



INTERNATIONAL COTTON ADVISORY COMMITTEE

1629 K Street NW, Suite 702, Washington, DC 20006 USA

Telephone: (202) 463-6660 • Fax: (202) 463-6950 •

Email: secretariat@icac.org • Internet: <http://www.icac.org>

Limitations on Organic Cotton Production

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Organic cotton has been produced for centuries, but it was first officially certified in 1989/90 by Turkey, followed by the USA. Other common names used for organic cotton, particularly at the beginning of production, are green cotton, biological cotton and environment-friendly cotton. There are countries where no insecticides or synthetic fertilizers are used to grow cotton, but production is not sold as organic because it lacks certification. In order to claim that cotton is organic and receive a premium price, cotton production must be recognized as organic by a certifying organization.

Certifying companies, which are well-known among producers, buyers and processors of organic cotton, have established their own organic cotton production standards. The number of certifying companies is small, and standards may vary among them. The Technical Information Section of the International Cotton Advisory Committee has kept track of organic cotton

production in the world for many years and has published many articles on the subject. However, in some cases, data from some countries has been unavailable, and the Section has been unable to update the information. It is assumed that production has not increased beyond the experimental stage in countries other than India, Turkey and the USA.

Organic Cotton Production in the USA

The Organic Trade Association, a membership-based business association representing the organic industry in North America through its Organic Fiber Council, has been able to keep a record of organic cotton production in the USA. In the USA, organic production prohibits the use of genetically engineered varieties, irradiation or sewage sludge, as well as toxic and persistent pesticides and synthetic fertilizers.

Organic Cotton in the USA

Year	Area (ha.)	Production (tons)
1990/91	364	330
1991/92	1,331	820
1992/93	2,552	2,155
1993/94	5,019	4,274
1994/95	6,417	5,365
1995/96	9,966	7,425
1996/97	4,362	3,396
1997/98	3,662	2,852
1998/99	3,791	1,878
1999/00	6,793	2,955
2000/01	4,370	1,860
2001/02	4,592	2,155
2002/03	3,660	

In the USA, most organic cotton is produced in Texas, where cotton yields are the lowest in the country. Four other states, Arizona, California, Missouri and New Mexico, together planted 24% of the organic cotton area in the USA in 2002/03. The same trend is expected in 2003/04. Unfortunately, sufficient information to produce organic cotton successfully is not available. In Texas, where organic cotton production has sustained so far, the Texas Department of

Agriculture and the Texas Organic Cotton Marketing Cooperative are active and provide advice in addition to certification. More information on the Organic Trade Association can be found on their web page at <http://www.ota.com>.

Organic Cotton Yields in the USA

Growers have adopted organic cotton on their own for many reasons, including the elimination of hazardous pesticide usage, reduced costs of production and environmental safety. However, the available literature does not indicate that farmers have adopted organic cotton production in order to improve yields. It can be assumed that the elimination of the two major inputs-synthetic fertilizers and insecticides-should bring a drastic reduction in yields. The current cropping systems in almost all cotton growing countries consistently require synthetic fertilizers. Unlike insecticides and herbicides, synthetic fertilizers are needed every year and in the same quantities if no major changes have occurred in the cropping system. In contrast, pes-

ticide use will depend on pest pressure. If there are more weeds in one particular year, more herbicides will be used, and insect pressure will determine the number of sprays required to control insects. The use of other chemicals like growth regulators, desiccants and defoliant that are also prohibited in organic farming is almost constant over the years, but the elimination of synthetic fertilizers may eliminate the need to spray chemicals to control undesirable vegetative growth.

The most appropriate yield comparison is the performance of the same variety on the same farm under organic and conventional practices. Though there would be differences among farmers, countries and years, a trend could be developed on how much yield increase/reduction can be expected under organic conditions. It would be even more desirable to calculate the cost of production per kg of lint or seedcotton. Unfortunately, no such data are available from any country.

In the absence of desirable data as mentioned above, a comparison of USA organic cotton versus the average yield for the country for the same years is presented here. The national average yield is for all cotton and for all states in the USA, while organic yields are based on the total organic cotton area and total production in the USA.

