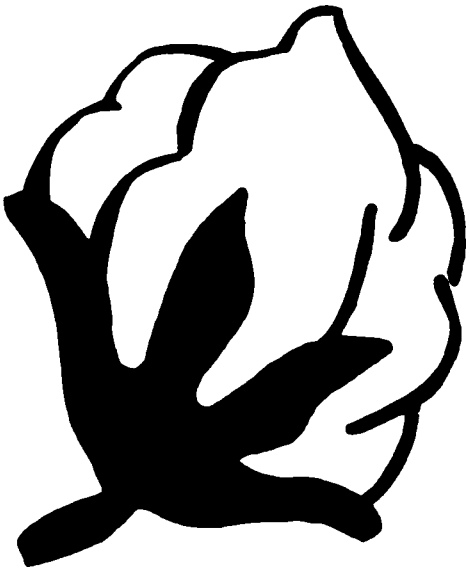

THE ICAC RECORDER

International
Cotton
Advisory
Committee

Technical
Information Section

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- **Update on cotton production research**
- **Nouvelles recherches cotonnières**
- **Actualidad en la investigación de la producción algodonera**

Contents

Introduction

In Greece, cotton is grown on about 400,000 hectares and it has a high socioeconomic importance. Cotton production is characterized by intensive farming with high inputs, with yields among the highest in the world. Foreign varieties are more popular than local varieties because of the liberty to import any variety recommended for cultivation in Europe. Insects are not a serious problem but plant resistance to wilt is necessary. Though land holdings are small, all farming operations including picking of cotton are mechanized. Production costs are high because of high input and labor costs and it would not be possible for Greece to continue producing cotton without the support of the European Union. The first article is on the status of cotton production in Greece, written with the objective of informing participants in the WCRC-2 about the cotton situation in Greece.

The Hellenic Cotton Board is the apex body on cotton in Greece and, in cooperation with the Greek Ministry of Agriculture and National Agricultural Research Foundation, is hosting the World Cotton Research Conference–2 in be held in Athens from September 6-12, 1998. A brief note on activities and achievements of the Hellenic Cotton Board is included here.

The US cotton industry is experiencing drastic changes in many aspects of cotton production. Apart from improvements in cotton varieties, which are believed to bring steady improvements in production, some of the new technologies that are extensively being pursued are precision/site specific farming, crop monitoring and modelling, gin process control and utilization of transgenic cottons. During 1997 and 1998, detailed reports have been published on the status of precision farming and computer-based plant monitoring systems. A new system of gin control monitoring, also claimed to have an impact on yield improvement through appropriate cleaning and drying during ginning, was reported in the December 1997 issue of *THE ICAC RECORDER*. Transgenic cotton has been discussed in more than one issue of *THE ICAC RECORDER*. The second article continues the discussion on transgenic cotton, concentrating on the economics of growing Bt cotton versus non-Bt cotton.

A DIALOG search on genetically engineered cotton is also a part of this issue.

The Cotton Foundation of the USA has decided to publish a new reference book titled *Uniform Harvest Aid Performance and Quality*. This is the fifth book in a series and is expected to be available some time in 1999. The other four reference books in the Foundation series are *Cotton Physiology*; *Weeds of Cotton: Characterization and Control*; *Vegetable Oils and Agrochemicals*; *and Cotton Insects and Mites: Characterization and Management*. The books can be ordered from

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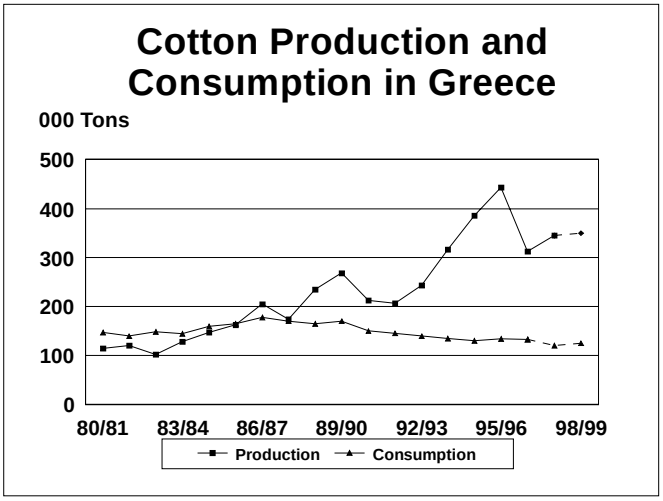
Since 1997, The Cotton Foundation has published an electronic journal on cotton, the *Journal of Cotton Science,* at Internet http://www.jcotsci.org/. The *Journal of Cotton Science* is a multidisciplinary, refereed journal published four times a year. The Editorial Board is comprised of experts in agronomy, arthropod management, weed science, cotton improvement, disease, physiology, soils and plant nutrition, engineering, ginning, quality measurements, cotton and other organic dusts, textile processing and economics and marketing, and, accordingly, papers are published in all disciplines. In addition to the online (HTML) version, a hard copy version (PDF) can be viewed and printed using the Adobe Acrobat Reader.

Cotton Production in Greece

Among the European Union countries, cotton is produced only in Greece and Spain. Cotton is grown on less than 10% of the cultivated area in Greece but is one of the most important cash crops. Because over 60% of total production is exported, cotton is the second largest source of foreign exchange earnings and represents over 35% of total export trade.

Cotton area averaged 150,000 hectares from 1954 to 1984. In the last ten years, however, cotton area has increased to 400,000 hectares.

Greece is one of the highest yielding countries in the world. Since the 1970s yields have averaged 850 kg/ha, although fluctuating from year to year due to the impact of weather conditions at harvest and temperatures at fruit formation.



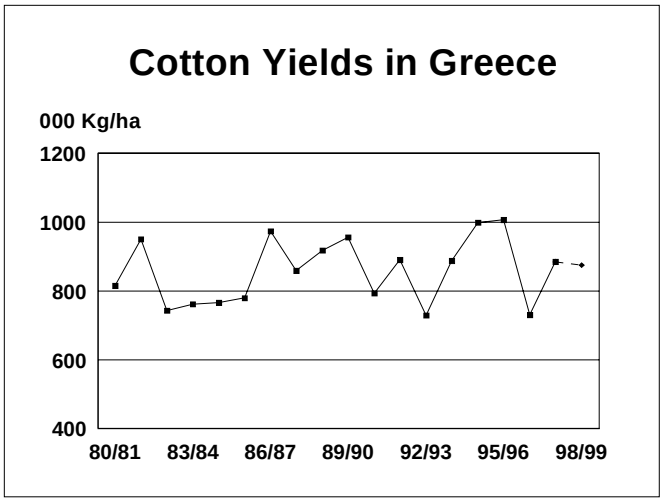
Production Regions

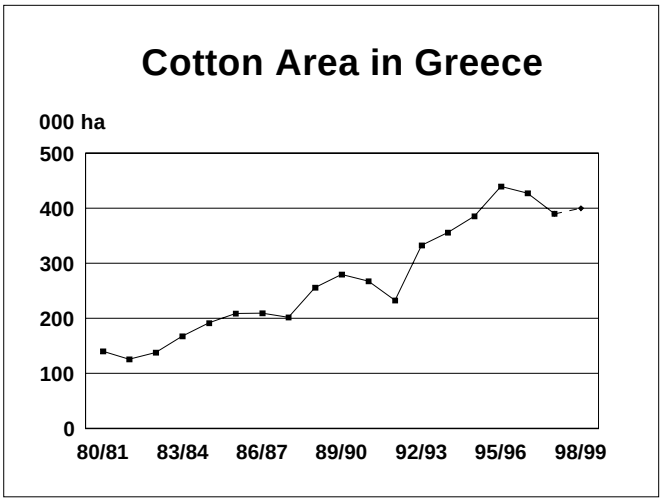
Cotton is grown in Epiros, Macedonia, Peloponessos, Thessaly, Thrace and the central and western part of Greece. Because of continued harvest damage and losses due to verticillium wilt, cotton production has tended to shift to Thessaly. Currently, Macedonia and Thessaly are major cotton producing areas. Field sizes are larger in Thessaly than in other production areas. Some cotton is also grown on the islands. Cotton area can be divided into three distinct production regions as follows:

Region	Share in Production	Characteristics
North (Macedonia Trace)	40%	This region is comparatively low yielding, has a shorter growing season and requires early maturing varieties. Average yield is 800 kg/ha lint, which is lower than the average yield of the country. Cotton planting under normal conditions would start April 25.
Central (Thessaly)	43%	The main and most productive region. Yields are high but have been affected by over 20 years of growing cotton in a mono-cropping system. Average yield is normally over 1,000 kg lint/ha. Soil is highly infected with verticillium wilt and only resistant varieties can be grown successfully. The large number of varieties permitted for cultivation has become a problem. The planting season starts April 10.
South West (Central Greece, Epiros, Peloponessos)	17%	Conditions are almost similar to the Central Region but yields are relatively higher (1,100 kg/ha). Planting starts ten days earlier than in the North Region.

Growing Conditions

Research recommends planting cotton if the top 5 cm of soil surface is dry and the soil temperature is above 14°C for four consecutive days. Many years of experience have shown that under normal climatic conditions, such a stage is reached by mid-April. Plants start squaring in June. From June to September it is usually dry, with a mean rainfall of not more than 20 mm per month. Picking starts by mid September, and it is completed before the rainy season starts, which extends from November through March.





Cotton is grown by small and medium-size farmers with an average cotton area of less than four hectares. About 95% of the total cotton area is irrigated and self-propelled big sprinklers are commonly used. Lately, drip irrigation has become popular, and about 30% of the total cotton area is irrigated by different types of drips. In the next few years, drip irrigation may be extended to more cotton area. Furrow irrigation is restricted to less than 5% of the area. The number of irrigations varies from two to six. It is mostly sunny during the growing and peak flowering season and over 2,300 heat units are accumulated in Central Greece and Thessaly during the season.

Cotton Producing Areas in Greece

Cotton production conditions in Greece can be characterized as high input, intensive farming. Fertilizer is applied on all area at a rate of over 500-800 kg/ha, 60-80 kg/ha being phosphorous. Potassium is rarely used, but, if applied, it is applied at the rate of 60-70 kg/ha. About 20% of the total cotton area gets at least 2-3 foliar applications of nitrogen. Nitrogen is also mixed in insecticide spray tanks. Most farmers adopt general recommendations from the government but about 15% of them decide based on their observations. During 1998/99 about 4,000 hectares are expected to be in organic production, which in Greece is usually called biological cotton. This production will be exported to Austria and Germany.

Local seed drills are used to plant cotton, and rows are spaced one meter apart, with 15 seeds dropped in one meter. Thinning is not usually required.

Variety Development

The main cotton research facility is based in the North at Sindos, Thessaloniki. The Cotton and Industrial Plants Institute, Sindos, of the National Agricultural Research Foundation under the Ministry of Agriculture is a multidisciplinary institute with most of the work on cotton. The Cotton and Industrial Plants Institute was established in 1931. Though the Cotton and Industrial Plants Institute is the principal research facility, research on cotton is also conducted by universities and other research institutes: University of Athens; University of Thessaloniki; University of Volos; Soil Science Institutes at Thessaloniki and Benakio; Phytopathological Institute, Athens. The Cotton and Industrial Plants Institute has a high priority for breeding, and over 75% of the staff is devoted to the development of new varieties. Zeta 2, which is among the most popular varieties, was developed at the Cotton and Industrial Plants Institute. Zeta 2 has been developed utilizing the Acala types from the USA and is thus also called Greek Acala. Other varieties with similar developmental history developed in Israel and the USA are popular under the names Acala of Israel and Acala of the USA.

Acala SJ2, Stoneville 506, Aria and Ultima are grown on a significant area. The most popular local varieties are Zeta 2, Zeta 5, Korina, Eva and Sindos 80.

Currently, only about 25% of the total area is grown under local varieties. There are over 120 varieties officially permitted for general cultivation in Greece, with 40 of them grown during 1997/98, and 15-20 considered to be planted on a significant area. Because of the large number of varieties, it is difficult to track the actual area under each variety. There is significant year to year variation in the area planted to different varieties.

The 120 recommended varieties include all types of plants, not only those with different morphological characteristics but also different physiological behavior. Early maturity is a high priority but all of them are not comparable in maturity. A large number of varieties is a problem for researchers who specify production technology. The National Agricultural Research Foundation recommends permitting only a few varieties. The currently applied variety approval rules permit automatic approval for cultivation in Greece of any cotton variety listed on the European Catalogue. For example, if a variety is developed in Spain or a new variety is imported into Spain from any part of the world and officially allowed for cultivation, it automatically becomes a recommended variety for Greek growers.

Seed Production

The recommended seed rate is 20 kg/ha, delinted and treated with Vitavax and Captan. There are three different channels regarding adoption of a new variety, i.e., local development of varieties using germplasm of domestic and foreign origins, direct introduction of varieties by the government or private sector, and adoption of varieties on the European Union list. The varieties that are adopted from the European Catalogue do not go through the testing stage. They are not tested for yield performance or fiber quality characteristics against varieties in production. Lack of a standard check is another reason for easy adoption of European Catalogue varieties. As these varieties are adopted directly by growers without scrutiny by researchers, production technology is also imported without adapting it to suit local growing conditions.

Locally developed varieties and direct introductions to Greece pass through evaluation trials conducted by the Institute of Variety Testing, Sindos, before the government recommends them for general cultivation. Yield trials are conducted for two years at five locations and the best performing variety is recommended for commercial production.

