Spatial Variation in Insect Populations and Site-Specific Integrated Pest Management

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SPATIAL VARIATION IN INSECT POPULATIONS

Insect populations exhibit dramatic and dynamic spatial variation in density and in the location of intraspecific phenotypes. This spatial variation is caused by the interaction between population dynamics, population genetics, and the biotic and abiotic environment. These interactions occur rapidly at rates that are closely tied to temperature, and the resulting variation may be evident at the within-field scale, or at a larger, landscape scale. Because insect life histories vary dramatically among species, generalizations about the causes of spatial variation in insect populations are problematic, but many populations go through similar processes that affect their spatial distributions and genetic structure over time. Processes that are relevant to population densities in agricultural settings include immigration, colonization, reproduction, emigration, and mortality. Immigration, colonization, and reproduction are part of population growth, whereas emigration and mortality cause population decline.

Population Growth and Spatial Variation

Immigration is the process of an insect population, comprised of a dispersive life stage, moving into a field. This may directly lead to spatial clustering of the immigrants at different scales. At the within-field scale, aggregations may occur at areas of initial contact (Fig. 6–1). Movement may be arrested via secondary plant metabolites (Metcalf & Metcalf, 1992), or initial immigrants may influence immigration behavior of other insects by the emission of pheromones or volatiles formed via the interaction of the host and the insect. At a landscape scale, immigration may be influenced by microenvironmental conditions that serve to define sites of specific behaviors, such as mating and resting (Tollefson & Calvin, 1994). Proximity to overwintering habitat or alternate hosts can influence spatial patterns during immigration (French et al., 1993). Furthermore, insects that do not overwinter in the landscape of the crop, but reinvade their geographic range on an annual basis via long-distance movement, may display spatial patterns resulting from immigration at a very large scale. The spatial patterns of these long-range migrants