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Introduction

Biological control agents are not commonly used in cotton to control diseases. There are a number of reasons for their inability to provide satisfactory control of seedling diseases in cotton. The mechanism of attacking the target pathogen and suitable conditions for multiplication of the useful pathogens in the soil are very important for effective control. Past experience shows that any agent fails to give desirable results if the product has a poor shelf life. The methods by which useful pathogens attack and inhibit the multiplication in the soil of the disease-causing pathogens, desired characteristics of new biological products and biological control agents' potential to replace fungicides are discussed in the first article Biological Control of Seedling Diseases.

An article on Organic Cotton Production was published in *THE ICAC RECORDER*, Vol. XI, No. 1, 1993, which covered all aspects of organic cotton growing. Organic cotton can be an interesting proposition for at least two reasons: First, to reduce the cost of production which has become very high due to the extensive use of agrochemicals, particularly insecticides; secondly, to avoid any impacts which agrochemicals may have on the environment. The extent of the use of chemicals, the amount of organic cotton produced in 1993, certification problems, loss in yield due to organic production, the expected premium for organic cotton and international concerns regarding organic cotton production and its utilization are discussed in the article Organic Cotton Production-II.

The third article is on Cotton Ginning ---- A Need for New Technology. Roller gins were the first machines to separate cotton lint from seeds. When cotton production grew in size, there was a need to design a machine which could gin cotton at a faster rate. The saw gin, which was much more efficient than roller gins, was accepted in spite of the fact that it caused higher fiber breakage than roller ginning because efficiency had a high priority. Since the invention of a saw gin two hundred years ago, there has been improvement only in machinery but not in technology. Pros and cons of the two ginning technologies are discussed along with a new technology called cage ginning in the article. Cage ginning has shown encouraging results and might become commercial in the next few years.

A DIALOG search of the Agricola database on defoliation of cotton is also a part of this issue of the publication.

Biological Control of Seedling Diseases

A proper plant stand is a foundation stone for a good cotton harvest. The cotton plant, with its indeterminate nature of growth, has a much greater genetic ability than many other agricultural crops to compensate for losses due to a poor plant stand, but this characteristic varies by variety. Modern short stature varieties with compact fruiting and shorter growing seasons have the least ability to compensate for any losses in plant stand. A poor plant stand has a direct bearing on yield. Seed rot, seedling diseases and damping-off affect stands and ultimately yield. The main pathogens responsible for seed and seedling root rot and pre- and post-emergence damping-off are *Pythium ultimum*, *Rhizoctonia solani* and *Thieloviopsis basicola*. Cultural control, seed and soil fungicides and host plant resistance are commonly used control methods. Seed treatment with fungicides is probably the most expensive method but is most commonly used because of its effectiveness. With growing concerns about increased use of chemicals in cotton production, biological control provides another option for minimizing plant stand damage.

Mechanism of Action of Biological Control Agents

Biological control involves the use of a biological agent against another biological agent to control the spread of harmful pathogens, insects or diseases. Useful biological agents greatly differ in their modes of action on the target pathogen in order to prevent or reduce the development of a disease. The control agent may cause biotic or abiotic stress on the pathogen. The mechanism of action may be one of the following:

- The biocontrol agent, when applied to the soil, starts multiplication under optimum conditions. It may multiply to such an extent that it excludes a pathogen from the root surface by occupying the majority or all of the area on the root or susceptible target portion of the plant.
- Certain biological control agents produce compounds which absorb iron and limit its availability to the pathogen, thus restricting its multiplication and establishment.

- The host species can be inoculated with a non-compatible race, strain or species of a pathogen which results in the production of phytoalexins by the host. Under such conditions, the pathogen is not able to establish on the host plant and the disease can be cured.

- Some biological control agents have the ability to produce antibiotics and other bioactive compounds toxic to the pathogen. *Rhizoctonia solani* on sugar beet is controlled by the antibiotic effect of the biological agent *Pseudomonas cepacia*. This phenomenon has a better potential to be utilized in cotton than others.

- Certain biological control agents on coming in contact with the root produce enzymes which are responsible for the breakdown of other compounds. Verticillium wilt of eggplant is controlled by the fungus *Talaromyces flavus* with the same action. *Talaromyces flavus* produces an enzyme, glucose oxidase, which converts the root glucose into hydrogen peroxide which is toxic to the pathogen.

Biocontrol Agents

Whatever the mechanism of action may be, biological control agents prevent the pathogen from establishing on the root of cotton. Bacteria, fungi, nematodes, protozoa and viruses have shown potential to be used as microbes to control pathogens. Microbial use is more successful in insect management than in disease management. A number of bio-insecticides are available on a commercial scale for use in cotton, and many of them are very effective in minimizing insecticide use, in some cases even eliminating the application of insecticides. Seed and seedling disease control not only help to give higher establishment but also healthy and vigorous seedlings for a better yield. The pathogens, once suppressed by the biological agents at an early seedling stage, have a limited chance of attacking the plant at a later stage. Some of the commonly tried biological control agents to control seed, seedling and damping-off diseases in cotton are as follows:

- ***Bacillus subtilis*** is the most commonly used bacterium in cotton. It has many products registered for use on cotton against seed and seedling diseases and pre- and post-emergence damping-off caused by *Rhizoc-*

tonia spp., *Pythium* spp. and *Fusarium* spp. The mode of action of *B. subtilis* is production of an antibiotic that destroys the pathogen and suppresses the disease. *B. subtilis* formulations are comparatively more tolerant to environmental stress, thus providing enhanced use in cotton. Most of the products belonging to *B. subtilis* are compatible with commonly used fungicides.

- ***Gliocladium virens*** is an antagonist of *Rhizoctonia solani*, *Pythium ultimum*, *Sclerotinia sclerotiorum* and *Sclerotium rolfsii*. One major problem with products belonging to *G. virens* is their poor ability to establish in the soil. Gliogard™ is a fungal formulation of *G. virens* and recommended for use only in greenhouse studies.

- ***Pseudomonas fluorescens*** is recommended for use against seedling diseases. In 1988, a product called Dagger G containing this bacterium in the mainstream was registered in the USA for commercial use on cotton. The product did not perform well the first year and had to be withdrawn from the market.

- ***Trichoderma harzianum***, found in many soils, is said to control seedling disease caused by *Rhizoctonia solani.* The bacterium has the ability to multiply at a higher rate on radish roots than on cotton.

- ***Enterobacter cloacae***, another very effective bacterium in controlling damping-off caused by *Pythium* spp, is recommended for use on cotton in addition to other vegetable crops. Some products carrying *E. cloacae* are at the field testing stage in Australia.

- ***Talaromyces flavus*** can actively colonize cotton roots and has been found to check the multiplication of the pathogen which causes verticillium wilt.

- ***Verticillium tricorpus*** has the potential to control rhizoctonia damping-off and verticillium wilt of cotton.

Reasons for Limited Success

From an environmental standpoint, it would be desirable if biological control agents could be recommended as a replacement for chemical fungicides. However, biological control agents are not recommended for use by themselves to control any cotton seed or seedling diseases or even damping-off because biological control agents fail to provide singly the same level of control which chemical fungicides can. There are many reasons why biological control agents have not been able to provide perfect control and reduce or eliminate the use of fungicides.

- Useful biological agents have tough competition from naturally occurring soil microorganisms, and sometimes soil microorganisms, even other than the disease-causing ones, overpower or affect the multiplication of useful agents.

- Soils vary in their ability to provide conditions suitable for multiplication of specific bacteria.

- Biological control agents are also very target-specific because of their ability to produce antibiotics harmful to the target pathogen. Some biological agents can be used to control only one disease while more than one disease might appear in the same field at the same time, making necessary the use of fungicides to control all apprehended diseases simultaneously.

- No biological control agent can be best utilized unless it has a good shelf life. Most biological agents can be stored best under refrigerated conditions for over one year but not at room temperature. The use of Dagger G could not be extended because of its inability to conform its field performance to its laboratory performance. Because Dagger G lost its efficacy somewhere between its manufacture and field application, the product was withdrawn.

- In addition to antibiotic effects, some biological strains also produce phytotoxin which is injurious to the growing root tissues. When phytotoxin comes in close proximity to the developing radicle, it kills the growing tip, ultimately resulting in the death of the seedling or severe stunting of the subsequent root system.

- Because biological control agents have to be used in combination with fungicides, it is very important that they are compatible with the popularly used fungicides.

Experimentation

Mitlehner and Mintz (1993) conducted field trials using various treatments of Gliogard^{TM}(GL-21) ---- a fungal formulation of *G. virens*. Two formulations of Gliogard ^{TM} were applied singly and in combination with Terraclor 10G to see if damping-off could be controlled effectively. Terraclor is a *Rhizoctonia* spp. specific granular fungicide. Biological and chemical fungicides were applied in furrows at the time of planting. The trials included early and late planting and were repeated at eight locations. All the planting seed of Deltapine 51 was treated with the non-specific *Rhizoctonia* fungicides Thiram and Apron and the insecticide Orthene 90. The average data for initial counts as a percentage of the check showed that all the Terraclor treated plots were better than the untreated. At early sowing, the overall average suggests that GL-21 at the rate of 3.4 kg/ha, alone or in combination with Terraclor, performed better than GL-21 at 5.6 kg/ha, alone or in combination with Terraclor. The combination of GL-21 at the rate of 3.4 or 5.6 kg/ha with 2.3 kg of Terraclor improved initial count on both sowing dates but the effect was more pronounced at early sowing. Biological and chemical fungicides seemed to work better at early sowing compared with late sowing. There was no consistency in the performance of GL-21 as GL-21 at 5.6 kg/ha lowered the initial count to 96% of the check in early as well as late planting. There was an indication that the dose of Terraclor could be decreased to half when applied in combination with GL-21.