Seed production other than breeders' seed is in the private sector. Sister lines, and not the single plants, from the multiple lines are bulked to produce breeder's seed. Breeders of the locally developed varieties are responsible for producing breeders' or nucleus seed and providing it to private seed companies for further multiplication and supply to growers. As single lines are bulked to produce nucleus seed, it is usually available in enough quantity to be grown on 10-20 hectares. The seed production chain is as follows:

Single Lines
↓
Nucleus Seed (Breeders Seed)
↓
Basic Seed
↓
Certified I
↓
Certified II

Basic seed is supplied to private companies for multiplication and to produce Certified I. Certified I, although available in sufficient quantity, is used for further multiplication, and only Certified II is sold to growers for planting.

Self-accountability is the major check in maintaining high seed quality. Farmers' quick reaction to varieties dictates maintaining a high quality standard in seed production and avoidance of unachievable claims about performance. The Hellenic Cotton Board makes sure that certification standards are met. According to the Hellenic Cotton Board, breeders' seed must be 200 meters apart from any other cotton field. Basic and certified seed producing crops must be at least 100 meters away from any other cotton field.

Seedcotton for the purpose of producing seed is delivered to certified ginneries. Seedcotton must have less than 12% moisture, otherwise it is not accepted for seed purposes. Minimum acceptable seed germination is 80%.

Cotton Diseases

Verticillium wilt, damping off caused by *Rizoctonia solani*, alternaria leaf spot caused by *Alternaria macrospora* and bacterial blight *Xanthomonas campestris* pv. *malvacearum* are found in Greece. Verticillium wilt is the most prevalent disease particularly in the Central Region. While damping off, alternaria leafspot and bacterial blight are controlled through seed treatment, susceptibility to verticillium wilt may result in heavy losses. The past two years, 1996/97 and 1997/98, had wilt problems and plant stand was seriously affected in certain parts of the country. In 1996/97 and 1997/98, the national average yield was 730 kg/ha and 885 kg/ha respectively as against 1,007 kg/ha in 1995/96. Experience with verticillium wilt has shown that if susceptible varieties are grown and soil infection is high, yield losses may reach 20-30%. A few years ago, verticillium wilt was a more serious problem in Central and South Greece. Now, to a great extent, it has been suppressed through development of resistant varieties. When favorable climatic conditions, i.e., low temperatures and high humidity, prevail for a long time, infection from the fungus appears during the flowering/boll setting stage. The severity of infection symptoms in diseased

plants varies according to soil, variety and weather conditions, from foliar chlorotic spots at the bottom of the plant to symptoms on the whole plant, up to wilting and partial defoliation. Recently, verticillium wilt has appeared more frequently in Northern Greece, where most of the early maturing varieties are not tolerant to the fungus.

In Greece, cotton varieties need a strong defense against verticillium wilt caused by race A of *Verticillium dahliae* and in the recent past, breeders have increased emphasis on genetic resistance. Resistant varieties have been imported from Uzbekistan and extensively utilized in the breeding program. Tashkent 3 and Tashkent 4 have proved to be a good source of resistance to the disease and multi genes involved in self defense have been successfully transferred to the local breeding germplasm. Among cultural methods, researchers strongly recommend stopping mono-crop cultivation of cotton and adopting rotations. However, it is estimated that on the national level more than 70% of total cotton area is not rotated with any other crop and on 20% of the cotton area wheat is planted only every third year.

Bacterial blight causing angular leaf spots is another disease that has a potential to become a major disease. In Greece, cotton planting starts in the middle of April and continues for almost three weeks. By mid April, soil temperature reaches close to 14°C and soil humidity is also high, which is favorable for the bacterium to start multiplication. Like the April temperature, peak season temperature is also just short by a few degrees of the most favorable conditions for multiplication of the bacterium, i.e. 35°C, but the long-term mono-cropping system contributes to carryover of the pathogen. Acid delinting and seed treatments keep the bacterium under control. Bacterial blight has been recorded in almost every cotton producing country, but it is not a problem in many countries because of lack of favorable conditions, particularly humidity. Cotton seed storage for less that six months helps the bacterium to survive in the seed coat and become active under favorable conditions.

Cotton Insects

A number of sucking insects show up on cotton, but pink bollworm *Pectinophora gossypiella* carries the greatest threat to cotton production in Greece. Cutworms *Agrotis* spp. may also appear some years; if required, granular insecticides are used. Aphids, jassids *Empoasca* spp., thrips and mites appear at different stages of crop development. Aphids attack cotton at an early stage but no insecticides are used to control them. For thrips control, granular insecticides applied before planting have proved to be a successful measure, but chemical control is not required every year. Spider mites *Tetranychus urticae* normally appear on the plant even before aphids, when the plant is at the 2-3 true leaf stage, but, on average, once in three years there may be a need to use insecticides for mites. If required, not more than two sprays are used, preferably in the form of a local treatment. Economic thresholds for various insects are as follows:

Cotton Insects and their Thresholds

Insect	Threshold
Aphids	30 aphids/leaf
Spider mites	3-8 infected plants per 10-meter row
Thrips	2 thrips/leaf
Agrotis	3 larvae per square meter
Pink bollworm	10 larvae/100 bolls
Cotton bollworm	5-8 larvae/100 bolls

Pink bollworm is a major pest every year, and on average 2-3 sprays are used to control it. In case of severe attack, the number of sprays directed to control pink bollworm may go to 4-5. According to researchers, the main reason for carryover of pink bollworm is crop residue left in the field. Though tobacco budworm *Heliothis virescens* does not exist on cotton and cotton bollworm *Helicoverpa armigera* is a minor pest, Bt cotton with Bollgard gene has been tried in Greece for at least two years. The results are inconclusive as yet.

Cotton is infested with a variety of broad leaf as well as grass leaf weeds which include, in the general order of occurrence in cotton fields, *Solanum nigrum*, *Cynodon dactylon*, *Datura stramonium* and *Sorghum halepense*. All area is herbicide treated.

Harvesting and Ginning

Over 95% of total production is machine picked in Greece. In 1972 there were 200 two-row picking machines and only 4% of the total production was machine picked. Now Greece has over 3,000 picking machines and almost every farmer has access to machine picking. A support program of the European Union to buy pickers at a discounted rate encouraged adoption of mechanical picking, and the Hellenic Cotton Board has played an important role in popularizing it. The Hellenic Cotton Board undertook research projects on mechanical picking and devised cultural practices suitable for machine picking. The Board also made aggressive efforts to form producer groups to work together. The producer groups pooled resources to buy pickers and use then collectively. Custom picking is also available. Mechanical picking was introduced in the early '60s and can be divided into four stages as follows:

Mechanical Picking in Greece

Stage	Period	No. of Picking Machines	% of Crop Harvested Mechanically
I	End of '60s	200	4
II	End of '70s	1,100	50
III	End of '80s	1,800	70
IV	1997	>3,000	95

Ginning is in the hands of the private sector and ginners are very active in the Greek cotton industry. The principal reason for their active role is processing of the subsidy from the European Union. There are 84 ginning factories scattered throughout the cotton growing areas in Greece. Most factories are

equipped with international standard machinery and keep aware of new developments in the ginning industry. The ginning capacity is enough to process all cotton production very easily. As there are no plans for extension in area, there is no need for additional gins.

Most of the seed goes to crushing mills. There are 26 oil extraction plants with a facility to process seed cake suitable for the livestock industry. The Hellenic Cotton Board is also responsible for monitoring quality standards for oil and cotton seed cake.

Cotton Production by Type

Type	Ten Years Average (1987-96, %)	1996/97 (%)
White	74	51
Light Spotted	19	33
Spotted	5	13
Tinged	1	2
Light Gray	< 1	< 1
Gray	< 1	< 1

Quality Standards

Farmers sell their seedcotton directly to gins. For the sake of fixing the price, seedcotton has five grades, A, B, C, D and E. All cotton growers sign contracts with ginning factories when selling their produce. A copy of the contract is provided to the Hellenic Cotton Board who makes sure that a minimum price is paid to the grower. Premiums, discounts and subsidy are adjusted at a later stage.

All cotton is classed, bale by bale, by trained classers. High volume instruments (HVI) are also partially employed, but grades are based on physical inspection by classers. The Hellenic Cotton Board, in addition to its main office in Athens, has 19 regional offices where classing is done. Low August temperatures may affect fiber maturity and consequently micronaire value. Zeta 2 is mostly used as a standard for fiber characters, particularly for fiber strength measuring 100-105/000 psi. Staff posted at regional stations visit every gin and collect two samples/bale. Samples are brought to the respective classing offices, classed and data on diskettes are provided to the Hellenic Cotton Board. 5% of samples are also analyzed for moisture content; if found below 8.5%, the weight of the bale is adjusted.

Greek cotton is mainly white cotton. Rains at the time of picking have a drastic effect on quality, as in the last two seasons. Data for 1996/97 indicated that white grade production was lower by about 22%.

Hellenic Cotton Board

Host of the World Cotton Research Conference–2

The Hellenic Cotton Board is a state organization under the Greek Ministry of Agriculture. The Board is a principal institution in production and development work on cotton in Greece. Its main functions and activities involve all segments of the cotton industry. It advises and offers services on cotton production, marketing, ginning, cotton classification, certification of seed production, testing and quality control of seed, fiber and textile products, processing, research, EU regulations and cotton policy applications in the country. The Hellenic Cotton Board is headquartered in Athens but maintains 19 regional offices throughout the cotton producing areas.

Functions

The main functions of the Hellenic Cotton Board are to

- Monitor various aspects of cotton production in order to devise a suitable policy for production and use of cotton and accordingly advise the Ministry of Agriculture to formulate its programs.
- Provide technical support, promote modern techniques and advise cotton producers on all aspects of cultivation, crop protection, choice of adequate varieties and farm machinery.
- Advise ginning factories on their establishments and equipment, and control their proper functioning.
- Classify Greek production bale by bale and provide quality control of raw cotton and textile products. Distribute official Greek standards for cotton classification.
- Supervise and maintain a complete record of cotton trade, consumption, exports and imports.
- Provide technical support to the cotton industry in order to achieve quality improvement and to overcome eventual difficulties of industrial production and reduce the cost of production.
- Undertake research projects, alone or in cooperation with universities and research institutes, on many aspects of production research and fiber quality.

Achievements

The Hellenic Cotton Board has made significant contributions to the improvement of cotton production in Greece, leading to the development of a successful cotton production sector. Some most recent ones are listed below.

- In order to overcome the problems of small land holdings, land fragmentation, expensive picking operations and lack of labor, the Hellenic Cotton Board implemented a very successful program for formation of groups and unions of farmers. Consequently, the program popularized mechanical cultivation, especially harvesting, and triggered reduction in cost of production.
- The Hellenic Cotton Board launched promotional campaigns for integrated pest management at the farm level, which lowered insecticide usage and had an impact on environmental protection.
- In the presence of a large number of recommended cultivated varieties, it was extremely difficult to keep varietal purity. Through strict certification standards, the Hellenic Cotton Board provided quality control of planting seed, which helped in purity maintenance of cultivated varieties. The Board ran vigilant campaigns for the promotion of varieties resistant to verticillium wilt and most suitable for Greek conditions.
- The Hellenic Cotton Board maintains laboratories with the latest equipment for HVI classification, quality control of seed, fiber, yarn and textile products.
- The Board played a significant role in income support for 120,000 cotton-producing families and 80,000 families involved in cotton processing operations.
- Cotton production has become the highest earning agricultural commodity in Greece
- Cotton production was introduced in marginal lands. Consequently, cotton area increased to over 400,000 hectares, lowering the high rate of urbanization in Greece.
- The Hellenic Cotton Board has been very active in promoting regional cooperation particularly through the Inter-Regional Cooperative Cotton Research Network for the Mediterranean and Middle-East Regions, as well as bilateral cooperation with universities and institutes within the country and abroad

On behalf of the Government of Greece, the Hellenic Cotton Board serves as a coordination agency with the International Cotton Advisory Committee. In collaboration with the Ministry of Agriculture and National Agricultural Research Foundation, the Hellenic Cotton Board is sponsoring and hosting the World Cotton Research Conference–2 to be held in Athens from September 6-12, 1998.

US Reaction to Bt Cotton

Genetically engineered Bt crops were grown on commercial scale for the first time in 1996. Despite considerable controversy, the US Environmental Protection Agency gave the go-ahead in 1995 for Monsanto, Ciba-Geigy, and Mycogen to sell cotton, corn and potato seed for planting on commercial scale. The three crops were engineered to contain an insecticidal toxin from *Bacillus thuringiensis*, a soil bacterium. The development of insect resistant crop varieties is so far the most successful application of agricultural biotechnology research. The Bt transgenic crops contained a *Bacillus thuringiensis* gene, capable of producing the insecticidal protein CryIA throughout the life of the plant. The toxin is produced by both the plant and the bacterium gene working together. Transgenic cotton resistant to the herbicide bromoxynil was also introduced almost at the same time. Though herbicide tolerant cotton also derived its resistance to the herbicide from a gene transferred from a bacterium, the two transgenics did not affect each other. Roundup Ready herbicide-tolerant varieties were grown on a commercial scale for the first time in 1997. Different transgenics have been named differently and, currently, the following types of transgenic cotton are available for commercial production in the USA.

Bt cotton – It is the most commonly used name derived from *Bacillus thuringiensis* and applies to varieties resistant to insects only. Bt cotton is called Bollgard® in the USA and Ingard® in Australia. Currently, all Bt varieties have the same gene but many new genes are being explored for expanding the basis of resistance.

BXN cotton – Like weeds, cotton is also susceptible to herbicides. A gene was obtained from the soil bacterium *Klebsiella ozeanae* and inserted into cotton so that a broad-spectrum herbicide Buctril® could be sprayed over the crop. Such varieties are called BXN varieties. The bacterium gene codes for the enzyme nitrilase and is capable of removing nitrile atom from the compound and detoxifying bromoxynil. The most appropriate time for spraying the herbicide is at the 2 to 4 leaf stage but can be used until 75 days to harvest.

