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Introduction

The fourth issue of *The ICAC Recorder* contains two main articles. In the first article attention is given to ginning technology and more specifically to the role of drying of seed cotton before it enters the gin. The article emphasizes that a well-managed drying operation is crucial for efficient cleaning and ginning as well as to assure optimal fiber quality. New research is summarized and technology alternatives are discussed. A second article deals with the increasing use of small tractors in the cotton farming systems in Africa. The article draws upon the proceedings of a seminar on farm mechanization held in 1988 in Montpellier, France, and emphasizes both the technical and socioeconomic implications.

Further articles concern the present status of mite control in cotton and some new research on the relationship between temperature, day-length, and growth of cotton. The literature survey at the end of the journal is the second part of the results of a search in the *Agricola* database of the National Agriculture Library of the USA on cotton plant physiology. The first part was published in the previous issue of *The Recorder*.

At the 48th Plenary Meeting of ICAC, a technical seminar was held on “New Developments on Pest Control and its Impact on Yield and Fiber Quality.” The proceedings of this seminar, containing the text of the nine presentations, have just been published and are available from the Secretariat on request. Next year’s seminar will be on “Cotton Production Research from a Farming Systems Perspective with Special Emphasis on Stickiness.” Suggestions for speakers are warmly welcomed.

Cotton Drying in the Gin: New Technologies

Regulation of moisture content of seed cotton coming to the gin is a vital part of the ginning operation. Both seed cleaning and the actual ginning are much smoother processes when conducted at low moisture levels from 6 to 7.5 percent. As seed cotton stored for ginning may have moisture levels of anywhere from 11 to 18 percent, the drying operation must reduce moisture levels by 5 to 10 percentage points.

The dark side of this operation is that, first, it costs money to do it and, secondly, it is detrimental to some fiber quality parameters which, true, are presently hardly appreciated in the grading system but nevertheless reduce the spinning value of cotton. Thus, the art of drying consists of maximizing the benefits obtained from more efficient ginning operations, while minimizing costs and quality reductions of the end-product.

In this article we will review some of the principles of the drying process, the latest research on the relation between (excessive) drying and fiber

quality, and some of the newly proposed technologies to improve the drying process in the gin.

In the vast majority of gins drying is done by either one or two tower dryers. This system, developed by engineers from the U.S. Department of Agriculture in 1932, consists of a series of shelves along which a mixture of hot air and seed cotton is conducted by air pressure. Typically, the dryer has 24 shelves with a spacing from 8.5 to 10 inches. Apart from the tower dryer the complete system includes a heater, air fans, a means of feeding the seed cotton to the hot air stream (the mix-point), and a device to separate the seed cotton from the hot air after drying (this is mostly accomplished in the seed cotton cleaner).

The seed cotton comes in at the top of the dryer where temperatures range from 95° C to 150° C. The seed cotton will travel through the shelves system on about 1.25 m³ of air per kg. of seed cotton. The seed cotton will be moved over a total distance of about 50 m. in 7 to 10 seconds. At the exit point of the tower dryer the temperature will have dropped to a range of 50° C to 75°C.

The degree of drying is dependent on the temperature and relative humidity of the drying air, the volume and velocity of the drying air, the exposure time, and the initial moisture content of the seed cotton. Of these parameters the easiest to manipulate is the temperature. Exposure time can be extended by adding a second tower dryer, but this obviously does not lend itself for constant adjustment. The air flow rates are basically determined by the operation rate of the gin, as the air flow feeds the seed cotton to the gin-stands.

Early models of the tower system were equipped with steam coil heaters, able to produce hot air up to 70°C. Because an increasing amount of cotton in harvested and stored under fairly humid conditions in the USA and other countries, higher power heaters were installed. Now most heaters used have at least the potential of seriously over-heating the cotton fibers and, thereby, causing irreversible damage. In the USA, it is recommended that “in no case should the temperature in any portion of the drying system exceed 177°C (350°F).” Apart from the reduction in some fiber quality properties at lower temperatures, as will be discussed later, cotton fibers will simply scorch at temperature beyond 230°C.

In this respect, it is of paramount importance to install an effective control system on the dryers consisting of temperature sensors. The location of the sensors is essential since temperature in the dryer drops as the cotton is moved downwards. If the sensors are installed too low, cotton can be overheated even when control panels indicate no excessive temperatures.

Research on the hot-air-based drying of cotton has indicated that most drying is accomplished in the initial seconds of the process and that, with time, the rate of drying decreases rapidly. One study shows that, independently from initial moisture levels, about 60 percent of the drop in moisture levels (to an end level of 4%) is accomplished in the first 5 seconds of exposure time. After 10 seconds about 90 percent of the drop in moisture levels was realized (Hughs, 1988). In another study reported by Mangialardi, the combined effect of exposure time and temperature was studied using a multipath tower system. The study showed that raising the temperature from 250°F to 350°F resulted in an additional moisture decrease of 1.3 percent at a 12 second exposure time with an initial seed cotton moisture content of 15 percent (Mangialardi, 1988).

The detrimental effects of overheating on fiber quality have long been es-

established and have been well documented. Especially, the substantial increase in short fibers in the gin stand, due to fiber breakage of excessively dry cotton, is well established. More recent research has focussed on the relation between heating and fiber strength, color and dyeability. Also the influence on micronaire in this process has been investigated.

In a series of laboratory studies conducted at the USDA-ARS Cotton Quality Research Station in Clemson, ginner cotton was oven-heated at temperature levels ranging from 120°C to 190°C, at exposure times up to 60 seconds. Subsequently these samples were tested for various fiber quality properties. It could be shown that fiber strength, as measured by both the stelometer and the HVI-equipment, decreased by about 0.5 gram/tex both with increasing temperatures and increasing exposure time. It was also shown that this effect largely occurred in the first 15 seconds of exposure. Further tests on color differences revealed no significant changes in yellowness associated with heating. As expected, fiber length measurements indicated an increase in short fibers. Over the temperature and exposure time ranges studied, this amounted to an increase of 1 percentage point. Again it appeared that the damage was done during the first 15 seconds of drying.

Additional tests were conducted to investigate possible changes in the chemical properties of fibers after heating. A sinking test was conducted to reveal changes in the surface properties of the fibers. Compacted tufts of cotton were released in an alcohol-water solution and the sinking time was recorded. It was shown that sinking time decreased according to temperatures and exposure time, indicating decreased surface tension. It is not clear how this would affect the spinnability of the fibers.

