INTERNATIONAL COTTON ADVISORY COMMITTEE

Standing Committee
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Organic Cotton Growing

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

Use of Chemicals

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

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

Country	Herbicides	Fertilizers	Insecticides	All Chemicals (% of total cost)	Total Seed Cotton Cost
Australia (irri.)	42.6	78.9	377.1	59	839.5
Australia (rainfed)	22.1	41.8	130.2	49	398.4
Brazil	12.2	49.2	49.8	35	318.4
Guatemala	13.4	59.2	470.0	86	634.8
Egypt	11.4	94.1	15.2	31	392.9
India (irri. Cen. S)		116.4	190.3	51	600.4
India (rainfed Cen. S)		45.6	80.6	44	287.3
Israel (upland)	72.5	301.3	355.0	37	1,985.7
Pakistan		43.3	72.92	66	176.7
Peru (south)		202.0	207.8	36	1,125.1
Turkey(Cukurova)	9.24	70.9	432.4	57	907.8
USA (irrigated SW)*		142.2	198.7	44	783.2
USA (rainfed Delta)*		85.8	194.6	76	369.8
Zimbabwe		57.7	42.0	50	200.3

* In the USA, herbicides are included under insecticides.

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

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

Suitable Varieties

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

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

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

Soil Fertility

Short stature plants tend to behave differently in the absence of synthetic inorganic fertilizers. Early maturing varieties, which are usually shorter in stature, enter into the fruiting phase earlier than tall growing cultivars and are also meant to form bolls at a higher rate. Such genotypes need fertilizers from the soil at a higher rate at fruit formation stage for optimum realization of yield potential and any setback at this stage is directly related to loss in yield. In the case of organic cotton production, fertility of the soil will be maintained through green manuring and organic fertilization, but the availability of nitrogen to the level of inorganic fertilization cannot be obtained. In the absence of a sufficient supply of nutrients from the soil, the plant will fail to express its optimum potential, increasing the gap between the genetic ability of the plant and its phenotypic performance in the field. Short stature plants are expected to remain substandard, thus producing less fruiting and ultimately less yield. Hardy genotypes can be developed which may not have a high yield level under conventional production but can give better yield when the soil is not supplemented with synthetic fertilizers. It is uncertain that these genotypes will be short in stature. It is assumed that genotypes performing better under organic conditions will result in rank growth if synthetic fertilizers are applied.

Insect Control

Under organic cotton growing conditions, the crop is going to be attacked by the same insects as under conventional production. It is assumed that the organically grown crop may be less attractive because of a less lush crop. Insects have to be controlled by cultural, biological and other such means of control

which are environmentally safe. Experience in the field shows that such methods are very desirable but it is doubtful that they can take the place of insecticides. The following options are available to control insects under organic production.

- Use of the sex pheromone/confusion technique to trap bollworm moths and minimize the multiplication of the insects.
- Use of novel insecticides permissible under the certification rules.
- Use of biopesticides safe to the environment.
- Enhanced use of predators and parasites will help to keep the insect pressure low.
- Transgenic cotton resistant to insects is not yet available for commercial production but could be another very useful measure to save the crop from insects.
- Host plant resistance in the form of genetically expressed morphological characters can also save losses in yield.
- In the long run, integrated pest management can go a long way to minimize reliance on insecticidal methods of control.

Certainly, the above mentioned methods have the potential to reduce the use of toxic chemicals but cannot be as effective and quick in action as insecticides. Moreover, most of them can prove their worth only if used on a larger scale and for a longer period of time. The plant's own system to repel insects or to resist insects can contribute a lot in escaping from heavy losses. The significance of certain special morphological characters will increase. In the case of where the jassid *Empoasca devastens* is a major insect, profusely hairy varieties will be more desirable. Multi Adversity Resistance can play a greater role in organic cotton production than in growing cotton under conventional practices.

Weed Control

Weeds are even more important to control than insects and organic methods of weed control are more readily available than organic insect control. Weeds can be controlled by mechanical means after they have shown up in the field; undoubtedly, the cost of this operation will increase. A good program of pre-irrigation and pre-sowing cultivation of land during the fallow period can minimize the weed problem. Suitable crop rotations can also be helpful to avoid carrying weed seeds in the field from one season to the other. In countries where herbicide use has become more common, it is feared that the weed pattern might change. Some minor weeds might become major weeds and vice versa. In organic cotton the objective of weed control will center around not only effective control but effective control at a lower price—not more than the herbicide and its application cost.