El-Zik et al (1993) studied for three years the effects of *G. virens* application on seedling emergence and survival, lint yield and fiber characters under field conditions. While they tried different strains of *G. virens*, the controls included the fungicides Apron and Apron+Vitavax in addition to untreated control. Seedling emergence and final stand for seed treated with *G. virens* strains were equal to the fungicide seed treatments and generally higher than untreated control. Seed treated with *G. virens* produced lint yield and fiber quality similar to the fungicide seed treatments, and some strains of *G. virens* resulted in higher yield than the untreated control. El-Zik et al (1993) also observed that, although some treatments were better in initial and final stand, they did not show a significant impact on yield, perhaps because a minimum level of population required to give a certain yield level was available even in the plots showing no impact of treatments. Most of the strains they tried were compatible with fungicides, but there were differences in the effectiveness of different strains.

Brannen and Backman (1994) tested two biological strains, GUS 2000 (Kodiak*) and GUS 376, for suppression of fusarium wilt caused by the fungus *Fusarium oxysporium* f. sp. *vasinfectum*. GUS 2000 and GUS 376 belong to the bacterium *B. subtilis* and were tested in hopper box formulations. All seed, with the exception of the untreated control seed, was pre-treated with metalaxyl-PCNB-carboxin, an industry standard treatment. In 1992 and 1993, both strains were tried on a moderately fusarium-resistant variety SV 453 and in soil with a known history of fusarium nematodes. In 1993, a fusarium-resistant variety SVLA 887 was also included in the trial. The results showed that both strains of *B. subtilis* colonized the rhizosphere throughout the cotton growing period. GUS 2000 was found to be better colonizing than GUS 376. Disease incidence was reduced in all the plots treated with GUS 2000. The GUS 2000 treated plots were better than the plots treated with fungicides alone. In 1992, it was observed that colonizing was affected by the seed surface pH so the seed used during 1993 was first neutralized with sodium carbonate. The seed pH increased from below 4 to 5.1 after neutralization which enhanced colonization.

Though not statistically significant, GUS 2000 provided the lowest absolute rate of fusarium wilt disease progress, the lowest percentage of plant stand and higher end season vigor. Better plant stand, absolute disease rate and vigor were all highly correlated with yield in 1992. However, yield increases were not obtained in 1993. In 1993, GUS 376 was found to give significantly higher yield over all fungicide treatments but not higher than combinations of biological strains with fungicides. Brannen and Backman (1994) concluded that the addition of a biological control organism such as GUS 2000 helped to suppress fusarium wilt.

According to Howell (1994), *Gliocladium virens* has been tried more extensively and found more successful than any other fungus. He found that the production of antibiotic compounds by *G. virens* was greatly affected by the strains and substrate on which it was grown. Howell (1994) confirmed the findings of El-Zik et al (1993) that ground millet provided better conditions for the preparation of biocontrol agents and their activity in the soil. The use of substrates stimulated high concentrations of antibiotics to achieve disease control with only that amount of biocontrol preparation that could be coated on the seed with a latex sticker. The different effectiveness of strains against any disease-causing pathogen was explained on the basis of production of different antibiotics. Howell (1994) reported that, of two strains of *G. virens,* one produced antibiotic gliovirin and was effective against *P. ultimum,* while the other produced gliotoxin and was more active against *R. solani*. Therefore, knowing what kind of antibiotic compound is produced by a biocontrol agent and which antibiotic is active against which seedling disease pathogen is very important. In case the soil is infested with more than one type of pathogen, the use of a combination of strains to control all the target pathogens would be required.

Despite the work which has been done on biological control as a source of non-chemical fungicides, there has been little success. However, experiments have shown that biological agents have a stimulating effect on the plant which enables it to bear more fruit. The stimulation effect of the treatment on the growth and development of the plant is not seen in sterile soil, leading to the belief that biological strains do not have a direct stimulation effect on the plant. It shows that the stimulation effect may be due to the suppression of minor root pathogens by the biological agents. If this is the case, the stimulation effect could be better achieved if biological control agents grow along with the root system.

References

Allen, Steve and Putcha, Subbu. 1993. Biological control of cotton diseases: is it possible? *The Australian Cottongrower*, Volume 14, No. 6, PO Box 766, Toowoomba 4350, Australia.

Brannen, P. M. and Backman, P. A. 1994. Decrease in *Fusarium oxysporum* f. sp. *vasinfectum* incidence through use of *Bacillus subtilis* seed inoculants. *Proceedings of the Beltwide Cotton Conferences*, National Cotton Council of America, PO Box 12285, Memphis, Tennessee 38182, USA.

El-Zik, K. M., Howell, C. R., Thaxton, P. M. and Brashears, A. D. 1993. Influence of strain carrier, and seed sticker on the capacity of the biocontrol agent *Gliocladium virens* to affect cotton seedling disease, stand, yield and fiber quality. *Proceedings of the Beltwide Cotton Conferences*, National Cotton Council of America, PO Box 12285, Memphis, Tennessee 38182, USA.

Howell, C. R. 1994. Fungal antagonists of cotton seedling disease pathogens, *Proceedings of the Beltwide Cotton Conferences*, National Cotton Council of America, PO Box 12285, Memphis, Tennessee 38182, USA.

Kenney, D. S., Howell, C. R. and Mint, E. B. 1992. Studies on the mode of action of *Bacillus subtilis* as a biocontrol agent. *Proceedings of the Beltwide Cotton Conferences*, National Cotton Council of America, PO Box 12285, Memphis, Tennessee 38182, USA.

Mint, E. B., Davis, R. A. and Smith, K. L. 1992. The use of fungicides, nematicides and other disease management practices in US cotton production. *Proceedings of the Beltwide Cotton Conferences*, National Cotton Council of America, PO Box 12285, Memphis, Tennessee 38182, USA.

Mitlehner, A. W. and Mintz, A. 1993. 1992 cotton seedling disease trials with *Gliocladium virens*. *Proceedings of the Beltwide Cotton Conferences*, National Cotton Council of America, PO Box 12285, Memphis, Tennessee 38182, USA.

Organic Cotton Production-II

Use of fertilizers and insecticides in cotton production has increased to the extent that cotton production is losing its profitability against other field crops. Environmental concerns are also increasing in society. Researchers have done a lot of work towards growing cotton with a minimum use of chemicals but much more is yet to be done. In the highest yielding cotton countries of the world like Australia, Guatemala and Israel, reducing the cost of production is even more important. One option is to produce organic cotton and sell it at a premium. Organic cotton is cotton grown without synthetic inorganic fertilizers, fungicides, herbicides, insecticides, growth regulators and defoliants and duly certified by a recognized certifying organization. Organic cotton is also sometimes called clean, natural, green or environment-friendly cotton. In order to be eligible for certification as organic cotton, cotton must be grown without the prohibited chemicals for a period of three years. Cotton produced without chemicals in the first and second years is referred to as transitional, pending certification or organic certified B cotton.

Use of Chemicals

Cotton has a comparatively longer growing period compared with many other field crops. Its longer stay in the field and specific fruiting behavior naturally increase its vulnerability to insect pests and diseases. For the sake of higher yield, the use of chemicals has increased tremendously in the past two decades. The biological balance has been disturbed, the cost of production has increased, insects have developed resistance to insecticides, the insect pattern has changed, etc., giving rise to multifarious problems in cotton production. Cotton has emerged as the major consumer of agrochemicals in the world. The cost of herbicides, fertilizers, insecticides and defoliants to grow one hectare of cotton under irrigated and rainfed conditions in selected countries is presented in the table which follows. Total seed cotton cost per hectare includes all field operations and inputs but does not include land rent, ginning, economic and fixed costs.

In all countries, agrochemical costs form more than or close to 50% of the total cost of seed cotton production. Exceptions have specific reasons such as government subsidies or the especially high cost of some other inputs.

Cost of Chemicals/ha in Cotton Production (in US$)

Country	Herbicides	Fertilizers	Insecticides	All Chemicals (% of total cost)	Total Seed Cotton Cost
Australia (Irri.)	42.6	78.9	377.1	59	839.5
Australia (Rainfed)	22.1	41.8	130.2	49	398.4
Brazil	12.2	49.2	49.8	35	318.4
Guatemala	13.4	59.2	470.0	86	634.8
Egypt	11.4	94.1	15.2	31	392.9
India (Irri. Cen. S)		116.4	190.3	51	600.4
India (Rainfed Cen. S)		45.6	80.6	44	287.3
Israel (Upland)	72.5	301.3	355.0	37	1,985.7
Pakistan		43.3	72.9	66	176.7
Peru (South)		202.0	207.8	36	1,125.1
Turkey(Cukurova)	9.24	70.9	432.4	57	907.8
USA (Irrigated SW)		142.2	198.7	44	783.2
USA (Rainfed Delta)		85.8	194.6	76	369.8
Zimbabwe		57.7	42.0	50	200.3

In the USA, herbicides are included under insecticides.

Organic cotton production is not farming by neglect nor is it leaving the crop at the mercy of insect pests and diseases. Soil fertility has to be maintained through organic fertilizers and insect pressure has to be kept at a minimum through various allowed means of insect control.

Suitable Varieties

Breeding for superior varieties has received the full attention of researchers in most countries. Breeders have done a wonderful job in modifying the plant to meet the needs of growers. Whether the presently available commercial varieties are suitable for organic production or whether new varieties have to be developed that can adapt to this changed set of environmental conditions is an important consideration for organic production. Currently, present commercially grown varieties are recommended for organic cotton production.

In the past two decades, emphasis in general breeding has been on varieties short in stature, early in maturity and responsive to high doses of fertilizers. Breeding efforts which shifted effective fruiting positions closer to the main stem and on lower parts of the plant have been successful. High response to fertilizers and a shift in fruiting positions are desirable characters for high input use but may not be desirable when no fertilizer is applied. Similarly, the response of early and closer to the main stem fruiting needs to be investigated in comparison with genotypes with scattered fruiting positions on the plant.