In another series of tests conducted in the same laboratory, the effect of micronaire values in the heat induced changes in cotton fiber was studied. It appeared that lower micronaire cottons (supposedly of equal maturity) were more susceptible to strength reductions and to changes in the chemical properties of the fibers. In this study, exposure times of up to 20 minutes were tested to be able to observe the extremes of heat damage on fibers. All above mentioned types of damage were more than proportionally affected by these long exposure times. Also significant color changes were recorded at these levels.

The tower drying system has recently been criticized as being largely non-functional, and various private companies claim that the drying that sup-

posedly takes place in the tower dryer actually occurs already at the mix point just before the seed cotton enters the dryer. Some additional drying then takes place in the cleaner as the cotton is separated from the hot air. If this is the case, tower dryers are virtually useless and might be removed. In fact, this is exactly what one big cotton producer (J.G. Boswell Co. in California) claims to have done without loss of drying efficiency. The air fans in the system can then be slowed down, resulting in energy conservation.

Various alternatives are proposed and are presently being tested. One proposal aims at transferring the drying process to the suction system used to pick up the cotton from the modules. Another system proposed is the installation of a high velocity blow box under the automatic feed control. The high velocity hot air meets the cotton in a crossflow and, apart from drying the cotton, separates it into single locks, which facilitates its further processing.

Yet another system uses the principle that most of the drying takes place when the seed cotton is accelerated in the hot air. The Fountain Dryer, as described by Samuel Jackson of Lubbock, Texas, uses a crossflow sys-

tem as well by simply blowing the cotton up in a container before it is fed to the seed cleaner. Another advantage of this system is the low seed temperature which is maintained during drying. This would better maintain the feed value of the seeds. Using this towerless system it has been possible to remove the push fans in the system and rely solely on the pull fans. This results in a cleaner gin (since there are no air leaks of the system) and energy saving can be obtained as well.

At the USDA-ARS ginning laboratory in New Mexico, several crossflow and counterflow drying systems are under study. The crossflow system under investigation completely breaks with the system of suction unloading of the modules combined with a pneumatic conveyor system to the lint cleaners. Instead, a simple belt conveyor system equipped with a hot air drying system is proposed. In this system, cotton lots of up to 18 inches deep could be adequately dried in 60 second heat exposure times. These exposure times could be obtained without being a constraint on the total operation speed of the gin. Important energy saving is imminent as a 25 hp belt conveyor replaces a 200-hp suction system, and hot air pressure could be reduced by 50 percent.

The counterflow system under study is part of a compact system which places seed cotton cleaning, conveying and drying in one operational unit. The seed cotton is moved forward over a series of spiked cylinders against a flow of hot air. Subsequently, the cotton is moved into a stick machine and back out again to the cylinder system for further drying and cleaning. Heat exposure time in this test module was 14 seconds and the speed of seed cotton over the cylinders close to 1,200 feet per minute. Potential advantages are compactness of the system, an important cut in horsepower requirements and associated energy costs, and facility of production as all parts are already used in the gin. New test data for this system are expected shortly.

In summary, it is evident that seed cotton drying remains a delicate matter in every ginning operation. Poor control systems or over-zealous ginning for grade can result in serious fiber damage. With the anticipated move to HVI-systems, the economic incentives to preserve quality will be reinforced. The presently used tower drying system is under attack as it appears that very little drying actually occurs in the system. New technologies are emerging and are being tested both in laboratories and on a commercial scale.

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Introduction of Small Tractors in West Africa

Production technology in French-speaking West-Africa has changed rapidly over the last 20 years. Before 1965 almost all labor was done manually, from soil preparation to harvesting and even transport. After 1965 the steady introduction of animal traction technology has changed this system into a more mechanized type of agriculture, especially for soil preparation and transport of harvest. In principle, animal traction technology is well suited for weeding as well, but this practice is not as widely used as mechanical ploughing. In 1986 the percentages of soil preparation by animal traction in the cotton areas of the major producing countries were as follows: Burkina Faso 34%, Côte d'Ivoire 28%, Cameroon 70%, and Mali 90%.

From the mid-seventies onwards attempts have been made to introduce, in a planned fashion, small tractors suited to the small scale enterprises typical of the area. The objectives envisaged by these efforts are to improve productivity and production of both cotton and food crops, without

disrupting the economic and social structure of agricultural production in these regions.

In all four of the above mentioned countries the cotton development companies have been involved in promoting and guiding the introduction of these tractors as part of their general responsibility to support the economic development of their areas of operation. This has not been a simple task as it involves a whole range of activities like selection of farmers, financing, insurance, maintenance, extension and, in some cases, adaptive research.

In this article we will review a few papers on these investment programs presented at a seminar held in Montpellier in September 1988 on the general theme, "Economics of Mechanization in Tropical Regions."

The idea to test small tractors which could be individually owned and operated by the small cotton farmers in the Savanna regions in West-Africa came from the limited success of the efforts to introduce regular (75-100 hp) tractors on a cooperative basis, accompanied by restructuring of the land to obtain economic size plots. Some success with these tractors has

been obtained in the lowland rice areas where farmers usually contract with private tractor owners to plow the land. However, in the upland cotton areas such an arrangement never gained root, and the initiative had to be abandoned.

The small tractor which came into the picture after these initial experiences was the 30 hp four-wheeler “Bouyer” manufactured in France. In 1985, the Compagnie Francaise pour le Developpement des Fibres Textiles (CFDT) obtained the licence to manufacture this machine. Officially renamed into “TE 80” but still widely referred to as “Bouyer,” the machine was improved significantly over the years, partly by replacing the original engine by a better performing MWM motor.

Presently, the tractor is delivered with certain standard tools such as plough, seeder and trailer but also with such features as a grain dehusker and grain mill, specially conceived for an African environment. Total cost price of the tractor is about \$9,000 (FCFA 2,900,000). The introduction of these machines started in the early 1970s, mainly in Côte d'Ivoire and gained momentum after 1977 when more machines were introduced in Burkina Faso, Cameroon and Mali. Most of the tractors were financed by

loans from the cotton development corporations and by the French Central Bank for Development Cooperation (CCCE). Initially, the farmer-recipients were subsidized, mostly by offering services free of charge, but in later stages these subsidies have been substantially reduced.

It is estimated that in 1988 a total of about 1100 small tractors were operating in four countries: Burkina Faso (280), Côte d'Ivoire (420), Cameroon (300) and Mali (130). It should be noted that the areas cultivated by these machines still constitute only a very small fraction of the total crop area in these regions. In Cameroon, as opposed to the other three countries, the equipment remains under ownership of the Cotton Development Corporation and is rented to associations of farmers.

