Participatory cotton breeding for organic and low input farming in Central India

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Introduction and Objectives

Up to 80% of the world’s organic cotton is produced in India. Controversially over 90% of the cotton area is grown with GM cotton. Available non-GM seeds are scarce and based on only few hybrids adapted to high input farming. Participatory plant breeding (PPB) offers a great opportunity for developing locally adapted cultivars as well as for maintaining and increasing genetic diversity. The close collaboration of all stakeholders allows the identification of cultivars that suit the circumstances of resource-poor farmers in marginal environments.

The main objectives are to (i) introduce participatory breeding approaches by combining knowledge and expertise of researchers and farmers, (ii) test improved cotton cultivars in smallholders’ organic cotton fields and (iii) gain information about the suitability of different species and cultivar types of cotton for organic and low input farming in Central India.

Materials and Methods

In total 56 cotton cultivars were tested in replicated field trials at the research station of bioRe (on-station), on bioRe farm and on farmers’ fields (on-farm) in Central India. The cultivars comprised the predominant tetraploid upland cotton *Gossypium hirsutum*, the tetraploid *G. barbadense*, and the endemic diploid *G. arboreum* species. Hybrids as well as traditional varietal inbred lines were included.

**Trial 1 Genotype x management interaction:** on-station trial with 7 genotypes in two management levels (conventional high vs. organic low input treatment)

**Trial 2 Cultivar testing:** Testing of 49 different species and cultivar types for their suitability under organic and low input farming (on farm mother trial of PPB)

**Trial 3 Genotype x environment interaction:** on-farm trial with 5 cultivars grown in 32 cotton fields of 18 organic farmers (baby trials)

**Trial 4 Selection:** Selection of single plants in F2:3 segregating populations on-farm

**PPB approach:** Farmers cultivars’ evaluation on-farm (mother and baby trials) and identification of important cotton traits in various workshops

Results

**Trial 1:** All 7 tested genotypes yielded higher under conventional high input conditions than under organic. No interaction (G x M) effect was observed. However yield and fibre quality was very low due to delay in sowing and waterlogging event in cropping season 2011/12. *G. arboreum* varietal lines were highest yielding and showed improved fibre quality, also better than commercial *G. hirsutum* hybrids under water logging conditions.

**Trial 2:** *G. hirsutum* varietal lines showed highest yield among all tested species and cultivar types as well as were the only cultivar type that reached acceptable fibre quality in terms of fibre length and finesse.

**Trial 3:** Soil type had a significant effect on cotton yield in farmers’ fields resulting in higher yields under heavy Vertisol compared to light Inceptisol. No interaction (G x E) effect was observed for yield and fibre quality among these baby trial sites.

**Trial 4:** Farmer’s selected partly different single plants than researchers. Their phenotypic selection showed equal or better fibre quality than researchers’ selections.

**PPB approach:** Farmers did not prefer the highest yielding cultivars, but showed particular preference for one cultivar depending on their soil type and irrigation facilities. Farmers also brought up additional cotton traits, such as boll opening, easy picking and germination rate that were important to them.

Conclusions

*G. arboreum* and *G. hirsutum* varietal lines can present a suitable alternative to commercial *G. hirsutum* hybrids for organic and low input farming, and hence contribute substantially to seed security on-farm.

Environmental and management conditions effect cotton yields, and to a lower extent fibre quality. Nevertheless, more attention should be paid in future to genotype selection and farm management strategies to tap the full potential in terms of fibre quality.

Farmers contribute substantially to the identification of suitable cultivars for organic and low input farming.