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

march1	Introduction
march2	Report on ICAC's 1990 Research Associate Program Fiber Quality: A Perspective from Breeders, Growers, Ginners, Marketing Executives and Researchers
march3	Short Notes

Introduction

This first issue of *The ICAC Recorder* in 1990 is almost entirely devoted to the report on the 1990 Research Associate Program which was held earlier this year. At the invitation of the Committee seven participants from six countries had an opportunity to tour the US for almost three weeks and learn about the various issues concerning improved fiber quality. Meetings were held with breeders, farmers, co-ops, gin experts, merchants, textile technologists and textile executives. We, again, would like to express our appreciation to all those specialists who contributed to the success of this program.

In the Short Notes section, information is included about a new simulation model for predicting the effects of Pix; a recently held workshop in Greece on plant growth regulators; new products in the field of biocontrol; a method for estimating the age of moths caught in pheromone traps; proposed improvements for the economic production of hybrids; product information about an overspray used to decrease stickiness in the mill; and the latest trends on the world cotton market.

Due to lack of space, the Dialog search on boll weevil intended for this issue will be published in the next issue of *The ICAC Recorder.*

Recently the Technical Information Section, in cooperation with CAB-International, published a scientific review article on stickiness in cotton. This is the second in our series of review articles on current research in cotton. The authors, Dr. Debra Hector and Dr. Ian Hodkinson, discuss the existing literature on this important and persistent problem in cotton production and use. Attention is paid to the causes of stickiness, the various methods to test cotton for stickiness, and the possible remedies, both in the field and in the textile mill. All readers of *The ICAC Recorder* should have received one free copy or more. For additional (paid) copies, please contact CAB-International, Wallingford, Oxon OX10 8DE, United Kingdom.

At the 368th meeting of the Standing Committee an amount of $30,000 was approved to be reserved in the budget for the promotion of regional cooperation in cotton research. In principle this budget item is intended to sponsor regional conferences, seminars or workshops. Although part of these monies haves been reserved already, the Secretariat is still open to consider project proposals conforming to the intended use.

The technical seminar at ICAC's 49th Plenary Meeting will be on the subject of "Cotton Production Research from a Farming Systems Perspective, with Special Emphasis on Stickiness." The Secretariat intends to invite seven to nine scientists active in these fields from all geographical regions. We would highly appreciate suggestions from our readers for this seminar.

Report on ICAC's 1990 Research Associate Program

Fiber Quality: A Perspective from Breeders, Growers, Ginners, Marketing Executives and Researchers

Over the past few years, the subject of fiber quality has drawn a lot of attention both at ICAC Plenary Meetings and other cotton seminars. It has become apparent that cotton will become an even less homogeneous product than it already is, with numerous differences in fiber quality, each having its specific place in the market. The driving force behind this development has been the changes in the textile industry in the last decade. Especially the introduction and perfection of open-end spinning technology has created a demand for stronger and finer cottons, qualities not as essential for ringspun cottons. Also, the use of High Volume Instrument cotton-testing machines for blending of cottons at the textile mill has opened the possibility of learning more about the relation between raw fiber quality and

yarn quality and will lead to a higher degree of quality specifications on the demand side. But also on the supply side several technological factors have played a role. Breeders have succeeded in mastering better the fiber properties of new varieties; plant physiologists understand better the bio-chemical processes responsible for specific fiber properties; and ginning research has received a boost by the availability of mini-gin plants able to gin-test small lots of cotton.

All these factors combined result in a dynamic field of basic and applied research with the involvement of a wide array of disciplines. It was felt that the subject of fiber quality was an appropriate topic for the Committee's annual Research Associate Program. A traveling seminar in the USA was conducted visiting representatives of all segments of the cotton industry to learn their views on the subject. The seminar included seven participants, all senior executives involved in either cotton production or consumption in their respective countries. The seminar started on January 10th in Las Vegas at the Cotton Beltwide Production Research Conferences and ended on January 26th in Washington DC. In the following pages a summary of the presentations and discussions during this seminar is presented.

Cotton Beltwide Production Conferences

This year the Cotton Beltwide Conferences consisted of more than fifteen separate conferences and special sessions, all running simultaneously. In total there were well over three hundred presentations; attendance was in excess of three thousand people. Just to give an indication, the Cotton Insect Research & Control Seminar alone was split up in three sub-conferences, each devoted to a separate class of insects.

Provided these facts, it should be evident that it is impossible to make even an attempt to summarize the findings of the conferences. What follows are some notes on selected presentations, mostly held at the Cotton Production and Cotton Quality Measurement Conferences.

Dr. Bill Meredith, cotton physiologist at Stoneville, Mississippi, pointed at the relation between cultural practices and fiber quality. Research indicates that, for example, high nitrogen applications lead to increased yellowness and decreased micronaire. In one study, a difference between 60 lbs/acre and 160 lbs/acre of nitrogen application caused a reduction in micronaire from 4.9 to 3.6. Other research points at the role of potash defi-

ciencies as a factor in reduced fiber quality. Dr. Meredith further stated that, today, the single most important decision the US farmer has to make affecting fiber quality is the timing of defoliation. Too early, it will lead to yield reductions and possibly decreased micronaire, too late, it will put the crop at risk of weathering or frost. Generally, according to Dr. Meredith, an optimal management for yield will converge with the objectives for optimal fiber quality. The one big exception is fiber strength, where there is a trade-off with yield.

Stanley Anthony, ginning expert from Stoneville, Mississippi, stressed the importance of a well-balanced gin outlay to obtain optimal fiber quality. Research indicates that it is possible to upgrade cotton gradually using an increasing number of seed and lint cleaners. If, for example, no such cleaners are used at all, a typical bale in the Mississippi Delta might have a grade index of 71.1 (Middling = 100). Adding two seed cleaners might give an index of 73.8, while adding one, two and three lint cleaners would give indicative grade index values of 85.4, 88.9 and 91.1 respectively. However, at the same time the short fiber content could increase from an initial 5.5 percent to 8.3 percent, thereby reducing the spinnability of the cotton. Some varieties appear to be easier to clean in the gin than others and,

therefore, show more potential. Studies indicate that the main factor here is leaf hairiness and leaf-tract density. It has been found that cleaning efficiency can differ as much as 20 percent between a hairy and smooth leaf variety. Obviously, the value of these characteristics should be evaluated from a insect management perspective as well.