Farmers applying for a tractor loan had to meet certain strict criteria. Depending on the country, a minimum farm size of 20-30 ha. and additionally, the availability of a workforce of 10 to 15 people was required. The reason for this last requirement is that a sufficient workforce had to be maintained to be able to harvest the crop -- a strictly manual operation -- in a timely fashion. These selection criteria meant that most participants were recruited out of a class of family farms where different generations of the

family live together in a rather complex social structure involving both individual farming and collective farming. In fact, this type of farm structure was the most common form in most countries some 10 to 20 years ago but, since the introduction of animal traction and the massive migration to the cities, many of those have been broken up into several unlinked units.

In a contribution to the seminar concerning Burkina Faso, Pescay remarks that the acquisition of a tractor has meant that these farms in fact were able to survive in their present form, and that the younger generation was prevented from forming its own farm units or migrating to the city. However, he continues, it also means that the farmers recruited come from a relatively small base and that, if the program is to be expanded, the criteria for selection have to be modified.

From the presented studies on the newly equipped farms it appears that the beneficiaries of the equipment continue to use animal traction and manual labor for certain types of work, among others, seeding. In fact, the tractor is basically used for two operations: ploughing and transport of harvest. In Mali, for example, an average of 44 percent of the operating time was devoted to ploughing and 15 percent to transport. Here the total operating

time included dehusking and grinding of grain which accounted for another 25 percent.

The reason behind this phenomenon appear to be largely of economic nature. Timely ploughing is considered the crucial operation in rainfed farming in the Savanna region. Every rainshower is important in this risky climate, and early crop establishment will assure that no water is wasted. All means available are employed to plough early, including tractors and animal traction. However, since most animals are weakened after the dry season, their performance is not yet optimal at that stage.

For subsequent operations, such as seeding, weeding and ridging, farmers have several options. Seeding has to be done immediately after ploughing and is preferably by hand using a rope with knots indicating the spacing of plant hole. Apart from a better precision, hand sowing with a group of ten people directly behind the tractor can be accomplished in as much time as ploughing itself, so there is not real need to do it faster. The tractor itself is frequently used for contract work at other farms as soon as the owner is ready with his own plots. These revenues are of great importance to the owner as, in the case of payment in cash, they come early in

the season when the farmer is usually short of cash or, in the case of the frequently occurring exchange against harvest labor, they assure him of a sufficient work force at harvesting.

At the time of weeding and ridging the farmers are generally less pressed by time and will opt to do it wither manually or using animal traction. Here, the variable costs are a matter of consideration as every hectare will take about 4 liters of diesel oil. Since family labor is readily available on the farm, there is not much incentive to use the tractors. Ridging is a somewhat more heavy job, and many farmers will use animal traction to accomplish this task.

From an agronomic point of view, the use of tractors has not led to significant increases in yields. Both in Mali and Burkina Faso yield comparisons between motorized farms and farms using animal traction reveal very little yield differences for the main crops: cotton, maize and sorghum. However, most farmers are better off than before because of area extensions ranging from 5 to 20 hectares. In Côte d'Ivoire this has resulted in that a fair number of farms are now able to commercialize their food crops instead of using it all for their own consumption.

The expansion of cultivated area has led to some concerns about soil erosion, as natural vegetation serving as water runoff barriers is eliminated. Corrective measures are now under research and are presently being implemented in most regions. In an African context the rapid area expansion has also importance as a way to secure the rights for cultivation of the land. Most land is considered to belong to the village and despite the fact that the right for cultivation of all the arable land is assigned to different families in a village, this right can easily be lost if the land remains uncultivated for too long a period.

The area expansion has been pushed to the limits of the work capacity of the family especially at harvest time. It has been observed that more children, women, and elderly now participate in the collective farmwork and more frequent use is made of traditional work parties.

From an economic perspective the results of the investment program are still uncertain as they seem to vary from year to year, according to climatic conditions, and the price and general farm policy relevant to the program. The tractors are probably the most expensive investment these farmers will ever make and, if it were not for the guaranteed support of the cotton

development corporations, most farmers might never consider it. Debt repayment is often close to 50 percent of the total income after the investment. Also, in a farming system operating so close to the absolute poverty line, farmers attribute a very high value to any cash expenses for farm inputs. Whenever there is an alternative to making these expenses, like using family labor, they will strongly consider it. In an overall evaluation, one should also consider the direct and hidden costs made by the cotton development corporations to implement and conduct the programs. Scarce human and capital resources are devoted to this effort. At the same time, however, it could be argued that the on-the-job training of young engineers in farm machinery and farm management is a very valuable and probably unique opportunity for human capital development in the region.

In conclusion one may note that after the first phases of the developing aid-sponsored investment programs in small tractors, it is clear that this technology, after a series of adaptations, has reached a certain maturity. Also, the supporting structures have gained an impressive level of expertise, which gives reason to anticipate that one day these structures could be run more independently from the cotton development corporations. The main remaining questions concern the financial viability from the perspec-

tive of the farmer. Especially since it appears that a second wave of investment will necessarily concern smaller farms having smaller labor forces, this issue will have to be studied in detail. Ideally, as most observers argue, ways and incentives should be found to raise the productivity per unit of land. This, without doubt, would also include measures to reduce the danger of soil erosion and assure the sustainability of the farming systems. However, it is by no means clear if the technical basis for such a development exists, and what is needed to adjust the economic environment of the farmers to stimulate such a development.

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Mite Infestation and Control

Spider mites have become one of the major cotton pests over the last decade. In a recent survey by the ICAC Secretariat it appeared that out of 27 countries, 15 pests (early season or late season). Among them are a few of the major cotton producing countries such as Brazil, Australia, USA, and Pakistan. There are several species of mites which are of particular importance. They are the Carmine spider mite (*Tetranychus cinnabarinus*), the Strawberry spider mite (*Tetranychus turkestanii*), and the Two Spotted spider mite (*Tetranychus urticae*).

Injury from the spider mites is confined to the leaves, as yellow and red spots appear on the surface followed by leaf abscission. Reduced leaf surface will result in lower photosynthesis and, consequently, lower yields. Spider mites are especially a serious pest in hot arid growing regions such as California, Australia and Egypt. In most growing areas the mites have many alternative hosts at their disposal, including commercial crops such as alfalfa, wheat and sunflower, and a wide range of weed species as well. It has been documented that initial mite infestations are frequently caused

by migrating populations from neighboring plots occupied by these alternative hosts. In hot weather a full generation cycle can be completed only five days. This is faster than the life-cycles of most predators, and results in economically damaging populations.

