

ANALYSIS OF AREA-WIDE MANAGEMENT OF INSECT PESTS BASED ON SAMPLING

David W. Onstad¹ and Mark S. Sisterson²

¹University of Illinois, Department of Crop Science, Urbana, IL 61801

²USDA ARS, San Joaquin Valley Agricultural Science Center, Parlier, CA 93648

ABSTRACT

The control of invasive species greatly depends on area-wide pest management (AWPM) in heterogeneous landscapes. Decisions about when and where to treat a population with pesticide are based on sampling pest abundance. One of the challenges of AWPM is sampling large areas with limited funds to cover the cost of sampling. Additionally, AWPM programs are often confronted with cooperators/farmers that resist participating in those programs. In this study, we evaluated AWPM programs based on sampling to determine under what conditions they reduce pest abundance and decrease pesticide use. We focused on a general insect pest, but results should be relevant to other pests that can be sampled before control.

We created an abstract model of the population dynamics of a pest inhabiting 1,600 sites in a 40x40 unit region. The pest has multiple generations per year and can move from natal site to any of eight neighboring sites in each generation. Population abundance and population parameters vary from site to site. Accordingly, simulations were completed

under assumptions about pest reproduction and biology that resulted in either low or high variation in pest abundance among fields. Fields were sampled to assess pest abundance on fixed intervals. Two AWPM programs were compared: synchronous and asynchronous. Synchronous AWPM treats all sites simultaneously once a spray threshold based on the mean pest density for the region is exceeded. Asynchronous AWPM permits cooperators to treat each site based on a sample from that site (the spray threshold is the same for all sites). In some simulations, site managers did not cooperate and those sites were never treated.

Synchronous AWPM can succeed even when a high proportion of fields are not sampled, but this type of AWPM allows pests in some fields to exceed acceptable levels as variation increases in the landscape. Because of high emigration from untreated fields in low variation scenarios, the number of treatments increases significantly as participation declines.