Commercially grown varieties have been tested under high input conditions as they were developed for such conditions. Varieties performing well under these conditions may not be able to maintain their yield level without synthetic fertilizers and insecticides. The breeding material for organic cotton production has to be screened under organic conditions. F_2 single plants, progeny rows or bulks should be continuously grown under organic conditions to select a variety for organic production.

Yield/Hectare

Cotton production practices have changed significantly from when there were no synthetic fertilizers and chemical means of insect, weed and disease control. Thus it is likely that there will be a loss in yield in organic growing. The magnitude of loss will depend upon a number of factors, i.e., variety, soil fertility, pest pressure, skill in handling organic cotton production etc. Loss in yield will also depend on the situation where cotton is grown. If it is an area of high pest pressure and a variety of insects appear simultaneously, chances are that insects might take a heavy toll. Comparatively tolerant varieties, even at the cost of slightly less yield potential, will be more suitable under such conditions. The magnitude of loss acceptable to the grower mainly depends on the price he gets for his organic cotton. Loss in yield is the most important consideration in deciding to shift to organic cotton or to continue with organic cotton. The variety and grower's skill to grow cotton without chemicals are considered the most important factors which can play a role in minimizing loss in yield compared with conventional production. No comparable statistics are available to report on yield loss, however, some data are as follows:

Organic Cotton Yield/ha 1993

Country	Total Organic Production (tons)	Organic Yield (kg/ha)	Conventional Production (country/state average)	% ± Organic Production
Argentina	1.8	290	451	-36
India	124.6	181	280	-65
Turkey	15.3	627	1009	-38
USA				
Arizona	1338.6	1076	1366	-21
California	3363.5	1076	1509	-29
Tennessee & Missouri	130.7	538	504	+7
Texas	653.2	538	544	-1
Virginia	1.1	544	709	-23

From this table, if we exclude Virginia where there were only 2 ha under organic production, it can be concluded that loss in yield in organic production is high if the average yield for the area is high. It shows that low yielding areas in the USA where agrochemicals are not used so extensively, organic cotton can be produced with lesser risk and smaller loss in yield. Heavy loss in yield in India could be due to high pest pressure in the absence of any biological control methods and also due to poor soil fertility. In low yielding countries where alternate methods of pest control and cheap labor is available to remove weeds and perform other field operations, it seems more economical to produce organic cotton. However, certification and enforcement of certification rules remain a problem.

Fiber Quality

Fertilizer application has a significant impact on fiber quality. Fiber length, fineness and maturity are usually more affected than other quality parameters. The absence of optimum doses of nitrogen at the time of boll formation and maturation will give comparatively shorter fiber length and higher micronaire value. Maturity is expected to improve but how much depends on the response of a variety to the changed situation. Seed maturity and ginning outturn are also expected to improve. Defoliants and desiccants, which make the crop mature early, including forced opening of late formed bolls, will not be used in organic cotton production. Elimination of defoliants and desiccants will have a favorable impact on quality in the form of better uniformity, particularly for fineness, maturity, staple length and fiber strength. The situation becomes more complex with the elimination of fertilizers and insecticides, which will have a variety of effects on plant morphology thus affecting many other characters. One undesirable factor could be a higher percentage of bollworm-infested cotton giving rise to more yellow spots, thus increasing the chances of discount due to lower grade. Although different varieties will respond differently to organic growing, one variety grown on the same farm under conventional practices and organic conditions can give an idea of the effect on fiber characteristics. In most cases, the experience has been that organic production gives a lower grade cotton.

Projects in Different Countries

In Argentina, 16 ha have been grown without chemicals out of which 6 ha were certified as organic in 1993.

Australia also has finalized certification standards. There are three registered certifiers for organic cotton, but so far most of the cotton is certified by Biological Farmers of Australia. Organic cotton to be sold in the local market does not require any certification but foreign buyers interested in buying certified organic cotton from Australia can apply to the Australian Quarantine and Inspection Service. Cotton is classed as "Organic Certified B" (equivalent to transitional cotton in the USA) and "Organic Certified A" (equivalent to organic cotton in the USA). Biological Farmers of Australia, which has finalized its standard requirements for certification, charges a levy of 0.5% on income from organic produce. The certified organic area in 1993 was approximately 700 ha. Total organic production was approximately 479 tons, thus reflecting a poor and economically unsustainable yield due to high insect pressure.

In Egypt, only SEKEM Farms is involved in organic cotton production. In Egypt, roughly 50% of the total insecticides are consumed by cotton. Various IPM techniques have made it possible to grow 1862 ha without insecticides (but not organic) in 1993. While there is promise for organic cotton in Egypt, local certification is not available yet.

In India, organic cotton production has been organized as a joint venture of the Gujarat State Cooperative Cotton Federation Limited and Bo Weevil of the Netherlands. The project, initiated in 1992, is underway at two places in Ahmedabad, Gujarat. During 1993/94, 687 ha of organic cotton were grown in India which were inspected and certified by a company called SKAL on behalf of Bo Weevil. According to reports available from India, 572 bales of organic cotton were sold at a premium price of 22% over non-organic cotton.

Turkey had 75 ha as pending certification and 25 ha of organic cotton in Izmir in 1993. Local certification is not available, and this cotton was certified by the IMO Institute of Marketecology in Switzerland.

In the USA, California Certified Organic Farmers, the Texas Department of Agriculture, Organic Crop Improvement Association International and TN Land Stewardship Association are engaged in certification of organic cotton. An Arizona Certification Board is also expected to become active shortly. These organizations have formulated their own certification standards. The Texas program is well established and more popular than the others. Post harvest handling standards are only available from the Texas

Department of Agriculture. In Texas, growers have also formed an association of organic cotton growers. Similarly, a marketing association is also said to be in formation. Some colored organic cotton is also grown in Arizona and California. In the USA, the approximate area under certified organic and transitional cotton or pending certification was as below:

Organic Cotton Area in the USA in 1992 and 1993 (in ha)

	1992		1993	
	Organic	**Pending**	**Organic**	**Pending**
Arizona	2,800	809	1,244	3,035
California	435	760	3,126	2,574
Tennessee/MO	172	266	243	142
Texas	166	635	1,214	4,856
Virginia		0.5	2	
Total	**3,573**	**2,471**	**5,829**	**10,607**

Cost and Expected Price

Cost of production data are not collected and, according to the Technical Coordinator of the California Certified Organic Farmers, even if they were, associations would not disclose their members' data. Some sketchy information available is as follows:

In Turkey, the cost of organic production is 10.7 to 15.1 percent higher than conventional production. The cost of insect control has been shown nil while the cost of fertilization is 11.7 to 17 percent more than organic production. Weed control costs also increased by a slight margin. In the USA, according to the information available from California, the cost of organic production/ha was higher by more than 13 percent over conventional production. Reports also indicate a higher cost varying from nothing to 50%. The increase in cost may be due to many factors like land use for a long time, manual labor, expensive biological control agents, etc. Taking on average a 25% loss in yield and a 10% increased cost in organic cotton, it will not be economical to grow organic cotton unless it fetches a 43% higher price than conventional cotton. Additional yarn manufacturing costs can also be expected due to extra segregation practices and additional cleaning procedures.

Some Fundamental Requirements for Certification of Organic Cotton

- The organic cotton producer must be registered with a recognized certifying agency with rules and standards established for the production of organic cotton. The producer will sign an agreement to abide by the rules of the certifying agency. The producer may use his whole farm or a part of it in organic production.

- The producer will keep a full record of all the fields in the program for a period of three years before the produce is certified as organic produce. He can grow any recommended variety for the region but cannot use forbidden products to grow the crop.

- The certifying agency through its inspectors will inspect the designated fields during the crop period and verify that only permissible production practices have been followed. It is the responsibility of the producer to make it known to the certifying organization all the production practices followed during any specific year.

- The producer will avoid contamination by drift from the neighboring non-organic production fields. He will observe a buffer zone specified by the certifying agency if the adjoining fields were sprayed. (A buffer zone generally recommended by some of the certifying agencies is eight meters.)

- The certifying agencies, unless part of the government, will charge a fee for inspection and other services. The fees may be fixed or determined on the basis of some percentage of the sale from the produce or percentage of net profit per unit weight or area.

- It is the responsibility of the certifying agency to make known to the producer in very clear form what is allowed and what is forbidden to be used in organic fields. It lies with the certify agency to reject any field for certification if a producer fails to satisfy the inspector that no non-allowed product has been used in the fields enrolled in the program.

- Seed treatment may or may not be allowed, depending on the certifying agency. Generally, seed cannot be treated with any fungicide or insecticide. Mechanical delinting will be preferred but acid delinting can be done wherever no other alternative is available.

- It is a general recommendation that the cotton plant rely on the available soil fertility. Enhancing soil fertility through addition of composed organic matter, mineral powders, microorganisms, all types of green manure crops (preferably legume crops) and crop residues is strongly recommended. Crop rotations and the use of cover crops are also important aspects of improving soil fertility. Natural sources of micronutrients are generally allowed to be used. Compost manure must be free of contamination of prohibited materials.

- All registered producers will be supplied with a list of allowed and prohibited materials. Although the allowed products vary with the certifying agency, some of the permissible products are wood ash, non-fortified marine by-products, fish meal, cottonseed meal, leather meal, potassium sulphate, sodium molybdate, sulphur (allowed only for foliar use as insecticide, fungicide or fertilizer), microbial weed killers and sulphate mineral trace salts. These products are allowed to be used wherever agronomically justified. The allowed, restricted and prohibited list may change from one year to the other. Sometimes application rates of particular products are also restricted.

- Plant or animal-based growth regulators are generally allowed. Mineral suspensions such as silica, used in the production of biodynamic production, is allowed.

- Cottonseed meal and gin trash if they do not contain pesticide residues can be used to enhance soil fertility, otherwise they must be composted prior to use.