Kenneth Cassman, agronomist at the University of California, presented his research on the role of potash for fiber quality and yield. Potash deficiencies are widespread throughout the US cotton belt and particularly in California. Apart from a direct detrimental effect on yield, they also make the crop more vulnerable to diseases. Research indicates that plants under K-stress contain 90 percent of their potash in the bolls. This means that basic plant functions are even more distorted that one would expect from total K values in the plant. It has been observed that when bolls of K-stressed plants are pruned, K-deficiency symptoms disappear and the plant resumes normal growth. K-deficiency causes lower fiber quality. Fibers are shorter and have lower micronaire values, strength, elongation and maturity. Because in these circumstances additional potash leads to higher mikes and longer fibers, the ginning out-turn increases as well. Values of up to 3 percent have been observed. Potash uptake depends on va-

riety. Those varieties which have better root development in the topsoil will suffer less from K-deficiency. This also explains why cotton generally is more easily affected by K-deficiencies than other crops in the same soil, as cotton is a deep rooting crop. Breeding efforts to improve this aspect might have a high payoff. Simultaneously, deep placement of potash fertilizers has proven to be a profitable practice in some cases. New machinery to achieve this is now available on the market. In another presentation, Gordon Tripper, elaborated on this aspect and indicated that a soil pH of 5.5 in the deep layer is conditional for the success of this practice.

A large number of presentations dealt with the value of plant mapping as a management tool. Plant mapping is based on the fact that each boll on the plant has its specific value based on predicted boll weight and survival chances. Farmers are advised to regularly uproot a few representative plants and see if the bolls are developing in a satisfactory fashion on all the crucial positions. Johnny Jenkins, cotton geneticist at Mississippi State, made an assessment of the profitability of each boll on the plant. His calculations show that the difference between the most profitable boll and the least profitable boll might be a factor of 40. Generally about 60 to 75 percent of the total value comes from first position bolls on every node.

The most profitable positions are situated on the first fruiting positions of node 9 to 14. Modern early maturing varieties get an increasing share of their value from nodes 6 to 9. The odds for survival ---- an important component of estimated profitability calculations ---- may vary from one out of two for the low risk positions, to one out of ten for the high risk positions.

Steve Verett, cotton producer and member of the USDA Advisory Committee on Marketing, elaborated on the recommendations made by this committee during the last year. The committee was formed to study the marketing system and recommend measures to improve its effectiveness and efficiency. The committee consisted of sixteen representatives from all segments of the cotton industry. In total, nine recommendations were made and, with the exception of one, were uniformly adopted by the Secretary of Agriculture. The most important and far-reaching recommendation concerns the introduction of HVI-based evaluation of fiber characteristics directly linked to the marketing loan. Reservations stating that this would in no instance lead to a reduction of the overall crop loan value were made. From 1991 onwards the target is to HVI-test all cotton to be eligible for the loan and introduce premiums and discounts based on HVI-measured strength. It is underlined that, at this stage, HVI-measurement will not re-

place manual grading but rather complement it. The premium scale for strength will take the 24 to 25 grams/tex range as the basis rate, with premiums paid for each unit above the basis, and discounts for each unit below this. Cotton with strength lower than 18 grams/tex would not be eligible for the loan. Also, it has been recommended that from 1993 onwards, the classers' grade be replaced by separate indications of color and trash. Initially this would be done by the grader, but when the technology permits it, instrument testing might replace it. Concerning the micronaire it is proposed that within the base range, currently from 3.5 to 4.9, a premium range would be installed for cotton having a mike value of between 3.7 and 4.2. Other recommendations concern further study methods of HVI calibration, the desirability and feasibility of a central databank of HVI information with the objective of reducing repetition of HVI testing of the same cottons, and the feasibility of using length uniformity index in predicting the value of cotton. Finally, the USDA was encouraged to start collecting marketing data on HVI quality factors and to develop statistical models which would indicate premiums and discounts paid for various fiber properties.

Chess Howard, vice-president at Graniteville Co., in his presentation defended the idea of a national databank for fiber quality information. Pres-

ently the situation is that any bale owner already can apply for USDA classing data for each and every bale. However, the administrative procedure to obtain this information prevents many owners from actually requesting this information. In economic terms, the databank will reduce the risk of not buying what one needs, and thus will theoretically lead to better prices for farmers. In addition, it would reduce the number of times a bale is HVI-tested by each consecutive owner, and would therefore also reduce the costs of the cotton. Mr. Howard argues that the present system has to change anyhow, because the presently used hardware to make the punch cards to store all the bale-relevant information is not available in the market anymore. Mr. Howard further argues that the interest of merchants to upclass the cotton they take into possession as a source of revenues is a non-argument. Every merchant who excels in this practice will ultimately lose market share in a competitive environment. At this stage of technology development, Mr. Howard argues, mill blending of cottons based on USDA-HVI classing results alone is not realistic. However, using some of the less critical parameters from the USDA databank, and thus limiting mill testing to only very few critical parameters, seems a viable compromise.

Dr. Lawrance Hunter, in his function as chairman of the ITMF working group on HVI technology, made a brief presentation of the status of HVI testing worldwide. According to the latest information from both HVI producers, 530 lines have been installed worldwide, of which 231 are in the US. Presently sixteen countries use the machines in their classing and grading operations. The vast majority of the machines are owned by textile mills. Dr. Hunter summarized the most pressing problems and needs of HVI systems: the presently used calibration cottons are tailored to the needs of US clients and do not provide strength as expressed in Pressley, a parameter still widely used in Europe; the two available systems provide different measurements of uniformity, one uses uniformity ratio, the other uniformity index; the method of strength measurement differs between the two systems, particularly the way the sample weight is estimated; there are problems with testing conditions, especially those influencing the moisture content of the fibers and thereby the strength measurement; although the trash measurement is fairly accurate it gives no indication of the cleanability, which is a function of the types of trash; at present there are no HVI instruments to test for stickiness, neps and short fiber content; concerning maturity, a choice has to be made to go either for the FMT instrument or to

wait for perfection of the Near Infrared method; and, finally, in respect to color, a satisfactory solution still has to be found for the exact measurement of spotted cottons.

