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Northerly Movement of Corn Borer Moths in Southern Minnesota

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ABSTRACT—Seventeen light traps were installed in 6 counties in southwest Minnesota in 1962 and 1963 and the nightly catches of moths of the European corn borer were recorded. The results show that moth catch was higher during nights with south winds and the nights immediately following such nights. This relation occurred over a large area and during the entire flight period. Moth population in southern Minnesota was increased when south winds prevailed during the flight period. The trapping and recording were carried out by 15 FFA members, 1 4-H member, and 1 adult farmer. The project demonstrates that these young people represent a valuable pool of human resources for use in solving certain scientific problems.

The European corn borer, *Ostrinia nubilalis* (Hbn.), is one of the most important insect pests of corn in Minnesota. It overwinters as a mature larva that pupates in May. Adult moths emerge and oviposit in June. Larvae feed on leaves, sheaths, tassel, and finally in the stalks of corn. Some of the larvae pupate and change to adults in late July, August, and early September. The eggs from these adults result in a second brood of infestation.

The level of the second-brood infestation in a given locality is dependent upon the amount of summer pupation and the number of moths that may come in from other localities.

Stirrett (1938), in his thorough study of the factors affecting corn-borer moth flight, did not mention the importance of wind direction and indicated that winds of velocities of 5 to 25 mph had little effect on flight. Schurr and Holdaway (1965) observed large-scale dispersal flights of corn borer moths in southern Minnesota during two consecutive summers. They considered that these flights originated in areas of Iowa but did not study the possible effect of winds.

The present study is conducted (1) to verify the flight from the south, (2) to determine if such flights take place throughout the period of summer-brood moth activity, and (3) to determine if such flights are associated with certain wind and temperature conditions.

The general procedure was to set up a series of light traps along a 150-mile east-west transect located in the southernmost tier of counties in Minnesota. The traps were less than 20 miles from the Iowa boarder and were in positions to intercept moths flying northward from Iowa.

Through the assistance of Vocational Agricultural teachers in six counties in southwest Minnesota (Rock, Nobles, Jackson, Martin, Faribault, and Freeborn), 17 cooperators (15 FFA members, one 4-H member, and one adult farmer) were recruited (not including the one whose records were not used). Each helped by placing one trap on his farm and by checking the moth catch daily during the second-brood moth flight. The distribution of the traps is shown in Figure 1. Thirteen of the 17 cooperators continued the project in 1963, and one recruited a neighbor to substitute in 1963.

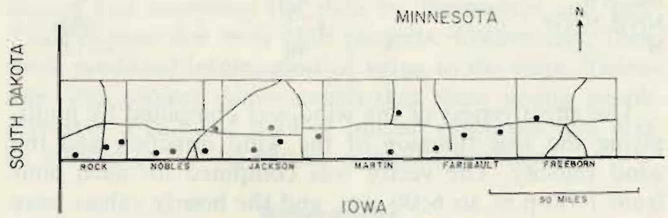

FIG. 1. The distribution of the 17 light traps in the 6 counties in southwest Minnesota.

Procedures

From August 1 to August 31, 1962, and from July 21 to September 9, 1963, the numbers of male and female moths caught in each trap each night were recorded. Before the season began each cooperator was visited and furnished with a reference collection containing male and female corn-borer moths and other moths that could be mistaken for corn borer-moths. Assistance was given to each cooperator in selecting the site on his farm for installing the trap. Detailed written instructions and record sheets were furnished. During the season, guidance when needed was given to the cooperators by their teachers. The cooperators and their teachers were visited again at the end of the season. Their performance and reliability by their identifications were evaluated by both their teachers and us. The records of one individual in the initial group were not used because his identification was of doubtful accuracy.

The correlation between the number of moths caught and weather conditions was analyzed. Each cooperator recorded the daily maximum and minimum temperatures. Neither the cooperators nor the nearest official weather stations kept wind records, however. Therefore, the wind records kept by five stations located around the trapping area were analyzed. It was found that the major charac-

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teristics of winds were very similar in the five localities (Minneapolis, Minnesota; Rochester, Minnesota; Des Moines, Iowa; Sioux City, Iowa; and Sioux Falls, South Dakota), suggesting that the wind pattern over the entire area, including the transect of traps, was about the same. Since we were interested in the effect of the winds from the south, the records of Des Moines, Iowa were used.