- In some countries gypsum is available at a cheap price and very helpful to correct salinity. It can be used only in mined form. Muriate of potash is not recommended. Use of sulphate of zinc is restricted.

- Even though the producer spends more on organic production, there is no guaranteed price for organic cotton. It may be double that of normal cotton or lower than normal cotton.

International Concerns

- No pre-tested and authentic guidelines are available to producers on the production of organic cotton. There is a need for systematic research on many aspects of organic cotton growing as a regular part of research programs.

- Certification facilities are not available to producers in many countries. While many countries need to formulate their own certification rules, there is a need to bring some kind of harmony among the existing rules at least within a country.

- Cotton grown without fertilizers and insecticides is named differently by different people. It is called organic, chemical-free, certified organic A, etc. There is a need to put organic cotton under one worldwide acceptable label.

- Maintenance of soil fertility for realization of optimum yield in organic cotton requires cotton growing with other forage and leguminous crops. Crops other than cotton are also to be grown without fertilizers and insecticides. Organic cotton has a market but there is a need to establish a market for other organically produced crops grown in rotation with cotton.

- Organic cotton can successfully be grown in large areas which require machine picking. On the other hand the use of defoliants is prohibited, so there is a need to find harvest aids that would permit picking of cotton without chemical defoliation.

- Standards also need to be established for manufacturing organic textiles. Presently, there are almost no standards for spinning, weaving and processing organic cotton in textiles.

Cotton Ginning --- A Need for New Technology

Ginning is the art of removing lint from the seed coat. But, with better understanding of fiber characteristics and more precise requirements of the textile industry, it has become more of a science. Cotton picked from the field cannot be utilized for the purpose it was grown unless it has been ginned. In some countries like Australia and the USA, the ginner is a processor and separates lint and seed as a service for the farmer. In others like India and Pakistan, the ginner is a processor and at the same time a trader who buys seed cotton, gins it and sells the lint and seed separately for his own account. In this age of quality-consciousness, a ginner has a number of objectives: Maximum marketable yield with the highest possible grade from a given quantity of seed cotton in order to satisfy the grower; the highest lint recovery and maximum price for profitability of the ginner-trader; and providing cotton which has been least damaged during ginning for the spinner. Ginning seed cotton at the minimum cost is foremost.

The ginning industry is very young compared with growing and commercial production of cotton. The saw gin was invented in 1794, and until then it was not possible to separate lint from seed at speed by any means of lint separation.

Roller Ginning

Roller ginning is a primitive type of ginning based on the principle of stretching fibers from the seed coat. The force with which the fibers are attached to the seed coat directly corresponds to the energy required to separate lint from seed. Roller ginning is used to gin long staple and extra-long staple cottons as it causes less fiber breakage.

A roller gin basically consists of a leather-covered roller which revolves in close contact with a fixed metal blade. The lint, after being removed from the seed coat, sticks to the leather roller and is pulled through a space smaller than the size of the seed to the other side of the machine. Separation of the seed from the lint is helped by a moving knife or a beater bar pushing the seed away from a stationary knife.

In Egypt, the largest producer of extra-fine cotton in the world, the ginning box consists of a complete leather roller with a stationary upper knife and reciprocating lower knife, seed fingers and a pusher board. Adjustments are possible in the ginning box in accordance with the variety, grade and size of the seed, length and strength of the fiber as well as the percentage and condition of trash content.

In the USA, all 49 roller gins are of the rotary type. There are many variations and refinements of the machines developed in the recent past, but the fundamental principle remains the same. The introduction of double action, rotating bars and many other developments has improved efficiency to a great extent, but still roller gins are slow in action and hence not economical, compared with saw gins, for cottons other than extra-fine.

In Morocco and Uganda, all cotton is ginned on roller gins. India and Turkey are two other countries where medium long staple is ginned on roller gins on a large scale. In Thailand, about 90% of the total production is ginned on roller gins. In all other countries, roller gins are used only for extra-fine cottons. According to the survey conducted by the ICAC last year, on average about 13% of the total world cotton production is ginned on roller gins.

Saw Ginning

Saw ginning is very efficient and the most widely used system of ginning. Lint removal from the seed coat works on two principles: Stretching and beating actions. Probably, the beating activity causes more fiber breakage and damage to the fiber. The lint ginned by saw ginning always has less trash but higher short fiber content, and the uniformity ratio is automatically reduced. The saws which stretch the fibers from the seed rotate through ginning ribs. When cotton falls on the moving saws, saw teeth which are designed to be parallel to the ribs, grab the fibers and take them through the ribs.

As a result of saw ginning, burs and sticks are removed while small trash particles are broken into smaller pieces and become more entangled with lint compared with roller ginning. However, the cotton becomes more open and fluffy and usually gives an improved grade, thus fetching a higher price for the seller. There are also chances of passing motes and seed coat fragments through the ginning ribs. *G. arboreum* and *G. herbaceum* seeds, being smaller in size than *G. hirsutum* or even *G. hirsutum* varieties with a lower seed index, frequently pass through the ribs. Special ribs are required to gin desi cottons.

Gin Efficiency and Costs

Though saw gins are measured by the number of saws instead of length in case of roller gins, saw gin stands of the same length as a roller gin are usually ten times more efficient. The average ginning capacity of some machines is as follows (Munro, 1987):

Ginning Capacity of Some Machines

Machine	**Lint output/hour**
Single roller 40 inch	25 kg
Double roller 40 inch	35 kg
High-capacity roller	150 kg
40 saw	150 kg
80 saw	340 kg
120 saw	500 kg
128 saw	over 1,000 kg

Modern big gin stands from Lummus having 158 saws with automatic feeding are able to gin over 2000 kg of lint per hour. Lint recovery in the case of saw ginning is lower by 1-2% compared with roller ginning, but blow room losses are lower due to less dust and trash carried along with the lint during ginning. Now more efficient roller gins are also being developed.

Ginneries are owned by growers, individual persons, private companies, farmer cooperatives, governments and corporations/boards. Whatever the ownership, the cost of ginning has an impact on the price received by the farmer. Some important factors which determine the cost of ginning are the cost of machinery, maintenance, labor, emission control and energy used to run the machine. The cost of ginning in some countries is below:

Cost of Ginning (in US$)

Country	Cost/kg	Cost/bale (480 lb.)
Argentina	0.27	58.8
Australia	0.20	43.4
Egypt	0.16	33.7
Israel (Upland)	0.17	36.2
Israel (Pima)	0.22	46.9
Pakistan	0.14	31.1
Syria	0.16	33.9
Turkey (Cukurova)	0.29	63.2
Uganda	0.38	83.5
USA	0.21	44.9
Zimbabwe	0.24	52.9

Source: ICAC Survey of the Cost of Production of Raw Cotton, 1992

Technological Problems and New Technologies

In some African countries like Kenya and Tanzania where both roller and saw gins are used to gin medium long staple cottons, roller ginned cotton fetches a higher price because of better preservation of fiber characteristics. On the other hand, saw ginned cotton is sold at a higher price in countries like Pakistan and India, maybe because it has less trash and more lint per unit weight. It is difficult to establish which kind of gin, roller or saw, is suitable for hand or machine picked cotton. In fact, the ability of the machine to gin cotton at an economical cost without any significant deterioration in the fiber quality is a more important factor.

Since the development of roller and saw gins, there have been many improvements in the systems and machines. Ginning efficiency has improved and pre- and post-ginning lint cleaning along with drying equipment have been successfully integrated with modern equipment. Better control over the ginning process and automation of the process from feeding up to baling is another significant achievement. But, there have been no inventions using a new technology to replace roller and saw gins. Both these technologies along with their pros and cons have been discussed above. When saw ginning was introduced, it was accepted despite the fact that it had higher probability of damaging fiber. In the 200 years since the invention of the saw gin by Eli Whitney in 1794, there has been no change in the technology.

Differential Ginning

Presently, two options are available for change in the technology of ginning. The USDA Cotton Ginning Laboratory in Stoneville, Mississippi, has been working on differential ginning for many years. A conventional saw gin stand has been modified by adding a powered auger in the center of the seed roll to move seed cotton laterally from left to right. In this process, the longest fibers are removed from the seed coat first and the seed cotton moves to the right. As more fibers are removed, the cotton continues moving from left to right. At the end of the ginning process lint is segregated into three different groups of fiber length. The amount of length removed by each section (left, middle and right) is approximately 50, 35 and 15%, respectively. Results (Columbus 1987) have shown that it is possible to separate lint into three groups of different staple length. The left position produces significantly better fiber quality parameters over the middle section. The fiber from the left section has better staple length, is stronger by 0.9 g/tex, has 3% less short fiber content, its coefficient of variation is also lower by 2.5% and micronaire is improved by 0.2. Seed coat fragments in the two sections are not different.

Columbus and Backe (1992) further have observed that differential ginning produces fiber which is superior not only in fiber parameters but also produces better quality yarn. They compared lint from conventional ginning with 55% and 45% of the lint removed by differential ginning on the left and right sections, respectively. They found that both portions of the differentially ginned lint contained less foreign matter than the control. The fibers from the left section measured longer, contained fewer short fibers and had a lower coefficient of variation. The yarn spun from the left side lint was stronger, had a better appearance and fewer imperfections. In spite of the qualities of the gin, it has not been possible to push this technology to a commercial stage.

Cage Ginning

A new concept of selective ginning has also been in development for almost ten years. Because of the machine's ability to take off only the fibers of particular length, it was first called selective ginning. But because the machine is in the form of a cage with rollers on the outside and inside of the cage, it is now called cage ginning and the machine is called a cage gin.

The machine consists of series of hard rollers mounted on the outer surface of a circular rotating cage. Air flow is directed to the center of the cage between the rollers which causes the seed cotton to adhere to the outer surface formed by the rollers. Lint is further pushed to the center of the cage between the rollers by a strong air stream. The rubber covered nip rolls, positioned inside the cage and pressing on the inner surface of the cage rolls, pinch the lint and pull it from the seed. The cage rollers are spaced such that the seed does not pass through the rollers.