Dr. Charles Bragg, textile technologist of USDA-ARS in Clemson, South Carolina, expressed the view that, although HVI testing has its feet on the ground now, there is still a long way of improvement and expansion ahead. On the strength side, more interest is shown by the industry in elasticity of the fiber and maximum elongation. In the area of fineness/maturity Dr. Bragg expects that new developments will go into the direction of exact measurements of fineness and maturity with even a maturity distribution. Trash content in the future will be probably characterized by parameters indicating total weight of the trash as well as average size of the trash particles. In his contacts with the spinning industry over the last few years, Dr. Bragg became aware of the dramatic surge for efficiency which occurred. If ten years ago spinners would find everything below 30 ends-down acceptable, today many mills strive for no ends-down at all. The concept of spinning limit has completely lost its meaning. Increasingly higher quality cottons are used for lower quality yarns. Modern mills look for good processing performance, have high quality expectations, look for uniform qual-

ity from one crop year to the other, want good dye uniformity, no yarn imperfections and high fabric strength. HVI has just started to provide some answers to these challenges, but according to Dr. Bragg it's still not doing enough and research and development in this area will remain strongly supported by the textile industry.

Helmut Deussen, president of the research and engineering division of Schlafhorst Inc., largely shared Dr. Bragg's concerns. He emphasized the concerns of non USA-based spinners for internationally compatible testing results. In particular, he referred to the problem of calibration of the strength readings with the presently available International Calibration Cottons and HVI Calibration Cottons. He further pointed out the relationship between micronaire and strength and the influence of sample preparation on this aspect. It seems that cleaned and opened samples, as opposed to raw cotton specimens, have a somewhat lower micronaire. If now cleaned and opened samples are used in the Shirley-FMT machine to determine fineness and maturity, the subsequent strength readings might be somewhat lower. Also, in the area of length Mr. Deussen stated that a consensus of either Mean Length (M) and Upper Half Mean Length (UHM), or 50 percent Span Length and 2.5 percent Span Length is urgently required.

Further, he mentioned the issue of short fiber content (SFC). Many spinners see this as the highest priority characteristic to be included in the HVI lines. According to Mr. Deussen, the only measurement available having a predictive value in spinning efficiency is the SFC measured by the Peyer Altmeter. This method, because of elusive sample preparation, is too time-consuming to be used in an HVI environment. Mr. Deussen suggested that maybe a mathematical formula, along the lines of the one proposed by Sasser, based on the uniformity index or ratio, could be incorporated in the software of the HVI lines to estimate SFC. Finally, Mr. Deussen challenged the research community to develop a reliable and fast method detecting stickiness in raw cotton.

Geoffrey Wilde, technical manager at Ralli Bros & Coney, presented the way his HVI lab deals with changes in relative humidity. Over time it proved next to impossible to maintain constant relative humidity in the lab, at least at reasonable costs. Instead of further pursuing strict humidity levels, the lab decided to study the exact influence of humidity on all measured fiber characteristics and try to determine an adjustment factor. Over a period of several days, they deliberately varied the relative humidity while using the same cottons over and over. Their findings were that the

strength readings could be modified by a simple correction factor per percentage point of relative humidity. This correction factor could be incorporated in the software of the HVI machine provided that the relative humidity is registered as well. This solution, according to Mr. Wilde, works satisfactorily and is a lot less expensive than investing in additional climate regulatory devices.

Dr. William Lalor, director for agricultural research at Cotton Incorporated, elaborated on some comparative experiments involving saw and roller ginning. This is an issue of current interest as there is a rising interest in roller ginning in the USA, not only because of increases in the production of the extra long staple Pima varieties, but also as an alternative for saw ginning of high quality upland varieties like DPL 90. In the experiments five varieties, SJ-1. SJ-2, DPL 90, Acala 1517-75 and Pima S-6, underwent four ginning treatments: roller ginning with no lint cleaning, roller ginning with two-stage lint cleaning, saw ginning with no lint cleaning, and saw ginning with two-stage lint cleaning. The lint was measured for a range of fiber quality parameters using an HVI line as well as the standard laboratory instruments. The nep count was based on a visual count in the carded web. The lint was further transformed into a 40s count yarn, which was also exten-

sively evaluated on quality parameters. Results indicate that of all measured parameters, roller ginning of upland cotton had a most favorable effect on fiber length (HVI-measured) and length uniformity. Further, in the case of both SJ varieties the nep count of the saw ginned cotton was also significantly higher. For the DPL 90 this was not the case. On the other hand, it turned out that roller ginned SJ cottons had a higher short fiber content (measured with the Array method). Dr. Lalor attributed this finding to the fact that roller ginning would separate a lot of the linters from the (upland) seeds, causing this high short fiber content. The yarns made out of the roller ginned cottons had more imperfections (thick/thin places, nep count), compared to the yarns made out of saw-ginned cotton. Although, part of this could be explained by the specific yarn count used for this experiment, these results do seem to be in line with earlier research.

Lubbock,Texas

Lubbock is situated in the middle of the High Plains of Texas. The main industry in this area is cattle, followed closely by cotton. The crop is grown in a high risk environment with many climatic hazards. Generally, this makes farmers reluctant to make large investments in the crop and, consequently,

input use is lower than in other areas in the US. For example, total variable cash expenses per acre in Texas are only one third of those in Mississippi and one fifth of those in California's irrigated areas. In Lubbock we had discussions with cotton production researchers, textile researchers and representatives of a large cotton cooperative.

