INTRODUCTION

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Insect resistance to chemical pesticides has been recognized for over 80 years. The number of insect and mite species resistant to DDT increased from seven in the early 1940's to over 447 a decade later (Georghiou 1986). In the Americas, there are populations of the bollworm, *Helicoverpa zea* (Boddie) and tobacco budworm, *Heliothis virescens* (F.), from one or more countries and locations within countries which are resistant to one or more members of all principle classes of insecticides (DDT, cyclodienes, organophosphorus, carbamate, and pyrethroids) (Georghiou 1986). Insecticide (DDT) resistance for *Heliothis virescens* (F.) in the United States was first documented in Texas (Brazzel 1963). Insecticide resistance for the bollworm was first documented in the United States by a study conducted in Louisiana from 1959-1961 (Graves et al. 1963). Results of this study indicated a 2-3X level of resistance to DDT. To date, pyrethroid resistance has not been documented for the bollworm in cotton in the United States. Reports of control problems with *Helicoverpa armegira* (Hubner) in Australian cotton and pyrethroid resistance in this species was first reported by Gunning et al. (1984).

Synthetic pyrethroids have been used on cotton in the United States since 1979 when permethrin and fenvalerate were registered for use against the bollworm, the tobacco budworm and numerous other cotton pests. Field populations of tobacco budworm and bollworm have been monitored throughout the cotton belt with one or more techniques (topical larval assay, adult and larval vial bioassays and percent control with commercial applications) since 1975. Results from these monitoring efforts are highly variable and a wide range of susceptibility has been reported among geographical locations and within locations during the same season.

Tobacco budworm control problems in cotton treated with pyrethroids were reported in California in 1980 and 1983 (Twine and Reynolds 1980, Martinez-Carrillo and Reynolds 1983). In 1985, tobacco budworm control problems were reported in south and west Texas (Plapp and Campanhola 1986). To date, tobacco budworm control problems have been reported from the west to the southern cotton growing areas of Louisiana and Mississippi. However, little effort has been made to link specific monitoring results with pyrethroid

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failures in the field to determine if resistant populations were truly responsible for these failures. Recently, the term "resistance" has been appropriately used where a field control failure was followed with results from some form of laboratory measurement of the susceptibility of the field population compared to a susceptible tobacco budworm population (Luttrell et al. 1987, Riley 1988). It is within this context that the resistance phenomenon becomes clear from a practical and academic viewpoint. Results reported herein will add clarity to this and other key issues. This supplement addresses areas of pyrethroid resistance using studies conducted in the field and laboratory. These include the status of resistance to pyrethroid insecticides in tobacco budworm and the bollworm within southwestern and mid-south U.S. and in Mexico. Results of several monitoring techniques are reported over several years for numerous populations. Additionally, several papers report how bioassay techniques relate to tobacco budworm and bollworm control in commercial cotton fields. Other papers furnish information which help to refine monitoring techniques. The use of ovicides to improve field control is considered and mixtures of pyrethroid, foramidine and organophosphorus insecticides were evaluated for synergistic activity in both the laboratory and field. Information on the genetics of pyrethroid resistance is presented as well as mechanisms of resistance in laboratory and field strains of the tobacco budworm.

It is hoped that this presentation of research studies will clarify current issues concerning resistance to pyrethroid insecticides. Additional questions will be generated from these results and research should focus on these questions. It is the hope of the authors that through a unified effort of all those interested in cotton insect control, pyrethroids along with other cotton insecticides can be better used to manage insect pests for years to come.

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