The machine works on the principle of pulling fibers from the seed but the air pressure is a much gentler action than pulling lint by saws and does not damage the fiber. Because pushing of the fibers between the cage rollers depends on the air stream, the amount of fiber removed from the seed coat is determined by the force with which air is pushed to the center of the cage. Thus, the percentage of fibers removed from the seed can be increased or decreased with adjustment of the air stream and also by nip roll pressure against cage rollers. The force with which the fibers are attached to the seed is also an important factor in determining the percentage of lint to be removed. The machine originally was not meant to remove short fibers.

Experiments have shown that cage ginning has advantages over saw ginning and roller ginning. Wilkes et al (1987) ginned four varieties of cotton on saw and cage gins and compared three different treatments. 50% of lint was removed in the case of cage ginning while the remaining 50% was removed by saw gin. Thus, the three treatments were saw ginning (100% lint removed by saw gin), cage ginning (50% lint removed) and residual ginning (50% lint left by cage ginning was removed by saw ginning). The lint removed by the three treatments was tested on HVI for fiber characteristics and quality of the yarn spun from the lint. It was observed that cage ginned lint produced longer fiber than residual ginning and normal saw ginning, residual ginned lint was slightly shorter than saw ginning, however, the differences were non-significant. Uniformity of the fiber length was consistently better in case of cage ginning but there was no difference in fiber strength values. Though differences were again non-significant, the micronaire value was higher in case of cage ginning. Ring spun and open end spun yarn of 14s and 22s from cage ginned lint was significantly better in strength compared with saw ginning and residual ginning. Residual ginned lint gave comparatively less strong yarn compared with saw ginning and, in most of the cases, the differences were statistically significant. The number of thick and thin places in both counts were in general lower in the case of cage ginning.

Wilkes and Mehner (1990) also compared yarn made from upland and Pima cotton ginned on cage gin and roller gin. The cage gin used was a large experimental gin with a cage diameter of 122 cm. Air pressure of 20, 30 and 50 pounds per square inch resulted in the removal of 68, 74 and 80% of lint, respectively. However, the amount of lint removed by the cage gin for experimental purposes for three upland varieties was Acala 1517-75, 92%; Deltapine 50, 88%; and NX 1, 96%. Lint from Pima S6 was also used for comparison of roller ginning with cage ginning.

The results showed that many fewer neps were found in cage ginned cotton compared with saw ginning and residual ginning. The spinning tests conducted on 30s and 40s yarn produced from upland cotton confirmed the earlier findings of stronger, more even yarn with fewer neps in the case of cage ginning. In the case of Pima cotton, the carding and combing losses were lower in the case of cage ginned cotton; the quality of 30s and 40s yarn was not affected. However, the 50s combed yarn from Pima cotton tended to be more even in cage ginning than in saw ginning.

According to the report published in the April 1994 issue of *Cotton Grower*, commercial scale tests with the cage gin have shown that the cage technology produced superior fiber quality compared with saw ginning. Cage ginning eliminates the entanglement of trash with cotton, reduces the number of neps and short fiber content. While it is easy to remove larger trash particles, the cage gin provides better opportunities to remove trash with lint cleaners or even at the mill. According to Lummus Industries, cage ginning is still at experimental stages and will take at least two to three more years before it becomes commercial.

Conclusion

Fiber characteristics need to be preserved to meet the needs of spinners and weavers for whom cotton is produced. With the advancement in fiber testing equipment and high speed testing, spinners' requirements have become more precise, and there is a need for better ginning technology to match the better understanding of known as well as unknown fiber characteristics. So far, no method of separating lint from seed is available which will not damage the fiber and efficiently gin cotton at the same time. There does not seem to be anything available to ginners in the near future. Cage ginning seems to have at least some promise.

References

Columbus, E. P. 1987. Differential ginning: A progress report. *Proceedings of the Beltwide Cotton Conferences*, National Cotton Council of America, P. O. Box 12285, Memphis, Tennessee 38182, USA.

Columbus, E. P. and Backe, E. E. 1992. Improved fiber and yarn quality through differential ginning. *Applied Engineering in Agriculture*, Vol. 8, No. 2, American Society of Agricultural Engineers, 2950 Niles Road, St. Joseph, MI 49085-9659, USA.

Klassen, P. 1994. Cage gin revolutionizes ginning process. *Cotton Grower*, Volume 30, No. 4. Meister Publishing Company, 37733 Euclid Avenue, Willoughby, OH 44094, USA.

Munro, J. M. 1987. *Cotton*. Second Edition of the Tropical Agriculture Series. John Wiley & Sons, Inc., 605 Third Avenue, New York 10158, USA.

Wilkes, L. H. and Mehner, M. L. 1990. Cage gin for upland and Pima cotton. *Proceedings of the Beltwide Cotton Conferences*, National Cotton Council of America, P. O. Box 12285, Memphis, Tennessee 38182, USA.

Wilkes, L. H., Watkins, K. E. and Lalor, W. F. 1987. Performance of selective gin. *Proceedings of the Beltwide Cotton Conferences*, National Cotton Council of America, P. O. Box 12285, Memphis, Tennessee 38182, USA.

Short Notes

- **Insecticide Resistance in S. littoralis**

  Spodoptera littoralis is a major cotton pest in many African countries. It is the most important cotton pest in Egypt, responsible for huge losses in yield in Madagascar, Sénégal and Togo, and also a pest of economic value in some parts of Morocco. Because of its ability to live on a variety of host plants (over 100) available in these countries, it can survive winter successfully and shift to cotton when fruiting forms become available in the field. Currently, no successful means of control are available other than chemical sprays, but, according to studies conducted by the Institut National de la Recherche Agronomique-INRA in France, *S. littoralis* has developed resistance to many pyrethroid insecticides. Samples were collected from Morocco, Egypt, Israel and Madagascar and treated with deltamethrine. It was found that, in Egypt and Madagascar, the insect has developed a fair degree of resistance to deltamethrine. The samples from Israel were used as a reference to assess the degree of resistance. The samples from Egypt were observed to be ten times more resistant to deltamethrine compared with Morocco and Israel. In Sénégal, pyrethroids are used at double the rate of recommended doses in order to provide effective control of *S. littoralis*. The insect in Madagascar has the maximum tolerance to deltamethrine compared with all countries in the study.

INRA recommends maintaining the optimum doses and decreasing the spray interval instead of doubling and tripling the dose of the insecticide. Researchers are looking into the possibility of integrating *Bacillus thuringiensis* and baculoviruses into the control methods as to minimize the use of insecticides in most effected countries. Encouraging results have been achieved in Togo, but commercial production and effectiveness of baculoviruses for only a short time are major constraints with which to contend (Source: *Afrique Agricultur*e, 19e Année - No. 211, Janvier 1994).

- **Cut-out in Cotton**

  The cotton plant has the ability to react very quickly to ambient conditions. This ability of the plant can be utilized not only to maintain a desired level of production but also a high quality of fiber. Dr. Tom Kerby, Director of Technical Services at Delta and Pine Land Company based in Scott, Mississippi, formerly of the University of California, was one of the Plenary Speakers to the World Cotton Research Conference-1, speaking on "The Use of Plant Monitoring to Ensure Optimal Cotton Crop Management." Dr. Kerby has established criteria to determine the cut-out of the plant in order to terminate insecticide spraying, irrigation, etc., and to improve uniformity of the cotton picked from a single plant.

According to work done in California and Australia, nodes above the white flower are directly correlated with the cut-out of the plant. If the number of nodes above the white flower has come down to four, cut-out of the plant has occurred. The procedure is as follows: On any specific day when it is intended to take the data, select the plants which have a white flower on the first position. The fruiting branch above the branch with a white flower should be counted as a first branch and every branch to the terminal node counted as a new node if it has a main stem leaf of at least 2.5 cm across.

It has also been observed that cut-out date is usually reached when 95% of the bolls have been formed, but when 95% of the total bolls are formed is another calculation to be made. According to recent data, it has been determined that 95% of the number of fruiting branches with first position bolls is almost equal to the number of fruiting branches required to hold 95% of all bolls on the plant. Thus the number of nodes above the white flower at which the cut-out occurs is the total number of fruiting branches minus the number of branches with 95% of first positions having bolls on them.

A number of factors have a strong influence on the number of nodes above the white flower. If there has been high early boll retention because of conducive growing conditions, the number of nodes above the white flower will be greater than normal; but, if there was early shedding, the number of nodes above the white flower for cut-out will be lower than normal value. Other factors which have significant impact on determining cut-out on the basis of nodes above the white flower are the following: varieties grown; growing conditions; average first position retention; average first position retention on the bottom five branches; target yield; total number of branches for 95% retention; and final plant height (*The Australian Cottongrower*, Volume 15, No. 2, 1994).

- **Delta and Pine Land Takes Over Pima Research**

  The Delta and Pine Land Company (D&PL), based in Scott, Mississippi, USA, is the largest producer and distributor of cotton seed in the world. The company also produces and sells sorghum, soybean and corn seed. Important cotton seed varieties of D&PL are Deltapine 50, Deltapine Acala 90, Deltapine 5690 and Deltapine 5415. Deltapine seed is produced in many countries while some others import seed from D&PL. So far, the company has been producing only upland medium staple cottons.

  Under an agreement signed by D&PL and the Supima Association, D&PL will assume the association's responsibilities to breed and promote Pima varieties. D&PL will also be responsible for seed production and marketing of Supima varieties. Supima, an association of US Pima cotton growers, will continue its role to promote the use of Pima cotton. The association, under an agreement with the University of Arizona and the USDA, had the sole responsibility to breed Pima varieties in the USA after the USDA terminated its research program on Pima cotton in 1993. D&PL now has the exclusive rights to produce and market Pima varieties in the US. The public varieties like S6 and S7 can still be produced and marketed by other companies. D&PL has also purchased the cotton planting seed business of Cargill, but the varieties with the brand name Paymaster and Lankart will continue to be sold and promoted under the same names (Source: *The Cotton Digest*, Volume 68, No. 11, 1994).

