Language: Russian
1 ref.
Subfile: OTHER FOREIGN
Document Type: ARTICLE

83051119 82085812 Holding Library: AGL
Alcohol dehydrogenase isozymes in Gossypium hirstutum and its putative diploid progenitors: the biochemical consequences of enzyme multiplicity (Cotton)
Hancock, J.F.;
Plant systematics and evolution. v. 140 (2/3) 1982. p. 141-149.
Wien, Austria, Springer.
ISSN: 0378-2697
NAL: 450 OS7
Language: English
3 p. ref.
Subfile: OTHER FOREIGN;
Document Type: ARTICLE

83041316 82075871 Holding Library: AGL

Role of pool of wild Gossypium L. species in cotton breeding.

Abdullaev, A.A.; Omelchenko, M.V.; Lazareva, O.N.; Rizaeva, S.M.

Sbornik Simpoziuma SEV a na temu "Izuchenie i ispol'zovanie istocknikov genov poleznykh rastenii tropikov i subtropikov: " 13-15 sentiabria 1981 / (vedecky redaktor: Pavel Valicek. p. 49.

Praga : , Institut tropickeho a subtropickeho zemedelstvi VSz, 1981.

NAL SB111.A2C65 1981

Language: Russian; English

English text p. 136.

Subfile: OTHER FOREIGN

Document Type: ARTICLE

82131479 82024764 Holding Library: AGL

Comparative toxicity of 131,596 chemicals to plant seeds (Corn, wild oats, cotton, soybean, radish)

Kenaga, E.E.;

Ecotoxicology and Environmental safety. v. 5 (4), Dec 1981. p. 469-475.

New York, Academic Press.

ISSN: 0147-6513

NAL: QH545.A1E29

Language: English

Includes 5 ref.

Subfile: OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: ARTICLE

82118845 82015017 Holding Library: AGL
Setting of bolls and seed in hybrids Fo, F1 and F2 obtained from crossing wild and ruderal forms with cultivated varieties (Gossypium hirsutum) (Cotton breeding, G.S. Zaitsev Scientific-Research Institute of Cotton Breeding and Seed Production).
Abdullaev, A.A.; Alikhodzhaeva, S.S.; Saidaliev, K.H.
Uzbekskii biologicheskii zhurnal. 1981. (3), 1981. p. 44-46.
Tashkent, "Fan".
ISSN: 0042-1685
NAL: 442.8 UZ1
Language: Russian
Subfile: OTHER FOREIGN
Document Type: ARTICLE

82022378 81055907 Holding Library: AGL
Genomes of the Australian wild species of cotton. III. Gossypium australe
Edwards, G.A.;
Caryologia. v. 33 (3) July/Sept 1980. p. 315-319. ill.
Firenze, Universita degli studi di Firenze.
ISSN: 0008-7114
NAL: 442.8 C25

19 ref.
Subfile: OTHER FOREIGN;
Document Type: ARTICLE

81145762 81038483 Holding Library: AGL
Leaf morphogenesis of some wild species of cotton.
Kliat, V.P.;
Uzbekskii biologicheskii zhurnal. 1980. (6) 1980. p. 56-59. ill.
Tashkent, "Fan".
ISSN: 0042-1685
NAL: 442.8 UZ1
4 ref.
Subfile: OTHER FOREIGN
Document Type: ARTICLE

81112439 81013404 Holding Library: AGL
Genome analysis of a diploid of cotton.
Abdullaev, A.A.; Rizaeva, S.M.; Lazareva, O.N.
Uzbekskii biiologicheskii zhurnal. 1980. (1), 1980. p. 66-67.
Tashkent, "Fan".
ISSN: 0042-1685
NAL: 442.8 UZ1
Language: RUSSIAN

Subfile: OTHER FOREIGN
Document Type: ARTICLE

80146611 80060138 Holding Library: AGL

Genetic parameters and association analysis in segregating populations of inter-specific crosses of diploid cotton

Tikka, S.B.S.; Badaya, S.N.; Patel, R.R.; Mehta, N.P.

Gujarat Agricultural University research journal. v. 5 (2) Jan 1980. p. 1-4. ill.

Ahmedabad, The University

NAL: S539.I4G8

Language: English

5 ref.

Subfile: OTHER USDA;

Document Type: ARTICLE