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Contents

Introduction

Cotton fiber, by virtue of its unique structure and quality characteristics, offers comfort and many desirable properties such as high tensile strength, exceptional absorbency, natural resistance to electrostatic build-up, excellent heat resistance and good processability. These qualities make it suitable for use in many kinds of products. Unfortunately, the share of cotton among fibers consumed in the world is decreasing. Currently, cotton is only about 40% of all the fibers consumed in the world, compared to 68% in 1960. However, cotton use can increase by competing with synthetic fibers and also by complementing synthetic fibers. A complementary use might be in the form of non-wovens where cotton use is currently only 8% of all fibers consumed. Cotton can be used in non-wovens in pure form, as well as in composites with other natural and synthetic fibers. The first article provides extensive analysis of the non-woven situation and looks to possible options on how cotton use could be enhanced in non-woven products.

Integrated pest management (IPM) is more important in cotton than in other crops because of the high use of insecticides. Although IPM has been talked about widely, its implementation has not been even with discussions. IPM is an integrated approach requiring a sound knowledge of many disciplines, unlike insecticide use where information on insects, threshold and insecticide use is more critical. IPM requires that farmers or persons developing IPM packages be fully aware of agronomic management, biological control, insecticide use, crop growth and other aspects of crop development. Farmers must accept some loss in yield offset by reduced costs of inputs, particularly insecticides. Important reasons for the slow implementation of IPM include the lack of proper advice to farmers, unacceptability of initial losses and slow results/impact. The European Union is sponsoring a large IPM project in six Asian countries; including three of the five largest cotton producing countries in the world. The Food and Agriculture Organization's Regional Office for Asia and the Pacific, Thailand, is implementing the project. The main thrust of the project is to produce trainers in cotton IPM and get farmers involved in IPM through the Farmer Field School program. The project started in 2000 and has already made significant achievements. Dr. Peter Ooi, Chief Technical Advisor of the project, describes the work and achievements realized so far in the second article.

According to the latest ICAC estimates, cotton will be planted on 47,000 hectares in Colombia in 2003/04. In Colombia, cotton area has been around 50,000 hectares in the last six years compared to 398,000 hectares in 1977/78. The main reason for such a drastic fall in area is insect pressure. In the late 1970s, tobacco budworm *Heliothis virescens* appeared as a devastating pest on cotton. Colombia had not yet recovered from this pest when boll weevil *Anthonomus grandis* emerged as an even more serious threat to cotton production in most regions of the country. Farmers' cooperatives and their federations, joined by government agencies involved in cotton research and development in Colombia, are anxious to revive cotton production. Recently, one farmers' cooperative signed an agreement with Monsanto to use Bt cotton on a commercial scale. 2003/04 will be the first year Bt cotton will be planted in Colombia. The government constituted a national biosafety regulatory body to deal with biotech products, the National Biosafety Council, which accorded the approval after two years of testing Bt cotton in the country. The third article looks into the reasons responsible for the decline in area, adoption of Bt cotton, and breeding and seed production in Colombia.

The Technical Information Section (TIS) of the ICAC has helped to establish and support a number of regional networks on cotton in the world. The main objectives of the regional networks are to facilitate communication among researchers, focus on common issues, know about each other's research programs and initiate common projects when possible. The Latin American Association for Cotton Research and Development (ALIDA), established in 1986, is the oldest network, and has been meeting regularly every two years in different countries.

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The 9th meeting of ALIDA was held in Goiania, Brazil, on September 17, 2003. Delegates from Argentina, Bolivia, Brazil, Colombia, Mexico, Paraguay, Peru, CIRAD and the ICAC, attended the meeting. Countries decided to conduct their next meeting in Colombia in 2005. Mr. Eleusio Curvelo Freire was elected as the new President of ALIDA.

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The TIS maintains a database on current research projects in cotton around the world which includes an explanation of how projects are executed and funded, a list of research institutes working on cotton, along with their complete addresses, and a list of key researchers with their main research projects. Email addresses of researchers and institutes are included in the database so they can contact each other directly. The objective of this database is to understand research systems and projects in various countries and to facilitate exchanges among researchers by making them aware of activities in other countries. The searchable database has information on 36 countries and is available free on the ICAC web page at http://icac.org/icac/cotton_info/research/res_proj_db/english.html. A hard copy can be purchased from the ICAC at <publications@icac.org>.

Non-woven Uses of Cotton

Cotton faces many challenges including prices that remain below the long run average, increases in cost of production; no/low increases in yields; highest use of pesticides; and a decline in fiber market share. Member governments of the International Cotton Advisory Committee have recognized the importance of promoting cotton as an environmentally-friendly product and decided to launch a cotton promotion program through additional manpower support to the ICAC Secretariat. ICAC will synthesize information on successful cotton promotion programs in various countries and present the information in concrete and replicable form for other countries. The demand for cotton in absolute terms is increasing, but the increase is slower compared to synthetic fibers; thus the share of cotton in fibers consumed at the end-use level is decreasing. There is a need to enhance demand, not only in traditional uses, but also through non-traditional uses of cotton.

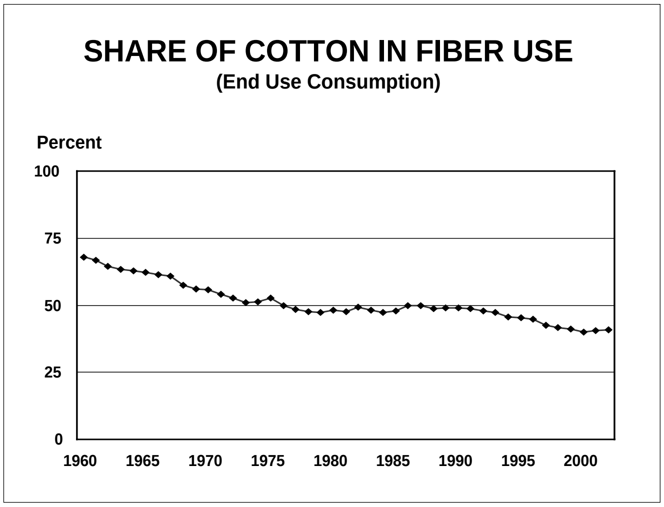
In the last forty years, the share of cotton among all fibers consumed in the world at the end-use level fell from 68.3% in 1960 to 40.8% in 2002. The lack of promotion is one factor responsible for this decline. Few countries have cotton promotion programs, even though such programs have proved their success. Cotton use can be increased not only by competing against other fibers, but also by complementing other fibers. Cotton can be blended with synthetic fibers and with other vegetable fibers.

Special Characteristics of the Cotton Fiber

The physical properties of cotton like length, strength, micronaire, etc. are well known for their impact on the end-product. However, cotton also has a number of other characteristics that are neither measured nor considered at the time of buying lint for processing.

The cotton fiber is a unicellular outgrowth from the seed epidermis and is composed of layers having a common center. The cuticle layer of the fiber consists of wax and pectin materials. The primary wall, the most peripheral layer of the fiber, is composed of cellulosic crystalline fibrils. All three layers of the secondary wall include closely packed parallel fibrils with spiral winding of 25-35° and represent the majority of cellulose within the fiber. The innermost part of the cotton fiber, the lumen, is composed of remains of the cell content. Before boll opening, the lumen is filled with liquid containing the cell nucleus and protoplasm. The twists and convolutions of the dried fiber are due to the removal of this liquid.