Roundup Ready cotton – Roundup Ready varieties are resistant to the herbicide Roundup Ultra in vegetative tissues but reproductive parts are susceptible. Roundup Ultra can be sprayed over the cotton crop to control a broad spectrum of weeds, particularly broad leaf weeds. Roundup Ready varieties contain a gene that provides the plant with an alternate pathway to produce the required essential amino acids. According to McD. Stewart (1991), resistance to glyphosate has been accomplished by two means: (1) placing of a strong constitutive promoter in front of a specific enzyme so that the enzyme is over-produced; and (2) making the enzyme insensitive so that aromatic enzymes are not produced. The most appropriate time for spraying the herbicide is not later than the 4-leaf stage or four nodes above the cotyledonary leaves.

Bt + Roundup Ready cotton – Two genes resistant to bud/bollworms and glyphosate herbicide have been inserted in one genotype. Such a variety is also called a "stacked gene variety" and is the first type of cotton that has at least two non-cotton genes. Roundup Ready insect-resistant transgenic varieties were planted on a commercial scale for the first time in 1998.

Bt + BXN – It is a mix of Bt and BXN non-cotton genes. Only one stacked gene variety, BG 4740 was available for planting during 1998.

Area under Transgenic Cotton in the USA

Transgenic Cotton	1996	1997	1998
		Million Hectares	
Bt cotton	0.73	1.01	0.6
BXN varieties	Seed production	0.12	0.8
Roundup Ready	Seed production	0.32	1.2
Bt + Roundup Ready	-	Seed production	0.4
Bt + BXN	-	Seed production	0.2
Total	**0.77**	**1.46**	**3.3**

In the USA, cotton is planted in 16 states divided into four different regions: West, Southwest, Delta and Southeast. Production characteristics of these regions differ. Herbicide tolerant cotton having resistance to bromoxynil or glyphosate could be planted successfully in any area infested with broad leaf weeds. But, Bt cotton is not suitable for planting in all states in the USA. The toxin produced by the Bt gene is specific in action and most effective against tobacco budworm, *Heliothis virescens*. The toxin does have a toxic effect on many other species of bollworms but the mortality rate is not comparable to that of the tobacco budworm. Accordingly, the areas that are affected by bollworms, particularly tobacco budworm, are more suitable for Bt cotton.

Need for Bollworm/Budworm Resistant Cotton

As in all other countries, cotton is attacked by a variety of insects in the USA. Since 1979, losses due to insects have been assessed at state and national level. At the time the survey was initiated, 20 years ago, boll weevil, boll/budworm, cotton flea-hopper, lygus bug, cotton leaf perforator, pink bollworm, spider mite and thrips were important insects. Minor insects were included under "others." While the "others" list has changed over time, aphids, beet and falls armyworm were added to the main insect list in 1989. In 1992, the European corn borer and sweetpotato whiteflies, now among the major insects in the Southeast and West respectively, were added to the main insects list. Now the list contains 21 insects responsible for economic losses to cotton in the USA (Williams, 1997).

Since 1979, in terms of losses in yield, the boll weevil has been a major pest only three times. Out of 18 times, 13 times boll/budworms caused more losses in yield than any other insect. Insect pressure varies from year to year and, accordingly, also the loss in yield due to a particular insect or group of insects. But, with the exception of only one year, boll/budworms have been either the first or second most important insect responsible for maximum loss in yield.

After many years of research it was concluded that boll weevil could be controlled successfully if it is attacked at the most vulnerable stage. Accordingly, the boll weevil eradication program was initiated in the USA and has proved successful in eliminating boll weevil in the Southeast and minimizing the population in many other states. Boll/budworms, which are in fact the major insects in the USA, require very careful monitoring of the pest population in addition to use of insecticides. While cost of insecticides increased, assessing pest damage and deciding when it is economical to spray also became very critical in plant protection. Boll/budworm control required changes in the traditional chemical control approach and that came in the form of transgenic varieties.

Losses in Yield Due to Insects

Year	Total Losses Due to Insects	Losses Due to Boll/Budworms
	%	%
1993	6.86	1.56
1994	6.03	1.8
1995	11.08	5.65
1996	6.61	2.37
1997	9.42	2.01

Cotton Production Regions and Their Characteristics

Cotton Region	States in the Region	Area 1997 % of Total	Production 1997 % of Total	Yield 1997 Kg/ha	Major Boll/Budworms	% Area Under Transgenics in 1997
West	Arizona, California	9	17	1,347	Pink bollworm, beet armyworm	18
Southwest	New Mexico, Oklahoma, Texas	42	31	606	Heliothis species, boll weevil	-
Delta	Arkansas, Louisiana, Missouri Mississippi, Tennessee	26	31	862	Heliothis spp., boll weevil beet armyworm	18
Southeast	Alabama, Georgia, Florida North Carolina, South Carolina Virginia	23	22	716	Tobacco budworm, bollworm	34

Cost of Bt Technology

Bt technology is not free for farmers, as they have to pay for the non-cotton gene that has been inserted into cotton. There is no doubt that it took many years for the private companies to find suitable genes, devise appropriate methods to diffuse them into the cotton genome, test new genotypes and satisfy all regulatory approval requirements before the seed was offered for commercial production. Fees charged to growers are related to the benefits/savings in planting transgenic cotton varieties. It was assumed that if Bt cotton was planted it would significantly reduce the need for spraying insecticides and, accordingly, the fee was related to the savings in insecticide use. Each farmer interested in planting Bt varieties had to sign an agreement with Monsanto Company and one of the important conditions has been not to keep the seed for next year nor pass it on to other cotton growers. Monsanto apparently intends to reap technology benefits for years.

In the absence of competition for the same type of varieties, it was not possible for transgenic cotton growers to negotiate the technology fee. During 1997 farmers could grow BXN varieties or Roundup Ready varieties. However, after 1997 the US Environmental Protection Agency stopped application of bromoxynil on BXN varieties. In March 1998, the Environmental Protection Agency once again granted registration for use of Buctril® on BXN cotton. BXN varieties seed was available for sale in 1998 but no technology fee for BXN gene was charged. The technology fee for various products is not constant. It may go up if stronger genes are identified and inducted into cotton, and it may go down if more companies identify new genes and offer insect resistant varieties with a variety of gene options.

For 1998, Monsanto has maintained the conditions of the agreement but has decided to make it a long duration agreement. Now farmers do not have to sign the agreement every year, but rather it will remain effective until either Monsanto or the concerned grower decides to terminate it. Monsanto has also decided to calculate the technology fee based on the variety planted and the seed drop rate for specific area. The seed drop rate is the number of seeds dropped from the planter to achieve the target plant stand.

Economic Benefits

Several studies have evaluated the economic performance of Bt cotton versus non-Bt cotton in the USA. Monsanto, the sole owner of the Bt gene technology, undertook a number of farmers' field studies to assess the economic benefits of Bt cotton. Monsanto collected data from comparable fields across regions in 1995 (from experimental use permits), 1996 and 1997. It was concluded that the combined cost of chemical control operations and the technology fee for Bt cotton could be less or more than insecticides for non-Bt varieties. However, Monsanto found a yield advantage in Bt varieties in the Southeast and Delta Regions. Similar studies in East Texas during 1996 and 1997 showed 33% higher insect control costs for Bt cotton but higher lint yield. Net return benefits were smaller in East Texas. In a widely circulated brochure (004-98-036, 1/98) and a paper presented at the 1998 Beltwide Cotton Conferences (Wier et al 1998), Monsanto has claimed that in the Southeast Region, on the average from 1995-97, Bollgard cotton produced additional returns of US$135/ha.

The Monsanto data showed that the economic advantage of growing Bt cotton does not depend solely on the cost of insect control operations. Insect control cost could be higher in Bt cotton (with most money spent to control insects other than boll/budworms. Bt cotton appears more suitable for the Southeast Region followed by the Delta Region. Economic evaluation of Bt cotton for some states in these two regions is discussed here. Data for other states are not available.

As shown in the table below on losses due to insects, boll/budworm losses were quite high in the USA during 1995/96. 1996/97 was a good year to introduce Bt cotton. Among all cotton producing states in the USA, Alabama

Technology Fee for Transgenic Cotton

Transgenic Cotton	1996 US$/ha	1997 US$/ha	1998 US$/ha
Bt cotton	80	80	80
BXN cotton	-	15	Free
Roundup Ready	-	12 = Stripper varieties 20 = Picker varieties	17 = Stripper varieties 22 = Picker varieties
Bt + Roundup Ready	-	101	101
Bt + BXN	-	-	80*

* BXN gene is free in 1998.

Performance of Bt vs Non-Bt Cotton 1995-1997

	Southeast Region		Delta Region		East Texas	
	Bt Cotton	Non-Bt Cotton	Bt Cotton	Non-Bt Cotton	Bt Cotton	Non-Bt Cotton
Lint yield (kg/ha)	1,046	918	1,081	1,030	612	548
Insect control (US$/ha)	114	66	198	213	162	103
Total return (US$/ha)	1,385	1,250	1,351	1,263	710	683
Bollgard advantage (US$/ha)	135		88		27	

Note: The cost of insect control in Bollgard includes the technology fee at the rate of US$80/ha. Total return figures are based on US$1.43/kg lint price.

is most affected by tobacco budworm. During 1994 and 1995, tobacco budworm most seriously affected cotton production in Alabama. Farmers there welcomed Bt cotton, and, out of the total cotton area of 227,000 hectares, Bt cotton was planted on 174,000 hectares, 77% of the total area. Consequently, insecticide usage was significantly reduced to the lowest level since synthetic insecticides were introduced. Only 20% of the total transgenic varieties area received any insecticide application and 10% of the area was sprayed only once. The average state yield increased significantly over 1995 to 840 kg/ha. Higher yields brought additional profit to growers (Smith, 1997).

According to Sutton (1998), it was not profitable to grow Bt cotton in Arkansas during 1997. Two similar fields on the same farm at seven locations were selected for comparing cost of production and net return from Bt versus non-Bt cotton varieties. Both fields were cultivated with the objective of maximizing yield and profit to the farmer. The differences between the Bollgard and non-Bt fields were in the area of technology fee, cost of insecticides and their application, growth regulators and second harvest costs. Based on harvested yield and an estimated price of US$1.37/kg of lint, net returns were calculated for Bollgard and conventional varieties.

In most Bt fields, the additional cost of the seed, the necessity of using plant growth regulators, the technology fee and the need to make second pick were responsible for higher cost of production. At three locations, net return was higher in Bt fields but the average of all locations indicated that there is a net loss in planting Bt cotton, partly because of lower yields in Bt fields at some locations. The studies were conducted by the University of Arkansas and reported at the 1998 Beltwide Cotton Conferences in January 1998. According to Kelly Bryant and colleagues, Bt cotton was profitable in 1996, with the difference in net income ranging from a US$39/ha decrease to a US$439/ha increase. During 1997, however, insect pressure was low in Arkansas, which saved on insecticide use in non-Bt varieties and changed the economics of Bt cotton. Bryant et al (1997) concluded that Northern Arkansas, where bollworm pressure is not as high as in Southern Arkansas, might not be economically suitable for Bt cotton.

In principle, if budworms and bollworms are controlled from the very beginning by planting Bt varieties, the plant should enter into the fruiting phase earlier than non-Bt varieties. And, if the plant has bolls from the beginning, it automatically avoids overgrowth and would not require growth regulators. The maturity of the crop should also be earlier and what went wrong in Arkansas during 1997, resulting in late crop maturity and required additional picking, is difficult to explain.

Gibson et al (1997) compared the costs and returns associated with growing Bt cotton and non-Bt cotton in Mississippi for two years. The data included test plot observations and surveys of farmers' fields. Both data sets indicated that Bt cotton had economic advantage over non-Bt cotton during both years. The total cost of production was not different in Bt and non-Bt cottons but higher yields in case of Bt cotton produced significant differences in net return to farmers. During 1995, due to high insect pressure, the cost of insecticides was reduced by one-third in Bt cotton. However, Bt cotton required more expense in the form of fertilizers, fungicide treatments and the technology fee. During 1996, though, the cost of insecticides was lower than in non-Bt cotton, but the additional cost of the technology fee for the Bt gene made insect control in Bt cotton more expensive. Yield in Bt cotton was again higher in 1996 but with a lesser margin and, accordingly, the advantage of growing Bt cotton was not as large as in 1995.

Monsanto's data (Wier et al 1998) suggests the performance of Bt versus non-Bt cotton in Mississippi has been similar to that reported by Gibson. Insect pressure during 1996 was low in Mississippi lowering the insect control costs of non-Bt cotton to the same level of Bt cotton. The data below indicate that in Mississippi, the economic advantage of planting Bt cotton was greatest during 1995.

ReJesus et al (1997) conducted two on-farm trials in South Carolina during 1996 and recommended adopting Bt cotton over non-Bt cotton. Data indicated non-significant differences in yields; however, the cost of insecticides was lower for Bt cotton.

In a separate study (ReJesus et al 1997) in South Carolina, farmers' reasons for planting Bt cotton were surveyed. Potential benefits from savings in insecticide use was the main reason for planting Bt cotton but fewer than 10% of farmers found yield increase the basis for planting Bt cotton. Most farmers did not expect to use pyrethroids, but at least 30% of them had to apply them.