Occurrence of heavy spider mite infestation has often been associated with the adverse effect of early season insect control measures. Most non-specific active ingredients used for this purpose will reduce populations of predators such as flower thrips, bigeyed bugs, and pirate bugs. Major outbreaks were first observed after the use of organochlorides for control of other pests. In cotton, the role of thrip control with either organophosphates or synthetic pyrethroids has especially received attention in research. Thomas F. Leigh, an entomologist at the University of California, states that a single individual of the *Frankliniella occidentalis* species is able to eliminate as much as 16 mite eggs or even more.

In an experiment conducted by CSIRO Cotton Research Unit in Australia, the effect of early season insect control on mite infestations was studied. In a report published in the August-October issue of the *Australian Cotton-grower*, the results indicate that in three out of the four test locations the

early use of the pyrethroid deltamethrin led to significantly higher infestations of mite compared to the check-plots beyond a period of seven to ten weeks after application (17.7 gm/ai/ha at 700 ml/ha). Also the early season application of the substances dimethoate and acephate had a tendency to lead to increased mite infestations, although the patterns here were less convergent. Consequently, the authors, Wilson and Leigh, recommend that Australian farmers not treat for thrips unless infestation reaches economic thresholds.

The role of early season pyrethroid sprayings in accelerated levels of spider mite infestations was confirmed in an experiment by Langston and Schuster at Texas A&M University. In this experiment, using artificial infestation, a series of insecticides belonging to all major chemical groups were sprayed early in the season. Although the two pyrethroids used initially led to reduced populations, two weeks later there was significantly higher damage compared to the check-plot.

Spider mite resistant and tolerant varieties have been bred with some degree of success. In Australia, the variety Siokra (okra-leaf), is rated a tolerant variety.

When treatment becomes necessary there are a few selective miticides on the market which should be used in preference over the broad-spectrum insecticides from a perspective of resistance development. It has also been observed in laboratory tests that the broad-spectrum insecticides methyl parathion and dimethoate seem to stimulate mite egg production.

Attention should be given to spraying technology as well, because the selective insecticides act on contact rather than being systemic. As most mites are located on the underside of the leaves, ground application systems are to be preferred. If sprayed by air, the plane should deliver the pesticides as close to the crop as possible.

The most frequently used selective miticides are Dicofol and Propargite. Sulfur dust is used in California, especially for control of Strawberry mites, but does not seem to provide adequate control for other species. In a five location field test conducted in Australia, Dicofol and Propargite were tested along with Profenofos, an organophosphate, for their control efficiency. One application early in the season was used. Dicofol was sprayed at 960 gm/ai/ha in 2.5 liters/ha; and Profenofos at 750 gm/ai/ha in 1.5 liters. In all locations but one, groundspray equipment was used well-di-

rected to the underside of the leaves. Compared to the check-plots it appeared that both Dicofol and Profenofos gave acceptable (50%) levels of control for a limited time, ranging from two to three weeks. In the case of Propargite, it outperformed the other products by providing a somewhat longer period of control ranging from three to four weeks.

The researchers observed that generally shorter periods of control were achieved where mite infestations were already high at the time of spraying. This result leads to the recommendation for more research to establish the correct economic threshold levels based on insect growth models combined with plant development data. Presently the economic thresholds are based on the number of infested leaves. Counting of individuals has so far been an excessively time-consuming exercise. It would be beneficial if the presently used plant washing technique combined with binocular microscope for research studies could be transformed into a workable field scouting method.

Most commercial consultants in California recommend to take action at 50 percent infested leaves. Actual economic injury levels are now estimated to be at 80 percent leaf damage. Research has established that the popu-

lation density causing economic damage depends as well on the species. It appears that *T. Turkestani* reaches its damage level at much lower densities than *T. urticae* and *T. pacificus*.

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New Insights Regarding the Effects of Low Temperatures and Day-Length on Growth

The role of temperature on cotton growth and development has been a subject of research since at least the beginning of this century. Initially, most research was devoted to study the impact of high temperatures. In his book, *The Cotton Plant in Egypt*, published in 1919, Balls (quoted in Gipson, J.R., 1986) claims that cotton grows best at temperatures around 32°C, while prolonged temperatures above 35°C are considered harmful. Later, as the cotton belt was extended north and southwards into regions with a milder climate, attention has been shifted to the impact of low temperatures.

Over time, comprehensive studies have been completed covering the influence of varying temperatures on all phases of cotton plant development. Especially in the vast body of research aiming at improving the earliness of cotton varieties, this aspect has been the center of attention. Since the 1950s, an increasing number of studies point at the interrelationship be-

tween day-length and temperatures, as both influence the energy balance of the plant in an interdependent way. It has been shown that studying any one factor in isolation can lead to serious flaws. It has also become evident that the final result of changes in the energy balance of the plant is highly variety-dependent. There seem to be certain energy thresholds which, combined with some conditional factors, apparently regulate growth and development of the plant. These thresholds differ from one variety to the other.

In a recently published article, Tondeur, Vershraege and Demol make an interesting contribution to this line of research. Using controlled-climate chambers in a greenhouse, they subjected cotton to two different temperature regimes, 24-16°C and 24-12°C, and three different day-length regimes, 16-8 h, 14-10 h and 12-12 h. They used the *G. Hirsutum* variety B 49 grown in 6-liter plastic bags. Their observations contain key indicators of vegetative growth, reproductive growth, and fiber production and quality.

Growth curves and final plant height indicate that the 4°C lower night temperature in the 24-12°C regime enhances total vegetative growth of the plant when the day-length is at least 14 hours. This is explained by the

longer period of vegetative growth, which is extended by some 20 days. Important, however, is that the effect is reversed for the day-length regime 12-12 h. Despite a growing-cycle of about 40 additional days as compared to the 24-16°C temperature regime, the plants under the 24-12°C temperature regime obtained a final height of 28 percent less than those under the 24-16°C regime. Apparently, the total energy intake per day is too low to benefit from the extension of the growing period. The same tendencies appear if the total dry weight of the plant is taken as an indicator of plant growth.

Concerning the earliness of the variety under these conditions, the researchers found that it was essentially determined by night temperature. However, increases in day-length did compensate somewhat for loss in earliness of the plants grown at low night temperatures, with the plants grown under 24-12°C at 16-8 h having exactly the same period to first flower (89 days). Interestingly, the total number of flowers produced seems to follow the same tendencies found for total vegetative growth. That is, for the day-length regimes 14-10 h and 16-8 h the total number of flowers produced at lower night temperatures is much higher. This is due to both the length of the flowering period (10 to 15 days longer) and the rate of flower

production per day (average of 4.4 at 24-12°C against 3.3 at 24-16°C). At the day-length regime of 12-12 the researchers found again a reversal of this phenomenon, as in that case the number of flowers produced at higher night temperatures was somewhat higher.