- ***Coton et Fibres Tropicales***

  The Centre de Coopération Internationale en Recherche Agronomique pour Développement-CIRAD has terminated the publication of a technical journal on cotton, *Coton et fibres tropicales*, as of the beginning of 1994. *Coton et fibres tropicales* has been published since 1946. In almost 50 years, more than 1,100 research articles were published in the journal, some in English and others in French. The Annual Crops Department of CIRAD, a program in which cotton is one of the components, is now publishing a new journal, *Agriculture et développement*. Researchers wishing to publish their research results on cotton are invited to contribute articles to *Agriculture et développement*. The papers may be sent to CIRAD-CA, Service de publications, de l'information et de la documentation, B. P. 5035, 34032 Montpellier, Cedex 01, FRANCE.

- **Patent for Transgenic Cotton**

  In the last issue of *THE ICAC RECORDER*, the broad spectrum patenting of transgenic cotton by the USDA to Agracetus Inc. was reported. There are different opinions about the impact of a broad spectrum patent on research and release of transgenic products in cotton. Some people are of the opinion that, as no conditions are imposed on research on genetically engineered cotton, there are no serious consequences of broad spectrum patenting by Agracetus. Others are concerned that granting vast authority to one company can harm the interests of other companies competitive in the same narrow field. According to Agracetus, no one can genetically engineer cotton without their permission, and although the stipulation may seem harmless now, others' interests in the long run may be affected. According to reports published in the April 1994 issues of the *Biotech Reporter* and *Seed and Crops Industr*y, the Indian government has revoked the transgenic patent of Agracetus because of its far-reaching implications for India's cotton economy. It is speculated that the Indian government's action might spark debate in the US and some companies who have an interest in transgenic cotton might also challenge the patent in the court. Calgene Inc. and Monsanto Co. have already negotiated a licensing agreement with Agracetus for their herbicide and bollworm-resistant cottons, respectively.

- **ICAC Activities**

  At the 53rd Plenary Meeting of the ICAC to be held in Recife, Brazil, from September 25-October 1, 1994, the Committee on Cotton Production Research of the ICAC will have its meeting and Technical Seminar on September 29, 1994. The Technical Seminar will be held on the topic "Fiber Characteristics and Spinners' Perspective: A Look into the Future."

  The Technical Information Section of the ICAC is in the process of updating the publication *Current Research Projects in Cotton*. The publication will contain reports on the research structure, research institutes with complete addresses, lists of research projects and names of the researchers in various disciplines of as many countries as possible. It is intended to publish this report at the time of the 53rd Plenary Meeting of the ICAC.

A DIALOG Search from the Agricola Database on Defoliation in Cotton

Defoliation ---- a prerequisite for machine picking ---- has the objective of getting rid of green leaves, enhancing crop maturity and minimizing trash in the seed cotton picked. Fiber characteristics are effected by the type and timing of the defoliant used. The key worlds used in the DIALOG search of the Agricola Database are are **Cotton** and **Defoliation**. There are 55 papers published from 1980 to date.

92000806 20373119 Holding Library: AGL
Defoliation of cotton leaves by chemigation methods
Sumner, H.R.; Chandler, L.D.; Herzog, G.A.; Dowler, C.C.
Proceedings / 1993. v. 3 p. 1610-1613.
Memphis, Tenn.: National Cotton Council of America, 1991- ISSN: 1059-2644
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 10-14, 1993, New Orleans, Louisiana.
Includes references
Place of Publication: Tennessee
Subfile: IND; OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article

91149311 20371585 Holding Library: AGL
Growth, boll opening rate and fiber properties of narrow-row cotton
Heitholt, J.J.; Pettigrew, W.T.; Meredith, W.R. Jr.
Agronomy Journal. May/June 1993. v. 85 (3) p. 590-594.
Madison, Wisconsin : American Society of Agronomy, [1949- 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

91126562 20337418 Holding Library: AGL
Experimental assessment of the impact of defoliation by *Spodoptera littoralis* on the growth and yield of Giza 75 cotton
Russell, D.A.; Radwan, S.M.; Irving, N.S.; Jones, K.A.; Downham, M.C.A.
Crop Protection. June 1993. v. 12 (4) p. 303-309.
Oxford : Butterworths-Heinemann Ltd. ISSN: 0261-2194 CODEN: CRPTD6
DNAL CALL NO: SB599.C8
Language: English
Includes references
Place of Publication: England
Subfile: IND; OTHER FOREIGN;
Document Type: Article

91105755 27865372 Holding Library: AFU; AGX
Timing of cotton defoliation based upon the upper most white flower as a measure of the maturity of the last effective boll population
Virgil, D. W.
ArU CALL NO: SB249.W44 1991
Language: English
"May 1991"
Thesis (M.S.)--University of Arkansas, Fayetteville, 1991.
Includes bibliographical references (leaves 46-48).
Place of Publication: Unspecified
Subfile: OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Monograph; Bibliographies

91088502 93028469 Holding Library: AGL
Cotton defoliation
Guthrie, D.S.; Edmisten, K.
AG - North Carolina Agricultural Extension Service, North Carolina State University. Jan 1993. (417,rev.) p. 116-121.
Raleigh, N.C. : The Service.
DNAL CALL NO: S544.3.N6N62
Language: English
In the series analytic: 1993 cotton information.
Subfile: EXT (STATE EXTEN. SERVICE);
Document Type: Article

91051962 92077898 Holding Library: AGL
Influence of harvest factors on cotton yield and quality
Williford, J.R.;
USDA, ARS, Field Crops Mechanization, Stoneville, MS
Transactions of the ASAE. July/Aug 1992. v. 35 (4) p. 1103-1107.
St. Joseph, Mich. : American Society of Agricultural Engineers. ISSN: 0001-2351
CODEN: TAAEAJ
DNAL CALL NO: 290.9 AM32T
Language: English
Includes references.
Subfile: OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article

91038552 92068306 Holding Library: AGL
Effect of cotton defoliants on leaf abscission, immature bolls and lint yields in a short-season production system
Chu, C.C.; Henneberry, T.J.; Reynoso, T.Y.
USDA-ARS, Western Cotton Res. Lab., Brawley, CA
Journal of Production Agriculture. April/June 1992. v. 5 (2) p. 268-272.
Madison, Wisconsin : American Society of Agronomy. ISSN: 0890-8524
CODEN: JPRAEN
DNAL CALL NO: S539.5.J68
Language: English
Includes references.

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

91031369 92064109 Holding Library: AGL
Cotton variety defoliation tests in Texas--1978
Miller, C.S.; Brendel, T.P.; McGinley, A.; Butler, B.
Texas Agricultural Experiment Station
Miscellaneous publication MP - Texas Agricultural Experiment Station. Mar 1980. (1445)
8 p.
College Station, Tex.: The Station. ISSN: 0097-6334 CODEN: TAEMA
DNAL CALL NO: 100 T31M
Language: English
Includes references.
Subfile: EXP STN (STATE EXPER. STN);
Document Type: Article

91020332 92057138 Holding Library: AGL
Water deficit effects on the cotton leaf cuticle and the efficiency of defoliants
Oosterhuis, D.M.; Hampton, R.E.; Wullschleger, S.D.
University of Arkansas, Fayetteville, AR
Journal of Production Agriculture. Apr/June 1991. v. 4 (2) p. 260-265.
Madison, Wisconsin : American Society of Agronomy. ISSN: 0890-8524 CODEN:
JPRAEN
DNAL CALL NO: S539.5.J68
Language: English

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

91009725 92049647 Holding Library: AGL
Harvest aids for cotton in Louisiana
Burch, T.A.; Crawford, S.H.; Millhollon, E.P.
Louisiana Cooperative Extension Service
Publication - Louisiana Cooperative Extension Service. Sept 1990. (2291,rev.) 6 p.
DNAL CALL NO: S67.P82
Language: English
Subfile: EXT (STATE EXTEN. SERVICE);
Document Type: Article

91007474 92047304 Holding Library: AGL
Defoliant combinations for improved cotton defoliation
Snipes, C.E.; White, B.W.; McCarty, W.H.; Cathey, G.W.
Mississippi State University, Research report - Mississippi Agricultural and Forestry Experiment Station. May 1992. v. 17 (2) 6 p.
Mississippi State, Miss. : The Station. ISSN: 0147-2186 CODEN: RRMSD
DNAL CALL NO: S79.E37
Language: English
Includes references.
Subfile: EXP STN (STATE EXPER. STN);
Document Type: Article

90128584 92028135 Holding Library: AGL
Effects of multiple PIX applications on cotton growth and yield
Burmester, C.H.; Adams, J.F.
Auburn University, Auburn, AL
Proceedings - Beltwide Cotton Production Research Conferences. 1990. p. 653-654.
Memphis, Tenn. : National Cotton Council of America. CODEN: BCOPB
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 9-14, 1990, Las Vegas, Nevada.
Subfile: OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article

90128579 92028130 Holding Library: AGL
The effect of time of application and chemical(s) for defoliation on cotton seed germina -tion
Baskin, C.C.; Snipes, C.E.; Palliwal, S.; Rosso, B.
Mississippi State University, Mississippi State, MS
Proceedings - Beltwide Cotton Production Research Conferences. 1990. p. 643-644.
Memphis, Tenn. : National Cotton Council of America. CODEN: BCOPB
DNAL CALL NO: SB249.N6
Language: English
Meeting held January 9-14, 1990, Las Vegas, Nevada.
Includes references.
Subfile: OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article