In Georgia, a statewide project was conducted during 1996 to evaluate the economic benefits of growing Bt cotton. Eight farmer field level research experiments were laid out on Bt and non-Bt varieties planted in close proximity and under uniform growing conditions. The results indicated that on average Bt cotton yielded 116 kg/ha more lint over non-Bt varieties at the

Performance of Bt vs Non-Bt Cotton in Mississippi 1995-1997

	1995		1996		1997	
	Bt Cotton	**Non-Bt Cotton**	**Bt Cotton**	**Non-Bt Cotton**	**Bt Cotton**	**Non-Bt Cotton**
Lint yield (kg/ha)	1,086	983	1,002	950	1,103	1,009
Insect control (US$/ha)	176	232	157	144	209	204
Total return (US$/ha)	1,380	1,176	1,279	1,218	1,372	1,239
Bollgard advantage (US$/ha)	204		61		133	

same producer's farm. The number of sprays was reduced by 2.5 sprays/field. Subtracting the technology fee of US$80/ha, on the basis of the 1996 pest situation, it was profitable to shift to Bt cotton in Georgia (Stark, 1997).

Additional Remarks

Limited choice – When Bt cotton was introduced in 1996, only two varieties NuCotn 33^{B} and NuCotn 35^{B} were offered for planting. Similarly, during 1998 Bollgard + Roundup Ready genes are available in two varieties, i.e., DP 458 B/RR and DP 688 B/RR, and Bt+BXN gene is available in only one variety, BG 4740. However, over 2 million hectares are seriously affected by tobacco budworm and bollworms in the USA and are considered to be suitable for planting Bt cotton with the current bacterium gene. Farmers are now being offered many Bt and Roundup Ready varieties and hopefully also for stacked gene varieties. If a Bt variety is not suitable for the one area, farmers may suffer some loss in yield and consequently dilute the performance of Bt cotton.

Impact of Bt cotton – In the long run Bt cotton will have a significant impact on production practices, particularly insect management. Currently, three possible results from Bt cotton are 1) the Bt toxin will contain some lepidopteran insects and, though the cost of insecticides will not increase, the yield of Bt cotton will be higher than non-Bt varieties; 2) Bt cotton will keep insect pressure below threshold levels and while there may not be a significant increase in yield, Bt cotton will bring significant reduction in insect control costs; and 3) a mix of the first two—there will be some reduction in insect control costs and there will also be some increase in yields. The latter seems most descriptive of the increasing number of experiments being reported.

Target for yield increase – None of the currently available commercial genes is supposed to boost yield potential. However, sub-threshold control of insects and weeds would affect yield and is the source of yield increases in Bt and herbicide resistant cottons. There is no evidence to suggest that genes are being explored, which could target physiological changes in the plant to give higher yield.

Abnormal behavior – Both Bt and Roundup Ready cottons showed unexpected reactions to the growing conditions in some areas during 1996 and 1997 respectively. Though so called ineffective control of worms by Bt cotton and malformation of leaves and shedding in Roundup Ready were small scale problems, the new gene's existence in the cotton genome may react undesirably to environmental conditions, particularly if they have changed from the period when transgenic cotton was tested.

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Short Notes

• A New Device to Repair Broken Bale Ties

The most common bale weight in the world is 218 kg. However, bales are smaller in Angola, Brazil, India, Myanmar, Pakistan, Sudan and Uganda weighing less than 200 kg. In China (Mainland) two types of bales are produced, 175 kg. (the size in India and Pakistan) and 80 kg. Export quality bales from Egypt are the heaviest in the world and on the average weigh 300 kg/bale. Whatever their weight, bales are commonly tied with six to eight ties. In India, Iran and Kirghizstan 10-12 ties/bale are used to secure the bale properly. Because bales are smaller in Thailand, they are tied only three times.

However secure the bale may be tied, there is always the risk of breaking during handling. Straps or wires, which encircle the bale, may break on the sides or middle of the bale while moving cotton from a gin to a warehouse or during the subsequent handling processes. Ties may break due to insufficient compression density, poor lint distribution within the bale, tying material that does not match the compression density, insufficient moisture in the bale, defective bale ties and failure to join them properly. Mishandling of bales and improper storage may also damage bale ties and result in their breakage.

If the ties break, the bale gets not only misshaped but more susceptible to contamination and occupies more space in the warehouse and during shipping. If the straps or wires break while the bale is still in the gin, the bale can be repaired though it has to be unpacked and repacked involving manual labor. Replacement of the wrapping material and recompression add to the cost while normal ginning operations have also to be stopped. Though expensive, it is easier to repair bales at the gin.

Some data show that in the USA on the average 0.4% bales experience broken ties every year. If the total US production is 20 million bales, about 800,000 bales will be repaired annually. The extent of shape defect, need for repair, need for unpacking and repacking, etc., will depend on the number of broken ties. Assuming that all necessary care is taken to avoid strap/wire breakage, some ties still will break due to various reasons.

The USDA-ARS Cotton Ginning Laboratory at Stoneville, MS, USA has developed a mobile device that can be used to recompress the bale only in the area of defective ties allowing replacement of individual or multiple straps/wires. The machine can be put on a trailer and moved to a warehouse or mill and easily used to repair defective bales. Currently, two models are available—manual and semiautomatic. Normal pressing time at the gin is one-minute/bale with four operators taking 30 minutes to repair the broken bale. With the help of the new device, one operator can repair 1 to 4 ties in 5 to 10 minutes. The machine works well in horizontal as well as vertical mode. Source: *The Cotton Gin and Oil Mill Press*, Vol. 99, No. 9, April 25, 1998.

• Some Basics of the Boll Weevil

Name

Latin name: *Anthonomus grandis*
Common name: Mexican boll weevil
Spanish name: Picudo

Related Species: *Anthonomus vestitus*

Affected region

It is a pest of the Americas only. Most countries in Central, North and South America have boll weevil as a major cotton pest.

Entry into some countries

USA: 1892
Venezuela: 1949
Colombia: 1950
Brazil: 1983
Paraguay: 1991
Argentina: 1993

Next possible target

Bolivia

Most hit countries

Many Central American countries like Costa Rica, El Salvador, Guatemala, Honduras and Nicaragua had to quit cotton production due to their inability to control the boll weevil economically.

Description

Egg: White, elliptical, 1 mm in length
Larva: White, legless, 6-8 mm at full-grown stage
Pupa: White, resembles adult weevil, 6-8 mm long
Adult: Grayish brown, prolonged snout, front leg has two spurs inside of leg, 8-10 mm long

Life cycle

Egg: Egg hatching in 3-5 days
Larva: 7-11 days inside the square
Pupa: 3-5 days inside the square
Adult: Feeds 2-4 days before laying eggs
No. of generations a year: Depends highly on climatic conditions. On the average, 8 generations exist in most countries.

Damage

Fruit is affected in two ways, feeding and egg laying. Males and females make a hole in the upper half of the flower bud and feed on anthers. Affected buds are mostly shed but may result in partial fertilization and deformed bolls with few seeds. Females lay their eggs inside the flower bud through a hole made in the lower part of the bud. After the eggs have been laid, the female seals egg punctures. Affected squares turn yellow and mostly drop to the ground in 2-3 days.

Alternate hosts
Cotton is the preferred plant but during the off season, many perennial plants serve as alternate hosts.

Favorable conditions for over-wintering
Mild winter
Perennial cotton
Frequent rains and high humidity
Excessive irrigation

Undesirable conditions for existence
Hot and dry weather during summer and cold and lack of vegetation in winter restrict multiplication of the boll weevil.

Most successful program
In the USA, the Boll Weevil Eradication Program has successfully eliminated the boll weevil from the Southeast.

Important components of the control strategy
Minimize the population whose next generation will coincide with the peak flowering stage.
Minimize the population going into hibernation.
Minimize the population emerging from over-wintering

Biological control
Wasp: *Catalocus grandis*

Bt cotton
Bt cotton resistant to boll weevil is not available yet but may become available in the next few years.

Resistance to insecticides
Boll weevil has a potential to develop resistance to insecticides but not equivalent to that of whitely and many bollworms.

International project
Integrated pest management of the boll weevil in Argentina, Brazil and Paraguay. The project is sponsored by the ICAC and funded by the Common Fund for Commodities.

Free exchange of information
Since July 1996, the ICAC has sponsored the Boll Weevil Mailing List on the Internet for exchange of information, which is open to anyone anywhere in the world. Interested researchers can exchange views and ask questions from the list participants on any aspect of boll weevil. Participation is free. To join the list, consult the ICAC web page at URL: http://icac.org/liststar/listserver.cgi or send an email message to bollweevil@liststar.icac.org.

• Cotton Production and Consumption

China (Mainland) is the largest cotton producer and consumer in the world. During 1998/99, production is expected to be 4.4 million tons as against consumption of 4.6 million tons. During 1998/99, production in the USA—the second largest cotton producing country—is also expected to be lower than the last year. US production in 1997/98 was 4.1 million tons and production in 1998/99 is estimated at 3.4 million tons. Only 60% of US production is consumed by the local textile industry. Current ICAC projections show that the US will export about 1.22 million tons in 1998/99 which is 10% more that total production in Uzbekistan or Francophone Africa. India is the 3rd largest cotton producer in the world with estimated production of 2.7 million tons in 1998/99. Production in India will be slightly short of local consumption by the textile industry. Last year, bollworm damage during September and rains during October affected cotton production in Pakistan. Total Pakistan production in 1997/98 will be 1.53 million tons, as against estimated local consumption of about 1.57 million tons. In Pakistan, 1998/99 is not expected to be different from the last year. Uzbekistan is expected to produce 1.13 million tons during 1998/99, and 80% will be exported to other countries as raw cotton.

During 1997/98, cotton was planted on 8.81 million hectares in India, more than in any other country. Leaf curl virus damage in the northern region has affected cotton's competitiveness against other crops, and many growers will consider growing alternate crops in 1998/99. During 1997/98, cotton was grown on about 5.37 million hectares in the USA and harvested area during 1998/99 is estimated at less than 5.1 million hectares. In China, cotton bollworm resistance to insecticide seriously affected area in the last few years and only 4.6 million hectares were grown to cotton during 1997/98, as against 6.4 million hectares in 1991/92. In China, cotton production is moving to Xinjiang in the northwest, with this region now contributing over one-fourth of total production. It is estimated that 4.4 million hectares may be planted to cotton in China during 1998/99. In Pakistan, 2.88 million hectares of cotton were grown during 1997/98 but there is a potential to bring more area to cotton from other crops as soon as growers feel safe from the leaf curl virus. However, increase in area is not anticipated in 1998/99. In Uzbekistan, area is almost stable around 1.5 million hectares.

In the Northern Hemisphere, planting of cotton starts in March/April and is completed in 2-3 months in most countries. Most countries in the Southern Hemisphere start planting in October. The current ICAC estimates show that total world production during 1998/99 may be 19 million tons, against consumption of 19.4 million tons. The five largest cotton producing countries will share 70% of production and 60% of consumption in the world. According to the ICAC, ending stocks (carryover from 1997/98) are currently placed at 9.6 million tons and exports and imports of cotton will be approximately 5.7 million tons. The USA will again be the largest exporter of cotton in the world during 1998 followed by Uzbekistan, Francophone Africa, Australia and Argentina. The US share of world exports will be about 23%, while Uzbekistan will export about 17% of total exports in the world.

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A Dialog Search of the Agricola Database on Genetically Engineered Cotton

The keywords used in the search are **Cotton** and **Transgenic** or **Bt** and the period covered is from 1995 to date.

3641803 20619439 Holding Library: AGL
Transgenic cotton resistant to herbicide bialaphos
Keller, G., Spatola, L., McCabe, D., Martinell, B., Swain, W. and John, M.E.
Monsanto, Middleton, WI.
London, UK: Chapman & Hall, c1991- *Transgenic Research,* Nov 1997, V 6 (6), p. 385-392.
ISSN: 0962-8819 CODEN: TRSEES
DNAL CALL NO: QH442.6.T74
Language: English
Includes references
Place of Publication: England
Subfile: IND; OTHER FOREIGN;
Document Type: Article
Descriptors: Gossypium hirsutum - Gossypium barbadense - biolistics - transgenic plants - herbicide resistance - bilanafos - acyltransferases - genetic transformation ;
Identifiers: phosphinothricin acetyltransferase
Section Headings: F200 PLANT BREEDING; H000 PESTICIDES-GENERAL

3637821 20611573 Holding Library: AGL
Helicoverpa/*Heliothis* management in NuCOTN and conventional cotton cultivars in Louisiana
Leonard, B.R., Fife, H., Torrey, K., Graves, J.B. and Holloway, J.
LSU Agricultural Center, Baton Rouge, LA.
Memphis, Tenn.: National Cotton Council of America, 1991- Proceedings / 1997, V 2, p. 863-867.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 6-10, 1997, New Orleans, Louisiana.
Includes references
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article
Descriptors: Gossypium - transgenic plants - insect pests - genetic resistance - insect control;
Section Headings: F821 PESTS OF PLANTS-INSECTS; F200 PLANT BREEDING

3635679 20615004 Holding Library: AGL
Shoot apex transformation of cotton using Agrobacterium
Gould, J., Zhou, Y., Shen, Y., Magallanes-Cedeno and Lou, J.
Texas A&M University, College Station.
Memphis, Tenn.: National Cotton Council of America, 1991- Proceedings / 1997, V 1, p. 453-454.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 6-10, 1997, New Orleans, Louisiana.
Includes references
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article
Descriptors: Gossypium hirsutum - transgenic plants - genetic transformation - agrobacterium tumefaciens;
Section Headings: F200 PLANT BREEDING

3635664 20614982 Holding Library: AGL
Transgenic brown lint cotton
Cooper, H.B., Pellow, J., Palmer, J. and Anderson, D.
J.G. Boswell Company, Corcoran, CA.
Memphis, Tenn.: National Cotton Council of America, 1991- Proceedings / 1997, V 1, p. 447-448.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 6-10, 1997, New Orleans, Louisiana.
Includes references
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76) ;
Document Type: Article
Descriptors: Gossypium - transgenic plants - lint - color - inheritance - herbicide resistance - fiber quality;
Section Headings: F200 PLANT BREEDING

