BIONOMICS OF INSECTS ASSOCIATED WITH CORN IN THE NEBRASKA SANDHILLS

by

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A DISSERTATION

Presented to the Faculty of

The Graduate College in the University of Nebraska

in Partial Fulfillment of Requirements

For the Degree of Doctor of Philosophy

Department of Entomology

Under the Supervision of

Professors John B. Campbell and Thomas J. Helms

Lincoln, Nebraska

February, 1974

TITLE

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ACKNOWLEDGEMENTS

My deep and sincere appreciation is extended to the following people for their assistance during the course of this study:

Dr. Thomas J. Helms and Dr. John B. Campbell, major professors, for their guidance throughout the course of this study and for making suggestions in the manuscript.

The supervisory committee for their cooperation, interest and assistance in planning and evaluation of the project.

Dr. Alexander B. Klots, formerly Research Associate, American Museum of Natural History, New York, N. Y., for identification of the webworm species found during this study.

Dr. George E. Ball, University of Alberta, Edmonton, Alberta, for identification of the carabids.

Dr. Charles A. Triplehorn, The Ohio State University, Columbus, Ohio, for identification of tenebrionids.

Mr. Brett C. Ratcliffe, University of Nebraska-Lincoln, for identification of scarabs.

Dr. R. H. Foote, USDA Systematic Entomology Laboratory, Beltsville, Maryland, and members of his staff, for identification of elaterid, braconid, ichneumonid and tachinid specimens.

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INTRODUCTION

The sandhill region of Nebraska, which is a vast natural grassland, is experiencing a period of rapid agricultural development. This area occupies 20,000 square miles of north central Nebraska and is characterized by rounded dunes interspersed with small valleys and numerous shallow lakes (U.S. Department of Agriculture 1941). These relatively flat interdune areas are suitable for profitable corn production when center pivot irrigation systems are used to deliver both water and nitrogen. Because of the abundance of groundwater, high-yielding irrigation wells can be obtained by drilling to depths of less than 300 ft. (Fenster and Lane 1973).

Investigations were conducted in the sandhill region during 1972 and 1973 in attempts to delineate the impact of the transition to irrigated corn on selected insects. Primary emphasis was placed on identifying indigenous species that may be economically important to corn production. Investigations included: transect surveys for the presence of corn pests in cornfields cultivated for various periods of time; comparisons of seasonal activity of insect species found in corn and grazing land; studies on the impact of irrigation on insects in the adjacent prairie; and examination of cornfields during the first year of production for damage by insects that had been associated with native grasses.

Land-use changes have often resulted in a drastic disturbance of the environment of the local insect fauna and consequent changes in its composition. According to Uvarov (1961), the essential feature of these changes is a radical reconstruction of the injurious fauna of useful plants. The results reported herein provide a point of reference for future development of pest management programs for corn in the Nebraska Sandhills, hereafter referred to as the Sandhills.

DESCRIPTION OF THE STUDY AREA

The study area included fields in the Sandhills and fields in non-sandhill locations. Non-sandhill fields were included to complete the north to south transects of cornfields from the area of the Niobrara River to the area of the Platte River Valley. The majority of the cornfields are irrigated by center pivot irrigation systems, each of which covers approximately 160 acres.

A serious problem associated with corn production in sandy soils is wind erosion. If the soil is left without cover, severe wind erosion results in drifts of sand and large eroded pockets called "blowouts." To reduce wind erosion, some growers sow a cover crop of ryegrass immediately after harvest. Porosity is a second serious problem associated with sandy soil. The poor water holding capacity of this porous soil dictates the almost continuous provision of irrigation water which in turn causes leaching. Fertilizer is usually applied at planting time, but must also be injected into the irrigation system during mid- and late summer because of leaching. This continual addition of water and fertilizer results in a nearly hydroponic culture.