The data show that organic cotton yields can be higher or lower than conventional cotton yields in a given year. In the last twelve years, from 1990/91 to 2001/02, the average shows that organic cotton yields were 6% lower compared to the conventional average yield for the country. However, the average of the last six years, from 1996/97 to 2001/02, shows a 24% reduction in yield under organic conditions compared to conventional production. The data for the last three years, from 1999/00 to 2001/02, show that on average organic cotton yields were 39% lower than the national average yield during the same time. These data indicate that, in the first six years of organic cotton production, on average organic cotton growers harvested 13% higher yields than the national average. However, recent data for the last six years and three years indicate that the difference between organic cotton and conventional production is widening. The last six-year period coincides with the adoption of transgenic cotton in the USA, which has a positive effect on yield, and organic cotton yields have been significantly lower, from 1998/99 to 2001/02.

Organic and Conventional Cotton Yields in the USA

Year	National Yield	Organic Yield	
	(kg/ha)	(kg/ha)	Percent
1990/91	711	906	127
1991/92	731	616	84
1992/93	783	845	110
1993/94	679	852	126
1994/95	794	836	105
1995/96	602	745	124
1996/97	792	779	98
1997/98	762	779	102
1998/99	702	495	71
1999/00	680	435	64
2000/01	708	426	60
2001/02	790	469	59

Organic Cotton in Turkey

Turkey is a pioneer in producing organic cotton. Organic cotton production started in Turkey in Kahramanmaraş in the Eastern Mediterranean region in 1989/90. The project was called Good Food Foundation and was followed by a second multinational project initiated in Salihli (Manisa) in the Aegean region by Rapunzel, a German company. Turkey significantly increased its organic cotton production during 1999/00 and 2000/01. According to Aksoy (2003), Turkey alone produced close to 10,000 tons of organic cotton in 1999/00 and 2000/01. In Turkey, there are small growers owning 15-20 hectares who produce organic cotton, and on average organic cotton growers

Organic Cotton Production in the World (tons)

Country	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03
Argentina	-	-	-	-	75	75	-	-	-	-	-	-	-
Australia	-	-	500	500	750	400	300	300	-	-	-	-	-
Brazil	-	-	-	1	5	1	1	1	5	10	20	-	-
Benin	-	-	-	-	-	-	1	5	20	20	30	-	92
Egypt	-	-	50	150	600	650	625	500	350	200	200	-	-
Greece	-	-	-	-	300	150	125	100	75	50	50	-	-
India	-	-	200	250	400	925	850	1,000	825	1,150	1,000	-	-
Israel	-	-	-	-	-	50	50	20	-	140	180	540	392
Kenya	-	-	-	-	-	-	-	5	5	5	-	-	-
Mozambique	-	-	-	-	-	100	75	50	-	-	-	-	-
Nicaragua	-	-	-	-	20	20	20	20	-	-	-	-	-
Paraguay	-	-	-	100	75	50	50	50	-	-	-	-	-
Peru	-	-	200	675	900	900	600	650	650	500	550	-	-
Senegal	-	-	-	-	-	1	10	10	50	125	200	-	-
Tanzania	-	-	-	-	-	10	100	100	100	200	250	-	500
Turkey	17	34	101	400	609	548	548	1,000	726	9,878	9,698	-	-
Uganda	-	-	-	-	25	75	300	450	250	200	275	-	200
USA	330	820	2,155	4,274	5,365	7,425	3,396	2,852	1,878	2,955	1,860	2,155	-
Zimbabwe	-	-	-	-	-	-	-	1	5	5	-	2-3	2-3

suffered a 5.4-7.4% reduction in yield. The paper suggests that some varieties suffered as high as 17-22% losses in yield. Varietal differences were significant.

Fiber quality was similar in both conventional and organic farming systems. Data for the year 2001/02 suggest that farmers received premium prices for organic cotton-26% when farmers sold seedcotton and 20% if they sold lint. The data comes from TARIS, a large farmers' cooperative that plans to expand organic cotton. TARIS started producing organic figs in 1992, followed by organic raisins in 1997, and organic olives in 1999. The organic cotton project was initiated in 1999, and by then the cooperative already had enough experience in producing crops under organic conditions. The success of organic cotton in Turkey comes from experience, as contract farmers are the ones producing most of the organic cotton and very little production is directly initiated by the farmers themselves. Turkey has a full chain of organic cotton products and most organic cotton is processed to produce summer clothing, T-shirts, baby wear, towels and home textiles.

Limitations to Organic Production

There are many reasons why organic cotton production has not extended to other countries. Nineteen countries tried to produce organic cotton during the 1990s. But many of them have already stopped, not for lack of desire or demand for such cotton, but for economic reasons. Insecticides need to be eliminated from the cotton production system because they are dangerous to apply, have long-term consequences on the pest complex, and deleterious effects on the environment. Also, heavy reliance on pesticide use has pushed many countries out of cotton production.

