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Organic Cotton Production

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In conventional production, all producers in the developed countries and in the majority of the developing countries heavily rely on chemical control of weeds, insects, diseases, in addition to the abundant use of fertilizers and defoliants. The use of chemicals has increased so much that they have not only posed a threat of environmental pollution, but also rendered cotton production a very expensive business. The cost of production is rising to the extent that cotton is losing its profitability. The residual effects of extensive use of chemicals are also being realized. The increased cost of production and environmental concerns have compelled researchers to look for agroecological approaches. The combination of cultural practices with environmentally safe control methods make it possible to grow cotton without the use of chemicals.

Cotton grown without such environmentally dangerous chemicals is called clean, natural, green or organic cotton. Sometimes the classification does not specify the length of time which the cotton was free of chemical use. In other words, green clean or natural cotton may be a cotton grown without

conventional practices, but is not certified by a recognized authority as an organic cotton. Such cotton may or may not bring a premium price to the producer.

Farmers intending to produce organic cotton and desirous to have their cotton certified as organic cotton must enroll with one of the certifying organizations accepted by their state or country. The producers entering into an agreement with the certifying organization to produce organic cotton must terminate the use of synthetic fertilizers and pesticides and all other materials prohibited by the registering organization. A period of three years from the last application of prohibited inputs will make them eligible to obtain organic certification status. A producer which meets all applicable standards under the agreement of organic production for the first and second annual cropping seasons will be certified as "Transitional - Organic Certification Pending." The produce of the third year where prohibited chemicals were not used will be certified as organic cotton.

In the USA, the following three organizations certify organic cotton:

- **California Certified Organic Farmers** was established in 1973. It has a membership of 635 growers, but only two of them are certified organic cotton producers, Cal-Organic and Miss Sally Fox of Natural Cotton Colors. More farmers are expected to join in the coming season.

- **Organic Crop Improvement Association**, based in Ohio, is an internationally recognized farmer-owned and operated certification program. The membership of over 2500 growers comes from Argentina, Bolivia, Canada, Germany, Holland, Japan, Mexico, Peru and the United States. It covers all crops, including cotton.

- **The Texas Department of Agriculture** started its Organic Certification Program for cotton in 1989 in response to a request about the production of organic cotton for baby diapers by a US company. An active program started in 1990, and a pilot project was launched in 1991 producing 600 bales from over 200 ha. The area for 1992 included 600 ha of transitional and 200 ha of organic cotton. The projected area for 1993/94 is 3200 ha of transitional cotton and 1600 ha of organic cotton. The Texas Department of Agriculture's certification program has been recognized as one of the

most important programs developed to enhance environmentally safe production practices.

Outside the US, a private company, **Bo Weevil** of Holland, is actively involved in the production of organic cotton and sustainable textile production. It works together with the Good Food Foundation, a cooperative of five European companies active in the development of organic food production. Bo Weevil initiated its first project on cotton in 1989 on an experimental basis in Turkey. In the meantime it expanded to 150 ha. In 1992/93, they set up a project in Paraguay. This year they are going to realize another project in the state of Gujarat in India. It is expected that a total area of 1500 ha will be involved in these projects.

Who Can Grow Organic Cotton?

The growing of organic cotton is risky. A farmer who grows cotton traditionally probably cannot switch easily to growing organic cotton in just one year. It will take at least three years before he is able to receive the price premium for organic cultivation. It is understood that farmers will learn quickly how to maintain a desirable level of soil fertility and to deal with vari-

ous pests. The initial financial loss cannot be waived, but can be minimized. The farmers have to study the ecosystem of the area where they are going to farm. They have to learn a whole new system of farming where soil management takes a high priority. It is also possible that some areas may not be economically suitable for organic production.

Yield Loss

The absence of synthetic fertilizers, herbicides, insecticides and maybe growth regulators under specific conditions will certainly result in loss of yield. How mush of a loss will greatly vary depending on the level of soil fertility, weed population and prevalence of insects and diseases. If the soil is rich in organic matter, it does not need nutrients other than nitrogen for conventional cultivation and if the precious crop was a leguminous crop, the yield loss may be at a minimum. there is no doubt that the reduction in yield will be the highest for the first year and will decrease in the following years. The reduction in yield on account of diseases and pest infestation will wholly depend on the severity of the pest occurrence. It will also be affected depending on the availability of non-conventional methods of control permitted by the certifying organizations. The yields my dip to one fourth of

those using conventional practices, but will rise steadily. It is difficult to say if they can attain the normal yield level of conventional practices.

