Chapter 8

Artificial Infestation of Field Plots

Gerald R. Sutter and Terry F. Branson

I. Introduction

Most naturally occurring insect pest populations have variable distributions that limit their usefulness as the pest component of field research systems. To eliminate this source of variation, workers with a variety of agricultural insect pests have developed methods to control infestations of field research plots. The success of these programs was dependent on three key factors: (1) a knowledge of basic biology of the pest, (2) the ability to colonize the insect successfully in the laboratory, and (3) the ability to produce an adequate supply of the desired life stage for application in the field.

Research programs involving the western corn rootworm (WCR), Diabrotica virgifera virgifera LeConte, have been limited to the past two to three decades, that is, when it became an economically important pest of maize in the major corn growing areas in the United States. Only within the past decade have researchers successfully colonized the WCR (Branson et al., 1975). Moreover, research programs had been restricted by the lack of suitable technology for manipulating this pest species in both the laboratory and field. During the 1960s and 1970s, researchers who attempted to evaluate germ plasm for host-plant resistance studies and to determine efficacy of insecticides and economic thresholds repeatedly referred to difficulty in interpreting field experiments due to lack of uniformity of naturally occurring WCR and northern corn rootworm (NCR), D. barberi Smith and Lawrence, populations (Ortman et al., 1974).

This chapter is concerned with methods for the WCR for which artificial
infestation techniques must take into account its univoltine life cycle and the presence of diapause in the egg (overwintering) stage. The procedure developed for this species should also be adequate for the NCR and has been successfully applied to species without egg diapause (Schalk et al., 1979).

The first attempt of an artificial infestation was by F. F. Dickey of Pioneer Hybrid Corn Co. involving the WCR (Ortman and Fitzgerald, 1964). Dickey obtained eggs from field-collected beetles, stored the eggs in soil in the laboratory, and the following planting season applied the soil–egg mixture to the base of corn seedlings to augment existing natural infestations; the technique was not described in detail. Chiang et al. (1971, 1975) extended this technique by using a mechanical device to dispense the soil–egg mixture.

With these early attempts, delivery of eggs to the field was cumbersome. The key breakthrough came with the introduction by Palmer et al. (1977) of a method of suspending rootworm eggs in a dilute agar solution. Corn plants were infested by dispensing an aliquot of the egg suspension in the furrow with the seed at planting time. The method allowed the accurate and reproducible infestation of small plots. Sutter and Branson (1980) then developed a mechanical system that quantitatively and uniformly dispenses agar suspensions of eggs in large-scale field plots.

This chapter describes the latest techniques for controlled field infestations with rootworms, including aspects of egg production, field plot preparation, the mechanical dispenser, and dispersal of eggs in the field, as well suggests guidelines based on past experience that indicate the kind of results that can be expected. Since the technique is relatively new, improvements are likely in the coming years.

II. Adult Collection and Egg Production

Eggs for field infestations must be collected from beetles in the laboratory; adults for egg production can be either collected from the field or produced in the laboratory. The method described here involves collecting beetles in the field and is one that has been used at our laboratory for the past 5 to 7 years. It represents a synthesis of ideas from Chiang et al. (1975), Fisher et al. (1984), and our unpublished experiences. Briefly, we collect from production cornfields having high pest population densities or from fields specifically planted with “trap crops” that are attractive to beetles.

When we rely on collecting from production cornfields, state survey entomologists and county agents are good sources for locating fields with high beetle populations (Chiang et al., 1975). Alternatively, we use trap-crop plantings, which have two basic requirements: They must be at-