A few of the corn growers routinely use soil insecticides as insurance against the western corn rootworm (WCR), *Diabrotica virgifera* LeConte, although the insect is not known to be of economic importance in this area. Use of soil insecticides during the first year of cultivation is a

common practice by some growers due to previous experience with cutworms and other insects which attack seedling corn.

The following are abbreviated locality descriptions of fields studied during 1972 and 1973:

Locality No. 1

Location - Cherry Co.; east side of Hwy. 83 and 2 mi. south of the junction of Hwys. 83 and 20.

Year first cultivated - 1963

Year first irrigated - 1966

Insecticide use - throughout entire cropping history

Field description - Sandhill

Locality No. 2

Location - Cherry Co.; 25 mi. south of Wood Lake, Nebraska.

Year first cultivated - unknown

Year first irrigated - 1960

Insecticide use - none

Field description - Sandhill

Locality No. 3

Location - Cherry Co.; 12 mi. north of the Thomas Co. line and 6 mi. west of Hwy. 83

Year first cultivated - 1967

Year first irrigated - 1967

Insecticide use - first year of cultivation only

Field description - Sandhill

Locality No. 4

Location - Cherry Co.; west side of Hwy. 83 and 13 mi. north of the Thomas Co. line

Year first cultivated - 1971

Year first irrigated - 1971

Insecticide use - none

Field description - Sandhill

Locality No. 5

Location - Cherry Co.; 13 mi. north of the Thomas Co. line and 2 mi. east of Hwy. 83

Year first cultivated - 1970

Year first irrigated - 1970

Insecticide use - soil insecticide during 1973

Field description - Sandhill

Locality No. 6a

Location - Logan Co.; east edge of Hwy. 83 and 15 mi. north of Stapleton, Nebraska

Year first cultivated - 1973

Year first irrigated - 1973

Insecticide use - soil insecticides

Field description - Sandhill

Locality No. 6b

Location - Logan Co.; 15 mi. north of Stapleton, Nebraska, and 3 mi. east of Hwy. 83

Year first cultivated - 1972

Year first irrigated - 1972

Insecticide use - soil insecticide during 1973

Field description - Sandhill

Locality No. 7

Location - McPherson Co. (Univ. of Nebraska Sandhills Ag Lab); 9 mi. north of the junction of Hwys. 92 and 97

Year first cultivated - 1973

Year first irrigated - 1973

Insecticide use - none

Field description - Sandhill

Locality No. 8

Location - McPherson Co.; 7 mi. north of the junction of Hwys. 92 and 97

Year first cultivated - 1973

Year first irrigated - 1973

Insecticide use - none

Field description - Sandhill

Locality No. 9

Location - Logan Co.; east side of Hwy. 83, 1 mi. south of Stapleton, Nebraska

Year first cultivated - unknown

Year first irrigated - 1968

Insecticide use - none

Field description - non-sandhill

Locality No. 10a

Location - Lincoln Co.; 15 mi. north of North Platte, Nebraska and 3 mi. west of Hwy. 83

Year first cultivated - unknown

Year first irrigated - 1968

Insecticide use - none

Field description - Sandhill

Locality No. 10b

Location - Lincoln Co.; 15 mi. north of North Platte, Nebraska and 3 mi. west of Hwy. 83

Year first cultivated - 1972

Year first irrigated - 1972

Insecticide use - none

Field description - Sandhill

Locality No. 10c

Location - Lincoln Co.; 15 mi. north of North Platte, Nebraska and 3 mi. west of Hwy. 83

Year first cultivated - 1973

Year first irrigated - 1973

Insecticide use - none

Field description - Sandhill

Locality No. 11

Location - Lincoln Co.; east side of Hwy. 83 and 1/2 mi. south of the Garfield Table Road