90099950 92007379 Holding Library: AGL
Cotton defoliation
Guthrie, D.S.;
North Carolina State University
AG - North Carolina Agricultural Extension Service, North Carolina State University. Apr 1991. (417,rev.) p. 106-112. Raleigh, N.C.
DNAL CALL NO: S544.3.N6N62
Language: English
In the series analytic: 1991 Cotton Information.
Subfile: EXT (STATE EXTEN. SERVICE);
Document Type: Article

90085469 91054231 Holding Library: AGL
Ginstar EC: A new defoliant for cotton
Stewart, J.F.; Dwyer, D.
Nor-Am Chemical Company, Fresno, CA
Proceedings of the Beltwide Cotton Production Conference. 1989. p. 76-77.
Memphis, Tenn. : National Cotton Council. ISSN: 1052-5351
DNAL CALL NO: SB245.B42
Language: English
Meeting held January 3-4, 1989, Nashville, Tennessee.
Subfile: OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article

90084933 91053597 Holding Library: AGL
Effect of early defoliation on yield and fiber quality in cotton (Gossypium hirsutum L.)
Hernandez-Jasso, A.; Solis, L.P.
Instituto Nacional de Investigaciones Forestales y Agropecuarias, Sonora, Mexico
Proceedings - Beltwide Cotton Conferences. 1991. v. 1 p. 525-527.
Memphis, Tenn. : National Cotton Council of America. CODEN: BCOPB
DNAL CALL NO: SB249.N6
Language: English
Paper presented at the "Cotton Improvement Conference,"1991, San Antonio, Texas
Includes references.
Subfile: OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article

90038265 91023934 Holding Library: AGL
Accelerated cotton boll dehiscence with thidiazuron
Malik, M.N.; Shabab-ud-Din; Makhdum, M.I.
Cotton Research Institute, Multan, Pakistan
Tropical Agriculture. Apr 1991. v. 68 (2) p. 149-150.
Guildford : Butterworth Scientific. ISSN: 0041-3216 CODEN: TAGLA
DNAL CALL NO: 26 T754
Language: English
Includes references.
Subfile: OTHER FOREIGN;
Document Type: Article

90017204 91010005 Holding Library: AGL
Induction of leaf abscission in cotton is a common effect of urea and adenine-type cytok -inins
Grossmann, K.;
BASF Agricultural Research Centre, Limburgerhof, Federal Republic of Germany
Plant physiology. Jan 1991. v. 95 (1) p. 234-237.
Rockville, Md. : American Society of Plant Physiologists. ISSN: 0032-0889 CODEN: PLPHA
DNAL CALL NO: 450 P692
Language: English
Includes references.
Subfile: OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article

89100880 90026333 Holding Library: AGL
Cotton defoliation
Guthrie, D.S.;
North Carolina Agricultural Extension Service
AG - North Carolina Agricultural Extension Service, North Carolina State University. June 1989. (417) p. 47-52.
Raleigh, N.C. : The Service.
DNAL CALL NO: S544.3.N6N62
Language: English
In series analytic: 1989 Cotton Information.

Subfile: EXT (STATE EXTEN. SERVICE);
Document Type: Article

89078433 90009668 Holding Library: AGL
Cotton harvest aid research
Millhollon, E.P.; Beck, A.W.
Red River Research Station
Annual research report - Red River Research Station. 1987. p. 184-189.
Bossier City, LA. : The Station. ISSN: 0886-4500
DNAL CALL NO: 100 L9333
Language: English
Includes statistical data.
Subfile: EXP STN (STATE EXPER. STN);
Document Type: Article; Statistics

89078295 90009529 Holding Library: AGL
Cotton defoliation test
Millhollon, E.P.;
Red River Research Station
Annual research report - Red River Research Station. 1985. p. 49.
Bossier City, La. : The Station. ISSN: 0886-4500
DNAL CALL NO: 100 L9333
Language: English
Includes statistical data.

Subfile: EXP STN (STATE EXPER. STN);
Document Type: Article; Statistics

89077909 90009129 Holding Library: AGL
Cotton defoliation research
Melville, D.R.; Barker, G.
Red River Valley Agricultural Experiment Station
Annual research report - Red River Valley Agricultural Experiment Station. 1982. p. 179-180.
Bossier City, La. : The Station. ISSN: 0886-4500
DNAL CALL NO: 100 L9333
Language: English
Includes statistical data.
Subfile: EXP STN (STATE EXPER. STN);
Document Type: Article; Statistics

89064242 90001181 Holding Library: GUA; AGL
Cotton defoliation and crop maturity
Crawford, J.L.; Seigler, W.E.; Brown, S.M.
University of Georgia College of Agriculture, Athens, GA
Bulletin - Cooperative Extension Service, University of Georgia, College of Agricult ure. Aug 1989. (1019, rev.) 11 p.
Athens, GA. : The Service. ISSN: 0092-9077
DNAL CALL NO: 275.29 G29B
Language: English

Subfile: EXT (STATE EXTEN. SERVICE);
Document Type: Article

88121588 89003622 Holding Library: AGL
Interaction of thidiazuron and phytohormones in the regulation of cotton leaf shedding
Zubkova, N.F.; Bukashkina, Z.V.; Kulaeva, O.N.
Agrokhimiia. Mar 1987. (3) p. 91-98.
Moskva : "Nauka". ISSN: 0002-1881 CODEN: AGKYA
DNAL CALL NO: 385 AG89
Language: Russian
Includes references.
Subfile: OTHER FOREIGN;
Document Type: Article

88116174 88065144 Holding Library: AGL
Effect of 2-butyltiobenzotiazole on defoliation activity of N-phenyl-N (1,2,3,-tiadiazole-5 -il) urea on cotton
Zubkova, N.F.; Gruzinskaia, N.A.; Bukashkina, Z.V.; Kas'ianenko, N.A.; Pakhomova, D.M.
Agrokhimiia. Jan 1987. (1) p. 98-104.
Moskva : "Nauka". ISSN: 0002-1881 CODEN: AGKYA
DNAL CALL NO: 385 AG89
Language: Russian
Includes references.

Subfile: OTHER FOREIGN;
Document Type: Article

88107954 88037549 Holding Library: AGL
Effect of nitrogen fertilizer rates and defoliation timing on cotton yield and quality--a GOSSYM-COMAX comparison
Burmester, C.H.; Adams, J.F.; Chapman, L.J.
Proceedings - Beltwide Cotton Production Research Conferences. 1988. p. 509-510.
Memphis, Tenn. : National Cotton Council and The Cotton Foundation.
CODEN: BCOPB
DNAL CALL NO: SB249.N6
Language: English
Conference held on January 3-8, 1988, New Orleans, Louisiana.
Subfile: OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article

88107779 88037374 Holding Library: AGL
Cotton cultivar response to selected defoliation treatments
Guthrie, D.S.;
Proceedings - Beltwide Cotton Production Research Conferences. 1988. p. 69-70.
Memphis, Tenn. : National Cotton Council and The Cotton Foundation.
CODEN: BCOPB
DNAL CALL NO: SB249.N6
Language: English
Conference held on January 3-8, 1988, New Orleans, Louisiana.

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

88107778 88037373 Holding Library: AGL
Response of Pima cotton to Prep and Prep + Folex treatments for once-over harvest
Malm, N.R.; Smith, F. Jr.; Roberts, C.L.
Proceedings - Beltwide Cotton Production Research Conferences. 1988. p. 68-69.
Memphis, Tenn. : National Cotton Council and The Cotton Foundation.
CODEN: BCOPB
DNAL CALL NO: SB249.N6
Language: English
Conference held on January 3-8, 1988, New Orleans, Louisiana.
Subfile: OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article

87124336 87069920 Holding Library: AGL
Effect of 2-chloroethylphosphonic acid on ethylene production in cotton leaves
Markiva, L.G.; Zubkova, N.F.; Prusakova, L.D.
Agrokhimiia. Feb 1986. (2) p. 104-108.
Moskva : "Nauka". ISSN: 0002-1881 CODEN: AGKYA
DNAL CALL NO: 385 AG89
Language: Russian
Includes references.

Subfile: OTHER FOREIGN;
Document Type: Article

87091406 87044773 Holding Library: AGL
Defoliation and acrylic film coating as means of increasing cotton boll temperatures
Bariola, L.A.;
Proceedings - Beltwide Cotton Production Research Conferences. 1987. p. 82-84.
Memphis, Tenn. : National Cotton Council and The Cotton Foundation.
CODEN: BCOPB
DNAL CALL NO: SB249.N6
Language: English
Includes references.
Subfile: OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article

87091404 87044771 Holding Library: AGL
Yield response and fiber quality of Pima cotton treated with Prep plant growth regulator
Malm, N.R.; Smith, F.B. Jr.
Proceedings - Beltwide Cotton Production Research Conferences. 1987. p. 78-79. Mem -
phis, Tenn. : National Cotton Council and The Cotton Foundation.
CODEN: BCOPB
DNAL CALL NO: SB249.N6
Language: English
Subfile: OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article

87089480 87042321 Holding Library: AGL
Influence of application date on harvest aids for cotton
Whitwell, T.; Brown, S.M.; McGuire, J.A.
Applied agricultural research. 1987. v. 2 (1) p. 15-19.
New York : Springer.   ISSN: 0179-0374 CODEN: AAREEZ
DNAL CALL NO: S539.5.A77
Language: English
Includes references
Subfile: OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article

87000324 86063572 Holding Library: AGL
Defoliation and desiccation of cotton in Turkmenistan
Bausova, A.S.;
Zashchita rastenii. 1985. (9) p. 43.
Moskva : "Agropromizdat". ISSN: 0044-1864 CODEN: ZSRSB
DNAL CALL NO: 421 Z1
Language: Russian
Subfile: OTHER FOREIGN;
Document Type: Article

87000323 86063571 Holding Library: AGL
Defoliation and dessication of cotton in Uzbekistan
Akbarov, K.A.; Matvienko, O.F.; Nazarov, B.P.
Zashchita Rastenii. 1985. (9) p. 42.