Caustic soda treatment of cotton fiber converts the fiber's natural waxes and fat into soap (saponification), while pectins and other non-cellulosic material are released so that impurities can be removed by washing. Bleaching takes away its natural color,



and mercerization further improves the ability of the fiber to absorb water, color and other chemicals/agents. Mercerization is usually done with 18-25% hydroxide under tension, which also improves luster in addition to absorption. Saponification, bleaching and mercerization still leave cotton nearly 99% cellulosic material.

Regarding other properties, cotton is a hygroscopic material, and moisture absorption is 7-8%. Moisture-regain ability of cotton is 7.1-8.5%. Cotton also swells in concentrated solutions of certain acids, salts and bases. Cotton is less affected by cold weak acids and shows fairly good resistance to alkalis. Cotton fiber is sensitive to visible and ultraviolet light, especially at high temperatures. Cotton's vulnerability to microorganism-effected degradation like cavitoma is well known.

Cotton for Non-wovens

Cotton has been used in non-woven form for a long time, and non-wovens might be its oldest use. However, it was in the early part of the 20th century that the textile industry showed increased interest in finding ways to make use of cotton waste. When a spinning mill buys cotton, the cost also includes fibers that will become mill waste in the form of fuzz and short fibers. The textile industry started looking for a technology that could convert cotton fiber waste into saleable products. Some of the first methods to bond short fibers used latex and resin. The products were rough and were used mainly as industrial wipes. Later, better quality products were developed for use as draperies, tablecloths, napkins, etc., but the quality of such products was far lower than woven and knitted products. That started the stage for quality improvement in non-wovens with a target to achieve a white, clean fabric, intermediate in quality between a woven fabric and paper. The basic approach required improvement in the quality of raw material (mill waste and regular lint used in spinning).

Currently, cotton is usually used in non-wovens in bleached form although supply is limited and processing costs have increased. The important steps in producing a bleached raw material are fiber opening and cleaning, alkali application, rinsing, bleach application, rinsing, finish application and drying. Bleaching improves uniformity and quality, and opens the way for more uses of cotton in non-woven products.

Bonding Methods

Spinning is the process of making yarn from loose fibers. Cotton was first spun by machines in England in 1730. The most crucial part of spinning is twisting a continuous strand of overlapping fibers to form yarn. Twisting is preceded by many operations like carding, drawing, etc. Non-woven fabric is prepared directly from lint without the spinning process. Fibers are bonded together to form a fabric through mechanical entanglement or chemical bonding. The commonly used methods for bonding cotton fibers are hydroentanglement, needle punching and thermal bonding.

The hydroentanglement of cotton in non-woven form produces strong products comparable to woven fabrics of the same weight. The absorbent properties of cotton are not sacrificed and the non-woven product can be processed like conventional woven fabrics for bleaching, dyeing and finishing. Wet processing is limited to fiber blends because of problems in recycling water and the quality of bleached cotton.

Needle punching does not sacrifice the absorbency of cotton either. However, the end product requires different needle punches depending on the weight of the product. 36-42 gauge needles have been found appropriate for non-woven fabrics, but if the material is too heavy the needle gauge may be reduced to 32 or even smaller. Finer fabrics may require 40-42 gauge needles.

Thermal bonding is the latest addition to the technology of bonding cotton fiber in non-wovens. In thermal bonding, the cotton web with blends of thermoplastic fibers is passed through two hot rollers. Temperature sensitive fibers melt and bond cotton fibers together. Polyester and polypropylene have been used in this process which affects the absorbency characteristics of cotton in the product.

Many kinds of adhesive materials have also been used in bonding cotton fibers, and resin is probably the most popular. Cotton fiber can also be bonded at regular intervals with adhesives. Stitch bonding, like sewing, has also been tried in non-wovens containing all cotton or blends with other fibers.

Non-woven Production in the World

According to Dobson (2001), only 0.4 million tons of non-wovens were produced in 1970, but production is estimated at more than four million tons now. Production of non-wovens is concentrated in the USA and Western Europe, which share about two-thirds of the total non-woven production in the world. Japan and China (Mainland) produce less that 10% of the total, with the rest of the world sharing only about one-fifth of total production. Non-woven producing countries share almost the same percentage of consumption, indicating that there is very little international trade in non-wovens. The U.S. share of non-woven production in the world declined from 53% in 1983 to 37% in 2002. Western Europe also reduced its production share over the same

Non-woven Production in the World (million tons)

Year	Production
1990	1.72
1991	1.86
1992	2.00
1993	2.12
1994	2.30
1995	2.46
1996 (1)	2.63
1997	2.82
1998	3.00
1999	3.28
2000 (2)	3.52
2001	3.85
2002	4.11

(1) Cotton shared 6% of all fibers used.
(2) Cotton shared 7.8% of all fibers used.

period from 34% to 29%, while Japan maintained its share. China (Mainland) improved its production and is by far the largest importer of non-wovens, producing 6% and consuming 11% of the world total in 2000. Production is expected to continue to increase in China (Mainland) and reach 7% of the world total in 2005 (Dobson, 2001).

Cotton is not a major fiber in the production of non-wovens. Manmade fibers dominate non-woven production, as almost 99% of total fiber consumed in non-woven production is synthetic. According to Dobson (2001), major fibers used in non-woven production are polypropylene (63%), polyester (23%), viscose rayon (8%), acrylic (2%), polyamide 1.5%, with all other fibers, including synthetic and natural, contributing only 3% of the share. This situation clearly indicates cotton's scope to become a partner with other fibers in non-woven production. The issue is not to replace wovens with non-wovens but to enhance the share of cotton in non-wovens.

The table above (data received through the courtesy of Mr. Mac McLean, Cotton Incorporated, USA) shows non-woven production of spunlaid, carded, airlaid pulp and wetlaid non-wovens. No reliable data on production of non-wovens using only cotton are available, but principally it is for oshibori and medical products. Most, if not all, is made in Japan. Carded cotton used to make tampons, cotton balls, cosmetic pads, quilt batting, swabs, pharmaceutical coil and a host of other products worldwide is not included in the data either. Nevertheless, the demand for cotton in non-wovens fluctuates depending upon the pricing of rayon.

Cotton Incorporated, USA

Cotton Incorporated is a U.S. research and promotion company owned by U.S. cotton growers whose efforts concentrate on building demand for cotton products and increasing cotton consumption. Cotton Incorporated is accredited with implementing one of the most successful cotton promotion programs in the world. Cotton Incorporated is currently engaged in a study to determine whether consumers prefer cotton in disposable non-woven products, and if they are willing to pay more for non-woven cotton personal care items. According to Cotton Incorporated, the target audience for this study is females between the ages of 18-49. Approximately, 1,000 women will be asked the following questions:

- What brand do you prefer to purchase and is that choice affected by fiber content?
- Do you have a fiber preference for these products?
- Will you pay more for a personal care product made of cotton?
- Would you like to know the fiber content or composition of personal care products?

Cotton Incorporated has undertaken significant efforts to enhance the use of cotton in non-wovens in general and, in particular, to expand cotton's application in the automotive industry. The most important aspects of these composites that are being developed are their capacity to resist heat and muffle sound. Cotton Incorporated is also working on a project to develop a cotton non-woven bale bag and significant progress has already been achieved. It is estimated that about 6,000 non-woven cotton bags were tested by gins in 2002, and the number is expected to increase to 200,000 in 2003. The process is used basically for bleached cotton, but for bale bags the process is working fine without bleaching. Cotton Incorporated also has a number of other initiatives in line for non-wovens.