Dr. John Gannaway, principal breeder at the Texas A&M Agricultural Experiment Station, explained that in Texas farmers are assisted by a public extension service, dependent on the Texas A&M University System. Each county in Texas (total 254) has at least one general purpose extension agent, but more often three or four. On the district level (total 24) these extension agents are supported by a cotton specialist, often a very experienced PhD holder. Apart from this public support system, many farmers will hire private consultants, either to take part of the decisions in specific fields, like insect control, or to take basically all farm management decisions for specific plots.

In Texas, according to the last count, farmers grow as many as 107 commercial varieties. However, many of these varieties are closely related. There are about 14 different types of varieties. Texas varieties represent a

large range of quality characteristics. In the fully irrigated El Paso area some varieties are of the Acala type, while on the high risk Rolling Plains they grow the robust Lankart 47. Common practice is that each crop year farmers buy only 10 percent of new seeds. The rest is first generation seed picked-up at the gin. Seed is planted at a rate of 12 to 25 lbs. per acre. Frequent replanting is often required.

Over the past few years Texas cotton has risen in measured quality. Particularly since the surge in rotor spinning for the lower count yarns, Texas cottons have increased in popularity because of the favorable price/quality relationship. The challenge for breeders is to produce good quality varieties able to sustain periodic droughts and cold weather towards the end of the season. Evidently, early maturing remains an important prerequisite for any variety on the plains. The role of the university breeding programs is to develop high quality germplasm, which then is handed over to the commercial breeders who finalize the work.

According to Dr. Gannaway, biotechnology will just be another tool for creating improved varieties. The work presently in progress mainly involves the isolation and incorporation of single genes, like the Bt-gene and the

herbicide tolerance gene. Fiber quality characteristics are believed to be regulated by several (groups of?) genes which may or may not be located on the same chromosomes. The successful transfer of these characteristics with their promotor genes, etc., will most likely be far more complicated. Fiber strength is probably the simplest characteristic in this respect but even with conventional breeding, strength can already be manipulated relatively easily.

The issue of hybrid cotton has lost a lot of interest in the last five years. It appears that no economically feasible way could be found to produce commercial Fl hybrids. All the attention is now focussed on F2 hybrids. Studies indicate that these hybrids produce more uniformly than expected and that hybrid vigor in yields is still close to 10 percent. This year Chembred Inc. will market four new F2 hybrid varieties all produced by chemically induced male sterility combined with insect pollination.

Dr. John Price, textile scientist at the International Center for Textile Research and Development, presented some basic facts about the importance of quality cotton for the textile industry. Yarn strength, one of the most important quality parameters in the spinning industry, is directly de-

pendent on fiber strength. However, this relationship is not strictly linear, but in fact is the compound result of two different curves. Both curves depict a relationship between yarn strength and twist multiplier. The first curve shows improved strength at higher twist levels because of improved cohesion, the second curve shows the effect of increased obliquity at higher twists causing lower fiber strength. Somewhere an optimum level is found, determined by these technical relationships as well as the raw cotton/yarn price relationship (as higher twists will mean more raw material per unit of yarn). Finer and longer cottons can shift the optimal twist to a lower level thus reducing the raw material needs. Lower twist multipliers generally will result in a softer feel of the fabric, an attribute which is generally valued higher in the apparel markets.

Presently the most common spinning technologies are ring and rotor spinning. Airjet spinning, with estimated sales of about 400-500 machines in the US now, has its feet on the ground. This system is well suited for cotton/polyester blends, but less suited for 100 percent cotton yarns. Research on friction spinning has decreased considerably in recent years, as the problem of obtaining reasonable strength levels has remained a big obstacle. Wrap spinning, a process frequently used on other fibers combining

filament with staple fibers, is technologically feasible in cotton but is hardly practiced because of insufficient demand.

The advantages of ring spinning are versatility and simplicity. With the development of the "Splicer," which is able to tie two loose ends leaving virtually no irregularity in the yarn, higher production rates can be achieved. Speeds of up to 22,000 rpm are the upper limit now. According to Dr. Price, ring spinning is pushing back after a relative decline over the past decade. The most important fiber characteristics remain length and uniformity.

Rotor spinning remains the most productive process. Yarn counts up to 30s and 40s can now be spun on rotor frames which can go as fast as 90,000 rpm. The yarns produced on rotors remain somewhat rough and have some tensile problems. The most important yarn characteristics are fineness, strength and fiber length, and uniformity. Neps do not appear as much as in ring spun yarns because this spinning technology will "hide" most of the neps on the inside of the yarn.

Darryl Lindsey and **David Stanford**, of the Plains Cotton Cooperative Association provided us with information on their organization and the way their cotton is marketed. Plains Cotton Cooperative Association (PCCA) was founded in 1953 to help cotton producers achieve the best competitive price for their cotton. As such, PCCA is a marketing cooperative. Presently the co-op counts about 22,000 members and is one of the most important agricultural cooperative structures in the USA. Their staff is highly professional and their offices are equipped with the latest technology.

Traditionally the buying/selling transaction has been a very labor-intensive process. The farmer wanting to sell its cotton would go to a gin and ask to get some offers from buyers. The gin executive then would go into his files and "recap" all the quality information of the particular lot of cotton. He would then call a few buyers who would take time to evaluate this information and prepare a bid. In most instances this elaborate process would lead to two or three serious bids ---- which could be accepted or rejected by the producer ---- followed by an eventual counterbid. Needless to say this way of marketing was found suboptimal and inefficient.

The PCCA member has the option of marketing his crop in two ways. Firstly, he can participate in a marketing pool, by which he transfers all marketing decisions to the executives of the co-op and receives an average price at the end of the season (after having received advances on the expected average during the season). Marketing expenses are deducted before arriving at the average price. Secondly, he has the option of marketing his own cotton using the TELCOT system via a computer terminal installed at his gin.

The TELCOT system carries full quality information on every bale entered into the system by the participants. The system is installed in the offices of over 200 gins and 40 cotton buyers. Cotton can be offered either as Regular Offer, which allows for a fifteen minute competitive auctioning of the lot, or as a Firm Offer, under which the farmer puts in his desired price for a specific time period. In this last system the buyer has the option of making an Automated Counter Offer in case he cannot agree to the initial price. The PCCA guarantees all sales made through the TELCOT system. The system is financed out of a commission on sales.

