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Ecology of Insect Swarms. III. Intraspecific Interference in the Swarms of Anarete sp. near felti Pritchard (Cecidomyiidae, Diptera)

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Ecology of Insect Swarms. III. Intraspecific Interference in the Swarms of Anarete sp. near felti Pritchard (Cecidomyiidae, Diptera)[1]

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During a study of the swarming behavior of the midge *Anarete* sp. near *felti* Pritchard, mating groups of midges were observed dropping out of a swarm onto a white board which was used to attract them (Chiang 1961). It was noticed that most of such groups consisted of more than two individuals. Since this phenomenon indicated an intraspecific interference in swarming insects and has been only occasionally recorded, some quantitative observations were made when the opportunity presented itself.

The groups of midges which dropped out were collected with an entomological aspirator and were transferred to alcohol, each group in an individual vial. This procedure was carried out during the hours 1100 to 1215 C.S.T., on August 18, 1960. 21 such groups were collected from two swarms. The individuals in each group were later sexed and counted. At the end of the period of observation and collecting, all the individuals remaining in the swarms were collected with a fine mesh net, sexed and counted. There were 235 males and 2 females. One of the females was on the board when collected.

The numbers of groups with different combinations of males and females are shown in Table 1. A normal mating pair and a group with one female and two males are shown in Figures 1 and 2 respectively. The distinctive genitalium of a female and that of a male are shown in Figures 3 and 4 respectively.

The results in Table 1 show the following points:

FIGURE 1: One female (large) and one male (small) in copulation.

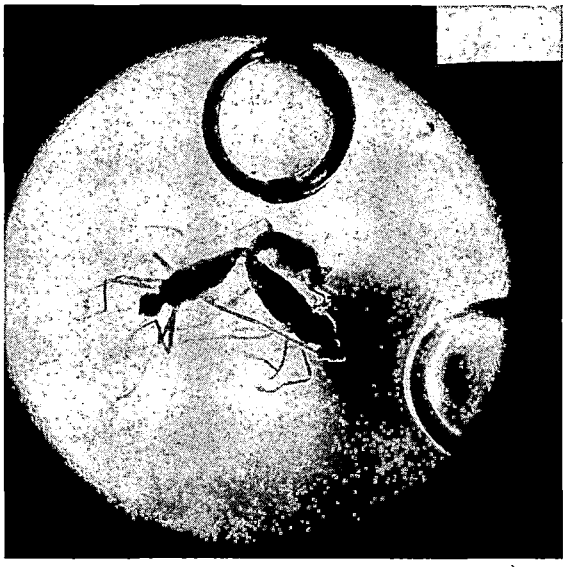

FIGURE 2: One female (heading lower right) and two males in a cluster.

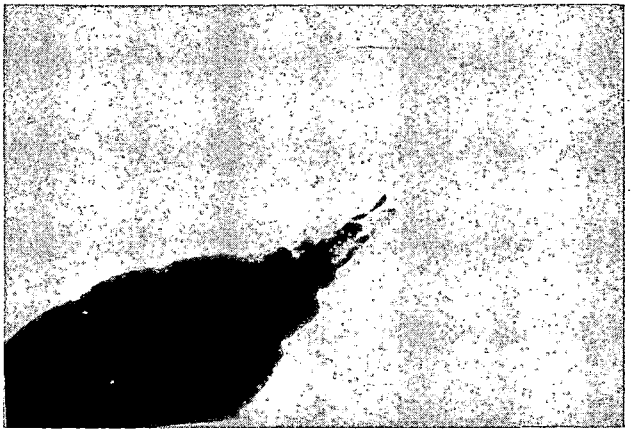

FIGURE 3: Distinctive female genitalium.

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TABLE 1. Frequency of drop-out groups with different combinations of male and female midges.

Category	Combination of Individuals in a Group ♀	♂	Number of Groups	Number of Females Involved	Number of Males Involved	Total Number Midges Involved
a	1	1	3	3	3	6
b	1	2	3	3	6	9
c	1	3	4	4	12	16
d	1	4	4	4	16	20
e	1	5	2	2	10	12
f	1	6	2	2	12	14
g	1	7	1	1	7	8
h	0	2	1	0	2	2
i	0	6	1	0	6	6
Total			21	19	74	93

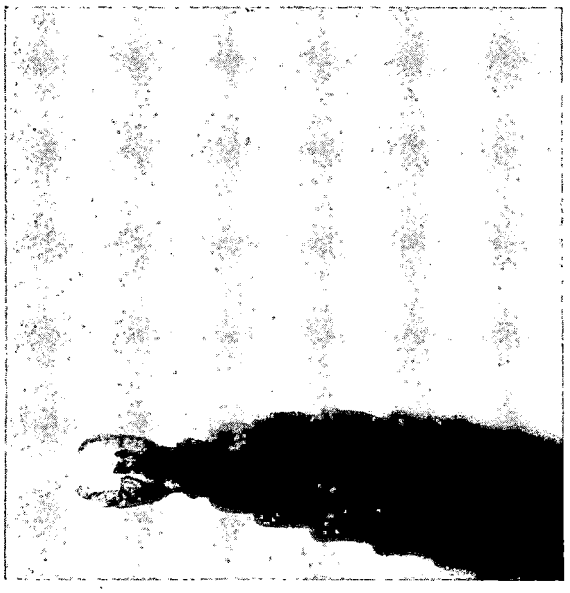

FIGURE 4: Distinctive genitalium of a male.