Additional Uses of Cotton in Non-wovens

Cotton has unique properties. In addition to being absorbent, cotton can be processed with many commercial finishing techniques to make cotton non-wovens such as semi-durable and durable apparel, hospital drapes and gowns, protective apparel, medical fabrics and sponges, rugs and carpets, home fabrics, insulation and padding, table-top applications and traditional textile enhancement. Raw cotton and bleached cotton can be finished commercially to impart the desired performance properties such as durability, liquid repellency, etc.

According to Parikh et al (2002), about 16 million cars and light trucks were produced and sold in the USA in 2001. On average, each car uses 20 sq. yards of non-woven fabric inside and in the trunk. Currently, almost all fibers used in making this non-woven fabric are synthetic. Cotton could replace some synthetic fibers maintaining the thermal insulation properties of the material currently used while adding to its biodegradable properties. Parikh et al (2002) suggested using other cellulosic fibers too, like kenaf, jute and flax, for developing low cost non-woven composites for automotive use. They prepared mixes from selected cellulosic and thermoplastic synthetic fibers and tested the needle-punched non-wovens for thermal conductivity and heat transmittance. The results showed that thermal insulation properties of the composites vary significantly, depending on the type of cellulosic fiber, pretreatment of fibers, ratio of cellulosic to synthetic fibers and densities of the composite. Cotton, kenaf, jute and flax were mixed with recycled polyester and polypropylene fibers in weight percent ratio of two sets. The thickness of the non-wovens prepared from the composites was 20 and 30 ounces/yard. All samples were conditioned for 24 hours at 20°C ± 2°C and 65% ± 2% RH.

The data showed that two-time needlepunched cotton-based composites had the highest thermal conductivity and the jute based composites had the lowest conductivity. Thermal insulation properties of jute-based mixes were practically the same as that of the control samples from pure recycled polyester/ substandard polypropylene fibers. Longer caustic boiling of kenaf fibers insured greater refining and accordingly denser packing of these fibers in the composite. Better packing improved thermal conductivity compared to the control prepared from unfinished kenaf sample. For samples with 50:50 vegetable/synthetic fiber ratio, the thermal insulation properties of the flax-based samples were the best. A four-time needle punched composite of carded cotton, recycled polyester and polypropylene in a proportion of 35:35:30, respectively, gave the highest thermal conductivity in the cotton-based samples. The conclusion is that the thermal conductivity and thermal transmittance of cellulose-based composites varies greatly depending upon the type of vegetable fibers, and the ratio of vegetable fibers to synthetic fibers. Bulk density, of course, has its own effect. But, cotton provides an excellent choice for composites with synthetic fibers and improves thermal insulation properties compared to pure synthetics. Machines are available to prepare and process natural fibers, including kenaf, flax and hemp for non-wovens. A new machine that is capable of accepting bales of various shapes, including round, was presented in a paper at the 2002 Beltwide Cotton Conferences by Wolpers and Cochran (2002).

Textile fabrics have many uses, and it is estimated that about one-fifth of textile fibers produced in the USA finds its way into industrial consumption. The proportion of industrial use may be different in different countries, but there is great potential to enhance the share of cotton in products prepared from composites that are not used by humans directly. Cotton can be mixed not only with kenaf, flax and hemp, but also with other lignocellulosic fibers like bagasse to prepare biodegradable non-woven materials. A large quantity of rind and pith fibers (bagasse) is available after sugarcane is crushed to extract sugar. In many cotton producing countries, sugarcane is a competing crop with cotton, although harvesting starts slightly later than cotton. But ginning and sugarcane crushing go on simultaneously, and both raw materials are available at the same time. Unfortunately, bulk bagasse has no economical commercial use and is consumed as in-house fuel at mills and at homes. Landfills, mulch or inexpensive ceiling tiles are not optimal uses of the sugarcane raw material. Chen et al (2002) reported on the composite preparation of bagasse, cotton and kenaf. They used a chemical method to extract bagasse fibers and then mixed them with kenaf and cotton in a proportion of 50:20:30, respectively. Bagasse was boiled in a NaOH solution, washed and dried to extract bagasse fibers. The kenaf fibers were also opened and cleaned. The weight loss during the opening and cleaning for kenaf and bagasse was 35% and 82%, respectively. Cotton fibers were added during the process of carding. The main objective of adding the kenaf fibers to the composite was to provide strength to the material. The needle-punched web was treated with a starch solution for adhesive bonding before making flower pots. The bagasse fibers are short and cannot be used alone for making a web. Blending cotton and kenaf plus starch application helped to make a durable non-woven. The pots made from this material biodegraded in soil in 23-50 days. The biodegradable pots could serve as an environmentally safe material compared to plastic flowerpots now commonly used in most countries.

The use of non-wovens can be enhanced by producing better quality products. Non-wovens have economic and environmental advantages against standard textiles or the products they are used to replace. However, properties of non-wovens can be enhanced to improve their use in many ways. One such way is to improve the strength of non-wovens. Work done in the Czech Republic has shown that non-woven strength can be improved many times by changing the structure of a non-woven from horizontal to vertical (Mackova et al, 2002). High-loft textiles are fibrous and have low density, which can be improved. Fibers are arranged horizontally, but mechanically, chemically or thermally bonded to give strength to the product. Researchers in the Czech Republic have developed a method to make a voluminous non-woven product called STRUTO® with fibers oriented mainly in a vertical direction. The STRUTO® system, already commercialized in Australia, the Czech Republic, China (Mainland), Malaysia, the USA, Venezuela and other countries, consists of a vertical vibration lapper and through-air thermobonding chamber. STRUTO® products are superior to standard high-loft textiles because of the following characteristics:

- The STRUTO® system consumes less raw material compared to traditional technologies for the same product.
- STRUTO® products are better in bulkiness, compressional resistance, resilience to loading, heat and sound insulation, filling and hygiene properties.
- The STRUTO® system can process all kinds of raw materials, including cellulosic and synthetics.
- The vertical structure of STRUTO® products does not affect the biodegradable properties of the product.

Cotton can be used in non-wovens as one of the blend components in more than one form. It can be blended with other natural/synthetic fibers or it can be used only on the surface layer or as a core layer in non-woven. Such non-wovens have been developed at the Textiles and Nonwovens Development Center in the USA (Sun et al, 2002) with cotton fibers on the surface or inside as core, laminated with meltblown and/or spunbonded webs. Both cotton-surfaced non-wovens and cotton-core non-wovens were found to have excellent soft hand, breath ability, absorbency, and tensile properties, making them ideal for many medical applications such as isolation gowns, hospital drapes and gowns, shoe and head covers, underwear, pillowcases, diaper components (acquisition, core, back sheet), feminine hygiene pads, baby wipes, etc. The proportion of cotton in the cotton-surfaced and cotton-core products can be adjusted to meet consumer needs and improve durability and usefulness of products developed by this method.

Issues for Consideration

Cotton can be used alone or in composite with vegetable and synthetic fibers in various combinations for making a variety of non-woven products that have diversified uses, like wipes, pads, medical and healthcare applications, swabs, puffs, filters, waddings, many forms of personal care items, feminine hygiene products, bedding, household furnishing, pillows, and others. According to the end-use, the raw material may have to be processed, like bleaching, for meeting specific customer needs. Bleaching is an expensive process and would go against cotton use in non-wovens because non-wovens are expected to be less expensive in processing/making. Thus, there is a need to lower the cost of processing involved in preparing cotton raw material for non-woven uses.

