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Grasshopper Management

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Introduction

Grasshopper populations are present at some level in Iowa field crops each year. Widespread fluctuations in grasshopper populations occur as a function of natural factors such as weather conditions, predators, parasites and disease. Severe infestations usually occur during periods of hot and dry weather. During the drought of 1988 and 1989, grasshopper populations grew to extremely high numbers.

This dramatic increase is made possible by the tremendous reproductive capacity of grasshoppers. During dry years, female grasshopper have been found to lay 400 eggs in one season. Conversely, cool, wet weather coupled with the presence of natural enemies, severely limit reproduction and survival leading to reduced populations.

Feeding by large numbers of grasshoppers can cause significant yield loss or crop removal. C.J. Drake and G.C. Decker in 1932 stated that "Seventeen adult Differential grasshoppers per square yard in a 40-acre alfalfa field consume a ton of dry alfalfa per day." C. Wakeland in 1946 stated that "A grasshopper will eat its own weight in green food in about 16 hours" (Hantsbarger, 1979).

Grasshopper Species

The two most common grasshopper species found in Iowa are the red-legged grasshopper (*Melanoplus femurrubrum*) and the differential grasshopper (*Melanoplus differentialis*). The red-legged grasshopper is approximately one inch long and has a reddish-brown back and yellow underside. As its name indicates, the red-legged grasshopper has reddish coloring on its legs. This species prefers to feed on alfalfa, small grains and soybeans (Pfadt, 1988).

The differential grasshopper is one and one-half to one and three-quarter inch long. This grasshopper is yellow with contrasting black markings. The hind legs have black chevron-like markings. In the Midwest, the differential grasshopper will feed on many plant species and can be a severe pest on alfalfa, small grains, corn and soybeans (Pfadt, 1988).

Life History

These two grasshopper species overwinter as eggs in the soil. Eggs are primarily laid in the soil of grassy areas. The grasshopper nymphs hatch in late May and early June. There are usually five or six nymphal instars before the adult stage.

Up to the fourth instar, nymphs will feed near the area in which they hatch as long as food is available. After that, the grasshoppers will move into nearby crops to feed. Initially they will feed on the outer rows of the field, but when they become adults, their increased mobility will move them deeper into the field (Pfadt, 1988).

Natural Enemies

Grasshoppers are attacked by many natural enemies, including predators, parasites and diseases. Most of these individual organisms account for a very small reduction in grasshopper mortality, but together they can significantly reduce populations.

Of these natural enemies, diseases are the most important. Two diseases are especially noteworthy. The fungal organism (*Entomophthora grylli*) appears to cause very heavy mortality in grasshopper populations. A grasshopper infected with this disease moves to the top of a plant and "grasps the plant with the front and middle legs and extends its hind legs" before dying (Hantsbarger, 1979). After the grasshopper dies, the fungus spores appear on the outside of the grasshopper, and are released into the surrounding area. Spores that land on a healthy grasshopper penetrate the cuticle and infect the grasshopper with the disease. This fungal organism is active during warm, humid weather.

Nosema locustae is a protozoan pathogen that occurs naturally and is also available commercially. It is a relatively slow-acting disease and takes about 13 days before the grasshoppers begin to show symptoms of illness. Grasshopper densities have been reduced by about 50% within four weeks following applcation.

The protozoan is typically applied with wheat bran bait. The bait is usually only applied once during the year and unfortunately remains viable for only a few hours in the field.

Because grasshopper hatching is staggered throughout the late spring and summer, not all of the population will be directly exposed to the pathogen. Therefore, for the disease to effectively control grasshoppers, a large proportion of the population must consume the bait and then spread the disease to others. This disease transmission usually occurs when sick or injured grasshoppers are cannibalized by other grasshoppers. As a result, disease transmission is relatively slow. The use of *Nosema locustae* can be effective in reducing grasshopper densities in rangeland situations, but its slow method of action usually prevents its use in field crops.

Grasshopper Management

Currently, there are no reliable sampling methods to accurately determine grasshopper populations in field crops. The lack of a sampling method has limited the development of economic thresholds for grasshoppers in corn, soybeans and alfalfa.

Sampling Grasshoppers in Soybean

Precise sampling information provides the foundation for ecological research and pest management. The sampling of highly mobile insects, such as grasshoppers, can be especially difficult. Grasshoppers cause considerable injury to soybeans through defoliation and pod feeding. The inability to attain absolute estimates of grasshopper densities in soybean and other row crops has impaired research progress, including the development of objective management guidelines. Objectives of this work were:

1. Establish a sampling technique for obtaining estimates of absolute densities of grasshoppers in soybean.

2. Model relationships among sampling techniques for estimating absolute and relative densities.

3. Provide models for projecting absolute estimates of populations from relative estimates.

Procedures

Preliminary observations indicated that grasshoppers are markedly less mobile at night. In addition, both naked-eye observations and observations with infrared night vision goggles suggested that grasshopper movement between fields and surrounding areas at dusk is not significant. It was presumed, therefore, that grasshopper densities in a given locations are similar during day and night and that absolute estimates of density could be most easily attained at night.