The effectiveness of the wind in the northward movement of moths depends on (1) the northward component of the wind and (2) the velocity of the wind. The northward component of winds of different directions is represented by the sine function of the angle between the wind direction and the east-west axis, as shown in Table 1.

Table 1. Sine Functions of Winds of Different Directions

Direction of wind	degree from the east-west axis	Sine function
S	90	1.0
SSE. SSW	67.5	0.9
SE. SW	45	0.7
ESE. WSW	22.5	0.4
E. W	0	0
ENE. WNW	22.5	−0.4
NE. NW	45	−0.7
NNE. NNW	67.5	−0.9
N	90	−1.0

The effectiveness of the wind was computed by multiplying the sine function of the wind direction and the wind velocity. The vector was computed for each hour from 7:00 p.m. to 6:00 a.m. and the hourly values were summed to give the overall south-wind vector for the night.

If the moth flight was associated with south winds, it was hypothesized that high catches would occur during nights with a high positive vector and low catches with a negative vector.

Results

At the initiation of the study, it was hypothesized that with traps spanning over 150 miles along an east-west transect, catch records of individual traps might show some differences due to local typography and to their positions relative to the source of moths. After studying the records it was soon realized that if such differences were present, the samples were not large enough to analyze the effects of topography and proximity to population concentrations. Therefore, the traps were simply considered as replicates. This was justified also because the wind pattern showed no consistent differences along the entire transect.

The average minimum temperatures, the wind vectors and the average number of moths caught per trap were plotted. Those for 1962 are in Figure 2, and for 1963 in Figure 3.

Discussion

The results show that high catches occurred during nights with a strong south wind, or during nights following such nights, and that this relation held during the

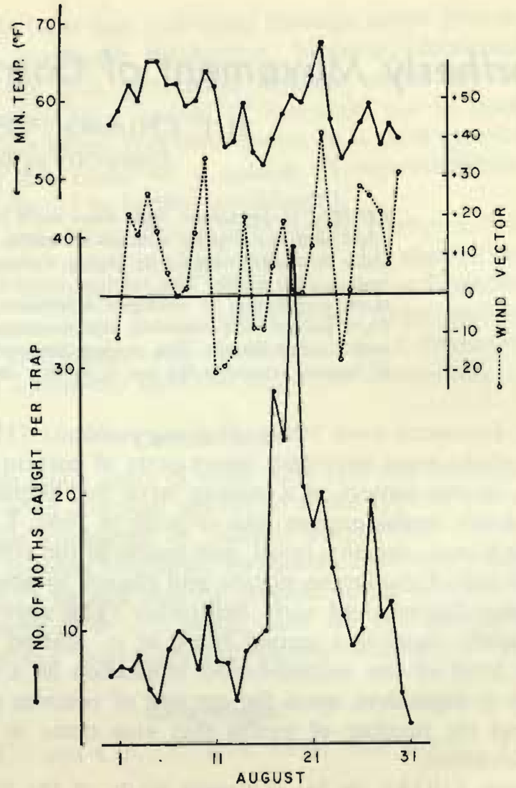

FIG. 2. The daily minimum temperature. wind vector and moth catch, August 1-August 31, 1962.

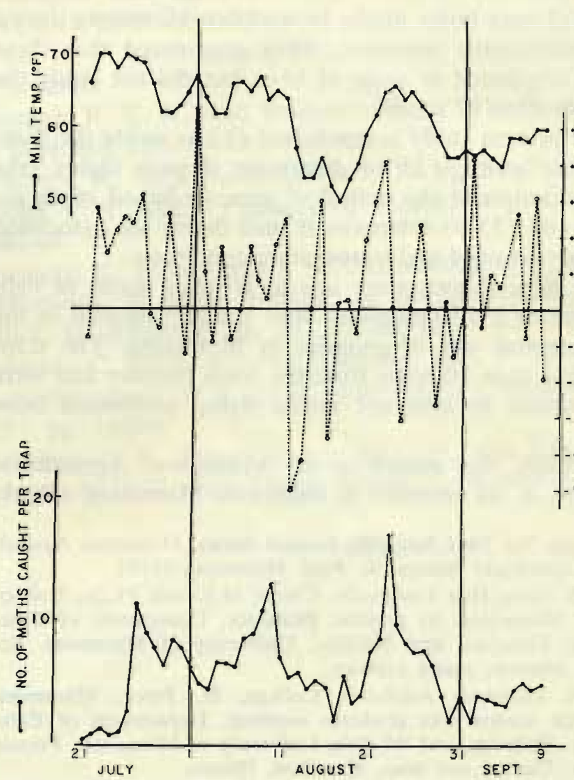

FIG. 3. The daily minimum temperature, wind vector and moth catch, July 21 to September 9, 1963.

month of August, in 1962, and for the entire flight period in 1963. It should be noted that because of the local meteorological patterns, nights with predominantly south winds also had higher minimum temperatures that also favored moth activity.