The non-woven raw material, where cotton is either the only raw material or is used in combination with synthetics or other cellulosic fibers, should be able to be processed and finished according to end-use requirements. Particularly in the case of a composite raw material, it is important that the raw material uniformly accept finishing products like dye or any other special character to be added to the end product.

All non-woven products derive their withstanding force and resist permanent deformation from three main sources: physical and mechanical properties of the raw material; bonding agent; and geometry of fibers in the product. These three aspects of non-wovens, discussed above, indicate a challenging task for improvement. The structure of fibers within a non-woven product can be changed to improve its properties, raw materials can be mixed in various proportions for various end-use products, and bonding methods also need to be improved. Cotton can play an important role as an absorbent material in the overall improvement of non-wovens. Studies have shown (Ramkumar and Sawhney, 2001) that needle-punching designs can be improved for increasing strokes per minutes, needle zone configuration and needle shapes and designs. Better needle punching can impart higher strength to non-woven products by inducing better fiber entanglement.

Two important characteristics of non-woven production are no/least raw material waste and low cost of production. None of the qualities of non-woven processing should be sacrificed while considering improvement in the existing products or developing a new product. Efforts need to continue to improve comfort and performance of non-woven products that use cotton in the composite or that are made from pure cotton.

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FAO-EU IPM PROGRAMME FOR COTTON IN ASIA[(1)]

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The FAO-EU Integrated Pest Management (IPM) Programme for Cotton in Asia involves six countries, namely Bangladesh, China (Mainland), India, Pakistan, the Philippines and Vietnam. Approved in 1999, the project did not begin until 2000 in China, India and Vietnam, and in 2001 in the other countries. Its objective is the "sustainable, profitable and environmentally sound production of cotton in the participating countries, through the development, promotion and practice of IPM by farmers and extension staff." The immediate objectives are the following:

- To develop a cadre of IPM cotton trainers from existing extension or field plant protection staff to train farmers in Farmer Field Schools (FFS).
- To promote cooperation for cotton's IPM among governments, research institutions, development agencies, exten-

(1) A project funded by the European Union and implemented by the Food and Agriculture Organization (FAO) of the United Nations.

sion services and farmers, and other NGOs, and to improve access for all interested parties to information from within and outside of the program area

- To have national policies on plant protection in cotton reoriented to support IPM development in the six Programme countries

The following are highlights of the main activities of the Programme in line with the immediate objectives above:

1. Training of Facilitators (ToF)

To conduct the education of farmers in FFS, IPM facilitators need to be trained. This is achieved through the Training of Facilitators (ToF) programs initiated in each participating country. ToF programs are season-long educational experiences where potential educators are trained in leadership, facilitation and ecology. From 2000 to 2002, twenty ToFs (against 19 planned) completed the training—two in Bangladesh, six in China, five in India, four in Pakistan and three in Vietnam. A total of 594 participants have graduated, with 435 more facilitators targeted in 2003. In general, ToF programs have achieved their objectives in equipping facilitators with new knowledge, attitude and skills. Facilitators learn alternative approaches to extension and adult education and the technical aspects of cotton production; they master the tools of agro-ecosystem analysis and are capable of sharing this experiential learning with farmers. They have also found new meaning in their extension role and gained credibility.

2. Annual Planning and Refresher Practicum for Facilitators

Highly skilled IPM facilitators are crucial to effectively run FFS. In 2003, the Programme initiated a comprehensive Annual Planning and Refresher Practicum for Facilitators. The practicum allows IPM facilitators to share and exchange experiences in addition to upgrading their skills in various aspects of farmer education.

RToF (refresher training of facilitators) is a specially designed and short refresher training (two weeks for cotton ToF graduates; four weeks for ToF graduates from other crops), has proved useful in refreshing and reinforcing facilitators' knowledge, skills and attitudes. Up until 2002, twelve RToFs with 207 graduates were undertaken—one for China, four for India, three for Pakistan, two for the Philippines and two for Vietnam. While RToFs continue to bring in more IPM facilitators trained in other crops, there is a need to upgrade the skills of IPM facilitators who graduated from ToFs and RToFs.

3. Farmer ToF (FToF)

FFS alumni with potential to become farmer-facilitators undergo a FToF program which provides 10 days of intensive training to enhance their capabilities in organizing farmer-to-farmer FFS (or F2FS). Vietnam started FToF in 2000 and China in 2002, totaling eight FToFs with 115 graduates. In 2002, Bangladesh implemented an experimental FToF with twelve farmers, three of them women. For 2003 and 2004, countries have planned a total of 88 FToFs with 1,320 participants.

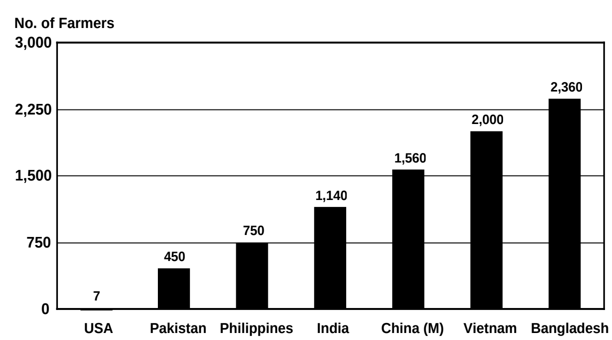
With importance given to scaling up cotton IPM through farmer to farmer field schools (F2FS), the Programme has given cognizance to the need to carefully monitor FToF and the quality of FToF-trained facilitators. Tools already developed for assessing performance of ToF-trained facilitators will ensure a common standard of evaluation.

4. Farmer Field Schools (FFS)

The Programme uses this primary learning approach to educate farmers about IPM through season-long learning that encourages self-discovery from scientific studies to enable farmers to become better decision makers as IPM experts. The important aspect of FFS is that the resulting process is learner-centered, participatory and relies on an experiential learning approach.

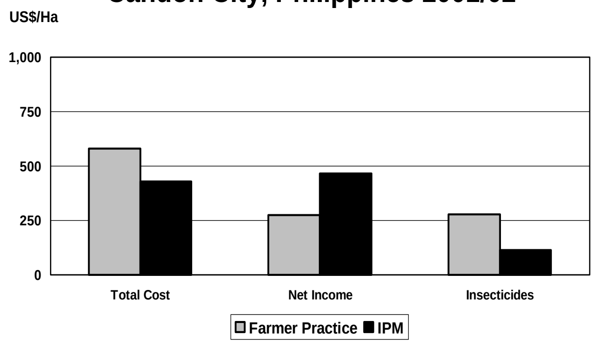
From 2000-01, graduates of ToFs and some IPM farmers (graduates of FFS) have facilitated 1,150 FFSs—51 in Bangladesh; 469 in China; 252 in India; 131 in Pakistan; 15 in the Philippines; and 232 in Vietnam. In total, more than 27,000 cotton farmers have been trained through FFS. These numbers are small compared to the total number of cotton farmers in the region. However, the Programme has piloted a way towards skill development to overcome inefficiency in cotton production. The Programme addresses the problems arising from technology transfer that instructed farmers (mainly illiterate and resource-poor) to follow practices that they could hardly understand or even afford (training and visit [T&V] system). The T&V system may be suitable for richer and more educated farmers with large farms (e.g., ten farmers per 1000 ha in the USA). However, over the last thirty years, the T&V system has had little impact on resource-poor farmers. Hence, to address the large number of resource-poor farmers in member countries (Figure 1), the Programme called for investment in farmer education, especially in understanding the scientific principles behind good agronomic practices. In the process, IPM farmers become experts in pest management as well as more productive and prof-

Figure 1: Number of Cotton Farmers Per 1,000 Hectares



Source: Data compiled from various sources for 2000 by the FAO-EU IPM Program (Walter-echols, per. Comm. 2003)

Figure 2: Farmer Practice vs. IPM Participatory Technology Development Experiment Candon City, Philippines 2001/02



itable, with skills acquired in all aspects of growing a healthy crop.

