Determining tolerance of non-GM cotton cultivars towards cotton bollworm in Central India

Figure 1: Healthy G. hirsutum capsule

Figure 2: Cotton capsules with bollworm damage (from left to right): Capsule with bore mark, capsule with damaged seeds, capsule with American bollworm (Helicoverpa armigera)

Figure 3: G. arboreum varietal line

Figure 4: G. hirsutum hybrid

Figure 5: Boxplot of the percentage of capsules with bollworm damage per plant from different cultivar types (AV, HH, HV) and sites (HS, LS). Different small letters indicate significant differences in bollworm damage between cultivar types.

Figure 6: Correlation of bollworm damage incidence of different cultivar types (AV, HH, HV) and sites (HS, LS). Each data point represents the mean of two replications with each five selected plants. AV: n=37, r=0.409, p=0.012, HS, n=24, r=0.366, p=0.079, HV: n=36, r=0.012, p=0.989

Background

› There is an increasing demand for organic cotton and India is the world’s biggest producer. However, trends suggest a serious shortfall in supply.
› The focus on genetically modified (GM) insect resistant Bt cotton led to a reduction of non-GM cotton breeding including seed multiplication and to a neglect of bollworm resistance.
› Smallholders have limited access to high-quality non-GM seeds.
› Cotton bollworm causes immense yield losses in organic cotton.

Objectives

In the scope of a participatory cotton breeding program in Central India we want to identify cotton cultivars with high level of resistance against bollworms under organic farming conditions. The main objectives 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
› To find correlations with yield data and morphological traits

Experimental Design

› Genotypes
  - 37 diploid endemic G. arboreum varietal lines (AV, Fig. 3)
  - 24 tetraploid upland G. hirsutum hybrids (HH, Fig. 4)
  - 36 tetraploid upland G. hirsutum varietal lines (HV)
› Two sites; irrigated heavy soil (HS) and rain fed light soil (LS) 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. 2), two times (HS) and three times (LS) on five plants per plot
  - Seed cotton yield on plot level (2 to 3 picking periods from Oct. 2013 – Jan. 2014)

Preliminary Results

› At the irrigated highly fertile HS site average damage of capsules per cotton plant caused by bollworms (67 %) was much higher compared to the low infestation (7 %) detected at the rain fed LS site (Fig. 6).
› G. hirsutum varietal lines were on average significantly (P<0.05) more susceptible to bollworms compared to G. arboreum hybrids and G. hirsutum varietal lines in HS and LS (Fig. 5).

Susceptibility towards bollworm infestation was significantly correlated between the two sites for G. arboreum varietal lines (r=0.41, p<0.05), whereas no correlation was found for G. hirsutum varietal lines (Fig. 6).

Significant negative correlation (r=-0.32; p<0.05) between bollworm damage (%) and yield data (kg/ha) were found for G. hirsutum hybrids at the HS site.

Two G. arboreum varietal lines and two G. hirsutum hybrids showed high level of resistance at both sites (Fig. 6)

Conclusion

To support sustainable agriculture breeding for pest resistant cultivars might be an essential prevention method. This gains even more importance since other pests have emerged and since the first Bt resistant bollworms have been identified. However, the assessment of resistance depends on high pest pressure and is very time consuming.

Acknowledgment

This project is supported by Mercator Foundation Switzerland, biotope Foundation Switzerland and Coop Sustainability Fund.