Moskva : "Agropromizdat". ISSN: 0044-1864 CODEN: ZSRSB
DNAL CALL NO: 421 Z1
Language: Russian
Subfile: OTHER FOREIGN;
Document Type: Article

86146404 86061972 Holding Library: AGL
Late season production management practices: crop preparation for harvesting
Cathey, G.W.;
Proceedings of the Beltwide Cotton Production Conference. 1986. p. 55-56.
Memphis : National Cotton Council.
DNAL CALL NO: SB245.B42
Language: English
Paper presented at the "Beltwide Cotton Production Conference,"January 4-9, 1986,
Las Vegas, Nevada.
Subfile: OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: Article

86132730 86049563 Holding Library: AGL
Defoliation recommendations for cotton
Harvey, L.H.;
Circular - Clemson University, Cooperative Extension Service. Apr 1986.(642) 9 p.
Clemson, S.C. : The Service.
DNAL CALL NO: 275.29 SO8E
Language: English

Subfile: EXT (STATE EXTEN. SERVICE);
Document Type: Article

85134247 85010165 Holding Library: AGL
Effectivity of chemical defoliation on boll opening and yield parameters of hybrid cotto n under different management practices
Jain, S.C.; Jain, H.C.; Katti, G.V.
Indian Journal of Agronomy. Sept 1983. v. 28 (3) p. 298-302.
New Delhi : Indian Society of Agronomy. ISSN: 0537-197X CODEN: IJAGA
DNAL CALL NO: 22 IN235
Language: English
Includes 8 references.
Subfile: OTHER FOREIGN;
Document Type: Article

85068085 84078354 Holding Library: AGL
Genetic control of early natural defoliation in cotton
Konoplya, S.P.;
Soviet Genetics. v. 19 (10) , Oct 1983 (pub. 1984). p. 1340-1346.
New York, N.Y., Consultants Bureau. ISSN: 0038-5409
NAL: QH431.A1G43
Language: English ; Russian
Translated from: Genetika, p. 1706-1713. (QH431.A1G4).
Includes references.

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

84069361 83108358 Holding Library: AGL
Aggressiveness of random and selected isolates of *Verticillium dahliae* from cotton and the quantitative relationship of internal inoculum to defoliation (Gossypium)
Ashworth, L.J. Jr.
Phytopathology. v. 73 (9) , Sept 1983. p. 1292-1295. ill.
St. Paul : , American Phytopathological Society. ISSN: 0031-949X
NAL: 464.8 P56
Language: English
Includes references.
Subfile: OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: ARTICLE

84014466 83063710 Holding Library: AGL
Effect of defoliation on the sowing qualities of cotton seed
Imamaliev, A. KHLOA; Bakhramov, K.; Akbarov, K.; Bar'etas, P.
Khlopkovodstvo. July 1981. (7), July 1981. p. 8-9.
Moskva : , "Kolos". ISSN: 0023-1231
NAL: 72.8 K522
Language: Russian
Subfile: OTHER FOREIGN;
Document Type: ARTICLE

84012511 83061752 Holding Library: AGL
Application of wilt control preparations simultaneously with defoliation (Cotton crop treatment, Verticillium dahliae pathogen).
Telliaev, R. and Ligai, A.
Khlopkovodstvo. Aug 1981. (8), Aug 1981. p. 31. ill.
Moskva : , "Kolos". ISSN: 0023-1231
NAL: 72.8 K522
Language: Russian
Subfile: OTHER FOREIGN;
Document Type: ARTICLE

84012509 83061750 Holding Library: AGL
Effectiveness of defoliants of the UDM type (Cotton crop defoliation and desiccation wi th mixtures containing fertilizers).
Nabiev, N.; Tukhtaev, S.; Shammasov, R.; Burkhanov, Sh.; Kiselev, A.
Khlopkovodstvo. Aug 1981. (8), Aug 1981. p. 28-29.
Moskva : , "Kolos". ISSN: 0023-1231
NAL: 72.8 K522
Language: Russian
Subfile: OTHER FOREIGN;
Document Type: ARTICLE

83145847 83043452 Holding Library: AGL
Cotton defoliation study (Chemical defoliants)
Kennedy, C.W.; Jones, J.E.

Report of projects - Louisiana Agricultural Experiment Station, Department of Agron - omy. 1982, p. 40.
Baton Rouge : , The Department.
NAL: 100 L936
Language: English
Subfile: EXP STN (STATE EXPER. STN);
Document Type: ARTICLE

83111590 83015957 Holding Library: AGL
Change in the content of sulfhydryl groups in the tissues of the zone of the abscission layer of leaves during natural leaf shedding and defoliation of cotton.
Otakhanova, I.; Imamaliev, A.I.
Vliianie vnutrennikh i vneshnikh faktorov na fiziologicheskie i biokhimicheskie protsessy khlopchatnika/pod redaktsiei N.N. Nazirova. p. 126-130. ill.
Tashkent : , Fan, , 1981.NAL: SB251.S68V55
Language: Russian
14 ref.
Subfile: OTHER FOREIGN;
Document Type: ARTICLE
83064168 82097345 Holding Library: AGL
Soycot surfactant: a new surfactant for use in post emergence weed control and cotton defoliation
Horton, K.;
Summary proceedings of the Beltwide Cotton Production Mechanization Conference. 1982., p. 98-99.

Memphis, Tenn., National Cotton Council of America. ISSN: 0409-0624
NAL: 72.9 C8292
Language: English
Subfile: OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: ARTICLE

83017008 82056391 Holding Library: AGL
Effect of chemical defoliation of cotton crop on the time of its maturity
Sodhi, K.S.; Singh, M.
Indian Journal of Ecology. v. 8 (1), Jan 1981. p. 36-40.
Ludhiana, Indian Ecological Society. ISSN: 0304-5250
NAL: QH540.I56
Language: English
Includes 3 ref.
Subfile: OTHER FOREIGN;
Document Type: ARTICLE

82145822 82037481 Holding Library: AGL
Effect of selective defoliation on yield and growth of cotton (Gossypium hirsutum L) vari - ety 'H-4'
Mehta, H.M.; Shah, C.B.; Patel, D.P.; Jadav, K.V.; Patel, H.V.; Patel, R.R.
Gujarat Agricultural University research journal. v. 7 (1), July 1981. p. 6-10. Ahmed - abad, , The University.
NAL: S539.I4G8
Language: English

Includes 6 ref.
Subfile: OTHER FOREIGN;
Document Type: ARTICLE

82109612 82008262 Holding Library: AGL
The effect of chemical defoliation treatment on fibre quality of H. 14 cotton Bangarwa, A.S.; Singh, C.; Malik, R.K.
Cotton Development. v. 10 (3/4), Oct. 1980/Jan 1981. p. 9-10. Bombay, Directorate of Cotton Development. ISSN: 0045-8759
NAL: SB251.I5C6
Language: English
9 ref.
Subfile: OTHER FOREIGN;
Document Type: ARTICLE
82048906 81079307 Holding Library: AGL
Cotton defoliation for early harvest
Sodhi, K.S.; Singh, M.
Progressive farming v. 16 (9), May 1980. p. 26.
Ludhiana, Punjab Agricultural University. ISSN: 0555-4365
NAL: S19.P7
Subfile: OTHER FOREIGN;
Document Type: ARTICLE

82041658 81073799 Holding Library: AGL
Mechanized filling complex (Application of cotton defoliation solution).

Saparov, A.;
Khlopkovodstvo. Aug 1980. (8), Aug 1980. p. 24-25. Moskva, "Kolos". ISSN: 0023-1231
NAL: 72.8 K522
Subfile: OTHER FOREIGN;
Document Type: ARTICLE

82041657 81073798 Holding Library: AGL
Defoliation of cotton crop
Imamalievc, A.; Turakhodzhaev, T.; Barbetas, P.
Khlopkovodstvo. Aug 1980. (8), Aug 1980. p. 23-24.
Moskva, "Kolos". ISSN: 0023-1231
NAL: 72.8 K522
Subfile: OTHER FOREIGN;
Document Type: ARTICLE

82040905 81073045 Holding Library: AGL
Cotton crop defoliation at different levels of fertilizer application (Turkmen SSR).
Bairamov, K.;
Khlopkovodstvo. July 1980. (7), July 1980. p. 24.
Moskva, "Kolos". ISSN: 0023-1231
NAL: 72.8 K522
Subfile: OTHER FOREIGN;
Document Type: ARTICLE

82016579 81052197 Holding Library: AGL
Cotton defoliation in Mississippi in 1980 (Harvest).
Mullendore, G.P.;
Aerial applicator. v. 19 (2), Mar 1981. p. 3-4. ill.
Santa Fe Springs, Calif., , Ned K. Rosenblatt.
NAL: 333.8 AE8
Subfile: OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: ARTICLE

81145570 81038291 Holding Library: AGL
Influence of Ethrel plant regulator on boll opening and defoliation of western cotton
Dunster, K.W.; Dunlap, R.L.; Gonzales, F.J.
Proceedings of the Plant Growth Regulator Working Group; Annual Meeting. 1980.
(7th), 1980. p. 15-21.
Longmont, Colo., The Group. ISSN: 0149-7685
NAL: SB128.P5
7 ref.
Subfile: OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
Document Type: ARTICLE

81047537 80101995 Holding Library: AGL
Use of infrared aerial photography as an aid in determining the defoliation and harvest
date in cotton.
Hochberg, R.; Nessim, B.; Rimon, D.
Special publication - Agricultural Research Organization. 1980. (160), 17 p. ill., map.

Bet Dagan, Division of Scientific Publications, Volcani Center.

Language: HEBREW ; ENGLISH
12 ref.
Subfile: OTHER FOREIGN;
Document Type: ARTICLE