a. Of the 21 groups which dropped on to the board, 18 (categories "b" through "i"), or 86%, involved multiple males with or without females. These are interpreted as representing unsuccessful matings. The category "a" which included 3 groups, or 14%, involved the normal combination of one male and one female. The individuals could be engaged in normal mating. Normal mating couples have been observed either to fall on to the swarm marker as in *Metriocnemus* (Gibson, 1945), or to drift downwind as in *Culicoides nubeculosus* (Downes, 1950). In the present study, it is difficult to say whether or not the three groups of category "a" represented all of the normal mating pairs. Thus alternative interpretations may also be offered. (1) The falling resulted from some unnatural positions which either individual might have assumed, and (2) these pairs represented multiple-male groups of which the extra individuals disengaged during the fall.

b. Out of the approximately 300 midges initially present in the two swarms, 87 of both sexes (29%) and 71 males (24%) (categories "b" through "i") involved in unsuccessful mating. These midges were collected as soon as they dropped out, hence the size of the swarms had been decreasing during the period of observation. Under natural conditions, however, some of these midges would probably rejoin the swarm after disengaging themselves, and the size of the swarms would not have diminished as much. It has been observed (Chiang, 1961) that the frequency of drop-out is proportional to the size of the swarm. Hence, the number of males involved in unsuccessful mating under natural conditions would perhaps be somewhat higher than 24% observed here.

c. Among the 16 multiple-male groups (categories "b" through "g"), one group had as many as 7 males, and there was not a predominance of 2-male groups. These two facts suggest that the males must have engaged themselves in a group instantaneously as the female entered the swarm. For, if the males had approached the female one by one, there would have been more groups with smaller number of males. The observation that only 2 females were among the 235 midges in the swarms also supports the suggestion. The instantaneous approach of the female by males has been reported by Downes (1950) in *Culicoides nubeculosus*, and implied by Knab (1906).

d. There were two groups with no female at all (categories "h" and "i"). This fact suggests two possibilities. First, a female midge had disengaged during the fall, and second, one of the males had been mistaken as a female.

e. There was no group with more than one female. This is to be expected in view of the known phenomenon that females independently enter the swarm of males and in view of the quick approach of the males as just described.

The facts observed are different from those recorded in other swarming insects. Knab (1906) observed in *Culex pipiens* that with the growing darkness in the evening, the excitement of the mosquitoes increased and that females entering the swarm would be pounced upon by two or three males. He further stated that such individuals tumbled over each other, fell to the ground and there separated. The midge in the present study is a diurnal species, and did not show extra excitement when multiple-male mating groups appeared. Cambournac and Hill (1940) in their work on *Anopheles maculipennis* reported that two males approached the same female, and the three flew together until one of the males gave up. It may be inferred from this statement that the presence of an extra male did not affect the balance of the normal pair in flight, and that normal mating ensued after the extra male left the pair. The midge in the present study

is again different in that the multiple-male groups did not maintain a normal balance and hence dropped out.

Another point may be mentioned. Multiple-male groups have been recorded for very few swarming insects. The paucity of records on this factor of intraspecific interference may be due to the difficulty in observing such incidences rather than suggesting that the factor is uncommon among swarming insects.

In summary, these observations show that a significant proportion of the male midges was involved in unsuccessful mating due to interference by other males, and also suggest that the male approached the females entering the swarm almost instantaneously.

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BOTANY

Occurrence and severity of the viruses of strawberry in Minnesota

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SUMMARY: Approximately 900 plants of commercially grown strawberries of 45 varieties and experimental seedling selections were collected from various parts of the state of Minnesota and indexed for the presence of viruses. Their presence in these plants was demonstrated by the appearance of symptoms in the indicator plant, *Fragaria vesca* L., after they were inarch-grafted. 93% of the plants indexed were virus-infected. Based on symptoms, the viruses have been classified into 14 symptom-types. It was found that mottle and mild yellow-edge were the two dominant viruses, whereas crinkle and vein chlorosis were of rare occurrence. There was no indication that certain symptom-types are associated with particular commercial varieties of strawberries or experimental seedling selections.

INTRODUCTION: Plakidas (6) first reported diseases of strawberries of a virus nature in the United States in 1926. Harris (3) reported the occurrence of a virus disease in England in 1933. Since then many reports on strawberry viruses have been made which have dealt principally with new diseases, methods of transmission and control measures. A comprehensive review of the literature has been made by Plakidas (7).

Investigations on the prevalence of strawberry viruses in commercial varieties grown in 11 eastern states was made by Demaree and Marcus (1). They found all the commercial varieties affected and that nearly all the plants of each variety were contaminated with certain viruses regardless of the states in which the strawberries were grown in the United States. This paper reports the prevalence of viruses in strawberries grown in Minnesota (1951–57).

MATERIALS AND METHODS: In Minnesota commercially grown strawberry varieties which were to be studied were collected by members of the staff or sent to the experiment station by nurseries and growers from 19 counties in Minnesota. In addition, clonal plants were also collected of potential new varieties from the University Fruit Farm of the Minnesota Experiment Station at Excelsior, Minnesota. Approximately 900 plants from 45 varieties and experimental seedling selections (Tables 1 and 2) were collected and indexed to *Fragaria vesca* L., an East Malling clone of the indicator species. When one or more stolons had developed on an indicator plant to the stage where the terminal bud was geniculate, it was grafted to a plant of a selected commercial variety. The inarch-grafting of stolon-to-petiole or stolon-to-stolon was used in all the studies (4, 5). The petiole selected for grafting was the youngest which could be handled with reasonable facility and generally was about the same diameter as the stolon of *F. vesca* (indicator plant).

Symptoms resulting from virus infection in the indicator plants usually began to appear within 4 to 8 weeks after grafting depending on the season of the year. The success of the grafts were determined by severing the grafted petiole or stolon from the test plant 10 to 17 days after the grafts have been made (2).

The development of symptoms in the indicator such as epinasty, chlorosis, stunting and crinkle were recorded and grouped together into classes according to a system developed by Skiles (10) (Table 3).

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