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# ORGANIC COTTON CULTIVATION

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Cotton is the most important fibre crop of India. It plays a dominant role in its agrarian and industrial economy. In India 8.9 million ha area is under cotton cultivation which occupies 25% of the world area and employs seven million people for their living. Cotton is the backbone of our Indian textile industry, accounting for 70% of total fiber consumption in textile sector, and 38% of the country's exports, fetching over Rs. 42,000 crores (Rajendran *et.al.*, 2000) . Annually an amount of 25 million tonnes of cotton is produced conventionally. To produce 1 kilo gram of non organic cotton a maximum of 29,000 litres water is needed and high levels of agrochemicals are used in the production (Meyer, 2001). Cotton consumes 10–12% of all pesticides and 24% of all insecticides used worldwide. In India, cotton is grown on 5% of the cultivable land, but receives 54% of the insecticides used in agriculture (Rajendran *et al.*, 2000). It is estimated that approx. 500 insect species have developed resistance against certain insecticides. In addition, pests of formerly minor importance became a serious problem due to declined population of natural enemies with wide application of broad spectrum pesticides (Oswald and Sauerborn, 1995). This has led many cotton farmers to a state of 'pesticide treadmill', characterized by increased input costs and decreased marginal returns (Poswal and Williamson, 1998).

The cultivation of cotton accounts for only 2.4% of agriculturally used areas. Thus, cotton production uses more natural resources like water and chemical fertilizers and pesticides per unit area than any other crop. Of these plant protection products many of them are highly effective neurotoxins, having been used as chemical weapons in the past. The chemicals used in the processing of non-organic cotton will pollute air, surface water, atmosphere and even people. Around 70 field workers are dying every day as a result of pesticides and insecticides application, the majority are children under the age of 14, additional 80 factory workers die every day because pesticide soaked cotton and fabric pollutes the air in warehouses and working areas (according to estimations of the WHO). Since 1998 in India alone 40,000 farmers committed suicide to escape their debts borrowed from companies. Massive human rights violations are commonplace. The consumer suffers from chemicals in

garments since non-organic cotton textiles irritate consumers' skin, as they can also cause neurodermatitis (chemical residues stay verifiable even in the ready-made garment). There is an urgent need to save our natural resources like soil, water, atmosphere and people from toxicity of these chemicals and pesticides. There is an immediate need to shift to organic farming which has been a regular practice in the ancient.

**Table.1: TOP TEN ORGANIC COTTON PRODUCERS OVER THE YEARS**

| S.No | 2008-09 | 2009-10 | 2010-11 | 2011-12 | 2012-13 |
|---|---|---|---|---|---|
| 1 | India | India | India | India | India |
| 2 | Turkey | Syria | Syria | Turkey | China |
| 3 | Syria | Turkey | China | China | Turkey |
| 4 | Tanzania | China | Turkey | Tanzania | Tanzania |
| 5 | China | USA | USA | USA | USA |
| 6 | USA | Tanzania | Tanzania | Mali | Burkina Faso |
| 7 | Uganda | Uganda | Egypt | Peru | Egypt |
| 8 | Peru | Peru | Mali | Uganda | Mali |
| 9 | Egypt | Egypt | Kyrgystan | Egypt | Uganda |
| 10 | Burkina Faso | Mali | Peru | Burkina Faso | Peru |

(Source: Organic Cotton Report, 2013)

## Organic farming

Organic farming is the form of agriculture that relies on techniques such as crop rotation, green manuring, compost and biological pest control. Organic farming uses fertilizers and pesticides but excludes or strictly limits the use of manufactured (synthetic) fertilizers, pesticides (which include herbicides, insecticides and fungicides), plant growth regulators such as hormones, livestock antibiotics, food additives, genetically modified organisms, human sewage sludge, and nanomaterials.

## Organic Cotton

Organic cotton is grown without pesticides and insecticides, furthermore organic cotton seeds are not genetically modified. Organic cotton cultivation involves methods and materials that have a low impact on the environment and reduces the use of toxic and persistent pesticides and fertilizers. Organic cotton farming replenish and maintain soil fertility. It builds up biologically diverse agriculture. Farmers of organic cotton and their families profit, because water, soil and atmosphere remains unpolluted and less diseases and toxication appears from organic cotton farming. By that, Organic cotton agriculture protects the health of people and nature. It also protects the planet by reducing the overall exposure to toxic chemicals and also from synthetic pesticides. These can end up in the ground, air, water and food supply, and are associated with health consequences, from asthma to cancer. Choosing organic cotton products are the easiest way to protect yourself and your skin.