The system has its advantages for both buyer and seller. For the buyers it is a much less costly way to do transactions and it enables them to select lots of cotton with exactly the characteristics their clients need. The sellers benefit from an improved price discovery mechanism as all closed deals can be monitored on the system. The farmer has full information on his expected profits. The monitoring system also includes weather reports, market news and day-long quotations from the New York Cotton Exchange.

Last year the TELCOT system handled over 1.25 million bales. A record was set in February 1989 when close to 385,000 bales were sold in one single trading session. The PCCA has been one of the driving forces in the development of HVI systems. Much of the initial research work has been done under contract with PCCA. Another innovation made by the cooperative is a strength premium program where farmers receive an extra cent per pound for each strength unit above 25 grams/tex, up to 28 grams/tex. Over the last six years this program has been effective and farmers have received an additional 12.5 million dollars for their crop.

Bob Hale and **Danny Davis** of the American Cotton Growers' textile division, gave a presentation about the operation of their textile mill. Originally

the American Cotton Growers mill was owned by a marketing pool organization, combined with textile manufacturing. The textile plant, situated in Littlefield, Texas, was completed in 1975. In 1987 the plant was sold to PCCA for around 100 million dollars and the ACG is now a division of PCCA.

The plant produces one fabric only, heavy indigo-colored denim of 14 ounces per square yard. This fabric is sold uniquely to the Levi Strauss Company, who cuts it into jeans. The mill uses about 90,000 bales of cotton a year for the production of 28 million yards of 60 inch denim. The fabric produced by the plant is subject to very tight quality specifications imposed by the Levi Strauss Company. Quality specifications include a minimum weight prior to washing and after washing, minimum tensile strength, residual shrinkage, stiffness, elongation before breakage and number of picks per inch.

To achieve these quality specifications the plant manager relies heavily on HVI testing of all bales. In fact, the grade of the bale is completely disregarded. For every bale of cotton offered the expected yarn strength is calculated on the basis of fiber characteristics as measured by the HVI sys-

tem. If a bale does not give a minimum expected yarn strength, it is not bought. Blending is largely based on micronaire. The 28 bales going in one blend come from three micronaire groups, actual blending taking place on the drawing frames. Most crucial in this operation is the blending-in of the new crop, especially because in west Texas average micronaire can differ as much as 1.5 points from one season to the other. The availability of a large pool of cotton with a wide range of qualities ensures the interseason uniformity of the end product. Further it helps that, with indigo dying, maturity is not so much a factor as the dye is not absorbed by the fiber but rather attached to the surface.

To participate in the cooperative mill the producer signs a mill option. This authorizes PCCA to withhold 5 dollars per bale from the sales of this producer. This capital is held by the mill for five years before repaying. Signing the mill option gives the producer the opportunity to participate in the mill's earnings.

Mrs. Barbara Sheaffer, president of Motion Control Inc., discussed the present status of HVI technology. According to Mrs. Sheaffer, the major improvements made in the last year largely relate to the accompanying soft-

ware. Users, especially those in the textile industry, are now able to use the data directly for inventory management and bale selection. The software also permits the user to obtain such derived parameters as uniformity ratio, staple length, count-strength product (estimation of yarn strength and estimated zero-gauge Pressley strength). Also, optional temperature and humidity sensors are now available to measure these parameters directly for each sample tested. This opens the door for the use of an adjustment factor along the lines proposed by Geoffrey Wilde of Ralli Bros & Coney.

The machines are now able to test 200-250/bales per hr. using either two or three operators. A fully equipped machine will cost around US$100,000 FOB at a US airport. It will measure micronaire, fiber length, trash (on an area basis), strength, elongation and color. The models used at the Textile Research Center in Lubbock had the Fineness/Maturity Tester integrated into the line but this setup is not commercialized. Mrs. Sheaffer disclosed that studies are in progress to develop an instrument to determine the kind of trash in addition to the relative trash area in the sample. On the subject of maturity she remarked that interest goes out to a concept of measuring the percentage of dead fibers, possibly with a quick chemical dye test. Other improvements anticipated are in the area of measuring roller ginned

cotton, which at present does not lend itself very well to automated sampling.

Dr. Jerry Quisenberry, research leader at the USDA-ARS station in Lubbock, gave an overview of the work in progress at this facility. The research has a multi-disciplinary character and is a combination of basic and applied research. One example is the research related to the concept of Thermal Kinetic Windows (TKW). This concept is used to explain why actual yields in the US are only 20 percent of observed potentials from record yields. In general this is caused by stress, either physical or biological. Temperature is an important factor in the physical stress complex affecting the plant. Research at a very basic level has indicated that each plant species, whether it is cotton or wheat, grows and develops best within a certain temperature range. This basic fact was substantiated by tests on the optimal activity of one basic plant enzyme and further documented by studying some processes during photosynthesis.

The temperature range of optimal plant activity is called TKW. Practical uses of this concept lie in the field of irrigation, where irrigation scheduling can be determined by assuring that canopy temperature remains within

the optimal range. Experiments in Lubbock have indicated that this could lead to important savings in irrigation water. Another more distant application is related to the potential of biotechnology. If it could be determined which genes in a plant make a particular enzyme perform optimally at a specific temperature, these genes then could be transferred from one plant species to another. In the case of cotton, one could speculate that incorporating a gene from wheat could reduce the plant stress caused by low temperatures. This type of research is being conducted in Lubbock.

Memphis, Tennessee

In Memphis, the Research Associate Program visited the field headquarters of the Cotton Division of the USDA Agricultural Marketing Service. This division has a marketing news service in charge of collecting and summarizing information to enhance market transparency; in relation to market support programs, a fiber technology branch responsible for conducting studies related to the development, improvement and maintenance of standards for cotton and linters and to define and prepare these standards; and a grading branch responsible for grading the cotton crop both

manually and with the HVI systems. The division is now fully supported by the fees associated with these services and no federal money is collected.

