Effect of Genotype, Edaphic, Environmental Conditions, and Agronomic Practices on Cry1Ac Protein Expression in Transgenic Cotton

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Poor Cry1Ac protein expression was common in the first years of transgenic (Bt) cotton in Australia, when single-gene Cry1Ac cotton (called Ingard in Australia and Bollgard in USA) was grown. Two-gene cultivars (called Bollgard II in both countries) show enhanced Cry1Ac protein expression compared with Ingard cultivars. Environment, soil properties, and agronomic management are believed to affect Cry1Ac protein expression. This research evaluated the impact of crop nutrition, plant population density, light intensity, water management, herbicide application, soil fertility, plant growth regulator application, and cotton cultivars on Cry1Ac protein expression in field and glasshouse experiments, as measured in cotton leaves using commercial quantitative ELISA assays. Cultivars provided the major source of variation in leaf Cry1Ac protein expression. Cry1Ac protein concentration ranged from 0.27 to 6.01 mg kg^{-1} in 15 experiments conducted over 4 yr. There was considerable variation among individual plants of a cultivar. Cry1Ac protein expression was highly heritable (h^2 = 0.94), as parent plants produced progeny with a similar level of Cry1Ac protein expression. Cry1Ac protein expression was higher in older (lower) leaves. Treatment effects were often more evident in older than younger leaves. Short episodes of waterlogging, shading, herbicide application, or plant growth regulator application did not significantly affect leaf Cry1Ac protein expression, while severely wilted plants exhibited reduced Cry1Ac expression. Cry1Ac protein expression was reduced under conditions that affected cotton growth and development or plant survival, such as drought or sodic/saline soil that severely impaired crop nutrition. Cry1Ac protein synthesis may be limited or the protein metabolized in plants subjected to environmental or edaphic stresses.