JOURNAL OF APPLIED ENTOMOLOGY
J. Appl. Entomol.

Chickpea-mediated effects of *Bacillus thuringiensis* on *Helicoverpa armigera* and its larval parasitoid, *Campoletis chlorideae*

M. K. Dhillon & H. C. Sharma

International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru, Andhra Pradesh, India

Keywords
Bacillus thuringiensis, *Campoletis chlorideae*, *Helicoverpa armigera*, chickpea, non-target effects, tritrophic interactions

Correspondence
Hari C. Sharma (corresponding author), Principal Scientist – Entomology, ICRISAT, Patancheru 502 324, Andhra Pradesh, India.
E-mail: h.sharma@cgiar.org

Received: August 5, 2009;
accepted: January 7, 2010.

doi: 10.1111/j.1439-0418.2010.01506.x

Abstract

Efforts are underway to express toxin genes from *Bacillus thuringiensis* (*Bt*) in chickpea for controlling the pod borer, *Helicoverpa armigera*. The interaction between *Bt* toxins, *Helicoverpa*-resistant chickpeas, and the parasitoid, *Campoletis chlorideae* are not fully understood. Therefore, we studied tritrophic interactions between *Bt* (administered as spray), chickpea genotypes, and the parasitoid, *C. chlorideae*. Chickpea genotypes resistant to *H. armigera* exercised a significant reduction in leaf feeding, survival and development of *H. armigera*, but did not influence the development and survival of the parasitoid, *C. chlorideae*. *Bt* sprays on different chickpea genotypes prolonged the larval period, and reduced pupation and adult emergence of *C. chlorideae*. Weights of *H. armigera* larvae showed a strong and positive association with *C. chlorideae* larval period on *Bt* treated, and a negative association on untreated chickpeas. The *Bt*-intoxicated *H. armigera* larvae also resulted in reduced weight of the cocoons and adults of *C. chlorideae*, suggesting significant influence of host size on development and survival of the parasitoid. *Bt* toxins were detected in *H. armigera* larvae fed on *Bt*-sprayed chickpeas, but not in *C. chlorideae* reared on *H. armigera* larvae fed on *Bt*-treated chickpeas, and in the parasitoid adults fed on honey intoxicated with 0.05% *Bt*. The adverse effects of *Bt* on the parasitoid were largely through early mortality of *H. armigera* larvae or poor quality of the host. This information would be useful for planning appropriate strategies for testing and deployment of *Bt*-transgenic chickpea with resistance to *H. armigera* for sustainable crop production.

Introduction

Chickpea (*Cicer arietinum* L.) is the world's third most important food legume, grown in tropical, subtropical and temperate regions, and is the premier pulse crop in the Indian subcontinent (Hulse 1991). It is valued for its nutritive seeds with high protein content (25.3–28.9%). Chickpea seeds are consumed fresh as a green vegetable, fried, roasted and boiled as a snack food. The grain after dehulling is largely consumed as split seeds as 'dhal', or the split seeds are ground as flour, which is used to make bread, snacks and sweets. The straw is used as feed for livestock. It is grown on about 10.38 million ha with a production of 8.57 million tonnes worldwide (FAO 2004). India is the largest producer as well as consumer of chickpea. In India, chickpea is grown on about 6.67 million ha with a production of 5.3 million tonnes (Majumder 2009). Chickpea yields are low (400–600 kg/ha), because of several biotic and abiotic constraints, of which the pod borer, *Helicoverpa armigera* (Hubner) (Noctuidae: Lepidoptera) is