Yield/Hectare

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

Organic Cotton Yield/ha 1993

Country	Total Organic Production (tons)	Organic Yield (kg/ha)	Conventional Production (country/state average)	% Loss in Yield Organic Production
Argentina	1.8	290	451	-36
India	124.6	181	280	-65
Turkey	15.3	627	1,009	-38
USA				
Arizona	1,338.6	1,076	1,366	-21
California	3,363.5	1,076	1,509	-29
Tennessee & Missouri	130.7	538	504	+7
Texas	653.2	538	544	-1
Virginia	1.1	544	709	-23

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

Fiber Quality

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

Projects in Different Countries
(Based on a Survey of Member Countries)

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

Australia also has finalized certification standards. There are three registered certifiers for organic cotton, but so far most of the cotton is certified by Biological Farmers of Australia. Organic cotton to be sold in the local market does not require any certification but foreign buyers interested in buying certified organic cotton from Australia can apply to the Australian Quarantine and Inspection Service. Cotton is

classed as "Organic Certified B" (equivalent to transitional cotton in the USA) and "Organic Certified A" (equivalent to organic cotton in the USA). Biological Farmers of Australia, which has finalized its standard requirements for certification, charges a levy of 0.5% on income from organic produce.

The certified organic area in 1993 was approximately 700 ha. Actual yield data are not available but it was poor and economically unsustainable due to high insect pressure.

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

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

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

In the USA, California Certified Organic Farmers, the Texas Department of Agriculture, Organic Crop Improvement Association International and TN Land Stewardship Association are engaged in certification of organic cotton. An Arizona Certification Board is also expected to become active shortly. These organizations have formulated their own certification standards. The Texas program is well established and more popular than the others. Post harvest handling standards are only available from the Texas Department of Agriculture. In Texas, growers have also formed an association of organic cotton growers. Similarly, a marketing association is also said to be in formation. Some colored organic cotton is also grown in Arizona and California. In the USA, the approximate area (in ha) under certified organic and transitional cotton or pending certification was as below:

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

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

Cost and Expected Price

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

In Turkey, the cost of organic production is 10.7 to 15.1 percent higher than conventional production.

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

Some Fundamental Requirements for Certification of Organic Cotton

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

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

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

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

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

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

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

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

- All registered producers will be supplied with a list of allowed and prohibited materials. Although the allowed products vary with the certifying agency, some of the permissible products are wood ash,

non-fortified marine by-products, fish meal, cottonseed meal, leather meal, potassium sulphate, sodium molybdate, sulphur (allowed only for foliar use as insecticide, fungicide or fertilizer), microbial weed killers and sulphate trace mineral trace salts. These products are allowed to be used wherever agronomically justified. The allowed, restricted and prohibited list may change from one year to the other. Sometimes application rates of particular products are also restricted.

- Plant or animal-based growth regulators are generally allowed. Mineral suspensions such as silica, used in the production of biodynamic production, is allowed.
- Cottonseed meal and gin trash if they do not contain pesticide residues can be used to enhance soil fertility, otherwise they must be composted prior to use.
- In some countries gypsum is available at a cheap price and very helpful to correct salinity. It can be used only in mined form. Muriate of potash is not recommended. Use of sulphate of zinc is restricted.
- Even though the producer spends more on organic production, there is no guaranteed price for organic cotton. It may be double that of normal cotton or lower than normal cotton.

International Concerns

- No pre-tested and authentic guidelines are available to producers on the production of organic cotton. There is a need for systematic research on many aspects of organic cotton growing as a regular part of research programs.
- Certification facilities are not available to producers in many countries. While many countries need to formulate their own certification rules, there is a need to bring some kind of harmony among the existing rules at least within a country.
- Cotton grown without fertilizers and insecticides is named differently by different people. It is called organic, chemical-free, certified organic A, etc. There is a need to put organic cotton under one worldwide acceptable label.
- Maintenance of soil fertility for realization of optimum yield in organic cotton requires cotton growing with other forage and leguminous crops. Crops other than cotton are also to be grown without fertilizers and insecticides. Organic cotton has a market but there is a need to establish a market for other organically produced crops grown in rotation with cotton.
- Organic cotton can successfully be grown in large areas which require machine picking. On the other hand the use of defoliants is prohibited, so there is a need to find harvest aids that would permit picking of cotton without chemical defoliation.
- Standards also need to be established for manufacturing organic textiles. Presently, there are almost no standards for spinning, weaving and processing organic cotton in textiles.