The first organic cotton project was started in the year 1990 in Egypt. Today organic cotton is grown in over 22 countries. As of 2013 the largest producers of organic cotton are India and Turkey. According to "Organic Exchange" China, Syria, Peru, Uganda, Tanzania, Israel, the United States and Pakistan are under the top ten organic cotton producing countries in the world. India took over Turkey's long-standing position as the leader, seeing its production increase by 300 per cent to reach 103,003 metric tonnes, or about 75 per cent of world organic cotton production.

**Table. 2: ORGANIC FIBER PRODUCTION IN MAJOR COUNTIRES OF WORLD**

| S.No. | Country | Fiber Production (mt) | Fiber production (% of total) |
|---|---|---|---|
| 1 | India | 103,003.52 | 74.20% |
| 2 | Turkey | 15,802.00 | 11.38% |
| 3 | China | 8,105.53 | 5.84% |
| 4 | Tanzania | 6,890.90 | 4.96% |
| 5 | USA | 1,580.00 | 1.14% |
| 6 | Mali | 860.00 | 0.62% |
| 7 | Peru | 478.50 | 0.34% |
| 8 | Uganda | 455.70 | 0.33% |
| 9 | Egypt | 420.00 | 0.30% |
| 10 | Burkina Faso | 370.00 | 0.27% |

(Source: Organic Cotton Report, 2012)

**Approaches to Organic Cotton Farming**

Since organic cotton production warrants the cultivation in the absence of agro-chemicals, it involves a careful selection of components of farming system keeping the local resources, agro-climatic features and socio-economic structure for the formation of a suitable package as follows:

**a. Soil**

The first and foremost important thing in organic farming is the selection of the soil for cultivation. The soils with high degree of soil erosion and heavily infested with perennial weeds should not be used for organic farming. The selected soils should be improved in their fertility levels only through organic means like farm yard manure, composts, green manuring etc., before opting for this type of cultivation. Even the soils with high pesticide residues can be improved gradually and made pesticide free through organic farming.

**b. Selection of Variety**

The farmer should be careful in varietal selection and choose those varieties which are hardy and capable of giving acceptable farming especially in the early phase of conversion towards organic farming are ideal. The varieties which respond well to chemical inputs may not be useful for organic farming. The selected varieties should be sucking pest tolerant and can be preferred over susceptible ones. Early

maturing varieties are less exhaustive and will also help the crop to escape heavy bollworm damage.

**c. Seed rate and sowing**

Acid delinted seeds cannot be used for organic cultivation according to international norms (e.g. IFOAM) for the purpose of certification of the fibre. However, those farmers who pursue organic farming for reducing the cost of cultivation and to increase the profitability could use acid-delinted seeds in order to avoid seed borne pathogenic infections and achieve optimum plant stand. However, if fuzzy seeds are used higher seed rate is to be used in order to achieve the same goal. About 25 kg/ha of seeds at 75×15 cm spacing ensures a final plant population of 85-90 thousand plants/ha. One row of fodder cowpea (*Vigna unguiculata*) should be drilled between two rows of cotton. This crop could be ploughed down and buried in soil just before its flowering.

**d. Manures and Fertilizers**

Soil fertility has to be maintained from the beginning and it should be improved gradually to realise economical production. Improvement and maintenance of organic matter of the soil plays an important role in organic cotton production, as it would increase physical parameters of soil, improve soil structure and enhance nutrient supply. Cotton is the highest nutrient up taking plant hence to meet the huge quantities of nutrient requirement large quantities of FYM is essential which is not generally available. In such case a combination of sources with different biological properties should preferably be used. Organic manures (FYM, compost, Vermicompost), *in situ* green manuring (Cowpea, Dhaincha) and Biofertilizers along with fertility restoring crop rotations can be made to meet the nutrient requirement.

**1. Organic manures:**

**i) Farm yard manuring (FYM)**

At the time of land preparation or in preparatory tillage FYM @ 15 t/ha must be added and mixed thoroughly. The applied FYM should be well decomposed and should be preferably treated with composting organisms such as *Trichoderma viride* for further decomposition. Once the farm yield is stabilized over a few years, the rate of FYM may gradually be brought down to 5-10 t/ha.

**ii) Vermicompost**

Vermicompost at the rate of 1-2 t/ha should be added supplementing FYM on the furrow lines on which sowing is done. Its nutrient composition varies with substrate that is verrmicomposted, but generally contains several diverse microflora which aid in good plant growth. It offers good scope for recycling of farm waste.