Varieties

Organized organic cotton production is only 3-4 years old and reliable data are not available to make a final decision on many issues. Presently it is advocated that the selection of cotton varieties for organic production is not different from conventional production and producers can select varieties which perform the best in their region. Response to soil type and irrigation conditions will not change, but undoubtedly their reaction to the absence of chemicals will make a big difference. The principal priorities like high yield, earliness and lint quality will not change, but organic production practices are going to affect them significantly.

Breeders have been inadvertently developing varieties which have a high response to synthetic fertilizers. Such varieties are going to behave differently under unfertilized conditions. Fertility stress in the form of low nitrogen supply will affect the vigor of the plant and thus, the fiber characters as well. Deficiency of other nutrients is also going to have an impact on yield

and quality of the lint. It seems that the breeding objectives will have to be reconsidered according to specific situations. Varieties which are hardy and capable of giving higher yields in less fertile soils will have to be bred. Natural plant tolerance in the form of genetic or morphological characters could prove to be a very desirable feature of varieties for organic farming. Yield evaluation trials of the breeding material and assessments of fiber characteristics have to be conducted under organic conditions, i.e., without inorganic fertilizers, herbicides, insecticides or growth regulators.

Site Selection

Site selection is the most critical factor in organic cotton production. Selecting land with depleted fertility and a perennial weed problem will limit the production capabilities. Such land should not be considered for organic farming. Since organic farming is not farming by neglect, the fertility level of less fertile soils should be improved through organic means before opting for an organic cultivation program. A period of three years from the last application of inputs of synthetic fertilizers and pesticides or other materials prohibited by the registering authority is required to obtain organic certification status. In the meantime, soil reaction can be ascertained and im-

proved. Potential drift from run off or spraying from the adjacent fields has also to be avoided.

Weed Control

Herbicide use for the control of weeds is prohibited in organic cotton production. In the advanced countries, the producers shifted from hand weeding to mechanical weeding in the 1940s and then to herbicide application in the 1960s. Now weeds are killed by chemical application either at pre-emergence stage when they are still in the soil or just after germination before they cause any damage or become capable of producing seed for multiplication. In countries like the US where herbicide application is as old as 35 to 40 years, significant ecological shift has been recorded. In the absence of competing weeds, weeds like prickly sida, nutshade, silverleaf nightshade and perennial vines, which were previously non-existent, emerged as major weeds. Such ecological shifts demanded the attention of researchers to study and describe new weeds. They also had to predict the new weeds which would grow as a result of the continuous use of herbicides.

It may not be wrong to anticipate a different ecological shift when the use of chemicals is stopped. The original weed pattern may return or some minor weeds might become major weeds. In any case, they have to be controlled by hand or by mechanical means. In this regard, precise cultivation closer to the plant will be very desirable. Even then, hand crews will probably be required to make more than one sweep. The cost of this operation will increase instead of decrease as in the case of fertilizer and insecticide use. A good program of pre-irrigation and timely cultivation can keep hand labor costs at a minimum. Suitable crop rotations can play a very important role in minimizing the weed problem. Otherwise, the certification rules do not permit the use of spot spraying, contact herbicides or any other method of herbicide use. Once the weed control system is established, cotton can probably hold its own against weeds.

Soil Fertility

In order to realize an economical harvest, fertility of the soil has to be maintained. It can be maintained primarily through applications of compost and decomposed livestock manure form sources like cattle-feeding operations, animal husbandry or production facilities including horses, poultry and

dairy manures. Suitable crop rotations will have to be found which cause the least depleting effect on the soil. The cropping intensity might be also affected. Legume cover crops (grown without inorganic fertilizers) may be necessary to increase organic matter and soil nitrification. In this regard, inoculation may be necessary to achieve maximum nitrogen fixation. fertilizers such as granular fish emulsion, humate or other blended organic fertilizers have to be added to the seed row and used for starter fertilization. Supplemental nutritional needs are supplied through foliar applications of seaweed, fish emulsion, humate, cytokinin or other approved organic fertilizers. Micronutrients have to be supplied through organic formulations so that the fiber quality is not affected. Biological enhancers are also permitted to be used for improving nutrient availability and their uptake. Green manuring can improve the fertility status of the soil in addition to its texture. Application of organic fertilizers will have the following advantages:

- Artificial fertilizers give rise to vigorous growth thus attracting insect pests. It is anticipated that the use of organic fertilizers on suitable hard varieties will result in lower pest infestation.

- Abrupt availability of nitrogen from synthetic fertilizers causes rapid cell elongation, but weakens the cell structure causing more stress and less tolerance to penetration by pests. Thus, cotton grown using organic fertilizers will be less vulnerable to sucking insects.