Growth curves also indicated that the total duration of the plant's life-cycle varies according to the climatic regime. These physiologically determined cycles follow exactly the same pattern as described for the vegetative growth period.

The shedding rates were influenced in a consistent way by day-length, decreasing from 60 to 48 percent at the lower night-temperatures and from 52 to 42 percent at the higher night temperatures.

The observed tendencies in total flower production and shedding rates result in a very marked effect in total seed cotton production per plant. It appears that at the lower night temperatures seed cotton production was higher compared to the higher night temperatures, with the exception of the plants grown under the 12-12 hour regime. The authors claim that this effect so far has not been described in literature, probably because most

research would study the effect of lower late-season temperatures as opposed to general lower temperatures. In this way, the beneficial effect of the lower temperatures on vegetative development might have been ignored.

A comparison of the harvest index (weight of seed cotton relative to total plant weight) obtained under the various climatic regimes reveals that at equal day-length regimes the index at lower night-temperatures. This leads to the authors to conclude that the lower night-temperatures are having a more favorable impact on the reproductive phase of growth than on the vegetative phase, and that the total production effect cannot be explained only by the differences in vegetative growth.

Also the differences in accumulated day-degrees could not totally explain the observed tendencies in production. Accumulated day-degrees were higher at the lower night-temperatures (because of the increase in the length of the growing period), but this also holds for the 12-12 day-length regime where, it was observed, total production was higher at the higher night-temperatures.

In terms of lint quality it was observed that total fuzz production was significantly increased at lower night-temperatures. Fiber length was found to be higher at the lower night-temperatures, again with the exception of the 12-12 h day-length regime. Differences did not exceed 2 mm. Other fiber characteristics, such as strength and maturity, varied very little at the different climatic regimes. Also, no consistent tendencies were found in the ginning ratios.

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Short Notes

- Plant Genetic Systems N.V. of Belgium, in a press release issued on October 25, claims to have made a significant step forward to the economic production of hybrids of various dicotyledons. In collaboration with Prof. Robert Goldberg of the University of California, they have isolated a gene that will prevent a plant from self-pollinating. The expression of this gene is regulated in the genetically engineered plants by a promoter, which assures that the gene is only expressed during a few days when the plant develops its pollen. After this period the gene is inactive, and normal development of the plant continues. The result will be male sterile plants, which then could be cross-pollinated with fertile plants. To speed up seed production, the researchers have inserted a herbicide resistant gene close to the pollination-inhibitor gene which opens the use of a herbicide to kill off 50 percent of the F1 generation, which does not include the pollination-inhibitor. Initial experiments with this technology concerned rape seed. A spokesman for the company announced that other potential crops for this technology include alfalfa, cotton and corn. Delta & Pine Land Co. of Stoneville, MS, has expressed an interest to use this technol-

ogy under a licence. Although it is clear that this technology will cut the costs of producing the hybrid seeds, it does not yet solve the economic problem of cross-pollination.

- In a legal battle over the use of the brand name *Sea Island Cotton*, the Caribbean Sea Island Cotton Co. has taken Threadtex Co. of New York to court. The dispute follows an advertising campaign in which Threadtex claims that its shirts are made from Sea Island cotton. The shirts, with a retail price of \$50 to \$75, are accompanied by a mini-booklet containing some historic facts about this type of cotton. The lawsuit claims that the shirts are made of Egyptian cottons and that the true Sea Island Cotton is presently grown only in a few islands in the Caribbean, most importantly in Barbados. Interestingly, in the USA's retail market it appears that an increasing emphasis is placed on the type of cottons used in apparel. Apart from the long term promotion of U.S. cottons in this market, sponsored by the U.S. cotton industry, also the indication of "Pima" cotton is used more frequently now.
- A new book on *Integrated Pest Management Systems and Cotton Production* has been published by John Wiley & Sons (ISBN 0-471-81782-1).

The editors are Raymond E. Frisbee, Kamal M. El Zik (both from Texas A&M University) and Ted Wilson (University of California). Frisbee has made an earlier contribution to the subject by editing the *FAO Guidelines for Integrated Control of Cotton Pests*, published in 1983. The 440 page book contains 14 contributions of major U.S. scientists in this field. The book has an entomological orientation, with strong chapters on the development of pest models, quantitative sampling principles and biological control of pest populations. Additional chapters handle plant diseases, nematodes and weeds.

- In an article for the *Australian Cottongrower*, Tony Wells and Steve Marsden announced that the CSIRO's Cotton Management Systems Group will test a new software package to improve irrigation scheduling in the 1989/90 crop season. The program, named Hydrologic, will advise its user on optimal irrigation scheduling. The program is designed according to state-of-the-art principles of interactiveness and user-friendliness. It uses standard meteorological data for estimating current water balancing, and optional data types for predicting the water balances in the remainder of the season. This can be either past weather patterns during the same period of time, or future weather patterns based on long range

wether forecasts. The program should be fed with some physical and agronomic data for each field to be irrigated. For example, for each field the program needs to have field-capacity and wilting points. Other data which can increase the accuracy of the program include fruit counts, leaf cover estimates, neutron-probe data and other soil-water parameters. A big advantage of the program is that it lends itself to numerous “what-if” exercises which will help the user in evaluating different strategies.

- In its efforts to “demystify” strength measurements on HVI machines, the International Center for Textile Research and Development in Lubbock, Texas, has done some experiments to determine the influence of moisture content in this process. As we know, cotton fibers are hygroscopic and, although conditioned before testing, will pick up moisture very rapidly and this will increase fiber strength. A USDA calibration cotton with known strength was, therefore, tested at various time intervals after drying. It appeared that if tested immediately after drying the strength reading was 16.8 g/tex at a moisture level of 4.1 percent. Redried and retested but now with an interval of 15 minutes, the strength reading was 19.8 g/tex at 4.5 percent humidity. Repeating the same procedure but now with intervals from 1, 2, 3 and 4 hours, the corresponding readings were 23.0, 27.5,

26.5 and 26.2 at humidity levels of 4.5, 4.4, 4.6, and 4.6 respectively. This only confirms the need for a strict application of all the recommended procedures for cotton testing. In another experiment, two bales of cotton were completely divided into 1/4 pound samples. All samples were tested at a uniform moisture content but still revealed ranges of strength measurements of 17 to 32 g/tex in one bale, and 20-33 g/tex in the other!

