Assessment of Effects of *Bacillus thuringiensis* Cry1A(c) δ-endotoxin on nitrogen fixing bacteria and their host plants in clay soil

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ABSTRACT

Farming is the backbone of the Kenyan economy and is important in the production of food crops for basic livelihoods and income generation in rural areas. However, yields have remained low owing to high disease, weed and pest incidences. Over the past 13 years, scientists have successful developed genetically modified (GM) crops (using genes from a soil bacterium, *Bacillus thuringiensis, Bt*) such as Bt maize and Bt cotton that are being introduced into Africa. Though seen as a promising technology, there is much debate about their potential short and long-term ecological effects on the environment. In addition, not many studies about their potential effects on beneficial soil microorganisms such as nitrogen fixing bacteria have been carried out in Kenya.

The aim of this project was to assess the effects of *Bacillus thuringiensis (Bt)* δ-endotoxin on nitrogen fixing bacteria in the soil, focusing on direct effects on diversity of nitrogen fixing bacteria (rhizobia), nitrogen fixation and host plant growth and productivity. In this study, Cry1A(c) δ-endotoxin from a local *B. thuringiensis* (ICIPE L1-2 isolate) active against *Chilo partellus* (Swinhoe) was used. Beans, *Phaseolus vulgaris* (L.) and Siratro, *Macroptilium atropurpureum* (DC.) seedlings were grown in potted soils that were treated with Bt toxin solution (100 µg/ml) and water as control. The plants were maintained in the greenhouse till nodulation and maturity stages when sampling was done for analysis. The results on the effects of Cry1A(c) δ-endotoxin on nitrogen fixation indicated comparable slow nitrogen fixing activity. However, there were no significant differences between the Bt toxin-treated and those treated with water (control) samples. In addition, the high concentration of Bt toxin Cry1A(c) (100 µg/ml), reduced the diversity of rhizobium species in the test samples compared to the control samples as indicated from the RFLP profiles. Comparison of the sequences of the isolates in the public database using Basic Local Alignment Search Tool (BLAST) on the National Center for Biotechnology Information (NCBI) website showed that the isolates shared sequence identity of between 93-100 % with known species from the genera *Bradyrhizobium* and *Rhizobium*. In conclusion, the presence of Bt δ-endotoxin in the soil does not interfere with host plant growth, nodulation, productivity and nitrogen

fixation. However, Bt δ-endotoxin appears to reduce the diversity of *Bradyrhizobium species* and *Rhizobium species* in the Siratro and bean test samples respectively.

Key Words: GM crops, Bt maize, Bt cotton, *Bacillus thuringiensis,* Cry1A(c) δ-endotoxin, *Macroptilium atropurpureum* (DC.)