

Geographic Variation in the Baseline Susceptibility of *Helicoverpa armigera* (Hubner) (Noctuidae: Lepidoptera) Field Populations to *Bacillus thuringiensis* Cry Toxins for Resistance Monitoring

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Abstract : The transgenic cotton expressing *Bacillus thuringiensis* (Bt) provides an effective control of *Helicoverpa armigera*, a most damaging pest of the cotton crop. However, Bt cotton may not be the optimal solution owing to the selection pressure of Cry toxins. As Bt cotton express the insecticidal proteins throughout the growing seasons, there are the chances of resistance development in the target pests. A regular monitoring and surveillance of target pest's baseline susceptibility to Bt Cry toxins is crucial for early detection of any resistance development. The present study was conducted to monitor the changes in the baseline susceptibility of the field population of *H. armigera* to Bt Cry1Ac toxin. The field-collected larval populations were maintained in the laboratory on artificial diet and F1 generation larvae were used for diet incorporated diagnostic studies. The LC₅₀ and MIC₅₀ were calculated to measure the level of resistance of population as a ratio over susceptible population. The monitoring results indicated a significant difference in the susceptibility (LC₅₀) of *H. armigera* for first, second, third and fourth instar larval populations sampled from different cotton growing areas over the study period 2016-17. The variations in susceptibility among the tested insects depended on the age of the insect and susceptibility decreased with the age of larvae. The overall results show that the average resistant ratio (RR) of all field-collected populations (FSD, SWL, MLT, BWP and DGK) exposed to Bt toxin Cry1Ac ranged from 3.381-fold to 7.381-fold for 1st instar, 2.370-fold to 3.739-fold for 2nd instar, 1.115-fold to 1.762-fold for 3rd instar and 1.141-fold to 2.504-fold for 4th instar, depicting maximum RR from MLT population, whereas minimum RR for FSD and SWL population. The results regarding moult inhibitory concentration of *H. armigera* larvae (1-4th instars) exposed to different concentrations of Bt Cry1Ac toxin indicated that among all field populations, overall Multan (MLT) and Bahawalpur (BWP) populations showed higher MIC₅₀ values as compared to Faisalabad (FSD) and Sahiwal (SWL), whereas DG Khan (DGK) population showed an intermediate moult inhibitory concentrations. This information is important for the development of more effective resistance monitoring programs. The development of Bt Cry toxins baseline susceptibility data before the widespread commercial release of transgenic Bt cotton cultivars in Pakistan is important for the development of more effective resistance monitoring programs to identify the resistant *H. armigera* populations.

Keywords : Bt cotton, baseline, Cry1Ac toxins, *H. armigera*

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