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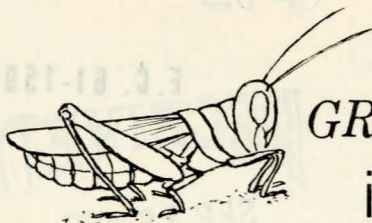
GRASSHOPPERS

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GRASSHOPPERS in Nebraska

by

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INTRODUCTION

For many years there has been a demand for basic information useable in the field on surveys, diseases, parasites, and control of grasshoppers. It is with this in mind that this work has been compiled. This publication is not intended as a technical work, nor will it answer all questions. If required, additional information is available through the University of Nebraska Extension Service or Experiment Station.

GENERAL INFORMATION

The life history of most grasshoppers is as follows: Nymphs hatch in the spring from eggs deposited in the ground the previous fall. The time of hatching is influenced by the weather. On the way to, or at, the surface of the soil, nymphs shed their natal skin, a white membranous covering which envelops and protects them. It takes about an hour for the nymphs to become colored, during which time they find a sheltered location, preferably in the sun. Feeding begins the following day.

From the time it hatches until it becomes an adult, the grasshopper moults five times (five instars), except in the case of Melanoplus differentialis (Thos.), which regularly has six instars, and M. bivittatus (Say), which frequently has six.

Approximately 40 days are necessary for development from hatching to the adult stage. An additional three weeks usually elapses before egg deposition begins. The process of egg deposition is similar in all species, but the habitat varies. The two-striped grasshopper (M. bivittatus) and the differential grasshopper (M. differentialis) usually prefer grass roots, especially bunch grass, or alfalfa crown covered with light debris, with good drainage and a maximum of sunlight. Thus their egg pods are often concentrated in the field margins.

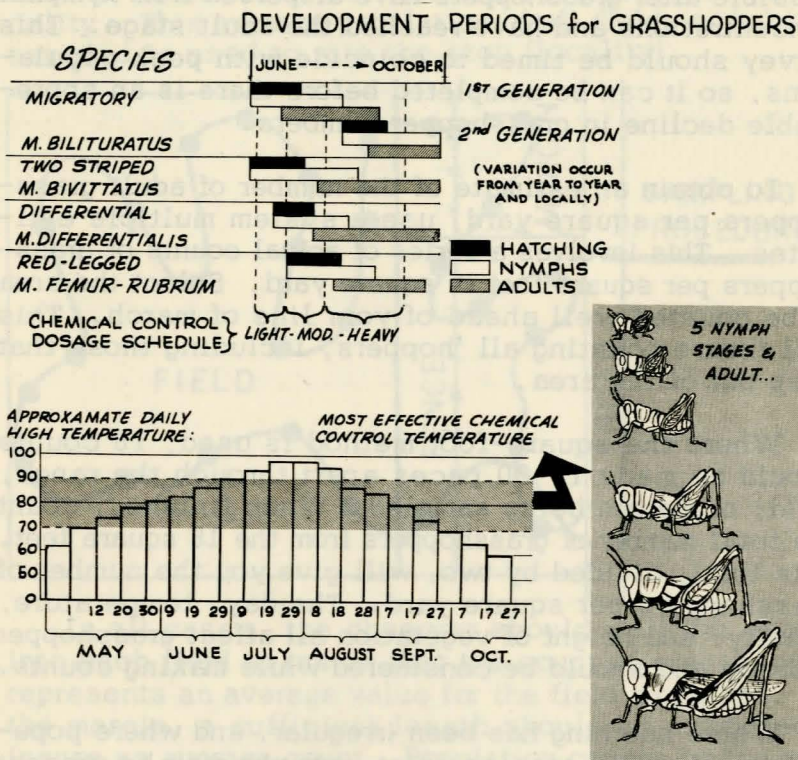
The migratory grasshopper (M. bilituratus (Walker)) (= mexicanus (Sauss.)), Packard grasshopper (M. packardii (Scudd.)), the red-legged grasshopper (M. femurrubrum (De geer)), and the Carolina grasshopper (Dissosteira carolina (L.)), tend to scatter their egg pods in more open ground. Also, M. bilituratus usually deposits its pods in masses in sand hummocks, roots of wheat stubble, or crowns of alfalfa.

Egg capsules of most species are deposited in the ground in the fall. The number of eggs per pod and the number of pods deposited per female depends on several factors, such as temperature, food available, drought,

etc. Dr. J. R. Parker^{1/} notes that the "...egg laying by individual grasshoppers shows the following maximum numbers of pods laid: A migratory grasshopper (M. bilituratus), 21 pods; a two-striped (M. bivittatus), 12; and a differential grasshopper (M. differentialis), 8."