3635655 20614957 Holding Library: AGL
Field evaluation of cotton transformed for tolerance to imidazolinone herbicides
Anderson, D., Pellow, J., Palmer, J., Grula, J., Cooper, H.B. and Rajasekaran, K.
J.G. Boswell Company, Corcoran, CA.
Memphis, Tenn.: National Cotton Council of America, 1991- Proceedings / 1997, V 1, p. 412-414.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 6-10, 1997, New Orleans, Louisiana.
Includes references
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76) ;
Document Type: Article

Descriptors: Gossypium - transgenic plants - herbicide resistance ;
Section Headings: F200 PLANT BREEDING

3635654 20614955 Holding Library: AGL
Fruiting patterns, maturity, and yield of Bollgard and Roundup Ready cotton varieties
Albers, D.W., Williams, C. and Mitchell, J.
Paymaster Cottonseed, Stuttgart, AR.
Memphis, Tenn. : National Cotton Council of America, 1991-
Proceedings / 1997, V 1, p. 411.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 6-10, 1997, New Orleans, Louisiana.
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article
Descriptors: cultivars - agronomic characteristics - transgenic plants - Gossypium;
Section Headings: F200 PLANT BREEDING

3635470 20614659 Holding Library: AGL
Farmers' expectations in the production of transgenic Bt cotton: results from a preliminary survey in South Carolina
ReJesus, R.M., Greene, J.K., Hammig, M.D. and Curtis, C.E.
Clemson University, SC.
Memphis, Tenn. : National Cotton Council of America, 1991-
Proceedings / 1997, V 1, p. 253-256.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 6-10, 1997, New Orleans, Louisiana.
Includes references
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76) ;
Document Type: Article
Descriptors: Gossypium - transgenic plants - farmers' attitudes - insect control - Bacillus thuringiensis;
Section Headings: F200 PLANT BREEDING ; F821 PESTS OF PLANTS-INSECTS

3635466 20614655 Holding Library: AGL
Economics of transgenic cotton: some indications based on Georgia producers
Stark, C.R. Jr.
University of Arkansas at Monticello, AR.
Memphis, Tenn.: National Cotton Council of America, 1991-
Proceedings / 1997, V 1, p. 251-253.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 6-10, 1997, New Orleans, Louisiana.
Includes references
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76); Document Type: Article
Descriptors: transgenic plants - Gossypium - insect control - cost benefit analysis;
Section Headings: E200 FARM ORGANIZATION AND MANAGEMENT; F200 PLANT BREEDING; F821 PESTS OF PLANTS-INSECTS

3635454 20614643 Holding Library: AGL
Economic analysis of insect management strategies for transgenic Bt cotton production in South Carolina
ReJesus, R.M., Greene, J.K., Hammig, M.D. and Curtis, C.E.
Clemson University, SC.
Memphis, Tenn.: National Cotton Council of America, 1991-
Proceedings / 1997, V 1, p. 247-251.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 6-10, 1997, New Orleans, Louisiana.
Includes references
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76) ;
Document Type: Article
Descriptors: Bacillus thuringiensis - transgenic plants - cost benefit analysis - Gossypium - insect control;
Section Headings: F200 PLANT BREEDING; E200 FARM ORGANIZATION AND MANAGEMENT; F821 PESTS OF PLANTS-INSECTS

3635451 20614640 Holding Library: AGL
Comparison of costs and returns associated with *Heliothis* resistant Bt cotton to non-resistant varieties
Gibson, J.W. IV, Laughlin, D., Luttrell, R.G., Parker, D., Reed, J. and Harris, A.
Mississippi State University, Starkville.
Memphis, Tenn.: National Cotton Council of America, 1991-
Proceedings / 1997, V 1, p. 244-247.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 6-10, 1997, New Orleans, Louisiana.
Includes references
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76) ;
Document Type: Article
Descriptors: Bacillus thuringiensis - transgenic plants - cost benefit analysis - Gossypium - insect control;
Section Headings: F200 PLANT BREEDING; E200 FARM ORGANIZATION AND MANAGEMENT; F821 PESTS OF PLANTS-INSECTS

3634730 20613886 Holding Library: AGL
Paymaster's picker type transgenic cotton varieties for 1997
Williams, C., Mitchell, J., Swindle, M. and Albers, D.
Paymaster Technology Corp., Stuttgart, AR.
Memphis, Tenn.: National Cotton Council of America, 1991-
Proceedings / 1997, V 1, p. 40-41.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 6-10, 1997, New Orleans, Louisiana.
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76) ;
Document Type: Article
Descriptors: Gossypium - new variety - transgenic plants;
Section Headings: F200 PLANT BREEDING

3634462 20613572 Holding Library: AGL
Attack of Leaf Curl Virus on cotton crop in Pakistan. Genetic engineering approaches to develop transgenic cotton resistant to Leaf Curl Virus
Saeed, N.A., Zafar, Y., Malik, K.A., Dever, J., Koonce, L. and Trolinder, N.
NIGBE, Faisalabad, Pakistan.
Memphis, Tenn. : National Cotton Council of America, 1991-
Proceedings / 1997, V 2, p. 1508-1509.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 6-10, 1997, New Orleans, Louisiana.
Includes references
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76) ;
Document Type: Article
Descriptors: Gossypium - transgenic plants - geminivirus group - disease resistance;
Section Headings: F833 PLANT DISEASES-VIRAL ; F200 PLANT BREEDING

3633606 20612518 Holding Library: AGL
Improved control of *Heliothis virescens* and *Helicoverpa zea* with a recombinant form of *Autographa californica* nuclear polyhedrosis virus and interaction with Bollgard cotton
All, J.N. and Treacy, M.F.
University of Georgia, Athens.
Memphis, Tenn.: National Cotton Council of America, 1991-
Proceedings / 1997, V 2, p. 1294-1296.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 6-10, 1997, New Orleans, Louisiana.
Includes references
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article
Descriptors: Gossypium - transgenic plants - insect control;
Section Headings: F821 PESTS OF PLANTS-INSECTS

3633590 20612502 Holding Library: AGL
Survival of *Helicoverpa zea* Boddie on Bollgard cotton
Meyers, H.B., Johnson, D.R., Singer, T.L. and Page, L.M.
University of Arkansas, Little Rock.
Memphis, Tenn. : National Cotton Council of America, 1991-
Proceedings / 1997, V 2, p. 1269-1271.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 6-10, 1997, New Orleans, Louisiana.
Includes references
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article
Descriptors: transgenic plants - Gossypium - Helicoverpa zea;
Section Headings: F821 PESTS OF PLANTS-INSECTS

3633580 20612492 Holding Library: AGL
Resistance of cotton with delta-endotoxin genes from *Bacillus thuringiensis* var. kurstaki on selected lepidopteran insects
Jenkins, J.N., McCarty, J.C. Jr., Buehler, R.E., Kiser, J., Williams, C. and Wofford, T.
USDA, ARS, Crop Science Res. Lab., Mississippi State, MS.
Madison, Wis. : American Society of Agronomy, [1949-
Agronomy Journal, Sept/Oct 1997, V 89(5), p. 768-780.
ISSN: 0002-1962 CODEN: AGJOAT
DNAL CALL NO: 4 AM34P
Language: English
Includes references
Place of Publication: Wisconsin
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article
Section Headings: F821 PESTS OF PLANTS-INSECTS; F200 PLANT BREEDING

3633432 20612336 Holding Library: AGL
Evaluation of insecticides for boll weevil control and impact on non-target arthropods on non-transgenic and transgenic Bt cotton cultivars
Parker, R.D. and Huffman, R.L.
IPM, Corpus Christi, TX.
Memphis, Tenn. : National Cotton Council of America, 1991-
Proceedings / 1997, V 2, p. 1216-1221.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English

Meeting held January 6-10, 1997, New Orleans, Louisiana.
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76) ;
Document Type: Article
Descriptors: Anthonomus grandis - insect control - chemical control – non-target effects - Gossypium – transgenic plants;
Section Headings: F821 PESTS OF PLANTS-INSECTS; F200 PLANT BREEDING

3633166 20612061 Holding Library: AGL
Effects of Karate insecticide on beneficial arthropods in Bollgard cotton
Cole, J.F.H., Pilling, E.D., Boykin, R. and Ruberson, J.R.
Zeneca Agrochemicals, Berkshire, UK.
Memphis, Tenn. : National Cotton Council of America, 1991-
Proceedings / 1997, V 2, p. 1118-1120.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 6-10, 1997, New Orleans, Louisiana.
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76) ;
Document Type: Article
Descriptors: Gossypium - transgenic plants - insect control - chemical control - nontarget effects;
Section Headings: F821 PESTS OF PLANTS-INSECTS

3633151 20612046 Holding Library: AGL
Efficacy of Dimilin (Diflubenzuron) and transgenic Bt cotton on several lepidopteran species
Weiland, R.T., McDonald, P.T. and Kish, M.K.
Uniroyal Chemical Company, Inc., Middlebury, CT.
Memphis, Tenn. : National Cotton Council of America, 1991-
Proceedings / 1997, V 2, p. 1095-1099.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 6-10, 1997, New Orleans, Louisiana.
Includes references
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article
Descriptors: Gossypium - transgenic plants - insect control - chemical control - genetic resistance;
Section Headings: F821 PESTS OF PLANTS-INSECTS

3632749 20611626 Holding Library: AGL
Performance and benefits of Karate insecticide on Bollgard cotton
Mink, J., Harrison, S. and Martin, S.
ZENECA Ag Products, Leland, MS.
Memphis, Tenn.: National Cotton Council of America, 1991-
Proceedings / 1997, V 2, p. 898-899.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 6-10, 1997, New Orleans, Louisiana.
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article
Descriptors: Gossypium - transgenic plants - insect control - chemical control;
Section Headings: F821 PESTS OF PLANTS-INSECTS; F200 PLANT BREEDING

3632748 20611625 Holding Library: AGL
Treatment thresholds for stink bugs in transgenic Bt cotton
Greene, J.K., Turnipseed, S.G. and Sullivan, M.J.
Clemson University, Blackville, SC.
Memphis, Tenn.: National Cotton Council of America, 1991-
Proceedings / 1997, V 2, p. 895-898.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 6-10, 1997, New Orleans, Louisiana.
Includes references
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article
Descriptors: Gossypium - transgenic plants - insect control - economic thresholds - Nezara viridula – Acrosternum hilare - Euschistus servus;
Section Headings: F821 PESTS OF PLANTS-INSECTS; F200 PLANT BREEDING

3632747 20611624 Holding Library: AGL
Influence of early season treatments on insect populations and yield in Bollgard (96 BG-1) and sure grow 501 cotton varieties
Scott, W.P., Snodgrass, G.L. and Adams, D.A.
USDA, ARS, Southern Insect Management Laboratory, Stoneville, MS.
Memphis, Tenn. : National Cotton Council of America, 1991-
Proceedings / 1997, V 2, p. 892-895.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 6-10, 1997, New Orleans, Louisiana.
Includes references
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article
Descriptors: Gossypium - transgenic plants - insect control - insecticides - chemical control;

Section Headings: F821 PESTS OF PLANTS-INSECTS; F200 PLANT BREEDING

3632746 20611623 Holding Library: AGL
Efficacy and duration of early season insecticides on transgenic Bt cotton
Ruscoe, J.T., Andrews, G.L., Phelps, J.B. and Bednarz, C.W.
Mississippi State University, Greenville, MS.
Memphis, Tenn.: National Cotton Council of America, 1991- Proceedings / 1997, V 2, p. 888-891.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 6-10, 1997, New Orleans, Louisiana.
Includes references
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article
Descriptors: Gossypium hirsutum - transgenic plants - insect control - chemical control - insecticides – Helicoverpa zea - Lygus lineolaris - Heliothis virescens;
Section Headings: F821 PESTS OF PLANTS-INSECTS; F200 PLANT BREEDING

3632739 20611616 Holding Library: AGL
Resistance monitoring in Bt cotton : first year observations
Hardee, D.D., Streett, D.A., Adams, L.C. and Elzen, G.W.
USDA, ARS, Southern Insect Management Laboratory, Stoneville, MS.
Memphis, Tenn. : National Cotton Council of America, 1991- Proceedings / 1997, V 2, p. 880-882.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 6-10, 1997, New Orleans, Louisiana.
Includes references
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article
Descriptors: Gossypium - transgenic plants - resistance management - Helicoverpa zea - Heliothis virescens;
Section Headings: F200 PLANT BREEDING; F821 PESTS OF PLANTS-INSECTS

3632736 20611613 Holding Library: AGL
Cholesterol oxidase: potent boll weevil larvicidal and oostatic agent suitable for transgenic cotton development
Greenplate, J.T., Corbin, D.R. and Purcell, J.P.
Ceregen, a Unit of Monsanto Company, St. Louis, MO.
Memphis, Tenn. : National Cotton Council of America, 1991- Proceedings / 1997, V 2, p. 877-880.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 6-10, 1997, New Orleans, Louisiana.
Includes references
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article
Descriptors: Gossypium - Anthonomus grandis - insect control - transgenic plants;
Section Headings: F821 PESTS OF PLANTS-INSECTS; F200 PLANT BREEDING

3632733 20611610 Holding Library: AGL
Transgenic BT cotton —cotton consultants perspective
Farr, C., Bull, L., Young, R. and Carter, R.
Mid South Ag Consultants Inc., Crawfordsville, AR.
Memphis, Tenn.: National Cotton Council of America, 1991- Proceedings / 1997, V 2, p. 875-876.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 6-10, 1997, New Orleans, Louisiana.
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article
Descriptors: Gossypium - transgenic plants - genetic resistance - insect pests;
Section Headings: F821 PESTS OF PLANTS-INSECTS; F200 PLANT BREEDING

3632728 20611605 Holding Library: AGL
Transgenic Bt cotton —consultant's views & observations
Carter, R., Clower, J., Young, R. and Lambert, H.
Agricultural Management Services, Inc., Clayton, LA.
Memphis, Tenn.: National Cotton Council of America, 1991- Proceedings / 1997, V 2, p. 874-875.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 6-10, 1997, New Orleans, Louisiana.
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article
Descriptors: Gossypium - transgenic plants - genetic resistance - insect pests;
Section Headings: F821 PESTS OF PLANTS-INSECTS; F200 PLANT BREEDING

3632726 20611603 Holding Library: AGL
Transgenic Bt cotton —problems from consultants' perspective
Lambert, H.
Lambert Agricultural Consulting, Inc., Innis, LA.