Dr. H.H. Ramey, head of the fiber technology branch, discussed the activities of the division. Many of these are related to the introduction of HVI testing in the grading of cotton destined for the loan program. The grading division presently operates with a total of 132 HVI systems coming in about equal proportions from Motion Control and Spinlab, the two HVI manufacturers. The machines were acquired in lots of ten through competitive bidding, with price as the single decisive consideration. Farmers pay presently 50 US cents for HVI testing on top of the $1.23 per bale for grading. Interestingly the grading branch uses the HVI systems almost like mobile units, transporting them northwards during the harvesting season.

The fiber technology branch is involved in a substantial program to ensure that grading is done in a standardized way. Hand grading goes on the basis of standard cottons. These cottons are selected with the utmost care, especially concerning the uniformity of each bale. Apart from the American Upland and Pima Grade Standards, also International Calibration Cotton Standards are used, including the "For Micronaire Only" option. With the in-

crease in HVI testing a need was created for HVI calibration cottons providing reference values for UHM (Upper Half Mean) length, M/UHM (Mean divided by Upper Half Mean) uniformity, HVI 1/8" and micronaire. Samples are available for short staple and long staple cottons.

To ensure that HVI measurements are comparable ---- a great concern of the cotton industry ---- an elaborate checking program has been put into place. Throughout each day a classing office is in operation, and samples are taken from each line and sent by overnight mail to Memphis to be retested. The machines in Memphis remain at constant performance with the help of a round test program involving more than thirty participating laboratories.

Allenberg Cotton Co. is a cotton merchant owned by the Louis Dreyfus Corporation. The company handles over one million bales of cotton yearly mostly originating in the USA. With this turnover the company is one of the five biggest cotton merchants in the world. There are basically three ways a merchant sells cotton: on "green card," using the USDA classing information as quality description; by private type, delivering on predetermined standard specifications; and finally by description, providing private HVI in-

formation on each and every bale. In the US an important number of mills have switched now to buying on "green card" or description, whereas in Europe most mills prefer the traditional private type system.

An HVI system was installed at the company's headquarters in 1988 with the objective of servicing those mills which demand testing information on every bale. A state-of-the-art conditioning system was put into place to ensure constant climatic conditions. Expenses for this system were at least as much as for the system itself. The company believes that HVI measurement is there to stay but measurements have to be perfected and other instruments should be added. The company is uneasy especially regarding the strength measurements, for which the methodology differs from one manufacturer to the other and which seems to be very sensitive to moisture content. Also, it is anticipated that in the future quality specifications in cotton contracts will be more of a scientific nature containing averages and some parameters indicating the distribution around the average.

Dr. William Mayfield, national program leader for cotton, USDA-Extension Service, explained the high degree of collaboration in the cotton industry in terms of technology development. By means of Cotton Incorporated every

cotton producer in the country makes its contribution to technology development. Also the National Cotton Council is very technology-minded and has its own technical services department. The farm supply industry (agrochemicals, machinery, etc.) makes donations through the Cotton Foundation, while the Federal Government participates by means of USDA's Agricultural Research Service. Finally there are the states who support technology development and transfer through the system of state universities. Dr. Mayfield believes that in this respect cotton is probably the best organized agricultural industry in the US.

According to Dr. Mayfield, cotton fiber quality will be improved significantly in the near future. Breeding will take care of higher strength cotton while maintaining good yields. With the release of the Deltapine Acala 90 a significant step forward has been made in this respect. Trash content can be reduced by breeding efforts as well but will mostly come from improved defoliation and harvesting practices, as well as improvements in ginning. Also length can be improved by better ginning, probably as much as 1/32" on average. However, improved varieties will remain the most important factor in this respect. In harvesting, technology attention is focussed on the

new John Deere harvester, which is equipped with easily adjustable pick units to accommodate 30 inch row systems.

Stoneville, Mississippi

In Stoneville, **Dr. Stanley Anthony**, head of ginning research at the Delta Branch Cotton Research Station, presented an overview of ginning research in progress at his facility. The general objective of the research is to ensure that the fiber quality desired by the textile industry is available, consistent, though, with acceptable farmer incomes. It is now well documented that basically each additional piece of equipment in the gin, whether it be seed cotton cleaners or lint cleaners, has an impact on fiber quality.

Much of the research directly focuses on selection of the optimal use of ginning equipment. The laboratory is equipped with a complete set of dryers, cleaners and ginstands. Bypasses enable the researchers to choose any possible ginning sequence and monitoring equipment to determine essential fiber parameters at different stages in the ginning process. A computer model was developed to assist the manager in achieving an optimal

product. It operates with basic price data for every quality of lint, combined with performance data from all pieces of equipment. Experiments with this model have showed that an additional profit of $20 a bale can be achieved along with better spinning performance of the fibers.

Other research focuses on the ginning process itself. Recently a patent referred to as differential ginning was awarded on a modification to existing ginstands. Basically this modification separates cotton fibers into three length groups and improves the quality and uniformity within each group. All seed cotton is fed to the left side of the stand, where the longest fibers are separated from the seed. Then the cotton seed travels to the middle part and to the right part of the stand, where shorter fibers are separated. Lint produced in each of the three segments exits the stand separately and is further separately processed by the cleaning equipment. Results have shown that especially the short fiber content of the "leftside" cotton can be reduced by as much as 62 percent. The ginstand operates at about 60-70 percent of the original capacity.

Attention is given to the upstream production systems also. As mentioned above, ginners are looking at varieties, especially their cleanability. Har-

vesting is under scrutiny as well. Experiments over the last two years have led to data on a process labeled "selective harvesting." Harvesting of the top and bottom crops are separated by eliminating part of the spindles. Results show that the top crop has better grades, shorter UHM length, lower micronaire, higher reflectance and lower yellowness. The parameters for the "total crop" were about equal to the “top" crop.

