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Evaluation of non-GM cotton cultivars for bollworm resistance

Participatory cotton breeding program for organic smallholders in Central India

Background

Cotton bollworms are among the most severe pests in cotton (*Gossypium spp.*) causing immense yield losses. Genetically modified cotton, expressing *Bacillus thuringiensis* (Bt) toxin, which is less susceptible to bollworms, is nowadays widely spread all over India. Even though India still is the world's largest producer of organic cotton, the area cultivated with organic cotton decreases steadily. The fast adoption of Bt cotton led to a neglect of breeding non-GM cultivars for pest resistance, especially towards bollworms. Hence it is difficult for smallholders of the organic sector to find suitable non-GM cotton cultivars.

Objectives

In the scope of a participatory cotton breeding program established together with smallholder cotton producers in Central India we want to identify cotton cultivars with high level of resistance against bollworms under organic farming conditions. The main objectives of this study are:

- To evaluate bollworm resistance of different cultivar types (different species, hybrids versus varietal lines)
- To classify susceptibility to bollworms among different genotypes and locations

Experimental Design

- Genotypes
 - 32 tetraploid upland *G. hirsutum* hybrids (HH1, Fig. 1)
 - 37 tetraploid upland *G. hirsutum* varietal lines (HV1)
 - 33 tetraploid upland *G. hirsutum* varietal lines (HV2, in light soil only)
 - 35 diploid endemic *G. arboreum* varietal lines (AV1, Fig. 2)
- Two sites; irrigated heavy soil and rain fed light soil in the region of Kasrawad in Madhya Pradesh, India
- Randomised complete block design, two replications per site
- Assessments
 - Percentage of capsules with bollworm damage (Fig. 3a, b, c), two times on five plants per plot
 - Seed cotton yield on plot level (2 to 3 picking periods from Oct. 2013 – Jan. 2014)



Fig. 1: *G. hirsutum* hybrid



Fig. 2: *G. arboreum* varietal line



Fig. 3: Cotton capsules with bollworm damage:
 a) Capsule with bore mark
 b) Capsule with damaged seeds
 c) Capsule with American bollworm (*Helicoverpa armigera*)

Preliminary Results

The average damage of bollworms across genotypes was much higher in the irrigated highly fertile heavy soil site (68 % of capsules) compared to the low infestation (9 %) in the rain fed light soil site. It was found that *G. hirsutum* varietal lines are significantly ($P < 0.05$) more susceptible to bollworms versus *G. hirsutum* hybrids and *G. arboreum* varietal lines in both heavy and light soil. While *G. arboreum* species are shown to be more tolerant against sucking pest than *G. hirsutum* species, this was not the case for bollworm damage (Fig.4). Correlations with yield data and morphological traits are in process.

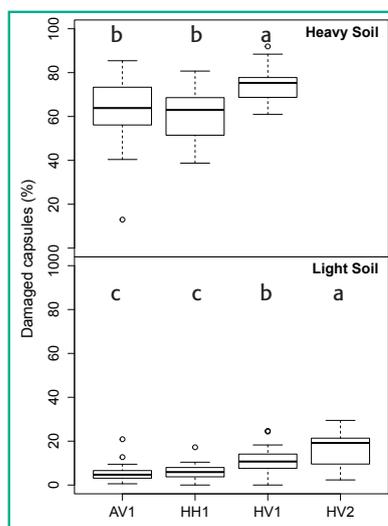


Fig. 4: Boxplot of the percentage of the capsules with bollworm damage per plant from different cultivar types (AV1, HH1, HV1, HV2) and sites (Heavy Soil and Light Soil). Different small letters indicate significant difference in bollworm damage between the cultivar types.

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