The wind conditions in August, 1963, had more nights with negative wind vectors, indicating that fewer nights were favorable to moth movement from Iowa into Minnesota. The general level of moth catch was much lower in 1963 than in 1962.

It is conceivable that the south wind not only moves moths from Iowa into Minnesota, but also will induce a continuous northward displacement. If this were true, then, when there were more warm nights and more south winds during moth flight in a given year, borer infestation would be found further north in Minnesota. This situation in fact occurred in 1949. In that year, the seasonal temperature was the highest in a 10-year period (Chiang and Hodson, 1959a), and the infestation extended farthest north (Chiang, 1961).

The second-brood adult population in a given area may be increased if the number of moths carried into the area exceeds that carried out of the area, and it may be reduced if the reverse is true. Since the borer populations south of Minnesota are likely to be higher, the displacement induced by south winds is likely to result in increases in moth populations in southern Minnesota. This was shown by the population records kept in Waseca, Minnesota, in 1955. In that year, the seasonal temperature was high, particularly in August (Chiang and Hodson, 1959a, Chiang et al, 1961), the per cent increase of borer population from summer to fall was also the highest both in an experimental plot (Chiang and Hodson, 1959b), and in Waseca County as a whole (Chiang et al, 1961).

In conclusion, the study shows that moth catch was higher during the nights with south winds and the nights immediately following such nights. This relation occurred over a large area and during the entire flight period. Moth population in southern Minnesota was increased when south winds prevailed during the flight period.

A Special Note Regarding the Cooperators

The names of the cooperators, their teachers, schools and home counties are listed below. Their efforts are gratefully acknowledged.

Working with these young people was an interesting experience for the authors. In six cases, two brothers served as a team and operated one trap. In some others, the entire family showed intense interest. Many of the cooperators received club credits in undertaking this project, and some received local press publicity. Thus, this activity, besides providing us with useful data, also aroused local interest in insect problems and highlighted the programs of FFA and 4-H clubs. Several of the cooperators continued to help us in another project in 1964.

Individually, the cooperators gained experience in obtaining and analyzing the data by themselves and produced reports for their club projects. Collectively, their work produced information of value to the state. Therefore, this project demonstrates that these young people represent a valuable pool of human resources that may be utilized in solving certain scientific problems.

FFA Member Cooperators	Vocational Agricultural Teacher	School	County
Baker, Warren & Gerhart	Erickson, Wendell	Hills H.S.	Rock
Bremer, Howard & Martin	Bellin, Floyd*	Ceylon H.S.	Martin
Boettcher, John	Johnson, Ramsey	Blue Earth H.S.	Faribault
Carson, Howard & Douglas	Stassen, Kenneth	Sioux Valley H.S.	Jackson
Clymer, Larry	Schwieger, Delbert	Jackson H.S.	Jackson
Evans, Paul	Johnson, Ramsey	Blue Earth H.S.	Faribault
Friedel, Dennis	Nelson, John	Alden H.S.	Freeborn
Hansen, Karen**		Luverne H.S.	Rock
Harens, Dave & Don	Larson, Walter	Worthington H.S.	Nobles
Murray, Daryl	Johnson, Ramsey	Blue Earth H.S.	Faribault
Ricard, Darwin, & Leland	Bellin, Floyd	Granada H.S.	Martin
Ruskell, Ken	Schweiger, Delbert	Jackson H.S.	Jackson
Saxon, Dale	Swanson, LeRoy	Round Lake H.S.	Noble
Spoelstra, Merle	Larson, Walter	Worthington H.S.	Rock
Swanson, Steven & Stuart	Erickson, Wendell	Hills H.S.	Rock
Tiesler, Glen**			Nobles
Timko, Terry	O'Conners, William	Lakefield H.S.	Jackson
Titus, Mark	Schweiger, Delbert	Jackson H.S.	Jackson

* County Agricultural Agent.

** Miss Hansen, 4-H member; Mr. Tiesler, adult farmer.

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