The FFS impact of the Programme is very visible. FFS farmers have gained skills in doing agro-ecosystem analysis, confidence in decision making, increased awareness about pesticides and health risks, and are capable of making comparative cost/benefit analysis. IPM has increased their net profit due to lower production costs (Figure 2). In general, over the region, IPM farmers generally profited from the skills acquired (Figure 3).

5. Farmer-to-farmer FFS (or F2FS)

In F2FS, skilled farmer-facilitators train other farmers in a FFS set-up, permitting enthusiastic FFS graduates to share their new knowledge with their neighbors, a major component of sustainable IPM practice. In the process, farmer-facilitators share experiences and strengthen skills through farmer-to-farmer meetings. By 2002, China and Vietnam had implemented 32 and 31 F2FSs, respectively. In Bangladesh, six F2FSs were conducted on an experimental basis. As with FToF, monitoring effectiveness of F2FS to ensure quality is receiving special importance.

6. Follow-up Activities for FFS Farmers

Post-FFS activities span a broad range of training, research activities and forums to provide opportunities for further learning and building local IPM programs. Basic skills gained in FFS are strengthened and expanded. For example, FFS farmers of Mamadapur (Karnataka, India) evaluated stem application and water spray to reduce thrips infestation, concluding that water spray would be equally effective. In China, FFS farmers critically evaluated the impact on yield of a number of products and methods for controlling disease. They analyzed the treatment outcome using a simple but effective statistical method. All these and many other examples generated by the Programme, including an important Bt cotton study conducted entirely by farmers, illustrate that FFS farmers are able to design and carry out experiments by themselves and can explain the rationale and their learning.

7. Farmer Research

Bt cotton introduction into China, and now India, postdates the design of the Programme. Now widely planted in China (over 90% in the province of Shandong and about 40% and increasing in the province of Hubei), expectations of the Bt cotton impact have led to research studies by farmers (supported by IPM facilitators and national and provincial researchers) in Xiantao city (Hubei province) and Weifang (Shandong province) in 2001 and 2002, and by Hannover University (supported by the Programme) from 2001 to 2002.

Results of field trials showed convincingly that IPM is crucial and has many benefits, irrespective of whether Bt cotton or conventional cotton is planted (Figure 4). IPM crops normally have higher natural enemy activity and yield more than non-IPM crops, including significantly less use of pesticides, and higher savings and profits to IPM farmers.

A number of challenges associated with growing Bt cotton have also been identified, *viz*: poor seed quality with over 50% farmers re-using seed; high seed costs (up to eight times higher than conventional seed, leading to sale of "false Bt cotton seed" at

Figure 3: Net Income Between Farmer Practice and IPM from Selected FFS 2001/02

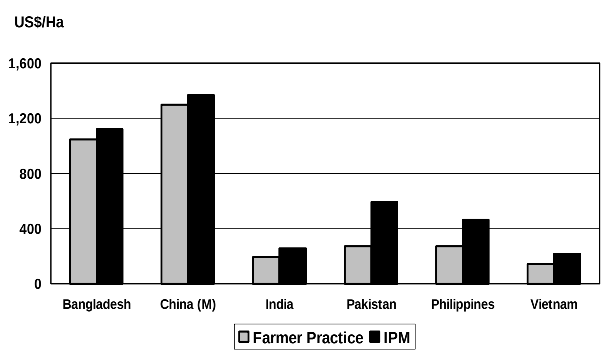
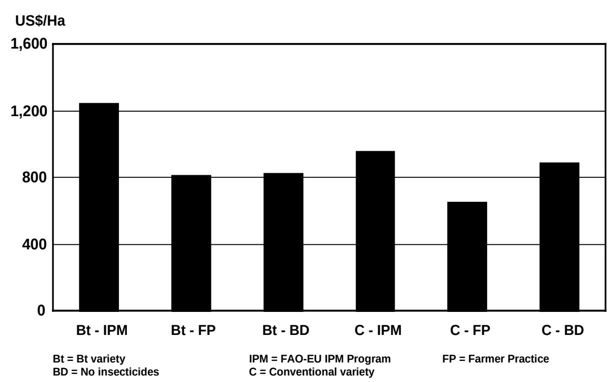


Figure 4: Net Income from Various Systems in Xiantao, Hubei, China (Mainland) 2001/02



lower prices); poor control of late generations of bollworms; inability to control pests so that farmers continue to spray pesticides heavily; increased problems with sucking insect pests (lygus bug, aphid, jassid, whitefly, mite) and some diseases; and poor farmer understanding of the role/use of Bt cotton in an IPM context.

8. Impact Evaluation

Impact evaluation of IPM is important for generating the baseline and follow-up data necessary to understand the success of the Programme in achieving its objectives. Thus far, work has concentrated on methodology development and training, while the actual country impact evaluation is at an early stage. Baseline data collection, based on questionnaire survey recall, was undertaken in China and India in 2000, and in Bangladesh, Pakistan and Vietnam in 2002.

Impact evaluation is being carried out by local institutions usually, independent from the national institution implementing the Programme.

9. Role of Women in Cotton Production

In all the Programme countries, women are involved in various activities of cotton production (e.g., sowing, harvesting, fertilizer application, handpicking insects and other pest management operations). These activities may vary between countries, within countries and also between different socio-economic categories within communities.

In Pakistan, a study carried out on the effect of pesticides on women cotton pickers' health, apart from being part of the documentary evidence used to influence policy, has laid the basis to address pesticide and health issues with women through "Women's Open Schools" (WOS). Elsewhere, in India for instance, a study has been initiated which aims to arrive at a more detailed understanding of women's role in cotton/IPM-related decision making. Also, a few all-women FFSs are being conducted on an experimental basis to throw light on the pros and cons of various FFS strategies.

In general, the Programme has placed emphasis on the need to improve the role and participation of women in IPM. So far, women have constituted on average about 23% of facilitators and 17% of farmers in the training.