Memphis, Tenn.: National Cotton Council of America, 1991-
Proceedings / 1997, V 2, p. 873-874.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 6-10, 1997, New Orleans, Louisiana.
Includes references
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article
Descriptors: Gossypium - transgenic plants - genetic resistance - insect pests;
Section Headings: F821 PESTS OF PLANTS-INSECTS; F200 PLANT BREEDING

3632722 20611599 Holding Library: AGL
Interactions of *Helicoverpa zea* and Bt cotton in North Carolina
Lambert, A.L., Bradley, J.R. Jr. and Van Duyn, J.W.
North Carolina State University, Raleigh.
Memphis, Tenn.: National Cotton Council of America, 1991-
Proceedings / 1997, V 2, p. 870-873.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 6-10, 1997, New Orleans, Louisiana.
Includes references
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article
Descriptors: Gossypium - transgenic plants - genetic resistance - insect control;
Section Headings: F821 PESTS OF PLANTS-INSECTS; F200 PLANT BREEDING

3632695 20611570 Holding Library: AGL
Bt cotton in Mississippi: the first year
Layton, M.B., Williams, M.R. and Stewart, S.
Mississippi State University.
Memphis, Tenn.: National Cotton Council of America, 1991-
Proceedings / 1997, V 2, p. 861-863.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 6-10, 1997, New Orleans, Louisiana.
Includes references
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76;
Document Type: Article
Descriptors: Gossypium - transgenic plants - genetic resistance - insect pests;
Section Headings: F821 PESTS OF PLANTS-INSECT; F200 PLANT BREEDING

3632692 20611567 Holding Library: AGL
Efficacy of grower-managed Bt cotton in North Carolina
Bacheler, J.S., Mott, D.W. and Morrison, D.E.
North Carolina State University, Raleigh.
Memphis, Tenn: National Cotton Council of America, 1991-
Proceedings / 1997, V 2, p. 858-861.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 6-10, 1997, New Orleans, Louisiana.
Includes references
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76 ;
Document Type: Article
Descriptors: Gossypium - transgenic plants - genetic resistance - insect pests;
Section Headings: F821 PESTS OF PLANTS-INSECT; F200 PLANT BREEDING

3627362 20607266 Holding Library: AGL
Influence of *Bacillus thuringiensis*-transgenic and nectariless cotton on insect populations with emphasis on the tarnished plant bug (Heteroptera: Miridae)
Hardee, D.D. and Bryan, W.W.
Southern Insect Management Laboratory, USDA, ARS, Stoneville, MS.
Lanham, Md.: Entomological Society of America, 1908-
Journal of Economic Entomology, Apr 1997, V 90 (2), p. 663-668.
ISSN: 0022-0493 CODEN: JEENAI
DNAL CALL NO: 421 J822
Language: English
Includes references
Place of Publication: Maryland
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76;
Document Type: Article

3613728 20598458 Holding Library: AGL
Cotton crop improvement through genetic engineering
John, M.E.
Agracetus, Middleton, WI.
Boca Raton, Fla. : CRC Press,
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ISSN: 0738-8551 CODEN: CRBTE5
DNAL CALL NO: TP248.13.C74
Language: English
Includes references
Place of Publication: Florida

Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article
Descriptors: Gossypium - transgenic plants;
Section Headings: F200 PLANT BREEDING

3601313 20583662 Holding Library: AGL
Pyramiding CryIA(b) insecticidal protein and terpenoids in cotton to resist tobacco budworm (Lepidoptera: Noctuidae)
Sachs, E.S., Benedict, J.H., Taylor, J.F., Stelly, D.M., Davis, S.K. and Altman, D.W.
Monsanto Company, St. Louis, MO.
Lanham, Md.: Entomological Society of America.
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DNAL CALL NO: QL461.E532
Language: English
Includes references
Place of Publication: Maryland
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article

3589596 20577093 Holding Library: AGL
Transgenic plants for the development of durable insect resistance: case study for cotton and *Bacillus thuringiensis* genes
Altman, D.W. and Benedict, J.H. and Sachs, E.S.
UST, Nashville, TN.
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Engineering Plants for Commercial Products and Applications / p. 106-114.
Annals of the New York Academy of Sciences, 0077-8923; V 792
DNAL CALL NO: 500 N484 v.792
Language: English
Meeting held October 1-4, 1995 in Lexington, Kentucky.
Includes references
Place of Publication: New York
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article
Section Headings: F821 PESTS OF PLANTS-INSECTS; F200 PLANT BREEDING

3587630 20575047 Holding Library: AGL
Stink bug thresholds in transgenic Bt cotton
Greene, J.K. and Turnipseed, S.G.
Clemson University, Blackville, SC.
Memphis, Tenn.: National Cotton Council of America, 1991-
Proceedings / 1996, V 2, p. 936-938.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Includes references
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article
Section Headings: F821 PESTS OF PLANTS-INSECTS

3587629 20575046 Holding Library: AGL
Strategies for managing stink bugs in transgenic Bt cotton
Turnipseed, S.G. and Greene, J.K.
Clemson University, Blackville, SC.
Memphis, Tenn.: National Cotton Council of America, 1991-
Proceedings / 1996, V 2, p. 935-936.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Includes references
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article
Section Headings: F821 PESTS OF PLANTS-INSECTS

3587628 20575045 Holding Library: AGL
Effects of natural enemy conservation and planting date on the susceptibility of BT cotton to *Helicoverpa zea* in North Carolina
Lambert, A.L., Bradley, J.R. Jr. and Van Duyn, J.W.
North Carolina State University, Raleigh, NC.
Memphis, Tenn.: National Cotton Council of America, 1991-
Proceedings / 1996, V 2, p. 931-935.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Includes references
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article
Section Headings: F821 PESTS OF PLANTS-INSECTS

3587627 20575044 Holding Library: AGL
Potential utility and susceptibility of transgenic Bt cotton against bollworms, European corn borers and stink bugs in NC
Bacheler, J.S. and Mott, D.W.
North Carolina State University, Raleigh, NC.
Memphis, Tenn.: National Cotton Council of America, 1991-
Proceedings / 1996, V 2, p. 927-931.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Includes references
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA;

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Document Type: Article
Section Headings: F821 PESTS OF PLANTS-INSECTS

3587446 20574860 Holding Library: AGL
Inter-plant movement and suppression of tobacco budworm in mixtures of transgenic Bt and non-transgenic cotton
Halcomb, J.L., Benedict, J.H., Correa, J.C. and Ring, D.R.
Texas A&M University, College Station, TX.
Memphis, Tenn.: National Cotton Council of America, 1991-
Proceedings / 1996, V 2, p. 924-927.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Includes references
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article
Section Headings: F821 PESTS OF PLANTS-INSECTS

3587443 20574857 Holding Library: AGL
Management strategies for large scale planting of Bt cotton
Miller, H.T. III
Miller Entomological Service, Drew, MS.
Memphis, Tenn.: National Cotton Council of America, 1991-
Proceedings / 1996, V 2, p. 920-921.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article
Section Headings: F821 PESTS OF PLANTS-INSECTS

3587441 20574855 Holding Library: AGL
Effects of large scale Bt cotton production on tobacco budworm populations
Worley, W., Mitchener, F., Miller, T. III., Luttrell, R.G. and Schneider, J.C.
Mitchener Farms.
Memphis, Tenn.: National Cotton Council of America, 1991-
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DNAL CALL NO: SB249.N6
Language: English
Includes references
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article
Section Headings: F821 PESTS OF PLANTS-INSECTS

3587405 20574818 Holding Library: AGL
Cotton insect management in transgenic Bt cotton in the Mississippi Delta, 1992-1995
Harris, F.A., Furr, R.E. Jr. and Calhoun, D.S.
Mississippi State University, Stoneville, MS.
Memphis, Tenn. : National Cotton Council of America, 1991-
Proceedings / 1996, V 2, p. 854-859.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Includes references
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article
Section Headings: F821 PESTS OF PLANTS-INSECTS

3580833 20569371 Holding Library: AGL
Maximizing seedling rates and fungicide treatments to obtain a stand of transgenic cotton
Sciumbato, G.L.
Mississippi Agricultural and Forestry Experiment Station, Stoneville, MS.
Memphis, Tenn.: National Cotton Council of America, 1991-
Proceedings / 1996, V 1, p. 262.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article
Section Headings: F831 PLANT DISEASES-FUNGAL

3580765 20569302 Holding Library: AGL
Anticipated changes in mid-south insect management resulting from adoption of Bt-transgenic cotton
Layton, B.
Mississippi State University, Mississippi State, MS.
Memphis, Tenn.: National Cotton Council of America, 1991-
Proceedings / 1996, V 1, p. 160-161.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article
Section Headings: F821 PESTS OF PLANTS-INSECTS; F200 PLANT BREEDING

3580763 20569300 Holding Library: AGL
Background and performance—Bt cotton
Deaton, W.R.
Monsanto Co., Memphis, TN.
Memphis, Tenn.: National Cotton Council of America, 1991-

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ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article
Section Headings: F200 PLANT BREEDING; F821 PESTS OF PLANTS-INSECTS

3580380 20568908 Holding Library: AGL
Bt cotton: opportunities and challenges
Benedict, J.H.
Texas A&M University Agriculture Research and Extension Center, Corpus Christi, TX.
Memphis, Tenn. : National Cotton Council of America, 1991- Proceedings / 1996, V 1, p. 25-29.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Includes references
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article
Section Headings: F821 PESTS OF PLANTS-INSECTS; F120 PLANT PRODUCTION-FIELD CROPS

3580007 20568493 Holding Library: AGL
Analysis of expressed proteins in fiber fractions from insect-protected and glyphosate-tolerant cotton varieties
Sims, S.R., Berberich, S.A., Nida, D.L., Segalini, L.L., Leach, J.N., Ebert, C.C. and Fuchs, R.L.
Ceregen, Chesterfield, MO.
Madison, Wis.: Crop Science Society of America, 1961- *Crop Science*, Sept/Oct 1996, V 36 (5), p. 1212-1216.
ISSN: 0011-183X CODEN: CRPSAY
DNAL CALL NO: 64.8 C883
Language: English
Includes references
Place of Publication: Wisconsin
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article
Descriptors: Gossypium hirsutum - varieties - transgenic plants - fiber - plant composition - recombinant proteins insecticidal properties - glyphosate - herbicide resistance - pest resistance - lepidoptera - lint - cleaning – delinting combing ;
Section Headings: F600 PLANT PHYSIOLOGY AND BIOCHEMISTRY; S200 AGRICULTURAL PRODUCTS-PLANT (NONFOOD AND NONFEED); F821 PESTS OF PLANTS-INSECTS; F900 WEEDS

3576922 20567784 Holding Library: AGL
Cotton rising from the ashes
Wilson, G.
South Perth, W.A.: Dept. of Agriculture, 1972- *Journal of Agriculture*, 1996, V 37 (3), p. 71-75.
ISSN: 0021-8618
DNAL CALL NO: 23 W52J
Language: English
Place of Publication: Australia
Government Source: State/Provincial
Subfile: IND; OTHER FOREIGN;
Document Type: Article
Descriptors: Gossypium - crop management - transgenic plants - pest resistance;
Geographic Location: Western Australia - cabt
Section Headings: F120 PLANT PRODUCTION-FIELD CROPS; F200 PLANT BREEDING

3576460 20566608 Holding Library: AGL
Tissue-specific and developmental regulation of cotton gene FbL2A. Demonstration of promoter activity in transgenic plants
Rinehart, J.A., Peterson, M.W. and John, M.E.
Agracetus, Middleton, WI.
Rockville, MD : American Society of Plant Physiologists, 1926- *Plant Physiology,* Nov 1996, V 112 (3), p. 1331-1341.
ISSN: 0032-0889 CODEN: PLPHAY
DNAL CALL NO: 450 P692
Language: English
Includes references
Place of Publication: Maryland
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article
Descriptors: Gossypium hirsutum - Gossypium barbadense - cotton - development - messenger RNA - complementary DNA - recombinant DNA - transgenic plants - amino acid sequences - promoters - transactivation - genetic regulation - growth stages - localization - gene expression - alcohol oxidoreductases - enzyme activity; Identifiers: molecular sequence data; genbank/u34401; acetoacetyl-coa reductase; polyhydroxyalkanoic acid synthase
Section Headings: F600 PLANT PHYSIOLOGY AND BIOCHEMISTRY; F200 PLANT BREEDING

3574041 20564044 Holding Library: AGL
Characterization and expression of Metallothionein-like genes in cotton
Hudspeth, R.L., Hobbs, S.L., Anderson, D.M., Rajasekaran, K. and Grula, J.W.
Phytogen, Pasadena, CA.
Dordrecht : Kluwer Academic Publishers.
Plant Molecular Biology, June 1996, V 31 (3), p. 701-705.
ISSN: 0167-4412 CODEN: PMBIDB
DNAL CALL NO: QK710.P62