Grasshopper populations were sampled from three fields at

selected intervals from 25 July to 29 August, 1989, and from 3 July to 9 September, 1990. To attain representative samples, rows 2 and 12 were sampled on each date. Sampling constituted day and night components. Two plant-removal samples per row were taken at night for estimates of absolute densities. For absolute estimates, a 56-cm diameter trash can filled with a liner was carefully placed over the plants. The liner was then quickly pulled from the trashcan and gathered around the plant stems at soil level. Stems were cut and the bag tied closed. Flashlights were used to provide adequate illumination for conducting the operation. Sweep samples (20 sweeps/row) were collected with a 38-cm sweepnet, both day and night, for estimates of relative densities. Sampling locations per row were selected at random from stratified areas designated for day-sweep, plant-removal, and night-sweep samples, respectively. Samples were returned to the laboratory so that counts and stage determinations could be made for each grasshopper species.

Results and Discussion

Regression analyses were conducted to model relationships among sampling techniques by stage class (nymphs and adults) and species (*M. femurrubrum* and *M. differentialis*) over years. Significant ($P < 0.10$) linear relationships were noted among all techniques for nymphs of both species. For adults, however, linear relationships only were significant between night sweeps and plant removal. Difficulty in obtaining significant relationships among day versus night techniques for adults is probably related to daytime flight activity. No species was observed flying at night.

Literature Cited

Pfadt, R. E. 1988. Field Guide to Common Western Grasshoppers. USDA APHIS, Wyoming Agricultural Experiment Station, University of Wyoming. Bulletin 912.

Hantsbarger, W. M. 1979. Grasshoppers in Colorado. Colorado State University Cooperative Extension Service.

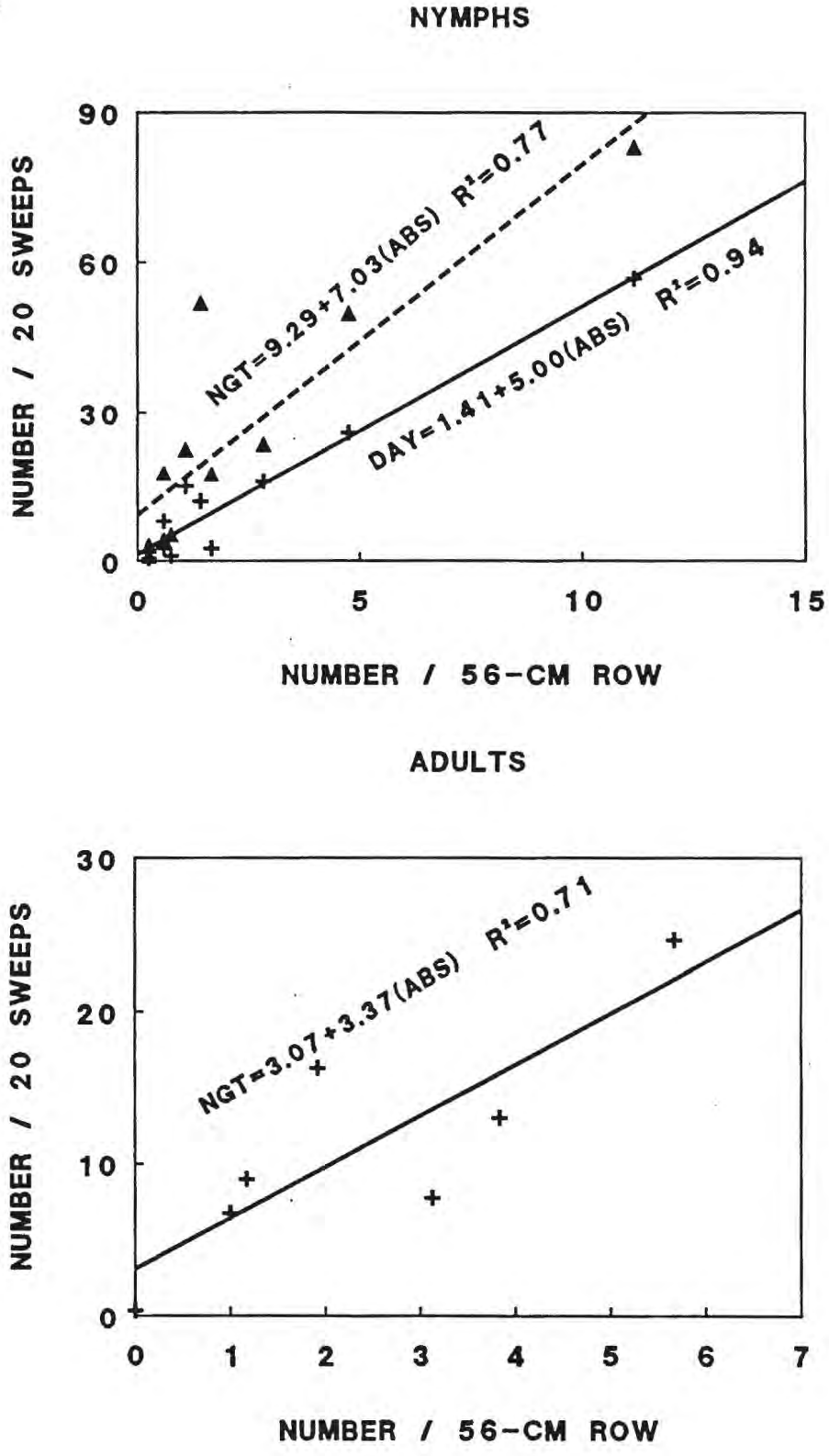

Figure 1. Relative vs. absolute density estimates for grasshopper nymphs and adults. Abs = plant removal; Day = day sweeps; Ngt = night sweeps.