10. Improved Access to IPM Information and Information Sharing

The Programme initiated a website in 2002, followed by circulation of a Cotton IPM Newsletter to all member countries, PMU and EU delegations. Eight regional workshops have been organized for sharing and exchanging information and experiences in the implementation of the project, namely:

- Regional Workshop on Helping Farmers to Understand Microbial Organisms Used to Manage Pests (Chainat, Thailand, 11–17 February 2001)
- Regional Workshop on IPM Impact Assessment Methods (Ho Chi Minh City, Vietnam, 25–31 March 2001)
- Meeting on Bt Cotton Study in China (Bangkok, Thailand, 4–5 May 2001)
- Regional Meeting on Planning and Evaluation (Ho Chi Minh City, Vietnam, 11–15 September 2001)
- Regional Workshop on FFS/ToF Curriculum Evaluation to Strengthen Farmer Education (Dhaka, Bangladesh, 11–20 March 2002)
- Programme Steering Committee (PSC) Meeting (Chizhou City, Anhui Province, China, 8–15 September 2002)
- International Course on Weed Ecology for Cotton IPM (Dagupan, Philippines, 23–27 September 2002)
- IPM Impact Assessment Workshop (Ayutthaya, Thailand, 3 March–4 April 2003)

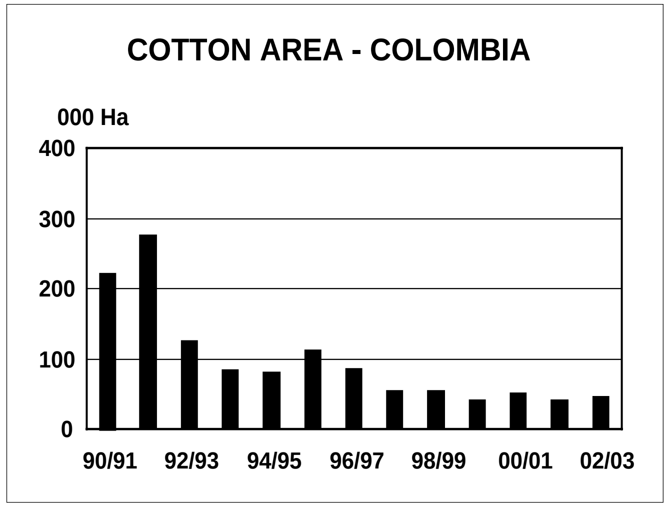
More information about the FAO-EU IPM Programme for Cotton in Asia may be obtained from www.cottonipmasia.org.

11. Health

Cotton's most intensive use of pesticides has obvious health risk implications, primarily to farmers who do the spraying and women helping in the cultivation (e.g., in pollinating hybrid seedcotton or during cotton picking). In addition, there are risks associated with storing pesticides in homes. Recognizing the urgent need to prevent/minimize such risks posed to these resource-poor cotton farmers, the Programme has given it high priority and has undertaken several health related activities that include engaging international consultants to train facilitators on pesticide poisoning symptoms; developing new exercises on self-monitoring of pesticide poisoning as part of post-FFS activity and for inclusion in ToF and FFS; special studies undertaken in Pakistan to assess the impact of pesticide on cholinesterase levels in the blood of women cotton pickers; developing plans for conducting health studies in Bangladesh and India; and developing plans in Pakistan to conduct student field schools in rural areas where children working in seedcotton production are exposed to pesticide poisoning.

Cotton Production in Colombia

Cotton area increased significantly in Colombia during the 1960s and reached 398,000 hectares in 1977/78. However, area fell in the following years with significant variations from year to year. Cotton was grown on only 47,000 hectares in 2002/03. The Colombian cotton industry is highly organized and devoted to increasing production and expanding area, but there are many limiting factors. Some of these factors are being researched extensively, and cotton is expected to recover in Colombia.



Reasons for Decline in Area

Cotton area fluctuated during the 1980s but fell drastically from 1982/83 onward. Farmers were interested in continuing to grow cotton because economically better alternate crops were not available, but they could not do so for the following reasons:

- Cotton was grown on a record 398,000 hectares in 1977/78, but severe attack of the tobacco budworm *Heliothis virescens* lowered the average yield to only 349 kg/ha, the lowest in forty years. Area was reduced to only 176,000 hectares in 1978/79 and the tobacco budworm continued having serious consequences for production in Colombia.
- The budworm population kept multiplying every year, forcing farmers to increase the amount of insecticides used to control the pest. The problem that started with the tobacco budworm was soon joined by the appearance and spread of the Mexican boll weevil *Anthonomus grandis.* The boll weevil was first detected in Colombia in 1951 but never became a threat to cotton. The boll weevil entered Colombia through the city of Cartagena and moved from the coast to the interior, colonizing the entire country in forty years, except for the Llanos Orientales region. Two reasons for the spread of the boll weevil are non-destruction of cotton stalks and year-round growing of cotton in the country. Colombia is the only country in the world where cotton is being harvested in one region while it is being planted in another region. The Andes Mountains divide these regions, but complete separation does not exist. At one stage, the most affected areas were sprayed up to twenty times per season, and most sprays were directed against the tobacco budworm. The sudden increase in insecticide consumption created insecticide shortages that affected area negatively.
- Cotton researchers were aware of the insect's behavior and losses caused in the USA. The boll weevil population increased year after year and losses due to pests increased too. Boll weevil control became a big problem from 1985 onward. Many farmers, already discouraged by the failure to control the tobacco budworm, feared more losses in yields and increases in the cost of production, and stopped producing cotton.
- Economic factors added to the gravity of the problem. A change in climatic conditions toward drier weather (resulting in lower yields) was also a factor, but the economics of cotton production and its marketing is the primary reason for the decrease in area. In 1992, Colombia opened up its cotton marketing system and removed subsidies on interest rates and long-term payment schedules that affected cotton production negatively. Colombia was a closed market prior to 1992 and imports of cotton were not allowed. Thus, local agencies were able to fix prices that were in the interest of cotton growers. The appreciation of the Colombian peso against the U.S. dollar further encouraged imports of cotton, harming local production.
- Other factors like inefficient transfer of technology to farmers, particularly about the two new pests, and lack of knowledge about the behavior of these pests under Colombian conditions, contributed to the reduction in area, although research and extension strived hard to meet farmers' expectations and lower the effect of the problem.

Production Conditions

In Colombia, cotton is grown by small, as well as large growers, with approximately 4,500 cotton growers in total. Cotton is grown in two main regions and four others that are separated from each other. Planting times are different in each. In the Sinú Valley region, where soil is mostly heavy clay, 81% of farmers grow cotton on less than ten hectares. Sixteen percent of the farmers grow up to fifty hectares and only 3% grow over fifty hectares. The Sinú Valley is the main production region dominated by small-scale farming practices but shares about 50% of the country's production. On average, each farmer grows 9.8 hectares of cotton. Cotton producing regions and their characteristics are as follows:

Precision planting is increasing to an estimated 60% of the area in 2003/04. All other farming operations are also mechanized.

Cotton Producing Regions in Colombia

Region	Share in Production	Characteristics
Cordova	50%	Small scale farming; cotton is planted in September.
Tolima	25%	Second in technology but soils are rich. Cotton is planted in February Most textile industry is located in this region.
Sucre	10%	Cotton is grown on small mountains like savannas.
Cesar (North & South)	5%	Used to grow over 200,000 hectares. It has been hard hit by insects and soils have deteriorated.
Meta	5%	Soils are acidic and cotton is planted in September. Cotton is grown only close to the river. It is the only boll weevil free region.
Cauca Valley	5%	It is the highest technology area with average yield of over 1.5 tons of lint. Cotton is planted from February to April.

Farmers generally follow the recommendations of agricultural experts regarding application of fertilizers, and cotton does not seem to suffer due to lack of nutrition, even though organic fertilizer is not added. On average, about 140 kgs. of nitrogen per hectare, 25 kgs. of phosphorous and 30 kgs. of potassium are added to cotton, but region-to-region variations exist. Potassium is applied before planting; most other fertilizers are applied at the pre-flowering stage, usually without overgrowth problems.