Language: English
Includes references
Place of Publication: Netherlands
Subfile: IND; OTHER FOREIGN;
Document Type: Article
Descriptors: Gossypium hirsutum - structural genes - multigene families - complementary DNA - introns - exons - metallothionein - nucleotide sequences - amino acid sequences - gene expression - messenger RNA - roots - root tips -
promoters - recombinant DNA - beta-glucuronidase - reporter genes - histoenzymology - transgenic plants ; Identifiers: molecular sequence data; genbank/z54188
Section Headings: F200 PLANT BREEDING

3572198 20562018 Holding Library: AGL
The alcohol dehydrogenase genes of cotton
Millar, A.A. and Dennis, E.S.
CSIRO Division of Plant Industry, Canberra, A.C.T., Australia.
Dordrecht: Kluwer Academic Publishers.
Plant Molecular biology, July 1996, V 31 (4), p. 897-904.
ISSN: 0167-4412 CODEN: PMBIDB
DNAL CALL NO: QK710.P62
Language: English
Includes references
Place of Publication: Netherlands
Subfile: IND; OTHER FOREIGN;
Document Type: Article
Descriptors: Gossypium hirsutum - complementary DNA - structural genes - multigene families – alcohol dehydrogenase - nucleotide sequences - amino acid sequences - isoenzymes - root tips - promoters - gene expression - messenger RNA - anaerobic conditions - multiple genes - gene conversion - introns - exons - transgenic plants; Identifiers: adh gene; molecular sequence data
Section Headings: F200 PLANT BREEDING

3566201 20557531 Holding Library: AGL
Implementing cotton integrated pest management
Matthews, G.A.
Imperial College of Science, Technology and Medicine, Silwood Park, Ascot, UK.
Cambridge : Cambridge University Press.
Experimental Agriculture, Jan 1997, V 33 (1), p. 1-14.
ISSN: 0014-4797 CODEN: EXAGAL
DNAL CALL NO: 10 Ex72
Language: English
Includes references
Place of Publication: England
Subfile: IND; OTHER FOREIGN;
Document Type: Article
Descriptors: Gossypium hirsutum - crop production - integrated pest management - insect pests - insect control - insecticide resistance - transgenic plants - farming systems - control methods - control programs;
Section Headings: F821 PESTS OF PLANTS-INSECTS; F120 PLANT PRODUCTION-FIELD CROPS ; J700 SOIL CULTIVATION

3564907 20555569 Holding Library: AGL
Structural characterization of genes corresponding to cotton fiber mRNA, E6: reduced E6 protein in transgenic plants by antisense gene
John, M.E.
Agracetus, Inc., Middleton, WI.
Dordrecht : Kluwer Academic Publishers.
Plant Molecular Biology, Jan 1996, V 30 (2), p. 297-306.
ISSN: 0167-4412 CODEN: PMBIDB
DNAL CALL NO: QK710.P62
Language: English
Includes references
Place of Publication: Netherlands
Subfile: IND; OTHER FOREIGN;
Document Type: Article
Descriptors: Gossypium hirsutum - Gossypium barbadense - structural genes - plant proteins - fuzz – complementary DNA - nucleotide sequences - amino acid sequences - transgenic plants - gene expression - messenger RNA - genetic regulation - antisense DNA - fiber quality; Identifiers: molecular sequence data; genbank/u30505; genbank/u30506; genbank/u30507; genbank/u30508; genbank/u92051
Section Headings: F200 PLANT BREEDING; F600 PLANT PHYSIOLOGY AND BIOCHEMISTRY; S200 AGRICULTURAL PRODUCTS-PLANT (NONFOOD AND NONFEED)

3559382 20551923 Holding Library: AGL
Pollen dispersal from two field trials of transgenic cotton in the Namoi Valley, Australia
Llewellyn, D. and Fitt, G.
CSIRO Division of Plant Industry, Canberra, Australia.
Dordrecht ; Boston : Kluwer Academic Publishers, c1995-
Molecular Breeding: New Strategies in Plant Improvement, 1996, V 2 (2), p. 157-166.
ISSN: 1380-3743 CODEN: MOBRFL
DNAL CALL NO: QK981.4.M63
Language: English
Includes references
Place of Publication: Netherlands
Subfile: IND; OTHER FOREIGN;
Document Type: Article
Descriptors: Gossypium hirsutum - transgenic plants - pollen - dispersal - spatial distribution – field experimentation - marker genes - reporter genes - kinases - outcrossing - cross pollination - risk - kanamycin – drug resistance - Bacillus thuringiensis - structural genes - bacterial toxins - crystal proteins - pest resistance - bioassays - Helicoverpa armigera - larvae - seedlings - insecticidal properties; Identifiers: non-transgenic plants; neomycin phosphotransferase ii Geo-

graphic Location: new south wales - cabt
Section Headings: F200 PLANT BREEDING; F821 PESTS OF PLANTS-INSECTS

3558942 20551342 Holding Library: AGL
Glyphosate-tolerant cotton: genetic characterization and protein expression
Nida, D.L., Kolacz, K.H., Buehler, R.E., Deaton, W.R., Schuler, W.R., Armstrong, T.A., Taylor, M.L., Ebert, C.C., Rogan, G.J. and Padgette, S.R.
Monsanto Company, St. Louis, MO.
Washington, D.C.: American Chemical Society.
J*ournal of Agricultural and Food Chemistry*, July 1996, V 44 (7), p. 1960-1966.
ISSN: 0021-8561 CODEN: JAFCAU
DNAL CALL NO: 381 J8223
Language: English
Includes references
Place of Publication: District of Columbia
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article
Descriptors: Gossypium hirsutum - transgenic plants - genetic vectors - gene transfer - genetic engineering - glyphosate - herbicide resistance - genetic markers - gene expression;
Section Headings: F200 PLANT BREEDING

3552990 20546732 Holding Library: AGL
Seasonal infestation by pink bollworm, *Pectinophora gossypiella* (Saunders) of transgenic cotton, containing the Bollgard gene, planted in commercial fields in central Arizona
Flint, H.M., Antilla, L., Leggett, J.E. and Parks, N.J.
USDA, ARS, Western Cotton Research Laboratory, Phoenix, AZ.
Dallas, Tex.: Southwestern Entomological Society.
The Southwestern Entomologist, Sept 1996, V 21 (3), p. 229-235.
ISSN: 0147-1724 CODEN: SENTDD
DNAL CALL NO: QL461.S65
Language: English
Includes references
Place of Publication: Texas
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76); AR-PWA;
Document Type: Article
Descriptors: Gossypium hirsutum - Pectinophora gossypiella - larvae - infestation - pest resistance – transgenic plants - Bacillus thuringiensis subsp. kurstaki - structural genes - crystal proteins - insect control - efficacy - population density - Bucculatrix thurberiella - crop damage; Geographic Location: Arizona - cabt
Section Headings: F821 PESTS OF PLANTS-INSECTS; F200 PLANT BREEDING

3552163 20544836 Holding Library: AGL
Metabolic pathway engineering in cotton: biosynthesis of polyhydroxybutyrate in fiber cells
John, M.E. and Keller, G.
Fiber Technology Division, Middleton, WI.
Washington, D.C.: National Academy of Sciences,
Proceedings of the National Academy of Sciences of the United States of America, Nov 12, 1996, V 93 (23), p.12768-12773.
ISSN: 0027-8424 CODEN: PNASA6
DNAL CALL NO: 500 N21P
Language: English
Includes references
Place of Publication: District of Columbia
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76) ;
Document Type: Article
Descriptors: Gossypium hirsutum - transgenic plants - gene transfer - alcaligenes - structural genes - acyltransferases - alcohol oxidoreductases - enzymes - genetic transformation - biolistics - polyhydroxybutyrate - biosynthesis - enzyme activity - fuzz - lint - thermal properties - specific heat - cooling - molecular weight – heat transfer; Identifiers: polyhydroxyalkanoate synthase; biolistic transformation; heat uptake; beta-ketothiolase; acetoacetyl-coa reductase; alcaligenes eutrophus; phaa gene; phab gene; phac gene
Section Headings: F200 PLANT BREEDING; F600 PLANT PHYSIOLOGY AND BIOCHEMISTRY; S200

3545155 20541566 Holding Library: AGL
Gene introgression for cotton improvement: contrast of traditional breeding with biotechnologies
Altman, D.W.
International Service for the Acquisition of Agri-Biotech Applications.
New York : Plenum Press, c1993.
Gene conservation and exploitation: 20th Stadler Genetics Symposium / p. 193-216.
Stadler genetics symposia series
ISBN: 0306445336
DNAL CALL NO: SB123.3.S83 1991
Language: English
Includes references
Place of Publication: New York
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76) ;
Document Type: Article; Legislation
Descriptors: Gossypium hirsutum - Gossypium barbadense - plant breeding - genetic improvement - introgression - germplasm - genetic resources - tissue culture - gene transfer - transgenic plants - literature reviews ;
Section Headings: F200 PLANT BREEDING

3542490 20538678 Holding Library: AGL
Trichogramma pretiosum efficacy in cotton under Bt -

insecticide combinations
Kring, T.J. and Smith, T.B.
University of Arkansas, Fayetteville, AR.
Memphis, Tenn.: National Cotton Council of America, 1991-
Proceedings / 1995, V 2, p. 856-857.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 4-7, 1995, San Antonio, Texas.
Includes references
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76) ;
Document Type: Article
Descriptors: Trichogramma pretiosum - thiodicarb - Bacillus thuringiensis - pesticide mixtures - parasites of insect pests - cyhalothrin - Heliothis virescens - Helicoverpa zea - integrated control - Gossypium;
Section Headings: F821 PESTS OF PLANTS-INSECTS

3542205 20538372 Holding Library: AGL
Cotton moth monitoring and control
Race, J.L.
Ag Consulting Co., Lubbock, TX.
Memphis, Tenn.: National Cotton Council of America, 1991-
Proceedings / 1995, V 2, p. 798-799.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 4-7, 1995, San Antonio, Texas.
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article
Descriptors: Gossypium - Heliothis zea - insect control - transgenic plants - pyrethroid insecticides - pheromones - beneficial insects; Identifiers: Bt-transgenic cotton
Geographic Location: Texas - cabt
Section Headings: F821 PESTS OF PLANTS-INSECTS; F200 PLANT BREEDING

3542204 20538371 Holding Library: AGL
Bt cotton: field performance in North Carolina under conditions of unusually high bollworm populations
Mahaffey, J.S., Bradley, J.R. Jr. and Van Duyn, J.W.
North Carolina State University, Raleigh, NC.
Memphis, Tenn.: National Cotton Council of America, 1991-
Proceedings / 1995, V 2, p. 795-798.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 4-7, 1995, San Antonio, Texas.
Includes references
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article
Descriptors: Gossypium hirsutum - transgenic plants - Helicoverpa zea - pest resistance - crop damage - crop yield;
Geographic Location: North Carolina - cabt
Section Headings: F821 PESTS OF PLANTS-INSECTS; F120 PLANT PRODUCTION-FIELD CROPS ; F200 PLANT BREEDING

3542200 20538367 Holding Library: AGL
Effect of natural enemies on survival of *Helicoverpa zea* (Boddie) larvae conditioned on transgenic cotton expressing delta-endotoxin of *Bacillus thuringiensis*
Mascarenhas, V.J. and Luttrell, R.G.
Mississippi State University, Mississippi State, MS.
Memphis, Tenn.: National Cotton Council of America, 1991-
Proceedings / 1995, V 2, p. 779-782.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 4-7, 1995, San Antonio, Texas.
Includes references
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article
Descriptors: Gossypium - transgenic plants - Helicoverpa zea - larvae - natural enemies - insecticide resistance; Identifiers: Bt-transgenic cotton
Geographic Location: Mississippi - cabt
Section Headings: F821 PESTS OF PLANTS-INSECTS; L600 ANIMAL PHYSIOLOGY AND BIOCHEMISTRY; L001 ENTOMOLOGY RELATED

3542199 20538366 Holding Library: AGL
Inter-plant movement of tobacco budworm larvae in mixed-plantings of Bt and non-Bt cotton
Parker, C.D. Jr. and Luttrell, R.G.
Mississippi State University.
Memphis, Tenn.: National Cotton Council of America, 1991-
Proceedings / 1995, V 2, p. 775-779.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 4-7, 1995, San Antonio, Texas.
Includes references
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article
Descriptors: Gossypium - transgenic plants - Heliothis virescens - larvae - seed mixtures - insect control – feeding behavior; Identifiers: Bt-transgenic cotton, Geographic Location: Mississippi - cabt
Section Headings: F821 PESTS OF PLANTS-INSECTS;

L300 ANIMAL ECOLOGY; L001 ENTOMOLOGY RELATED

3542198 20538365 Holding Library: AGL
Field evaluation of Bt -transgenic cotton in the Mississippi Delta
Davis, M.K., Layton, M.B., Varner, J.D and Little, G.
Mississippi Cooperative Extension Service, Charleston, MS.
Memphis, Tenn.: National Cotton Council of America, 1991-
Proceedings / 1995, V 2, p. 771-775.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 4-7, 1995, San Antonio, Texas.
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76) ;
Document Type: Article
Descriptors: Gossypium - transgenic plants - Heliothis virescens - Helicoverpa zea - field tests - crop yield - insecticides - crop quality - production costs; Geographic Location: Mississippi - cabt
Section Headings: F120 PLANT PRODUCTION-FIELD CROPS; F821 PESTS OF PLANTS-INSECTS; F200 PLANT BREEDING

3542197 20538364 Holding Library: AGL
Efficacy of selected seed mixes of transgenic Bt and nontransgenic cotton against bollworms and tobacco budworms in South Carolina
DuRant, J.A.
Clemson University, Florence, SC.
Memphis, Tenn.: National Cotton Council of America, 1991-
Proceedings / 1995, V 2, p. 769-771.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 4-7, 1995, San Antonio, Texas.
Includes references
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76) ;
Document Type: Article
Descriptors: Gossypium - transgenic plants - Helicoverpa zea - Heliothis virescens - seed mixtures - crop yield; Geographic Location: South Carolina - cabt
Section Headings: F821 PESTS OF PLANTS-INSECTS; F120 PLANT PRODUCTION-FIELD CROPS; F200 PLANT BREEDING