- The Cotlook A Index, an average of the lowest 5 out of 11 comparable quotes for cotton delivered at port in Northern Europe, averaged 82 US cents per pound during the first quarter of the present crop season. The ICAC Secretariat's estimation of world cotton production this season is 80.2 million bales (of 480 lbs.), and consumption is forecast at a record 86.1 million bales. Consequently, stocks will decrease from 32.2 million to 26.5 million bales at the start of next season. The A index has already been as high as 85 US cents but uncertainty about the amount of cotton to be imported by China (Mainland) and some forecast adjustments for the Soviet, Indian and Pakistani crop have softened world market prices somewhat. It is further anticipated that in response to the high prices during this season, the 1990/91 crop will grow to a record level of 88.5 million bales. In the absence of a major recession, world cotton consump-

tion is expected to continue to grow to 87.2 million bales in 1990/91.
(Source: *COTTON: Review of the World Situation*, November-December 1989)

A DIALOG SEARCH FROM THE AGRICOLA DATABASE ON COTTON PHYSIOLOGY

New findings in cotton physiology over the past ten years have significantly altered the way the crop is grown today. The application of growth regulators and defoliants is only one example of this. In this literature search, references of articles on cotton physiology published during the last two years are included. The search was carried out exclusively on the *Agricola* database of the National Agricultural Library of the USA. This is the second part of the results of the search. The first part was published in the September issue of *The Recorder*.

SAMPLE RECORD

The positions of the key field s are shown In the following sample record.

An HL	88037272 88003307 Holding Library: AGL
TI	Interspecific gene flow In Cucurbita: C. texana vs. C. pepo .
AU	Kirkpatrick, K.J.; Wilson, H.D.
JN PY	American Journal of botany. Apr 1988. v. 75 (4) p. 519-527.
	maps. Columbus, Ohio : Botanical Society of America.
SN CO	ISSN: 0002-9122 CODEN: AJBOAA

CA	DNAL CALL NO: 450 AM36
LA	Language: English
	Includes references.
SF	Subfile: OTHER US (NOT EXP STN, EXT, USDA; SINCE 12/76);
DT	Document Type: Article
DE	DESCRIPTORS: cucurbita texana; cucurbita pepo; gene flow; biogeography; pollination; xenoglossa; pollinators;
ID	Identifiers: xenoglossa strenua
GL	Geographic Location: texas
SH	Section Headings: PLANT BREEDING(F200); PLANT TAXONOMY AND GEOGRAPHY(F700); ENTOMOLOGY RELATED(L001)

Key to Data Fields

AN	DIALOG Accession Number
AN	AGRICOLA Accession Number
AU	Author
CA	Call Number
CO	CODEN
DE	Descriptor
DT	Document Type
GL	Geographic Location

HL	Holding Library
ID	Identifier
JN	Journal Name
LA	Language
PY	Publication Year
SF	Subfile
SH	Section Heading/Code
SN	ISSN
TI	Title

Data present in record depend on output format requested and type of record.

DIALOG File 10: AGRICOLA - 1979-89/JUL See file 110(thru 1978)

88107842 88037437 Holding Library: AGL

Fruiting and growth characteristics of cotton grown under drip and conventional irrigation
Stichler, C.;

Proceedings - Beltwide Cotton Production Research Conferences. 1988. p. 171-172.

Memphis, Tenn. : National Cotton Council and The Cotton Foundation. CODEN: BCOPB

DNAL CALL NO: SB249.N6

Language: English

88107834 88037429 Holding Library: AGL

GOSSYM/COMAX evaluation in Texas

Childers, R.E.; Metzger, R.B.; Parnell, C.B.; Akins, D.C.

Proceedings - Beltwide Cotton Production Research Conferences. 1988. p. 155-158. ill.

Memphis, Tenn. : National Cotton Council and The Cotton Foundation. CODEN: BCOPB

DNAL CALL NO: SB249.N6

Language: English

88107814 88037409 Holding Library: AGL

Developmental behavior of four upland cotton (*G. hirsutum* L.) cultivars

Rimon, D.; Smith, C.W.

Proceedings - Beltwide Cotton Production Research Conferences. 1988. P. 111-119.

Memphis, Tenn. : National Cotton Council and The Cotton Foundation.

CODEN: BCOPB

DNAL CALL NO: SB249.N6

Language: English

88107811 88037406 Holding Library: AGL

A new coumarin in cotton

Chan, B.G.; Wilson, F.D.

Proceedings - Beltwide Cotton Production Research Conferences. 1988. P. 106-107.

Memphis, Tenn. : National Cotton Council and The Cotton Foundation. CODEN: BCOPB

DNAL CALL NO: S8249.N6

Language: English

88107802 88037397 Holding Library: AGL

Contribution of petiole to cotton shoot nitrate reduction

Chu, C.C.; Bariola, L.A.

Proceedings - Beltwide Cotton Production Research Conferences. 1988. p. 91.

Memphis. Tenn. : National Cotton Council and The Cotton Foundation. CODEN: BCOPB

DNAL CALLNO: SB249.N6

Language:English

88107797 88037392 Holding Library: AGL

Early events in fiber cell development

Davidonis. G.;

Proceedings - Beltwide Cotton Production Research Conferences. 1988. p. 86.

Memphis. Tenn. : National Cotton Council and The Cotton Foundation. CODEN: BCOPB

DNAL CALLNO: SB249.N6

Language:English

88107796 88037391 Holding Library: AGL

A comparison of ovule and suspension culture-derived fibers with fibers produced in plants

Triplett, B.A.;

Proceedings - Beltwide Cotton Production Research Conferences. 1988. p. 86.

Memphis, Tenn. : National Cotton Council and The Cotton Foundation. CODEN: BCOPB

DNAL CALL NO: SB249.N6

Language:English

88107795 88037390 Holding Library: AGL

Reproductive development and yield in cotton cultivars differing in maturities

Landivar, J.A.; Baker, D.N.; Hodges, H.F.

Proceedings - Beltwide Cotton Production Research Conferences. 1988. p. 85.

Memphis,Tenn. : National Cotton Council and The Cotton Foundation. CODEN: BCOPB

DNAL CALLNO: SB249.N6

Language: English

88107794 88037389 Holding Library: AGL

Leaf area index development and yield in cotton cultivars differing in maturities

Landivar, J.A.; Baker, D.N.; Hodges, H.F.

Proceedings - Beltwide Cotton Production Research Conferences. 1988. p. 84-85.

