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Yield Loss and Cost of Producing Organic Cotton

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Loss in Yield in Organic Production

The cotton plant's need for nutrients is different at different stages of development. A plant needs maximum nitrogen at the time of peak flowering, and its needs for potassium are the highest at the time of boll maturation. If plant needs are not met properly and an unrelated supply of nutrients, irrespective of needs, is provided, yields will be greatly affected.

Under conventional production practices, the plant need for nitrogen is managed through application of nitrogenous fertilizers in various quantities at various stages of plant development. In organic production, nitrogen availability is not only constant but it is highest at the time of planting and is reduced, particularly due to irrigation, as the season progresses. In organic production, there is no way to manage the availability of nitrogen in the soil in consonance with plant needs.

Some recent work in the USA has shown that availability of potassium in the soil may be enough for normal growth, but plant needs for potassium increase so much at the time of boll maturation that it is difficult for the plant to coop up the necessary potassium requirements (Hake et al, 1991). Consequently, foliar application of potassium under conditions where cotton yields have reached their peak may result in increased yield. Potassium limitations may be large in early maturing short duration varieties where bolls are formed in a short period of time.

According to Swezey and Goldman (1996) organic cotton yields did not differ significantly from conventional production yields.

They recorded higher boll retention on first positions under organic conditions but almost equal plant height, nodes and fruiting branch production in both production systems. Not many details of the production practices are available but two factors would temper a shift to organic production based on the results. First, the data were recorded during 1995, which was an abnormal year. Cotton yields increased in rainfed areas by over 15% while they decreased in irrigated areas. In this trial, according to Swezey and Goldman, yields were low in both production systems due to late planting under spring conditions. Second, the data were recorded at two different farms.

One of the most important barriers to organic production in California is growth regulation and defoliation without conventional crop preparation materials. In California, growers have tried mechanical topping and regulation of late season irrigation and mild organic acids, humates, salts, sodium nitrate and zinc and magnesium sulfate to dry down green foliage and avoid late picking (Swezey and Goldman, 1996). No pre-tested information is available on the effects of these chemicals, their time of application, suitable doses and/or mode of action.

It is generally thought that there will be a loss in yield in organic production but how much is not known. While the loss will mainly depend on soil fertility, it will also be affected by agronomic operations and varietal needs. It is understandable that the maximum reduction in yield will be experienced in the first year of shifting to organic production. But, there is no authentic information on the magnitude of loss in the first year, a very important consideration for a grower initiating organic cultivation. It is assumed that the loss in yield will lessen with the inclusion of nitrogen fixing leguminous crops in the production system or addition of organic fertilizers.

Cost of Producing Organic Cotton

Under mechanized farming, the most notable impact of organic cotton production is that it is more labor intensive than conventional cotton. Labor will replace industrial inputs. In countries where labor is available in abundance at a comparatively low cost, such substitution would reduce cost.

The cotton plant, being highly vulnerable to insect pests and diseases, demands stringent plant protection measures against pests. In most countries, insecticides are the largest component in costs. Similarly, synthetic fertilizers are also an important component of cost of production. The cost of insecticides and fertilizers together forms about 40% of the total seedcotton production cost in Brazil, China (Mainland), India, Pakistan, Sudan, Turkey, USA and Zimbabwe. The cost of insecticides and fertilizers is less than 15% of the total seedcotton production cost in Argentina and Syria because of a lesser need to spray cotton in these countries. Similar data on cost of insecticides and fertilizers for at least 31 countries are available from the ICAC. The cost of producing a hectare of cotton and share of insecticides plus fertilizers in the total seedcotton cost for twelve countries is given in the table above.

Cost of Fertilizers and Insecticides

Country	Cost (US$) Per Ha.	% of Seed-Cotton Cost
Argentina (Sáenz Peña)	23	6
Australia (New South Wales)	241	31
Brazil (Northeast)	283	40
China (Mainland)	315	48
India (Central South)	163	39
Pakistan (Punjab)	282	40
Paraguay	156	23
Sudan (Acala)	199	37
Syria	162	13
Turkey (Aegean)	478	47
USA (National)	218	39
Zimbabwe	100	37

These countries not only represent various geographical production regions but also represent a variety of cotton growing conditions. The data suggest that if insecticides and fertilizers are not applied, the cost of producing cotton will be reduced substantially. However, in organic production it has been observed in the USA that in most cases the cost of production has increased. A shift to mechanical and manual weed control operations from herbicide use is a major reason for increased cost of production under organic conditions. In labor intensive farming, the cost of insecticides like sulfur dust and fertilizers like compost manure, which are approved by the certifying organizations, is very small relative to the cost of the chemicals used in conventional production. The only other additional cost over normal production is the charge by the certifying organization for its services to monitor field operations.