The Organic Trade Association undertook an extensive effort in 2002/03 to identify the problems with organic cotton production in the USA. The Organic Fiber Council of the Organic Trade Association contacted all organic cotton growers in the USA and tried to collect information through a survey. The ICAC Secretariat also undertook a survey of U.S. organic cotton growers in 1994, but satisfactory information for sound conclusions could not be obtained because many growers were reluctant to share information. ICAC's survey focused on two issues: 1) cost of production of organic cotton versus conventional cotton, and 2) price premium on organic cotton. According to the survey undertaken by the Organic Fiber Council in 2002, the main problems for organic cotton producers are weed management in the absence of herbicide use, defoliation (due to the prohibition of herbicides) and insect control. Some farmers also complained about seed treatment, which is not permitted in organic certification. In the USA, even organic cotton is picked by machines, thus defoliation is a serious problem that hand-picked cotton does not have.

The following factors have limited the expansion of organic cotton production. Suitable measures must be adopted to promote appropriate production practices if organic cotton production is to expand. Certain comments may be specific to cotton, but most others will apply to organic production in general.

Suitable Varieties

Cotton producers in all nineteen countries mentioned adapted current varieties to organic production practices. Commercially grown varieties have been tested and developed for high input conditions. Under such conditions, any genotype not perform-

ing well will automatically be discarded. Varieties performing well under optimum conditions may not be able to maintain their yield level without synthetic fertilizers and insecticides. 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 for organic production. In the last three decades, emphasis has been placed on varieties shorter in stature, earlier in maturity and responsive to high doses of fertilizers. Shifting effective fruiting positions closer to the main stem and on lower branches has been pursued. High responses to fertilizers and a shift in fruiting positions are desirable characters for high input use, but may not be desirable in the absence of synthetic fertilizers. 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.

Varieties that are suitable for high fertilizer use have been grown under organic conditions. Consequently, such varieties must have suffered heavier losses in yield than expected, discouraging farmers from continuing organic production. There is a need to develop varieties suitable for organic production conditions, maybe not as high yielding as normal varieties but hardy and able to produce good yields under organic conditions. Varieties for organic production must be developed under organic conditions.

Fertilizer Use

Synthetic fertilizers are applied to cotton and to other crops in order to meet nutrient needs for the plant. Nutrient needs change from minimum to maximum for N, P and K during the course of development. Nitrogen, which leaches with water and can be lost through evaporation, must be applied when needed for optimum plant growth and fruit bearing. This is the reason why the timing of applications and dosage are critical for realizing optimum yields. P and K can stay in the soil and be used when needed, but yields are seriously affected if the timing or dosage for nitrogen are changed.

Short stature plants are expected 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 and any setback at this stage is directly related to loss in yield. Green manuring and organic fertilization can be employed to maintain the required nutrient supply, but the availability of nitrogen to the level of inorganic fertilization cannot be achieved. There is a need to find better alternatives for synthetic fertilizers so that the plant does not suffer due to insufficient nutrient supply, particularly nitrogen.

Pest Control

The cotton plant is naturally vulnerable to a variety of insects, which are going to attack under organic growing conditions. Insect pressure can be lowered by enhancing biological con-

trols to compensate for the lack of insecticide use. The cotton plant has one of the best built-in compensation systems of many field crops. It can make up for early losses, but it cannot make up for a loss suffered after a certain time because cotton growing conditions have a certain cut-out period when the plant ceases to bear more flowers and bolls. This happens because the plant becomes physiologically exhausted and is unable to carry out physiological processes at the required rate, or because ambient conditions have changed and do not allow for normal growth. All out efforts have to be made to save the maximum number of buds, flowers and bolls from the very beginning, as provided by insecticides. Hence, it is necessary to find alternate means of insect control. Multi-adversity resistance can play a greater role in organic cotton production than in conventional cotton growing.

Production Technology

Conventional cotton requires a technology package that includes the best use of inputs and production practices. Systems of disseminating the package might differ, but in most countries, it is free and delivered directly by the extension service to farmers' doorsteps. The advice, or technology package, on how a producer can achieve maximum yield includes guidance, from variety selection, planting time, soil preparation, elimination of weeds, irrigation, insect control, all the way to picking and storage of seedcotton until it is sold. Australian cotton producers achieve the highest or second highest yields in the world, almost three times the world average, and they still hire private consultants for advice on production technology. In the USA, the system is different and farmers rely on more than one source of information. In most West African countries, advice comes along with input supplies. In many Asian countries, advice on production technology is the responsibility of governments and is delivered through a broad network of extension workers especially trained in technology dissemination.