Memphis,Tenn. : National Cotton Council and The Cotton Foundation. CODEN: BCOPB

DNAL CALL NO: SB249.N6

Language:English

88107793 88037388 Holding Library: AGL

How feasible is the idea to fertilize cotton with carbon dioxide?

Mauney, D.R.; Hendrix, D.L.

Proceedings - Beltwide Cotton Production Research Conferences. 1988. p. 84.

Memphis, Tenn. : National Cotton Council and The Cotton Foundation. CODEN: BCOPB

DNAL CALL NO: SB249.N6

Language:English

88107792 88037387 Holding Library: AGL

Cotton leaf area distribution In relation to yield development

Oosterhuis, D.M.; Wulschleger, S.D.

Proceedings - Beltwide Cotton Production Research Conferences. 1988. p. 82-84.

Memphis, Tenn. : National Cotton Council and The Cotton Foundation.CODEN: BCOPB

DNAL CALLNO: SB249.N6

Language:English

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Water deficits and concentrations of free ester IAA in young cotton fruits and their ab -
scission zones

Guinn, G.; Brummett, D.L.

Proceedings - Beltwide Cotton Production Research Conferences. 1988. p. 82.

Memphis, Tenn. : National Cotton Council and The Cotton Foundation. CODEN: BCOPB

DNAL CALLNO: SB249.N6

Language: English

88107790 88037385 Holding Library: AGL

Responses to water stress In developing cotton bolls

Timpa, J.D.; Klich, M.A.

Proceedings -Beltwide Cotton Production Research Conferences. 1988. p. 82.
Memphis, Tenn. : National Cotton Council and The Cotton Foundation. CODEN: BCOPB
DNAL CALL NO: SB249.N6
Language: English

88107789 88037384 Holding Library: AGL
Hydraulic conductivity of roots and root cells of nutrient-stressed cotton seedlings
Radin, J.W.; Matthews, M.A.
Proceedings -Beltwide Cotton Production Research Conferences. 1988. p. 81.
Memphis, Tenn.: National Cotton Council and The Cotton Foundation. CODEN: BCOPB
DNAL CALL NO: SB249.N6
Language: English

88107788 88037383 Holding Library: AGL
Water relations of drip- and furrow-irrigated cotton in Arizona
Radin. O.W.; Mauney, d.R.; Kerridge. P.C.
Proceedings - Beltwide Cotton Production Research Conferences. 1988. p. 81.
Memphis.Tenn. : National Cotton Council and The Cotton Foundation.CODEN: BCOPB
DNAL CALLNO: SB249.N6
Language:English

88107785 88037380 Holding Library: AGL
Management strategies for maximum cotton production an the southern High Plains of

Texas. IV. Canopy gas exchange

Peng, S.; Krieg, D.R.; Gertsis, A.C.; Hopkins. H.J.; Hatfield. J.L.

Proceedings - Beltwide Cotton Production Research Conferences. 1988. p. 76-77.

Memphis, Tenn. : National Cotton Council and The Cotton Foundation. CODEN: BCOPB

DNAL CALL NO: S8249.N6

Language: English

88107774 88037369 Holding Library: AGL

Apparent photosynthesis of cotton genotypes as a function of leaf age

Landivar, J.A.; Baker, D.N.; Hodges, H.F.

Proceedings - Beltwide Cotton Production Research Conferences. 1988. p. 60-63.

Memphis, Tenn. : National Cotton Council and The Cotton Foundation. CODEN: BCOPB

DNAL CALL NO: SB249.N6

Language: English

88107773 88037368 Holding Library: AGL

Carbon partitioning and photosynthetic efficiency during boll development

Oosterhuis, D.M.; Wulschleger, S.D.

Proceedings - Beltwide Cotton Production Research Conferences. 1988. p. 57-60. ill.

Memphis, Tenn. : National Cotton Council and The Cotton Foundation. CODEN: BCOPB

DNAL CALL NO: SB249.N6

Language: English

88107772 88037367 Holding Library: AGL

Leaf age--gas exchange characteristics

Krieg. D.R.;

Proceedings - Beltwide Cotton Production Research Conferences. 1988. p. 55-57.

Memphis, Tenn. : National Cotton Council and The Cotton Foundation. CODEN: BCOPB

DNAL CALL NO: SB249.N6

Language: English

88107771 88037366 Holding Library: AGL

Why does photosynthesis decline with leaf age?

Cornish. K.;

Proceedings - Beltwide Cotton Production Research Conferences. 1988. p. 50-55.

Memphis, Tenn. : National Cotton Council and The Cotton Foundation. CODEN: BCOPB

DNAL CALL NO: SB249.N6

Language: English

88107763 88037358 Holding Library: AGL

Developmental changes in the tannin content of cotton leaves: implications in breeding for pest resistance

Bell, A.A.;

Proceedings - Beltwide Cotton Production Research Conferences. 1988. p. 31.

Memphis, Tenn. National Cotton Council and The Cotton Foundation. CODEN: BCOPB

DNAL CALL NO: SB249.N6

Language:English

88107753 88037348 Holding Library: AGL

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Kerby, T.A.; Johnson, S.; Keeley, M.

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Language: English

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An approach to batch production of cotton plantlets from shoot tip culture in vitro

Hsi, Y.L.; Wei, Z.C.; Wang, Y.F.

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Nanjing, China : Chiang-su sheng nung yeh k'o hseuh yuan.

DNAL CALL NO: S539.5.C55

Language: Chinese Summary Language: English

88103574 88055285 Holding Library: AGL

Interactions between nitrogen nutrition and mild water stress as factors influencing susceptibility to photo-inhibition of cotton and Solanum

Khanna-Chopra, R.; Ferrar, P.J.; Osmond, B.

Plant physiology & biochemistry. 1987. v. 14 (1) p. 59-69.
New Delhi : Society for Plant Physiology and Biochemistry.
ISSN: 0254-3591 CODEN: PPHBD7
DNAL CALL NO: QK861.P54
Language: English

88103521 88055232 Holding Library: AGL
The influence of volatile plant allelochemicals on the third trophic level (parasitoids) and their herbivorous hosts
Vinson, S.B.; Elzon, G.W.; Williams. H.J.
Series entomologica. 1987. v. 41 p. 109-114.
Dordrecht : Dr W. Junk.
DNAL CALL NO: QL461.S4
Language: English

88101605 88052891 Holding Library: AGL
A new protocol for isolation of mitochondrial DNA from cotton seedlings
Hsu, C.L.; Mullin. B.C.
Plant cell reports. 1988. v. 7 (5) p. 356-360. ill.
Berlin, W. Gar. : Springer International. ISSN: 0721-7714 CODEN: PCRPD8
DNAL CALL NO: QK725.P54
Language: English

88101355 88052635 Holding Library: AGL

Disruption of the polar auxin transport system in cotton seedlings following treatment with the defoliant thidiazuron

Suttle, J.C.;

Plant physiology. Jan 1988. v. 86 (1) p. 241-245.