SURVEYS

There should be four basic types of survey for grasshoppers each year: Developmental, nymphal, adult, and egg. These surveys can provide an accurate evaluation of the existing populations and an index of what to expect in the future.



^{1/} Dr. J. R. Parker was chief of the Research Lab., U.S.D.A.

Adult Surveys

The adult survey is probably the most important and most informative of the four types. The adult survey will give an evaluation of present conditions, the time and amount of egg deposition to expect, and the localities in which grasshoppers can be expected. It will mark areas of local and general infestation and native and/or migratory infestations. The population census will also give an indication of the grasshoppers' general well-being, the diseases, parasites, and predators present.

The adult survey should be conducted as soon as possible after grasshoppers have dispersed from nymphal concentrations and have reached the adult stage. This survey should be timed to coincide with peak populations, so it can be completed before there is an appreciable decline in grasshopper numbers.

To obtain an estimate of the number of adult grasshoppers per square yard, use a system multiple estimates. This involves a series of actual counts of grasshoppers per square foot or square yard. Select the area to be counted well ahead of your line of march. This will insure counting all 'hoppers, including those that jump out of the area.

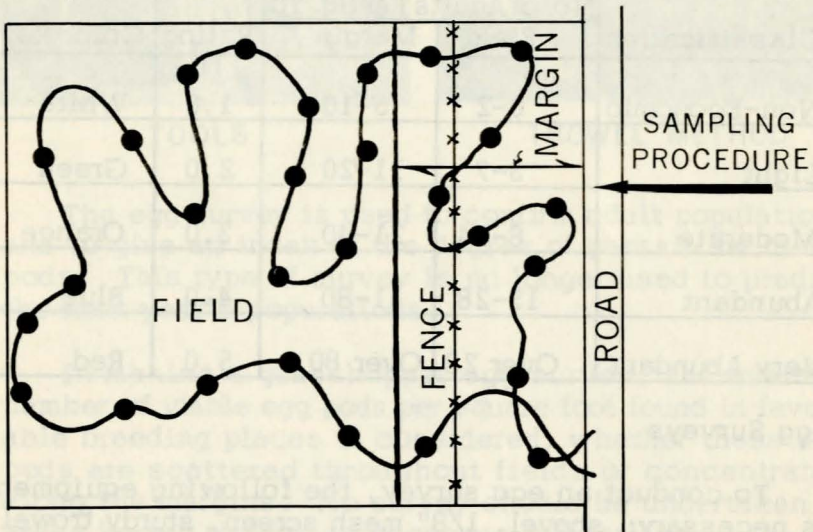
Where the square-foot method is used, 18 counts should be made 15-20 paces apart through the range, field, or margin being sampled. When finished, count the total number of grasshoppers from the 18 square feet. This total, divided by two, will give you the number of grasshoppers per square yard. The day, temperature, density, and height of vegetation all affect grasshopper activity and should be considered while making counts.

Where hatching has been irregular, and where populations of mixed species exist, nymphs may be present with adult grasshoppers. In making the adult survey, the nymphs in the fourth instar half grown or more should be counted as adults. If the nymphs are below the fourth instar and are numerous, it may be advisable to delay the survey until a later date. If delay is imprac-

tical, reduce the count of first to third instar nymphs to one-third, to give an equivalent adult count.

In large fields of 80 acres or more, and in range where vegetation is uniform, only one habitat need be examined.

In diversified crop areas, where fields are usually less than 40 acres, two or more fields should be sampled and the population of each crop determined. In range areas, where several vegetative types exist, each of the habitats should be sampled and the population in each habitat determined. These populations should then be averaged to determine a population for the locality. This average population of all fields or habitats sampled is used to rate the stop (locality).



In all cases, the observer should walk far enough into each field to insure that the count of grasshoppers represents an average value for the field examined. On the margin, a sufficient length should be examined to insure an average count. Population counts on the margin should also represent an average value for the entire width, from the edge of the road to the edge of the field. For narrow margins of less than two rods, the population count should be reduced proportionately. When there is no distinct vegetative difference, either in plant growth

or varieties of plant species, between the field and the margin, and there is no concentration of hoppers along the margin, the field count should apply. This would apply to some ungraded roads or roads through crops.

When marginal and field ratings differ, the higher rating should be assigned to the stop (locality). Field counts are not to be combined with the marginal counts and the average used to obtain ratings.

The rating table used by the U.S. Department of Agriculture and the State cooperating agency in their formal survey is given in Table 1.