Whatever the system may be, organic cotton farmers need advice, without which they can be risking their investment. Unfortunately, whatever little advice on organic cotton is available is not authenticated or equivalent to conventional production technology packages. It is wrong to assume that the elimination of fertilizers, pesticides and other agrochemicals would simplify cotton production practices. On the contrary, it is more challenging to grow cotton without agrochemicals, but organic cotton growers lack advice on recommended production practices.

Lack of Information on Cost of Production

When fertilizers and insecticides were first adopted in most countries, cotton yields started to increase. The development of suitable varieties further enhanced the effect of high input use. However, current trends indicate that average yields are not increasing and that the cost of conventional cotton production continues to inflate, affecting the economics of producing cotton. Higher costs without yield increases are forcing farm-

ers to abandon cotton production, or to continue producing but under increased costs to governments that subsidize production one way or the other. Cotton growers in many countries have become more interested in reducing the cost of production if they cannot increase yields, as an indirect way of increasing profitability.

Organic production practices generally lower costs of production per unit area. But the economics of reducing expenditures incurred in growing a unit area are determined by the effect on yield. Lower total costs/ha do not mean lower costs per kg of lint, if the elimination of prohibited agrochemicals significantly reduces yield/ha. It is generally accepted that the elimination of synthetic agrochemicals will affect yields, but the impact on yields and the cost of production have not been established. Potential organic cotton growers will definitely consider the economics of growing organic cotton versus conventional production before making a decision. Unfortunately, information on cost of production of organic cotton versus conventional production under various sets of production conditions is not available. In the absence of such information, farmers are reluctant to adopt organic production.

Price Premium

It is anticipated that certified organic cotton will fetch a premium price. However, it has been seen that organic producers have not received premiums, and sometimes they have been penalized for producing lower grade cotton because of bollworm damage. Data have been collected for over ten years in many countries, but there is no conclusion regarding the average premium or discount on organic cotton versus conventional cotton. Without a price premium, organic cotton will not be profitable because of reductions in yield. Solid indications that price premiums can be expected would encourage organic production.

Need for Alternate Inputs

Synthetic fertilizers and insecticides were adopted because of the high benefit-cost ratios. The impact of fertilizer and insecticide use is quick and very effective. Nitrogen can be applied and becomes available to the plant immediately, or it can be applied for slow release. Herbicides and insecticides provide immediate effects. The elimination of synthetic fertilizers and pesticides deprives the plant two major safeguards, i.e. protection against nutrient starvation and protection against insect pests, unless alternative systems with equally quick and effective action are available. Unfortunately such alternatives are not available. Manual and mechanical means of weed control exist but they are not feasible for large scale farming systems, and alternatives to insecticides and fertilizers are slow in action. Although claims have been made about no yield reduction, and even in some cases claims of higher yields, there is every likelihood that organic production will give lower yields compared to conventional practices. A mixed message is not helping new producers to adopt organic production.

Tied Crop Rotations

Rotating crops in the same field is one of the means of improving soil fertility. A general principle of rotation in planting says that deep-rooted crops should be followed by shallow-rooted crops. But once a cotton field becomes eligible for full certification, usually after a transitional period of three years, it must be planted only with organic crops when cotton is not in the field. Thus, cotton must rotate with another organic crop, or the field should be left fallow for recuperation of soil fertility, which may not be acceptable under the current pressure for high cropping intensity. If an organic cotton producer is willing to plant a rotation crop, he has to learn how to produce the second crop under organic conditions also.

Non-Organic Genetically Engineered Cotton

Genetically engineered Bt cotton cannot be certified as organic even if grown under organic conditions, although the Bt gene and the new series of genes being introduced to provide cotton with resistance to a variety of pests could contribute significantly to enhance organic production. Without going into a discussion of whether or not transgenic varieties should be eligible for certification as organic, transgenic cotton has not encouraged organic production, but rather negatively affected any plans to expand organic production of cotton.

Certification

Certification and labeling are areas that need attention. Certification is an additional cost and in some cases organic producers have complained about it. The de-facto organic cotton produced in many countries, particularly in Africa, could be easily certified as organic if the service were available free, the same way extension services are available to farmers at no cost in many countries.

Marketing

The most sensitive aspect of organic cotton production and expansion lies in marketing, and market linkages between cotton producers and international buyers, ranging from access to market information and distribution channels. This article has discussed only the most important production limitations, but processing and marketing issues have not been discussed here.

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