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Refuge Cropping Systems for *Helicoverpa armigera* (Hubner) Resistance Management in BT Cotton (*Gossypium hirsutum*)

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Abstract: A field experiment was conducted at The Main Agricultural Research Station, University of Agricultural Sciences, Dharwad for two consecutive years (2004-05 and 2005-06) to identify and evaluate the suitable refuge crops/cropping systems for *Helicoverpa armigera* (Hubner) resistance management in Bt cotton (*Gossypium hirsutum* L.) cultivation. The experiment was laid out in randomized complete block design with five cropping systems : 80 % Bt cotton + 20% non Bt cotton, 80% Bt cotton + 20% marigold-chickpea, 80 % Bt cotton + 20% Okra-chickpea, 80% Bt cotton + 20% chilli and 80% Bt cotton + 20% pigeon pea as treatments with four replications in replacement series. Significantly higher seed cotton yield (1637 kg/ha) was recorded in Bt cotton + Okra-chickpea refuge cropping system, Bt cotton + marigold-chickpea refuge cropping system (1612 kg/ha) and Bt cotton + chilli refuge cropping system (1526 kg/ha) than in Bt cotton+ non-Bt cotton refuge cropping system (1240 kg/ha) and Bt cotton + pigeon pea refuge cropping system (1215 kg/ha). It is therefore suggested to adopt okra-chickpea or marigold-chickpea or chilli refuge cropping systems with Bt cotton for higher production and greater economic benefits.

Key words: Bt cotton · Cropping systems · *Helicoverpa armigera* · Refuge cropping and Resistance management

INTRODUCTION

Extensive cultivation of Bt cotton (*Gossypium hirsutum* L.) can impose a continuous and intense selection pressure on bollworms, *Helicoverpa armigera* (Hubner) leading to the latter's development of resistance to the toxin. One of the conditions for environmental release of Bt cotton is that each such field is to be surrounded by a belt of non Bt cotton of the same variety to serve as "refuge" for bollworm. Refuge is any host plant (non Bt cotton, alternate host) that does not produce Bt toxin and has not been treated with conventional Bt formulations. Refuge crops enable mating between resistant and susceptible adults, resulting in production of susceptible offspring [1, 2]. The refuge cropping strategy is designed to ensure that Bt susceptible insects will be available to mate with Bt resistant insects, should they arise. Available genetic data indicates that susceptibility is dominant over resistance [2]. The offsprings of these matings would most likely be Bt susceptible, thus mitigating the spread of resistance in the population. It has been very widely reported that these norms are not followed in practice, which could lead to rapid build up of Bt toxin resistance in bollworm. However, some workers have questioned the need for refuge cropping in the Indian farming situations. *Helicoverpa armigera,* the most predominant bollworm in India has a large number of alternate hosts like chickpea, pigeon pea, marigold, chilli and okra which serve as its natural refuge. Consequently Genetic Engineering Approval Committee (GEAC) of Government of India (GOI) first approved the use of any popular non Bt hybrid as refuge crop in the year 2006. Subsequently, GEAC also approved pigeon pea as a refuge crop. This necessitates

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