Evaluation of non-GM cotton cultivars for bollworm resistance

Participatory cotton breeding program for organic smallholders in Central India

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Summary: Organic cotton farmers in India face increased problems to find suitable non-GM cotton seeds on the market. Due to the fast adoption of genetically modified Bt cotton, non-GM seed production and breeding activities have been abandoned.This study compares the resistance against cotton bollworms of over 100 cultivars of different cotton species under organic conditions. On average 70% of the assessed capsules were damaged by cotton bollworms, with significant genotypic differences in the susceptibility. Thus, big potential for organic cotton production lies in the breeding for more pest resistant cultivars, the improved management and the re-establishment of seed sovereignty for smallholders.

Background

Cotton (*Gossypium spp*.) is an important cash crop for fibre and oil production and assures millions of farmers' families income. Cotton is like no other plant highly susceptible to various pests. Therefore, genetically modified (GM) cotton, expressing *Bacillus thuringiensis* (Bt) toxin, was introduced and is nowadays widely spread all over India. GM cotton is less susceptible to bollworms, which is the major pest, causing enormous yield losses word-wide. The fast adoption of GM cotton let to a neglect of breeding on non-GM cultivars for pest resistance, especially towards bollworms. This makes it difficult for smallholder of the organic sector to find suitable non-GM cultivars on the Indians seed market. An economically reasonable production of organic cotton is only feasible with an elaborated control of the cotton bollworm, based on inherent resistance and treatments with botanical pesticides. Therefore, a non-GM cotton seed-chain has to be re-established in India to sustain the organic cotton production.

Main chapter

Even though India still is the world's largest producer of organic cotton, the area cultivated with organic cotton decreases steadily. This trend is accelerated through the impede access of farmers to high quality non-GM seeds and through the problem of GM contamination. To support organic cotton farmers in India participatory breeding projects and evaluation programs have been initiated in Madhya Pradesh in Central India realized in collaboration with the Research Institute of Organic Agriculture (FiBL), bioRe a local organic cotton producer and the University of Agricultural Science, Dharwad.
In this study the susceptibility of different cotton cultivars comprising 30 tetraploid upland *G. hirsutum* hybrids, 65 *G. hirsutum* varietal lines and 37 endemic diploid *G. arboreum* varietal lines, towards cotton bollworms was compared at two different sites (heavy soil, irrigated and light soil, rainfed) representing farmers' main organic growing conditions. The cultivars were planted in two replications per site in 4-row plots with cultivar type specific plant density. The total number of harvested bolls and the damaged bolls caused by bollworms of five selected plants per cultivar, replication and site were assessed during the picking period (October 2013 till January 2014). Yield components, fiber quality and morphological traits were also assessed.
The average investation of bollworms across genotypes was much higher under the irrigated high fertile heavy soil site (68% of capsules) compared to the rainfed light soil site with shorter vegetation period and very low infestation (9%). At the heavy soil site response of the different cultivars towards the

bollworm differ significantly ranging from 39% to 91% infestation. Variation within cultivar type was higher than between species.
Therefore, breeding for pest resistant cultivars is essential for yield stability of organic cotton production, especially under favourable growing conditions. Increasing the genetic diversity of *Gossypium spp*. in India gains even more importance since other pests have emerged and since first Bt resistant bollworms have been identified. Resistant cultivars have economic benefits and are not harmful to the environment. Initiating decentralized participatory breeding programs for pest resistant non-GM cotton cultivars adapted to farmers' conditions and increasing the self-sufficiency of smallholders could account to a better choice of suitable cultivars and lead to a sustainable increase of yield in the organic cotton production.

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