Dr. Lynn McDonald, director of research at Stoneville Pedigreed Seed Company, presented the breeding research program of his company. This involves largely a classical breeding process, aiming at stress-tolerant, high yielding varieties. It takes the company twelve years from first crossing to commercialization of a new variety. Winter nurseries for promising lines are available in Mexico. Dr. McDonald stated that as the company’s clients are farmers, they would have to make a product valued by this customer group. This means that yield will be an overriding factor as long as the market dictates it. However, in the research department they would like to be prepared when other considerations become important.

Stoneville Pedigreed Seed Company has changed ownership recently and is now owned by Calgene of Davis, California, a prominent biotechnology

company with a strong research interest in cotton. Although it is anticipated that genetically engineered cotton will see the marketplace in the 1990s, classical breeding will most likely remain the dominant way to develop better varieties in the coming decade, according to Dr. McDonald.

Washington, D.C.

Drs. Frank Werber and **James Coppedge**, national program leaders of USDA-Agricultural Research Service for Fiber Quality and Crop Entomology respectively, presented an overview of research under their respective field of competence. The most important objective in the fiber quality research program remains the development of instruments to measure these fiber qualities. The first three priorities in this respect are short fiber content, neps and maturity. The most promising technology to measure short fiber content, as well as neps, is the electro-optical method of measuring single fiber length, diagram and shape, as developed by Shofner PM Inc. This system called Advanced Fiber Information System is presently commercially available. However, it will probably take several years of testing and evaluation before it can be routinely used in grading and bale selection. In the field of maturity there are several options such as improved ver-

sions of the FM-tester, and near infrared measurement. Recently, attention has shifted to a quick dying test developed in the ARS-Southern Region Research Center in New Orleans. In its present configuration the test takes three minutes and uses a sample of carded web. Additional research will be directed toward improving its operation.

The second objective of the program is to improve fiber processing technology from field to mill in order to preserve optimal fiber quality. This includes optimal harvesting and ginning practices as well as research into new fiber finishes to enhance the quality of the product. Example of this is the development of new cross-linkers which will enhance the easy care properties of cotton. The third objective is to increase the strength of cotton to levels beyond 40 g/tex. This would mainly come from concentrated efforts in breeding superior varieties. Dr. Werber put all these research efforts in perspective by mentioning that a chemical company like du Pont alone would spend yearly about $220 million to improve their synthetic fiber products. This compares with less than $15 million spent on cotton programs serving the same objectives.

Dr. Coppedge presented an overview of the major entomological research programs. In boll weevil control the main emphasis will remain on area eradication programs, based on extensive monitoring combined with aerial spraying. Additional resources will be devoted to developing a control substance containing an attracticide and a toxic as an alternative to the presently available insecticides. In regard to pink bollworm there is the conviction that major emphasis should shift to cultural and biological control. Many pink bollworm infested areas have increasing problems with secondary pests such as aphids and whitefly, A shorter season, less dense plant populations, intelligent use of plant growth regulators and destruction of stalks are elements in the cultural arena. Mating disruption and mass trapping using slow release formulations of pheromones and mass breeding, and release of sterile males are presently the main components of biological control programs. In *Heliothis,* control progress is being made toward developing inherited sterility, a technique which results in sterile offspring. Also, emphasis is put in developing a chemical control strategy combining an attractant, a toxic and a feed stimulant.

Short Notes

- At the Beltwide Conferences in Las Vegas, Tom Kerby, cotton extension specialist from California, presented the computer model CALEX, developed to predict the effect of the plant growth regulator Pix. The model draws on more than 45 experiments conducted over the last ten years with this chemical used in a range of climatic and cultural conditions. The model takes the basic form of a linear regression equation. It takes into account all that is known about Pix California. Due to its demonstrated sensitivity to environmental conditions, the model should extensively be revised if used in other environments. CALEX depends on a regression formula involving the following dependent variables: plant vigor index (expressed as a relative internode distance compared to an unstressed Acala variety), the number of the node providing the first fruiting branch, row spacing, days after planting of application, dose, retention percentage of fruits, and other variables. The objective of the model is to recommend the application of specific doses of Pix at specific dates in the season. This past season model validation experiments have been conducted and preliminary results are promising, according to Dr. Kerby.

- A workshop on Cotton Growth Regulators was held from 6-7 December in Athens, Greece. This meeting, hosted by the Hellenic Cotton Board, was part of an inter-regional cooperative research network for the cotton producing countries in the Mediterranean region. Participants of the workshop came from Belgium (textile research lab), Bulgaria, Egypt, Greece, Italy, Spain, Syria and Turkey. At present, growth regulators are used to some extent in Bulgaria, Greece, Spain and Turkey. At the workshop it was agreed that research efforts concerning growth regulators should be directed to improvement of operation mechanisms of these substances, specification of proper rates, time of application and ways of use, search for new products, benefits through yield and fiber quality, and environmental safety. Participants agreed on a common research program with three main directions:

  a) basic research on the metabolism of growth regulators;

  b) applied research on growth retardants (application rates, varietal effects, etc.);

  c) applied research on regulation of cotton seed germination (Greece and Bulgaria).

It is anticipated that all countries would conduct at least one collaborative experiment each year. Agreement was reached on a protocol for an experiment on interaction between fertilizer application and use of growth regulators. The group plans to meet again at the end of 1990 to discuss progress. (According to a statement of the workshop provided by Dr. Kosmidou-Dimitropoulou.)