The University of California Cooperative Extension Service (Klonsky et al, 1995) has prepared some estimates for organic cotton production at various yield levels which are reproduced in the table below.

Organic Cotton Production Cost Per Hectare (US$) - 1995
(San Joaquin Valley, California, USA)

	Yield Level (kg/ha lint)						
	730	840	954	1,036	1,178	1,290	1,400
Cultural operations	1,146.5	1,146.5	1,146.5	1,146.5	1,146.5	1,146.5	1,146.5
Harvesting and assessment	195.2	224.9	254.5	276.8	313.8	343.5	375.6
Postharvest costs	34.6	34.6	34.6	34.6	34.6	34.6	34.6
Interest on operating capital	86.5	86.5	86.5	86.5	86.5	89.0	89.0
Cash overhead costs	447.3	447.3	447.3	447.3	447.3	447.3	447.3
Non-cash overhead costs	111.2	111.2	111.2	111.2	111.2	111.2	111.2
Total cost/ha	2,021.3	2,050.9	2,080.6	2,102.8	2,139.9	2,172.0	2,204.1
Cost/kg lint	2.8	2.4	2.2	2.0	1.8	1.7	1.6

The estimates suggest that it was economical to produce organic cotton in the Northern San Joaquin Valley if the minimum yield level did not drop below 1,036 kg/ha of lint. During 1994/95, the average yield under conventional practices was 1,163 kg/ha and it cost on the average US$2,198/ha to produce one hectare of cotton, or US$1.89/kg.

Organic cotton has been grown in Nicaragua for four years on an experimental basis. The comparative cost of four important operations in organic cotton vs. conventional production is as follows:

Cost of Production in Nicaragua

Operation	**Conventional Production**	**Organic Production**
Fertilizers	60.70	9.2
Weed control	31.18	73.3
Pest	340.95	28.9
Technical assistance		27.4

In Nicaragua, cotton is generally sprayed on the average 13 times, which is a significant reduction in insecticide use over the last five years. In organic production, insect control operations included the application of an extract from a local plant which has an insecticidal effect in addition to chemicals permitted by a certifying organization. The cost of frequent visits to advise the growers as compared to almost free advice from the public sector is included under technical assistance. It seems that organic production is less expensive in Nicaragua but its economics depend on the yield level and the premium received. Given the fact that the chemical insecticides are the most effective control method against insects, high insect pressure could greatly affect yield.

Unlike conventional farming, most organic cotton production data are proprietary and difficult to obtain.

Effect on Quality

The literature shows that, if nitrogen is not applied to cotton when needed, micronaire is enhanced and staple length reduced. Elimination of insecticides from the production system will increase the appearance of yellow spots. In the USA, many fiber technology laboratories, including the International Textile Center in Lubbock and the Institute of Textile Technology in Charlottesville have tested organic cotton. But, no data are available to determine the effect of eliminating insecticides and fertilizers. Personal communications with some laboratories have indicated that cotton grade is usually lower in the case of organic production. Swezey and Goldman (1996) also studied the effect of organic growing conditions on fiber quality and did not find any differences in fiber length, strength and micronaire. However, organic cotton had a higher percentage of spotted cotton.

Premium for Organic Cotton

A premium would be expected by organic cotton growers to compensate for yield loss and additional costs of production. Information available shows that premiums range from zero to 100%. Klonsky et al (1996) have analyzed the economic performance of organic cotton in the Northern San Joaquin Valley of California and concluded that organic production must have a premium price to remain economically viable.

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~~DNA Fingerprinting for Identification of Varieties~~

~~Selection within the existing population is a recognized method for development of varieties. Spontaneous mutations, out-crossings or a mixture could be responsible for variations within a pure breeding variety. Identification of such varieties based on morphological differences is always a major issue. Even if a variety was developed through hybridization between cultivars having a narrow genetic base, identification becomes difficult unless the new genotype has a marker gene. Marker genes with prominent morphological differences are, first, not easily available and, second, they may carry undesirable effects. Breeding for induction of a prominent morphological character or to avoid the undesirable effect of a marker gene is not recommended~~