On average, cotton is sprayed 5-10 times per season mainly against boll weevil *Anthonomus grandis*, Colombian pink bollworm *Sacadodes pyralis*, pink bollworm *Pectinophora gossypiella*, fall armyworm *Spodoptera frugiperda* and various sucking pests. Most farmers apply the same number of sprays within a region. One farmers' association in the south of the Cesar Valley, on the self-initiative of farmers in the region, has been able to lower the cost of production significantly by reducing the number of insecticide sprays to two per season for the last two years and maintain yields.

Diseases are not important in Colombia. However, false mildew caused by a fungus belonging to *Ramularia* spp. is slightly on the rise. The disease appears late in the season and thus has little effect on yield. Reasons for the fungus infestation are high plant density and excessive vegetative growth due to fruit shedding or overfertilization. Varieties like DPL Opal have been affected, and defoliation at crop maturity, when plants need leaves for carbohydrates to fill bolls, is not desirable. Premature defoliation of leaves can affect yields and disturb the plant canopy. Some leaf shedding helps with better penetration of insecticides and can also enhance boll opening. So, yield losses from false mildew depend on when leaf shedding occurs and how much. There is no fear that the disease will become a significant problem, but there is a need to remain aware of the disease intensity and its occurrence. The losses should be monitored so that, if needed, appropriate measures are taken to stop the spread of the disease.

Anthractonsis, a seedling disease caused by the fungus *Colletotrichum*, also called "witch broom disease," used to be a serious problem in Colombia when Stoneville varieties were popular in the country. The fungus lives and survives on and inside seed. Since the elimination of Stoneville varieties and their replacement with delinted Deltapine varieties the problem has disappeared. Lately, there have been some symptoms of a reappearance of the disease, even in DPL Opal, but it might

Major Insects by Region in Colombia

Region	Major Insects in Order of Importance
Cordova	Boll weevil, pink bollworm and fall armyworm. Whitefly became a problem in 2002/03.
Tolima	Pink bollworm and boll weevil; the region has good boll weevil control. Average number of sprays is five.
Sucre	Boll weevil, pink bollworm and fall armyworm. Average number of sprays is 6 per season.
Cesar (N & S)	Boll weevil is the worst; plant protection not organized. Average number of sprays is 8.
Meta	Pink bollworm and fall armyworm. Average number of sprays is 4.
Cauca Valley	Boll weevil, pink bollworm and whitefly. Average number of sprays is 5-6.

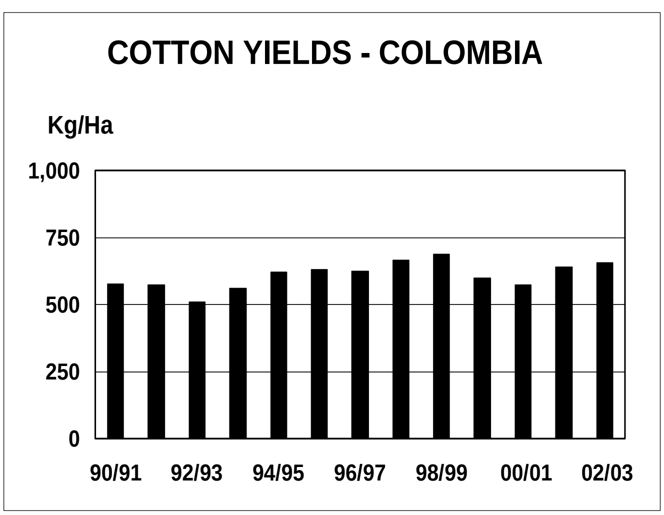
come from planting seed saved by farmers from previous crops when undelinted seed was used. The use of gin-run seed needs to be stopped so that the disease does not reappear.

Most cotton in Colombia is not irrigated. Irrigation water is available, but there is no canal system to bring water to cotton fields, and only 10% of the total cotton area gets irrigation. The Sinú Valley region gets sufficient rainfall and the Alto Magdalena and Cauca Valley are mostly irrigated. The northern part of Cesar Valley has an approved irrigation extension project lying unimplemented for many years. Underground water is 100-150 meters deep and pumping water from the ground is not commonly practiced by farmers, except in the Cauca Valley. Irrigation is seen as a limiting factor to increase yields in Colombia. Years of disc plowing have created a hard pan in the root zone that has a negative effect on yields.

Cotton Yields

Cotton yields improved significantly during the 1950s and 1960s, and the national average yield was close to 600 kg of lint/ha. There has been great variation from year to year, but Colombia has not seen an increase in average yields for the last thirty years. The average yield in 1968/69 from a total area of 233,000 hectares planted to cotton was 596 kg/ha. The average in 2002/03 was 685 kg/ha and is expected to be 636 kg/ha in 2003/04. Colombia has grown varieties developed outside the country for a long time, and the two key factors affecting yield, i.e. agronomic practices and plant protection, were improved over thirty years ago. Insects have affected yields but perfections in agronomic management practices to improve yields have compensated for the losses due to tobacco budworm, boll weevil and pressure from other insects. The national average yield would have dropped if the affected area had not been taken out of production.

Colombia has the potential to improve yields if input applications, particularly insecticide use, are better managed. However, there would be a chance of increasing the cost of production which in Colombia is already high. Additional increases in the cost of production would upset Colombian farmers who are already growing cotton with very little economic margins. Colombia needs to consider production technology options to reduce the cost of production, rather than focusing on increasing yields.



Breeding and Seed Production

Colombia has an active breeding program but has not been able to cover most area with locally developed varieties. Currently, about 80% of the total area is planted to varieties developed in the USA. In the past, varieties were imported and planting seed was produced locally. But now, even planting seed is imported from the USA at a high cost. The most popular variety in 2002/03 was DPL Opal, and an average seed rate of 20-25 kg. per hectare was used. About 600-700 tons of planting seed was imported into Colombia in 2002/03. A farmers' cooperative has formed a seed company called SEMSA that is now involved in multiplication of local varieties developed by breeders from Corporación Colombiana de Investigación Agropecuaria-CORPOICA (Colombian Corporation for Agricultural Research). Delta and Pine Land Company has a joint venture with the local company Semillas Valle S. A., which imports Deltapine varieties and test them at multiple locations in Colombia for one year. The best performing variety is submitted to the government for approval and permission to import. Unfortunately, SEMSA is not properly equipped to undertake seed production and distribution. The competition from public sector breeders is not strong, and the private sector has no breeding programs either. Therefore, recommendations from Semillas Valle S. A. are accepted without challenge.

Development of varieties must be backed by a successful seed production system, without which any variety will fail. There seems to be a problem with the cotton breeding system in Colombia, where a good team of breeders is working on developing varieties for local conditions, but their varieties are not successful on the market. The development of local suitable varieties is not a difficult task, and most countries have succeeded in doing it for their production practices and growing conditions. Those who have failed to adopt local varieties have common reasons: production of a good quality pure crop; processing seedcotton without mixing; proper seed storage; and required treatments, like delinting or fungicide treatments or treatments with other chemicals. Colombia needs to establish its own seed production system comprised of the whole chain, starting from growing a pure crop from breeder's seed through to an efficient seed supply system. Colombia needs to produce seed for a few years so that farmers automatically develop confidence in local varieties and seed production.