Table 1. Adult Evaluation Table

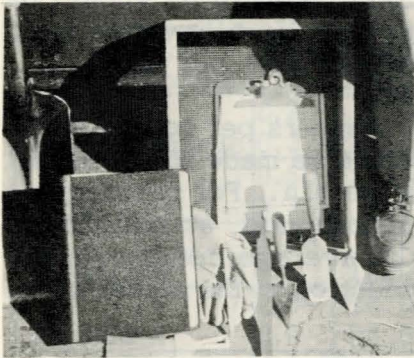
Classification	No. of Adults Per Sq. Yd.		Rating	Color Key
	Field	Margin		
Non-Economic	0-2	5-10	1.0	White
Light	3-7	11-20	2.0	Green
Moderate	8-14	21-40	3.0	Orange
Abundant	15-28	41-80	4.0	Blue
Very Abundant	Over 28	Over 80	5.0	Red

Egg Surveys

To conduct an egg survey, the following equipment is necessary: shovel, 1/8" mesh screen, sturdy trowel, and a file.

The survey consists of examining a square foot of soil to a depth of about two inches. This can be best accomplished by using a well-sharpened mason's trowel and shaving the area being examined, or by sifting the soil sample through the screen. Each method has its advantages and disadvantages. The sifting method is more reliable and should be used whenever practicable. Where soils are heavy or hard and sifting cannot be done, the trowel method is more applicable. The trowel

method is faster, but the danger of missing some of the egg pods is greater. In rangeland survey, the sifting method should be used almost exclusively as many of the egg pods of range grasshoppers are so small they can be easily missed. Where the trowel method is used, avoid being too selective in choosing samples and in estimating the size of the sample.



TOOLS



TROWEL METHOD

The egg survey is used to confirm adult populations and to give an index of the degree of parasitism in the pods. This type of survey is no longer used to predict the next year's populations.

In making a grasshopper egg survey, the average number of viable egg pods per square foot found in favorable breeding places is considered, whether these egg pods are scattered throughout fields or concentrated along the margins. No survey should be undertaken in areas known to lack an economic infestation.

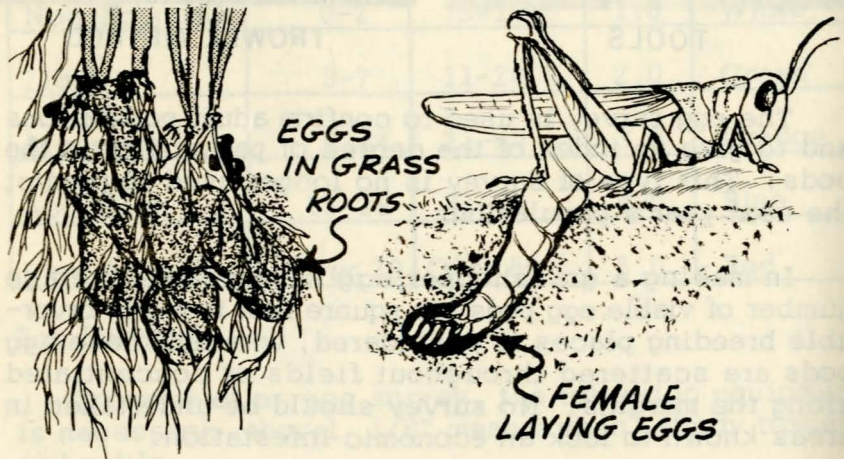
Five one-square-foot samples should be taken in both the field and the field margin in areas where important egg populations may occur. In areas known to be undesirable for grasshopper egg deposition, the number of samples may be reduced proportionately.

The field samples should be distributed so that representative parts of the field habitat are included. The margin samples should also be chosen on a repre-

sentative basis, taken from at least a ten-foot width of margin and not confined to clumps of grass or other favorable spots. If the margin is less than ten feet wide, the egg-pod count should be reduced proportionately.

When the egg survey is made, the adult grasshoppers may not all be dead; the number of adults per square yard, both in the field and along the margin, should be considered in rating the samples. No allowance need be made for populations of four or less per yard.

For populations of 5 to 10 'hoppers per square yard, an addition of 0.5 egg pods should be made to the actual average egg count for field or margin. For populations of 10 to 20 live 'hoppers per square yard, an addition of 1.0 pod should be made to the average count. In the case of a narrow margin, no reduction in the actual count should be made.



Only the viable egg pods are to be counted. Egg pods containing blister beetle, bee fly, or carabid larvae should be considered as destroyed. In some areas the eggs in the pod might be shriveled and no longer viable because of extreme heat or lack of moisture. All egg pods should be carefully examined before they are counted.