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Negative cross resistance of cry 1Ac toxin selected *Helicoverpa armigera* to chemical insecticides

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SUMMARY

Development of resistance to any xenobiotics imposed against cotton bollworm, *Helicoverpa armigera* (Hubner) is real and it has to be managed with a sound IRM strategy. Limited use of insecticide molecules in case of partial or complete failure of Cry toxin is well thought. As of now, ETL based application of chemical pesticides in Bt-cotton is recommended once after 90 DAS or 1-2 times based on ETL. Accurate prediction and management of resistance requires information on cross-resistance characteristics of the insecticide employed in BT - crops. Study on the pattern of cross-resistance of Cry 1Ac toxin selected (for seven generations) *H.armigera* to chemical insecticides (*viz.*, cypermethrin, fenvalerate, endosulfan, quinalphos, chlorpyriphos, methomyl and spinosad) conducted under laboratory conditions using discriminating doses of insecticides revealed negative cross resistance as Cry1Ac toxin selected *H. armigera* individuals were more susceptible to all the chemical insecticides tested irrespective of the group, compared to the unselected larvae from non-Bt cotton fields. The study strengthens the concept of "using chemical insecticides" as one of the tools in Bt resistance management strategy to increase the life of Bt technology.

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Key words : Cross resistance, Cry 1 Ac, Xenobiotics, *Helicoverpa armigera*, Bt cotton, Resistance management

The American bollworm, *Helicoverpa armigera* is a serious pest in many countries on various crops, including cotton, where it is the most serious. Different pesticide molecules have been employed for its control and that has resulted in development of resistance. Therefore, application of higher doses more frequently or discovery of new molecules for effective control has been practice. Since the commercial release of transgenic Bt- cotton, incorporating a gene for a highly specific insecticidal protein from *Bacillus thuringiensis* in 1996 in US, many countries including India have adopted the technology. Bt- cotton has found favour with farmers in many parts of the world and the area under Bt- cotton has been increasing year after year, currently at 0.5 m.ha. As a result there has been tremendous reduction in overall use of insecticides (Kranthi *et al*., 2004; Rajanikantha and Patil, 2004) and better environment in cotton growing regions.

It is expected that any competitive biological system would respond to high level of selection pressure by mechanisms that would either avoid or mitigate it. Random genetic changes that keep happening in a population of insects might include resistance alleles at very low frequency, which can rapidly increase when challenged. *H. armigera* has already developed resistance to many potent insecticides, especially to pyrethroids (McCaffery *et al*., 1989; Armes *et al*., 1996; Kranthi *et al*., 2001, Fakrudin *et al.,* 2004). There is also an indication that mechanisms of detoxification for different insecticides do overlap (Vijaykumar and Patil, 2005). In this context, wide spread use of Bt- cotton and other Bt- crops has to be considered. Like with chemical insecticides, *H.armigera* has a potential to develop resistance to Cry toxins under field conditions due to continued selection pressure, throughout the crop growth period, if proper resistance management tactics are not implemented. So far there is no field resistance observed for Bt Cotton. However, wide geographic variation in susceptibility of *H. armigera* to Cry1Ac toxin has already been reported in India (Gujar *et al.*, 2000; Kranthi *et al*., 2001; Fakrudin *et al.*, 2003; Jalali *et al*., 2004), China (Wu *et al*., 1999) and in Australia (Liao *et al*., 2002). The ability of lepidopterans to develop

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