Pest Management

Pest types and pressure vary in various countries and regions, but it is estimated that on a world scale, about 20% of all agricultural chemicals are used on cotton alone. Pesticides are a major part of these chemicals. Yields are going to be mush lover in the absence of insecticides. Alternate methods of insect and disease control must be adopted to realize an economical yield level. Some methods permitted under the certification systems are the following.

- Sprays with local botanicals
- Use of sex pheromones/confusion techniques
- Use of *Bacillus thuringiensis* and baculoviruses
- Enhanced use of biological control through the release of predators and parasites

- Use of novel insecticides like soaps and oils which are permitted under certification rules

The transitional period may be difficult due to higher pest pressure, lack of experience with new methods of cultivation and disappointingly low yields. Volunteer predators will multiply in a couple of years and help to reduce the insect pest pressure. While the role of built-in genetic mechanisms of the plant cannot be ignored, new practices which can be regulated under specific conditions have to be further explored. Higher plant resistance at the cost of lower yields may also be acceptable. For the control of diseases, the Multi Adversity Resistance program may help.

Harvesting Aides

Defoliation of cotton is not important in countries where cotton is hand-picked, but it is one of the most important aspects of harvesting where cotton is machine-picked. In certain areas, defoliation consumes a significant portion of pesticide use. Defoliants serve three purposes: (1) they make mechanical picking easier by eliminating the green leaves which might jam the picker; (2) hibernation of late season insects in green leaves can be reduced if green leaves are eliminated from the open cotton; (3) they reduce

the moisture content of the seed cotton by easing evapo-transpiration in the canopy.

Alternate methods of defoliation have to be found. In California, several naturally occurring materials have been tried for defoliation, with little success. Other possibilities explored also included a machine that defoliated cotton with heat from propane gas. Defoliation was comparable, but, due to higher cost, the machine was abandoned.

The best way to prepare the crop for harvesting would be to manage nutrients and irrigation so that the plant cuts out in time for leaves to dry up and fall off before picking.

Excellent cotton defoliation can be obtained from a frost occurring at a time when the crop has terminated, but still has green leaves. Producers in areas with seasonal frosts thus have a natural advantage. Also, some varieties shed leaves at a faster rate than others. This characteristic could be further investigated and utilized.

In the absence of any other suitable defoliation method, attempts are being made to try approved materials such as magnesium chloride, sea slat,

weed oils or other natural chemicals. Spindle picking of green cotton (undefoliated) is also being tried in the US.

Certification

All cotton certified as organic or transitional must be inspected during growing by designated personnel from the certifying organizations. A list of the authorized methods and materials is published by each certifying organization and made available to the producers registered with them. Buffer zones are designed and inspected for cleanliness, especially if the harvest is being conducted by a contract harvester or someone other than the producer.

Each gin which handles organic of transitional cotton must be certified as an organic processor prior to ginning any certified cotton. A complete record of the cotton is maintained for tracing each bale of organic or transitional cotton at the gin. If any byproduct of ginning, such as motes, seed or gin trash and burs, is to be sold as certified organic of transitional, it must also meet the same inspection and physical segregation standards as the cotton lint.

Standards for post-harvest handling from the gin to the consumer are not available yet, but are being developed by the Texas Department of Agriculture. Regulations for production methods have been established by each certifying organization. Production, processing and all following operations are monitored in the light of established principles.

Certification of production and processing of organic cotton is handled mainly by private organizations, with the exception of the Texas Department of Agriculture which is a state program. Arizona is just entering the certification program. It is reported that the USDA is expected to develop a national standard for organically grown cotton later this year.

Textile Manufacturing

The Texas Department of Agriculture is also developing certification standards for the production of organically produced fibers into textile materials. Because finishing and dying are mostly chemical processes, they will require the most attention if apparel manufactures want to label finished products as organic. Currently, organic cotton is knitted into T-shirts, sweaters, interlocks, shorts, denims, infant wear, pajama fabrics, cotton sheets, tow-

els and kitchen linens. The international interest in organic cotton is growing, encouraging producers in the form of higher prices to produce more and more cotton grown without the use of chemicals.

It is difficult to assess the long term trend. It seems organic cotton in the long run will capture a small but viable segment of the market. The size of the organic cotton market will depend on the price of the organic cotton in comparison with its cost and yields level. The premium price of US$1.75 to $1.95 fetched by California producers and US$1.0 to $1.35 by the Texas producers is certainly due to scarce supply and relatively higher demand. Probably such a margin will not be sustained.

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