- Some new biological control products have been introduced to the US market or will see the light very soon. PBT Inc. will market a product called Cytokin. It contains the natural plant hormone, cytokinin, which is extracted by the root system. According to a company spokesman, the product would promote root development, and would have yield effects because of better fruit retention and early maturity. The product would be particularly useful when applied to a plant just coming out of a (water) stress situation. Sandoz Inc. is coming with a newly formulated Bt-based biopesticide. The product, Javelin WG, comes in a wettable granular formulation and is recommended on *Heliothis and Spodoptera* in combination with pyrethroids. Most producers will use a feed stimulant to enhance its effectiveness. Calgene has acquired a US patent on a proprietary gene that induces tolerance to the herbicide bromoxynil. The

patent has been assigned to Rhone-Poulenc, the company which markets Bromotol, a herbicide based on bromoxynil, which currently cannot be used in broadleaf crops. Calgene has successfully incorporated the gene in cotton plants and has reached the stage of field experimentation. (Source: *Cotton Grower)*

- The International Center for Textile Research and Development has made an evaluation of the effectiveness of the chemical PC-3 in reducing stickiness problems in the textile mills. PC-3 is a substance mainly used as an overspray for seed cotton in the gin, to enhance ginning performance. According to the manufacturer, Power V. Inc. of Dallas, Texas, the product will enable the gin to process cotton at higher humidity levels (up to 9%), reduce static electricity caused by friction in the flow of cotton through the gin, and eliminate stickiness caused by immature fibers, honeydew and seed-coat fragments. In the context of the latter ascribed characteristic the Textile Center did an experiment in yarn production using raw cotton preconditioned in three ways: one stored for 24 hours under 70°F and 55% R.H. (dry cotton), the second stored under 70°F and 80% R.H.(wet cotton), and thirdly one conditioned at 70°F and 80% as well but followed by a treatment with PC-3 (wet treated cotton). The

samples used for each lot were taken from a bale with high reducing sugar content (1.26% and 1.2% for the dry and wet cotton respectively). Samples sizes in the carding experiments were 50 pounds for the dry and wet cotton and 100 pounds for the wet treated cotton. In opening and carding the wet treated cotton outperformed the other two with no processing difficulties. The dry cotton caused one blockage ("choke") at the access to the card, while the wet untreated cotton caused four blockages and six instances upon which the card operator had to make corrections to avoid collapse of the cardweb. In the subsequent drawing process no major differences were observed among the samples. In roving, a total of eight roving breaks occurred using the wet untreated cotton. The dry cotton produced two breaks, although some stickiness could be observed. The wet treated sample was processed only after a similar cotton sample was processed to "run-in" the equipment. This (wet treated) "run-in" sample caused 5 breaks and showed severe symptoms of stickiness. The subsequent sample of wet treated sliver gave no processing problems. Ring spinning (over a duration of 4 hrs, and 45 min.) appeared to be problematic for the "run-in" lot (33 breaks or the equivalent of 46.3 per 1000 spindle hours). However, the original wet treated cotton gave the best performance (3

breaks). The untreated samples were intermediate in performance (19.7 and 10 breaks respectively for the wet and dry cottons). The ring spun yarns gave no difference in quality. In rotor spinning roughly the same performance was observed in the opening, carding and drawing stages as in ring spinning. The samples were used to make an Ne 10 count yarn at 36,000 rpm over 80 rotor hours. The yarn produced from the treated cotton was "seemingly stronger and more regular" compared to the yarn from untreated cottons. In conclusion the author states that "it would appear that the overspray has a positive influence on certain areas of processing." Additional research, using larger samples and dirtier cotton is recommended.

- With the increasing sophistication of insect monitoring and control techniques more information is needed on the population dynamics of insect pests. Although the regular counting of moths trapped by pheromone traps provides important information, it presents only a limited estimation of how the population will develop over time. Data about the age or age groups would be very useful complementary information. However, so far most ways to estimate the age of moths require too much time and are not overly accurate. Research carried out at the Biloela Research Station in Australia

has been focussed on this aspect of insect control. In particular, efforts were directed to age determination of pink spotted bollworm *(Pectinophora scutigera)* and American bollworm *(Heliothis armigera).* Researchers opted to investigate the fluorescent pteridine content of moths of various ages. Laboratory experiments with *H. armigera* showed that the pteridine content of female abdomens increases with age, while the fluorescence intensity for the same substance decreased in case of male thoraces. Overall temperature seems to have an important impact on pteridine levels, which is considered to be the main obstacle for the development of a viable field test. (Source: *Australian Cottongrower)*

- In India, the commercial production of hybrid cottons has been a major achievement of the cotton sector. The first hybrid (H4) was released in 1970. Today, an estimated 35 percent of the cotton area in the states of Maharashtra, Madhya Pradesh, Karnataka and Gujarat, is grown with hybrids making up for over 65 percent of the total production in these four states (central zone). One of the obstacles for even more widespread adoption of these varieties is the high cost. Hybrid seeds are priced fifteen to twenty times as much as normal varieties. This, of course, has to do with the high production costs of hybrid seed production, as crossings are

done by hand. In a recent article, Bhale, Deshmuth and Rao, all researchers at the Central Institute for Cotton Research in Nagpur, point at ways to reduce the costs of producing hybrid seeds. In an experiment conducted over two years they showed how to increase boll setting percentage from initial levels of 31 to 37 percent, to levels between 50 and 75 percent. They achieved this result by reducing the actual days plant crossing took place, by either doing it on alternate days or delaying it for about two weeks. On these "idle" days mature flower buds were removed, thereby managing the plant's sink activity. These types of treatments all had about the same seed yield per plant as the control treatment (continuous crossing and no bud removal). Seed quality, as expressed in germination percentage and seed index improved somewhat, but were influenced by the year as well. The significance of the study lies in the fact that equal seed yields could be obtained by reducing significantly the number of labor days and thereby costs of production.

- In December 1989 and January 1990 cotton prices fell. Earlier the A Index reached 85 US cents a pound, but since, prices have dropped to levels around 75 cents. Increased production estimates for the USSR and China and less than expected cotton imports into China have changed the

supply/demand picture unfavorably for cotton producers. Added to this should be nervousness in trade circles about a business recession in the USA limiting cotton consumption, and the bankruptcy of one of the major US cotton merchants, an event which caused an important downward pressure on the New York Futures Market. However, the latest estimates of world supply and demand by the ICAC show demand for cotton of roughly 4.8 million bales in excess of supply in the 1989/90 crop season. Reduced stocks and the lowest stock-to-use ratio at the end of the season in the last few decades will be the result. Therefore, if concerns about the US economy and the effects of the merchant bankruptcy abate, prices would probably rise again to over 80 US cents a pound, resulting in a season average of about 81 US cents.