**2.Green manuring**

**i) Fodder cowpea (*Vigna unguiculata*)**

*In situ* green manuring with fodder cowpea and its burying at 40 days after sowing or at the time of its flowering will ensure a steady Nitrogen supply during the grand-growth phase and flowering period, when the N demand peaks up in the cotton

crop. This will hasten the microbial activity in soil, reduces weed growth and enhances build up of natural enemies in the crop stand. Cowpea decomposition provides around 400-500 kg dry matter per hectare with 2.5% N and contributes 10-12 kg N/ha during squaring. Its additional benefits include smothering of weeds, controlling seasonal soil erosion and nurturing natural enemies of cotton pests.

**ii) Dhaincha (*Sesbania aculeata*)**

Dhaincha can be raised in dense stand around cotton field in 5-6 rows. Its lopping cut and spread between cotton rows at 65-70 days after sowing. It has fast decomposing nature and the decomposed dhaincha leaves provide N during early boll development period. The crop will stalks act as temporary mulch which is helpful in preventing soil moisture evaporation.

**3. Biofertilisers**

Seed inoculation of *Azatobactor* or *Azospirillum* @ 200 g/seed required for sowing one acre is recommended.

**f. Weed Management**

Fields not infested with perennial weeds such as *Cyperus* sp. (Motha), *Cyanodon dactylon* (Doob) and *Sachharum* sp. (Kans) should be preferred for organic farming as these are difficult to control. However, if such weeds occur in patches, their underground propagatory structures (stolons, rhizomes etc.) must be exposed by summer cultivation or removed through mechanical/manual means. Composting can recycle the weeds removed. It must be ensured that the FYM, compost added is completely decomposed, otherwise many seeds of annual weeds, introduced through FYM, will germinate and aggravate the weed problem. Growing a crop of cowpea between 2 rows of cotton will also suppress the early emerging weeds.

**g. Selection of Crop Rotations**

Crop rotation plays a very important role in restoring soil fertility and minimizing damage due to insect pests and weeds. High nutrient-exhaustive rotations must be avoided and instead rotations with a legume that is recommended for the locality may be adopted.

**h. IPM strategies for crop protection**

The crop protection is challenging in organic cotton cultivation because protection measures revolves around the use of bioagents like predators (*Chrysoperla sp*. or *Apertochrysa sp*,). egg parasitoids (*Trichogramma sp.*), larval parasitoids (*Habrobracon* spp.), insect pathogens (*Helicoverpa armigera* Nuclear Polyhydrosis Virus [NPV]) and a bacterium, *Bacillus thuringuiensis* var. *kurstaki* (B.t.k.) formulations along with utilization of bird perches and botanical insecticides like neem products.

Avoidance of pesticide application by introducing biocontrol agents, either by natural augmentation processes or by artificial releases increased the stability of cotton cultivation. The basic concept of conserving natural mortality agents of pests

can be achieved in organic cotton cultivation, primarily by reducing insecticide application. These toxicants destroy both, pests and their natural enemies, and so, are not desirable for common use. To sum up, the following pest suppression strategies are recommended for organic cotton cultivation.

i. Select a reasonably tolerant cultivator against sucking pest complex.

ii. Release of *Chrysoperla* spp. @ 500-1000/ha based on the intensity of jassid damage between 20-25 days of crop growth.

iii. Release of egg parasitoids *Trichogramma* as Trichocards @ 10/ha once at 45-50 days and then after 10-12 days, twice more in order to kill bollworm eggs effectively.

iv. Spray HaNPV @ 250 LE against the young larvae of American bollworm when spotted in the field and can be repeated after 15 days for retaining good inoculum of the pathogen.

v. Spray with any commercial *B.t.* formulation @ 1.5 l/ha t control the boll worms.

vi. Release of Larval parasitoid like *Habrobracon hebator* is also useful for controlling growing bollworm larvae and other caterpillars damaging leaves and flowers.

vii. Invite the birds by placing bird perches @ 5-6/ha to eat the larvae. This would help in increasing the predatory bird visit in cotton fields.

viii. The need-based botanical insecticides, seed kernel extract can be used at 5% v/v or 1-% oil is very useful to deter pest activity in the crop.

ix. Monitoring of bollworm using the respective pheromone traps would give a clue regarding their first occurrence in a season in order to initiate adequate and suitable crop protection measures.

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