Year first cultivated - unknown

Year first irrigated - 1970

Insecticide use - none

Field description - non-sandhill

Locality No. 12

Location - Keith Co.; 10 mi. north of Paxton, Nebraska

Year first cultivated - 1970

Year first irrigated - 1970

Insecticide use - none

Field description - non-sandhill

METHODS AND MATERIALS

Webworm Sampling and Rearing

Collections of webworms were made at 2 locations during 1972 (Localities 6b and 10b) and at 3 locations during 1973 (Localities 6a, 7 and 10c). Larvae were taken from soil surrounding coleoptiles of damaged corn plants during May - July of 1972 and 1973, then transported to the laboratory in 2-dram vials containing moist sand. The difficulty of identifying webworm larvae to the generic and specific levels necessitated larval rearing and subsequent adult identification before damage could be attributed to individual species. During 1972, larvae were placed onto soil adjacent to seedling corn plants growing in 4-in. clay pots. All attempts to rear field-collected larvae failed during 1972. During 1973, field-collected larvae were successfully reared on an artificial diet, Riddiford's modified diet (Dupnik and Kamm 1970). Larvae were placed in 1-oz. cups (Fig. 1) (Van Brode Milling Co., Inc., Clinton, Mass.) containing the artificial diet and held in a growth chamber (80-85°F, 60-65% relative humidity and 16-hour photophase).

Eggs were obtained from webworm moths which were collected at Locality 7 on September 15, 1972 and held in 2 x 2 1/2 in. screw-cap jars. Larvae hatched from these eggs were placed into 1-oz. media cups (Fig. 1). The food source consisted of leaf tips of seedling corn which were inserted

through 1/2-in. slits cut in cup lids. Cellucotton was packed around the slits to avoid larval escape.

Webworm damage to corn, and resulting stand reduction, was studied at weekly intervals in 3 replicates (50 ft. long and 4 rows wide) that had been randomly selected from a large webworm-infested area at Locality 10b during 1972 (Table 1). To provide estimates of larval numbers, damaged plants in the second row of each plot were removed from the soil and examined. Infestations at other localities during 1973 were similarly sampled.

Five-minute counts were made of webworm moths which flew along or across transects of pastures adjacent to Localities 7 and 10c in an attempt to measure periods of peak flight activity (Fig. 5). Fifty moths were randomly collected after each transect-count was completed, and the total numbers of each species present, expressed as a percentage of the sample, was multiplied by the total number of moths observed during the counting period. These data were used to estimate the species composition of the observed moth flights (Fig. 6).

Pitfall Trapping

Pitfall traps were used during 1972 and 1973 to capture adults of 4 selected families of beetles, Carabidae, Scarabaeidae, Tenebrionidae and Elateridae. Although accurate measures of true population sizes could not be obtained from this approach, it was helpful in identifying periods of

major insect activity as well as indicating comparative differences in beetle activity between habitats.

The tops of the pitfall traps were prepared by drilling 1/2-in. holes into 2 1/4-in. metal screw-cap lids, inserting a 4-oz. funnel into each and soldering them in place. These tops were attached to 2 x 2 1/2 in. jars filled to the level of 1 in. with 80% ethanol and buried with the funnel rims flush with the soil surface. Jars were replaced on a weekly basis and samples stored for later identification. To prevent sand from filling the holes in the soil, 3 x 6 in. segments of galvanized pipe were used as a liner.

During 1972, 32 pitfall traps were arranged in the prairie at Locality 7 in a 4 x 8 lattice with 20 ft. spacing between traps. At Locality 6b, 20 traps each were placed in the cornfield and adjacent prairie with a 20-ft. spacing between traps and a 5 x 4 lattice arrangement.

During 1973, extensive pitfall trapping was conducted at 2 locations (Localities 7 and 8). At Locality 8, 27 traps were placed in the cornfield as well as in the adjacent prairie. Each replicate consisted of a series of 3 randomly arranged equilateral triangles with their basal angles spaced 50 ft. apart and having either 5, 15 or 50 ft. sides. Traps were placed in the corners of each triangle. Three replicates were placed in the prairie with the bases of each triangle in replicate 1 located 50 ft. from the junction of the prairie and the cornfield. The vertex of each triangle pointed away from the cornfield. Replicates