3542196 20538363 Holding Library: AGL
Secondary pests in transgenic Bt cotton in South Carolina
Turnipseed, S.G., Sullivan, M.J., Mann, J.E. and Roof, M.E.
Edisto Research and Education Center, Blackville, SC.
Memphis, Tenn. : National Cotton Council of America, 1991-
Proceedings / 1995, V 2, p. 768-769.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 4-7, 1995, San Antonio, Texas.
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article
Descriptors: Gossypium - transgenic plants - Nezara viridula - Acrosternum hilare - crop damage - insect control;
Geographic Location: South Carolina - cabt
Section Headings: F821 PESTS OF PLANTS-INSECTS; F200 PLANT BREEDING

3542195 20538362 Holding Library: AGL
Resistance of the pink bollworm to Bt transgenic cotton
Bartlett, A.C.
USDA, ARS, Western Cotton Research Laboratory, Phoenix, AZ.
Memphis, Tenn. : National Cotton Council of America, 1991-
Proceedings / 1995, V 2, p. 766-768.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 4-7, 1995, San Antonio, Texas.
Includes references
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76); AR-PWA;
Document Type: Article
Descriptors: Gossypium - Pectinophora gossypiella - transgenic plants - insecticide resistance - adaptability;
Section Headings: F821 PESTS OF PLANTS-INSECTS; L200 ANIMAL GENETICS; L001 ENTOMOLOGY RELATED; F200 PLANT BREEDING

3542194 20538361 Holding Library: AGL
Expectations for transgenic Bt cotton: are they realistic?
Bradley, J.R. Jr.
North Carolina State University, Raleigh, NC.
Memphis, Tenn.: National Cotton Council of America, 1991-
Proceedings / 1995, V 2, p. 763-765.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 4-7, 1995, San Antonio, Texas.
Includes references
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article
Descriptors: Gossypium - transgenic plants - insect pests -

biological control - adaptability - insecticide resistance ;
Section Headings: F821 PESTS OF PLANTS-INSECTS; F200 PLANT BREEDING

3542193 20538360 Holding Library: AGL
Effect of transgenic cotton expressing endotoxin protein on arthropod populations in Mississippi cotton
Luttrell, R.G., Mascarenhas, V.J., Schneider, J.C., Parker, C.D. and Bullock, P.D.
Mississippi State University.
Memphis, Tenn.: National Cotton Council of America, 1991-
Proceedings / 1995, V 2, p. 760-763.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 4-7, 1995, San Antonio, Texas.
Includes references
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76) ;
Document Type: Article
Descriptors: Gossypium - transgenic plants - arthropod pests - pest resistance - crop yield - field tests – agricultural statistics; Identifiers: Bt-transgenic cotton, Geographic Location: Mississippi - cabt
Section Headings: F200 PLANT BREEDING; F821 PESTS OF PLANTS-INSECTS

3542192 20538359 Holding Library: AGL
Impact of transgenic cotton on pink bollworm and other lepidopteran insects
Watson, T.F.
University of Arizona, Tucson, AZ.
Memphis, Tenn.: National Cotton Council of America, 1991-
Proceedings / 1995, V 2, p. 759-760.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 4-7, 1995, San Antonio, Texas.
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76) ;
Document Type: Article
Descriptors: Gossypium - transgenic plants - Pectinophora gossypiella - pest resistance - Bucculatrix thurberiella - estigmene - field tests; Identifiers: Bt-transgenic cotton, Geographic Location: Arizona - cabt
Section Headings: F200 PLANT BREEDING; F821 PESTS OF PLANTS-INSECTS

3536022 20533661 Holding Library: AGL
Bacillus thuringiensis var. kurstaki [CryIA (C)] protein expressed in transgenic cotton: effects on beneficial and other non-target insects
Sims, S.R.
Ceregen, Chesterfield, MO.
Dallas, Tex. : Southwestern Entomological Society.
The Southwestern Entomologist, Dec 1995, V 20 (4), p. 493-500.
ISSN: 0147-1724 CODEN: SENTDD
DNAL CALL NO: QL461.S65
Language: English
Includes references
Place of Publication: Texas
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76) ;
Document Type: Article
Descriptors: Gossypium hirsutum - transgenic plants - simulation - Bacillus thuringiensis subsp. kurstaki - beneficial insects - lepidoptera - coleoptera - diptera - homoptera - neuroptera - orthoptera - bacterial toxins – insecticidal properties - nontarget organisms - nontarget effects; Geographic Location: Missouri - cabt
Section Headings: H000 PESTICIDES-GENERAL; L001 ENTOMOLOGY RELATED; L002 APICULTURE RELATED; F200 PLANT BREEDING

3535672 20533279 Holding Library: AGL
Survival and growth of bollworm and tobacco budworm on nontransgenic and transgenic cotton expressing a CryIA insecticidal protein (Lepidoptera: Noctuidae)
Halcomb, J.L., Benedict, J.H., Cook, B. and Ring, D.R.
Texas A&M University Agricultural Research and Extension Center, Corpus Christi, TX.
Lanham, Md.: Entomological Society of America.
Environmental Entomology, Apr 1996, V 25 (2), p. 250-255.
ISSN: 0046-225X CODEN: EVETBX
DNAL CALL NO: QL461.E532
Language: English
Includes references
Place of Publication: Maryland
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76) ;
Document Type: Article
Descriptors: Gossypium hirsutum - Helicoverpa zea - Heliothis virescens - transgenic plants - Bacillus thuringiensis subsp. kurstaki - gene expression - endotoxins - larvae - pupae - survival - biological development - growth – age differences; Identifiers: insecticidal crystal proteins
Section Headings: F821 PESTS OF PLANTS-INSECTS; F200 PLANT BREEDING; L600 ANIMAL PHYSIOLOGY AND BIOCHEMISTRY; L001 ENTOMOLOGY RELATED

3530967 20529849 Holding Library: AGL
Field performance of transgenic Bt cotton in multiple locations across the Belt
Kerby, T., Wofford, T., Presley, J. and Thomas, J.
Delta and Pine Land Company, Scott, MS.
Memphis, Tenn.: National Cotton Council of America, 1991-
Proceedings / 1995, V 1, p. 574-576.

ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 4-7, 1995, San Antonio, Texas.
Includes references
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article
Descriptors: Gossypium - bacillus thuringiensis - transgenics - field tests - cultivars - plant height - fiber quality - cost benefit analysis - crop yield - pesticides - lepidoptera; Geographic Location: southern states of USA - cabt
Section Headings: F120 PLANT PRODUCTION-FIELD CROPS; F200 PLANT BREEDING; F821 PESTS OF PLANTS-INSECTS

3530965 20529847 Holding Library: AGL
Breeding strategies for development of transgenic BXN cotton
Coulombe, B.A. and Panter, D.M.
Stoneville Pedigreed Seed Co., Stoneville, MS.
Memphis, Tenn.: National Cotton Council of America, 1991-
Proceedings / 1995, V 1, p. 572-573.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 4-7, 1995, San Antonio, Texas.
Includes references
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article
Descriptors: Gossypium - herbicide resistance - bromoxynil - variety trials - weed control - crop yield, Geographic Location: Mississippi - cabt
Section Headings: F120 PLANT PRODUCTION-FIELD CROPS; F900 WEEDS ; F200 PLANT BREEDING

3530650 20529520 Holding Library: AGL
Potential economic benefits to society from Bt cotton
Eddleman, B.R., Dearmont, D., He, Q. and McCarl, B.A.
Texas A&M University System, Corpus Christi, TX.
Memphis, Tenn. : National Cotton Council of America, 1991-
Proceedings / 1995, V 1, p. 393-396.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 4-7, 1995, San Antonio, Texas.
Includes references
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76) ;
Document Type: Article
Descriptors: Gossypium - transgenics - economic impact - Bacillus thuringiensis - forecasting - simulation models - crop yield - pesticides - cost benefit analysis - support measures; Geographic Location: USA - cabt
Section Headings: F120 PLANT PRODUCTION-FIELD CROPS; E100 ECONOMICS-GENERAL; X100 MATHEMATICS AND STATISTICS

3530487 20529353 Holding Library: AGL
Bacillus thuringiensis CryIA protein levels in raw and processed seed of transgenic cotton: determination using insect bioassay and ELISA
Sims, S.R. and Berberich, S.A.
Ceregen, Chesterfield, MO.
Lanham, Md.: Entomological Society of America, 1908-
Journal of Economic Entomology, Feb 1996, V 89 (1), p. 247-251.
ISSN: 0022-0493 CODEN: JEENAI
DNAL CALL NO: 421 J822
Language: English
Includes references
Place of Publication: Maryland
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article
Descriptors: Gossypium hirsutum - transgenic plants - Bacillus thuringiensis subsp. kurstaki - endotoxins - cottonseed - cottonseed oilmeal - plant composition - Heliothis virescens - larvae - diet - growth - bioassays - elisa; Identifiers: raw cottonseed; processed cottonseed; insecticidal crystal proteins
Section Headings: F821 PESTS OF PLANTS-INSECTS; F200 PLANT BREEDING; R300 FEED COMPOSITION

3530116 20528961 Holding Library: AGL
Insect management considerations in a Bt cotton production system
Phillips, J.R.
University of Arkansas, Fayetteville, AR.
Memphis, Tenn.: National Cotton Council of America, 1991-
Proceedings / 1995, V 1, p. 175-177.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 4-7, 1995, San Antonio, Texas.
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article
Descriptors: Gossypium - transgenics - pest management - bacillus thuringiensis - integrated pest management - cultural control - pest resistance - insecticide resistance; Geographic Location: USA - cabt
Section Headings: F120 PLANT PRODUCTION-FIELD CROPS; F821 PESTS OF PLANTS-INSECTS

3530114 20528959 Holding Library: AGL
Bt cotton —a new era in cotton production
Jenkins, J.N. and McCarty, J.C. Jr.
USDA, ARS, Crop Science Research Laboratory, Mississippi State, MS.
Memphis, Tenn. : National Cotton Council of America, 1991-
Proceedings / 1995, V 1 p. 171-173.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 4-7, 1995, San Antonio, Texas.
Includes references
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76); AR-MSA;
Document Type: Article
Descriptors: Gossypium - transgenics - cultivars - Bacillus thuringiensis - field tests - pest resistance - insecticides - crop damage - crop yield - pest control; Geographic Location: mississippi - cabt
Section Headings: F120 PLANT PRODUCTION-FIELD CROPS; F200 PLANT BREEDING ; F821 PESTS OF PLANTS-INSECTS

3530111 20528956 Holding Library: AGL
Transgenic cotton products from Stoneville
Kiser, J.
Calgene Inc., Davis, CA.
Memphis, Tenn.: National Cotton Council of America, 1991-
Proceedings / 1995, V 1, p. 169-170.
ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 4-7, 1995, San Antonio, Texas.
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article
Descriptors: Gossypium - cultivars - transgenics - weed control - herbicide resistance - pest resistance - Bacillus thuringiensis - fiber quality - cost control; Geographic Location: California - cabt
Section Headings: F120 PLANT PRODUCTION-FIELD CROPS; F200 PLANT BREEDING; F900 WEEDS; F821 PESTS OF PLANTS-INSECTS; S200 AGRICULTURAL PRODUCTS-PLANT (NONFOOD AND NONFEED); E200 FARM ORGANIZATION AND MANAGEMENT

3478480 20487279 Holding Library: AGL
The effects of transgenic cotton, *Gossypium hirsutum* L., containing *Bacillus thuringiensis* toxin genes for the control of the pink bollworm, *Pectinophora gossypiella* (Saunders) and other arthropods
Flint, H.M., Henneberry, T.J., Wilson, F.D., Holguin, E., Parks, N. and Buehler, R.E.
Western Cotton Research Laboratory, USDA, ARS, Phoenix, AZ.
Dallas, Tex.: Southwestern Entomological Society.
The Southwestern Entomologist, Sept 1995, V 20 (3), p. 281-292.
ISSN: 0147-1724 CODEN: SENTDD
DNAL CALL NO: QL461.S65
Language: English
Includes references
Place of Publication: Texas
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76); AR-PWA ;
Document Type: Article
Descriptors: Gossypium hirsutum - transgenic plants - Bacillus thuringiensis - genes - pest resistance - Pectinophora gossypiella - bemisia - infestation - crop yield - lint - length - strength; Identifiers: Bemisia argentifolii, Geographic Location: Arizona - cabt
Section Headings: F821 PESTS OF PLANTS-INSECTS ; F200 PLANT BREEDING ; F600 PLANT PHYSIOLOGY AND BIOCHEMISTRY

3440704 20455829 Holding Library: AGL
A procedure for biolistic transformation and regeneration of transgenic cotton from meristematic tissue
Chlan, C.A., Lin, J., Cary, J.W. and Cleveland, T.E.
The University of Southwestern Louisiana, Lafayette, LA.
Athens, Ga.: \b International Society for Plant Molecular Biology, University of Georgia.
Plant Molecular Biology Reporter, Mar 1995, V 13 (1), p. 31-37.
ISSN: 0735-9640 CODEN: PMBRD4
DNAL CALL NO: QK710.P63
Language: English
Includes references
Place of Publication: Georgia
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article
Descriptors: Gossypium hirsutum - meristems - genetic transformation - gene transfer - transgenic plants - regenerative ability - culture media - culture techniques - explants;
Section Headings: F200 PLANT BREEDING; F600 PLANT PHYSIOLOGY AND BIOCHEMISTRY

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