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DNAL CALL NO: 450 P692

Language: English

88101316 88052596 Holding Library: AGL

Changes in free and conjugated indole 3-acetic acid and abscisic acid in young cotton fruits and their abscission zones in relation to fruit retention during and after moisture stress

Guinn, G.; Brummett, D.L.

Plant physiology. Jan 1988. v. 86 (1) p. 28-31.

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ISSN: 0032-0889 CODEN: PLPHA

DNAL CALL NO: 450 P692

Language: English

88101245 88052525 Holding Library: AGL

Chemical modification of the cotton plant

Urwiler, M.J.; Stutte, C.A.

Special report - University of Arkansas. Agricultural Experiment Station. June 1988.
(132) p. 61-64.

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Language: English

88101237 88052517 Holding Library: AGL

Drought tolerance and osmotic adjustment

Oosterhuis. D.M.; Wullschleger, S.D.

Special report - University of Arkansas. Agricultural Experiment Station. June 1988.
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DNAL CALL NO: 100 AR42SP

Language: English

88099869 88046879 Holding Library: AGL

Photosynthesis of cotton plants exposed to elevated levels of carbon dioxide in the field

Radin, O.W.; Kimball, B.A; Hendrix, D.L.; Mauney, O.R.

Photosynthesis research. 1987. v. 12 (3) p. 191-203.

Dordrecht : Martinus Nijhoff/W. Junk. ISSN: 0166-8595

DNAL CALL NO: QK882.P58

Language: English

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Water exchange and productivity of cotton under soils of differing dampness in Karakal -
pak

Vodnyi obmen i urozhainost' khlopchatnika pri razlichnoi vlazhnosti pochvy v Karakal -
pakii / K.M. Mirzambetov otvetstvenyi redaktor H.T. Tadzhitdinov

Mirzambetov, K. M.; Tadzhitdinov, M. T.

95, [1] p. : ill. ; 20 cm.

Tashkent : Fan. 1984.

DNAL CALL NO: SB251.S68M57

Language: Russian

88098489 88908479 Holding Library: AGL

Work from the Department of Plant Physiology

Trudy Kafedry fiziologii rastenii / Gosudarstvennyi komitet vysshego, srednego spet -
sial'nogo i professional'no-tekhnicheskogo obrazovaniia Soveta ministrov Tadzhikskoi
SSR, Tadzhikskii gosudarstvennyi universitet im. V.I. Lenina

Universiteti davlatii Tojikiston ba nomi V.I. Lenin. 94 p. : ill. ; 21 cm.

Stalinabad : Universitet, 1961.

DNAL CALL NO: QK753.T7T7

Language: Russian

88094735 88048300 Holding Library: AGL

Structural and genetic variation of natural pesticides in pigment glands of cotton

(Gossypium)

Bell. A.A.; Stipanovic. R.D.; Elzen, G.W.; Williams, H.J. Jr.

ACS Symposium series - American Chemical Society. 1987. (330) p. 477-490.

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DNAL CALL NO: QD1.A45

Language: English

88092883 88043193 Holding Library: AGL

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Reaksie van katoen op enkele kommersiele groeistimuleermiddels

Dippenaar. M.C.;

Applied plant science = Toegepaste plantwetenskap. 1988. v.(1) p. 25-30.

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DNAL CALL NO: SB317.5.A6

Language: Afrikaans Summary Language: English

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Causes of sterility of hybrids between Old World and New World cotton species -

Prichiny steril'nosti gibridov mezhdu starosvetskimi i novosvetskimi vidami khlopchatnika

Shariaeva, G.S

Prichiny steril'nosti gibridov mezhdu starosvetskimi i novosvetskimi vidami khlopchatnika

Shariaeva, G. S.;

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Karachi, Pakistan : Muhammad Ali Society, 1985.

DNAL CALL NO: TRANSL 34783

Language: English

88088399 88042777 Holding Library: AZUA; AGL

Physiology

Oosterhuis, D.M.;

Arkansas farm research - Arkansas Agricultural Experiment Station. July/Aug 1988. v. 37 (4) p. 8.

Fayetteville, Ark. : The Station. ISSN: 0004-1785 CODEN: AKFRAC

DNAL CALL NO: 100 AR42F

Language: English

88087707 88041798 Holding Library: AGL

Concentrations of abscisic acid and indoleacetic acid in cotton fruits and their abscission zones in relation to fruit retention

Guinn, G.; Brummett, D.L.

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DNAL CALL NO: 450 P692

Language: English

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Influence of monooxygenase inhibitors on the metabolism of the herbicides chlortoluron and metolachlor in cell suspension cultures

Cole, D.J.; Owen, W.J.

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DNAL CALL NO: QK1.P5

Language: English

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Mukhamedova, S.; Smirnova, L.S.; Abduazimov, Kh.A.

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DNAL CALL NO: QD241.K453

Language: English; Russian

88086138 88040079 Holding Library: AGL

Changes in lipids and pigments of cotton seeds during their processing

Gusakova, S.D.; Asilbekova, D.T.; Nazorova, I.P.; Khomova, T.V.; Tyshchenko, A.A.;

Glushenkova, A.I.

Chemistry of natural compounds. July 1988. v. 24 (1) p. 35-42.
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DNAL CALL NO: QD241.K453
Language: English; Russian

88086137 88040078 Holding Library: AGL
Use of the Vaskovsky-Sventashev reagent for complex detection of phospholipids and
in their preparative separation by the TLC methods
Isamukhamedov, A.Sh.; Gazizov, F.Yu.
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DNAL CALL NO: QD241.K453
Language: English; Russian

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Initiation and characterization of a cotton (*Gossypium hirsutum* L.) photoautotrophic cell
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Blair, L.C.; Chastain, C.J.; Widholm, J.M.
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Language: English

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Altman. D.W.;

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DNAL CALL NO: QK725.P54

Language: English

88084756 88038486 Holding Library: AGL

Genetic control of esterase, superoxide dismutase, and 8-phosphogluconate dehydrogenase in cotton (*Gossypium hirsutum*)

Sharopova, N.R.; Abzalov, M.F.; Fatkhullaeva, G.N.; Pomertsev, A.A.; Sozinov, A.A.

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Language: English; Russian

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Isoosmotic regulation of cotton and peanut at saline concentrations of K and Na

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