The varieties currently grown in Colombia were not purposely developed for Colombian conditions. They may be performing well and may even be better than locally developed varieties. But, in the absence of local seed production facilities, it seems that the secret of success lies in the supply of pure and high germination seed. Seed imported into Colombia is produced, processed and packed in the USA. Even if production costs are the same, international transportation unnecessarily adds to the cost of planting seed, and local breeding work becomes useless. It is estimated that on average, a kilogram of imported seed costs US$4.40, one of the highest costs in the world.

Bt Approved for Commercial Production

Cotton growers are enthusiastic to adopt new technologies, and the Colombian government, the Confederación Colombiana del Algodon-CONALGODON (Colombian Cotton Confederation), Fondo de Fomento Algodonero (Fund for Promotion of Cotton Production) and other agencies involved in research and development of cotton in the country encourage them to do so through various programs.

Colombia conducted trials on Bt cotton for two years and approved insect resistant Bollgard (Bt) cotton for commercial production. Multiple location trials were conducted extensively in the Cordoba region, and Bt cotton has been approved for this region only. Large-scale trials on 200 hectares in 2002/03 helped the government to make this decision.

CONALGODON has a membership of 27 farmers' cooperatives, and one of the largest farmers' organizations, Agremiación, has signed an agreement with Monsanto to grow the Bt variety DPL Opal for one year. In 2003/04, only 5,000 hectares will be planted to the Bt variety, and Monsanto will buy all the seed produced by farmers so that they do not retain it for next year. Farmers will pay 200,000 pesos/ha (US$73/ha) as a technology fee, while the price for conventional seed is 12,500 pesos/ha (US$4.40/ha). The high cost of the Bt technology may limit its use by small growers, who are the majority in Colombia. The average number of sprays in Cordoba is 7-9 per season, and Monsanto claims that five of them are targeted to control the Colombian pink bollworm. It is also claimed that as each spray costs 50,000 pesos/ha (approximately US$18/ha), farmers will save 250,000 pesos/ha (US$90/ha) and get better yields due to reduced insect damage. Transgenic DPL Opal seed produced in South Africa will be imported into Colombia.

The government of Colombia has established the National Biosafety Council (NBC) at the Colombian Agriculture Institute (ICA) for the introduction, production, release, commercialization and quality control of genetically engineered material and its products. Under the government order, NBC will establish procedures for regulation of genetically engineered products. The Council will review and evaluate data generated in Colombia for any risk to beneficial insects and the environment before approval is granted for a genetically engineered plant or living organ to be released for large scale use. The Council comprises three members from the Colombian Agriculture Institute and representatives from seed companies, farmers' associations; and the environment, agriculture and health ministries. All genetically engineered products must be registered with the Council. Approval for commercial production in the Sinú Valley does not automatically approve GE cotton use in other regions which have to seek specific approval from NBC. NBC has the authority to deregister any registered product that is not found satisfactory with regard to the criteria established for approval of these products.

Studies have shown that under Colombian conditions out-crossing occurs at 1.25% at a distance of one meter. Thus, the usual distance of 50 meters will be observed between a Bt and a conventional variety. Refuge crops will be planted in the ratio of 80:20 or 96:4 as has been the case in the USA when Bt cotton was introduced. In the first option, 20% of the non-Bt crop can be sprayed with conventional insecticides, while the second option requires that the 4% area should be planted under unsprayed conditions. Initial observations show that boll weevil was detected in higher numbers on the Bt variety compared to normal DPL Nucot33B. Bt cotton provided good control of lepidopterans and also conserved beneficial insects. The current agreement dictates that Monsanto introduce the Bollgard DPL Opal, instead of Nucot33B, which showed high micronaire, and Monsanto will train farmers and extension advisors on how to grow Bt cotton. The seed harvested from the Bollgard DPL Opal will carry the GMO logo.

Picking and Classification of Cotton

Although expensive, most cotton is still picked by hand in Colombia. No data are available but personal communications indicate that hand-picking costs are almost double the cost of machine picking. It is believed that machine picking will occur if Colombia is able to revive cotton production.

Colombian cotton fiber quality is uniform because farmers are organized into cooperatives. Therefore, farmers grow few varieties and follow uniform agronomic practices. The effect of irrigation is minimal. Distribuidora de Algodon Nacional (DIAGONAL), an association of spinners and textile owners that buys all lint from farmers and sells it to its members, has to buy all cotton, including low quality cotton. DIAGONAL sells cotton to its customers proportionally including, for example, low and high micronaire cotton. It is not desirable for mills to buy low and high micronaire cotton, thus mills are beginning to buy cotton directly from farmers. There are ten HVI systems in Colombia owned by various agencies. Most are owned by DIAGONAL, and all cotton is classed on HVI. CORPOICA has one HVI unit for research purposes.

Picking of Cotton in Colombia

Region	Hand (%)	Machine (%)
Tolima	30	70
Cauca Valley	70	30
Cordova	100	-
Sucre	100	-
Cesar	100	-

Research

Poor cotton production conditions have affected research capabilities as the incentive to invest in cotton production was reduced. Cotton research was curtailed, and whatever efforts were being made were not encouraged or genuinely appreciated. In 1998, the government recognized the deteriorating situation and decided to reorganize the cotton research system. The government launched the Plan Nacional de Investigaciones en Algodón (National Research Plan for Cotton) to be implemented by CORPOICA. The Fondo de Fomento Algodonero was established with the mandate to provide financial support to cotton research undertaken mainly by CORPOICA, but also by other institutions. The fund is managed by a board of directors comprised of various segments of the cotton industry and chaired by the Minister of Agriculture and Rural Development or its representative. The fund is autonomous in function and receives half a percent of the lint price from textile mills that buy local cotton. The fund also receives 1% of the price of cotton seed delivered to crushing mills or sold elsewhere. Each farmer association is responsible for the unaccounted seed (total seed produced minus seed sold to crushing mills and sold elsewhere). The government matches the fund peso for peso, and money thus collected is spent on cotton research.

There are a number of factors that can bring yield improvements in Colombia. If resources become available, they can be utilized to pursue irrigation projects, improve production technology, expand research capabilities and enhance utilization of Colombian cotton quality characteristics by the spinning industry. Local varieties can only be adopted in Colombia if a seed production system is established.

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INTERNATIONAL COTTON ADVISORY COMMITTEE

The International Cotton Advisory Committee is an association of governments having an interest in the production, export, import and consumption of cotton. It is an organization designed to promote cooperation in the solution of cotton problems, particularly those of international scope and significance.

The functions of the International Cotton Advisory Committee, as defined in the Rules and Regulations are

- To observe and keep in close touch with developments affecting the world cotton situation
- To collect and disseminate complete, authentic and timely statistics on world cotton production, trade, consumption, stocks and prices
- To suggest, as and when advisable, to the goverments represented, any measures the Advisory Committee considers suitable and practicable for the furtherance of international collaboration directed towards developing and maintaining a sound world cotton economy
- To be the forum for international discussions on matters related to cotton prices

Membership of the Committee, which represents the bulk of the world's production, trade and consumption of cotton, comprises the following governments:

Argentina
Australia
Belgium
Benin
Brazil
Burkina Faso
Cameroon
Chad
China (Taiwan)
Colombia
Côte d'Ivoire
Egypt
Finland
France
Germany
Greece
India
Iran
Israel
Italy
Korea, Rep. of
Mali
Netherlands
Nigeria
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