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Drift of Terrestrial Arthropods in an Irrigation Canal Following a Wide-Area Application of ULV Malathion[1]

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Abstract

Numbers of arthropods drifting in an irrigation canal were recorded at 30-min intervals during and after an upstream application of ULV malathion. Flower-visiting and parasitic Hymenoptera were the first insects to increase; a bimodal drift pattern resulted from an interruption in the spray application. Diptera exhibited a delayed response but the numbers collected, especially *Paracantha culta* (Wiedemann), suggest high susceptibility. Ants occurred in large numbers over a long period, but mortality was probably low. Miridae and Cicadellidae were probably more susceptible than Orthoptera and adult Odonata but had similar delayed drift patterns. Tetragnathidae were the most, and Thomiscidae the least, susceptible spiders.

ULV malathion at 8 fl oz/acre (9.7 oz AI) was applied aerially to a 16-mile[2] area in Dawson County, Nebraska, in August, for 3 consecutive years, in an attempt to reduce the populations of the western corn rootworm, *Diabrotica virgifera* LeConte. The fate of many organisms was monitored in corn and alfalfa, the 2 principal crops in the area, but manpower limitations prevented complete monitoring of other habitats.

Giles (1970) used surface-drift samples in monitoring a study in Ohio in which malathion was applied to a forested watershed. The treated area in Dawson County is traversed by 2 irrigation canals. Numerous arthropods were observed drifting down these canals after the 1968 and 1969 treatments. An experiment was designed to determine the composition of this drift during the 1970 treatment.

Methods

A rectangular net 2 ft wide × 1 ft deep, constructed of 18 mesh/in. plastic screen, was used to collect the surface drift. The net was submerged to a depth of 6 in. Samples were taken from a bridge 1 mile downstream from the point where application of the insecticide began on Aug. 10, 1970. Samples, each of 10-min duration, were taken every 30 min, beginning at 2:50 p.m. and continuing until 8:20 p.m. on the day the treatment was applied. Spraying, in a N–S direction, began at 2:00 p.m. and progressed from W to E in the direction of the canal's flow. The surface current was slightly less than 1 ft/sec which would have permitted the 1st affected arthropods to appear in samples ca. 4:20 p.m. Eastward progress in making the malathion application was at a slower rate than the flow of the canal, the sample point itself not being treated until 6 p.m. A 30-min break in the continuity of the treatment occurred between 5:00 and 5:30 p.m. ca. 1/4 mile upstream from the sample site.

Results and Discussion

Many species of arthropods appeared in the surface drift but, except for cited examples, there were few individuals of any 1 species. Thus, arthropods were grouped by families or orders as they appeared in similar patterns in the drift. Figure 1 presents the data graphically.

Flower-visiting bees and wasps, and parasitic Hymenoptera, were among the 1st numerous insects to appear in drift. At the time of their 1st appearance, only a small part of the area had been treated and only insects having an immediate loss of coordination could have been involved. The bimodality of abundance in drift is further evidence of an immediate response. Bees and wasps decreased in abundance following the interruption in the treatment at 5:00 p.m., increased again after treatment was resumed, and decreased rapidly after the entire area had been treated.

The early appearance of ants in the drift indicates that some individuals must have been affected immediately. Numbers gradually increased, and the drift of ants continued long after the entire area had been treated. Considering the abundance of ants and their presence on vegetation overhanging the canal, we are inclined to conclude that mortality was low in spite of the large number collected in drift.

The families Dolichopodidae (several species) and Tephritidae (almost entirely *Paracantha culta* [Wiedemann]) accounted for 48% of all the drift of the order Diptera. The preponderance of these 2 families suggest they may have been especially susceptible, even though their appearance in the drift was somewhat delayed. The numbers of *P. culta* seemed large in relation to the low abundance of thistle, its known host, along this canal.

The lapse in time to the 1st appearance in drift was even greater for Hemiptera (mostly Miridae) and leafhoppers (Cicadellidae). In alfalfa, the mortality of Miridae exceeded 90%; thus immediacy of response is not related necessarily to mortality. A similar pattern was exhibited by Orthoptera (52% late instar to adult *Melanoplus differentialis* [Thomas]) and Odonata. Both of the latter groups are known to have survived the treatment in some numbers.

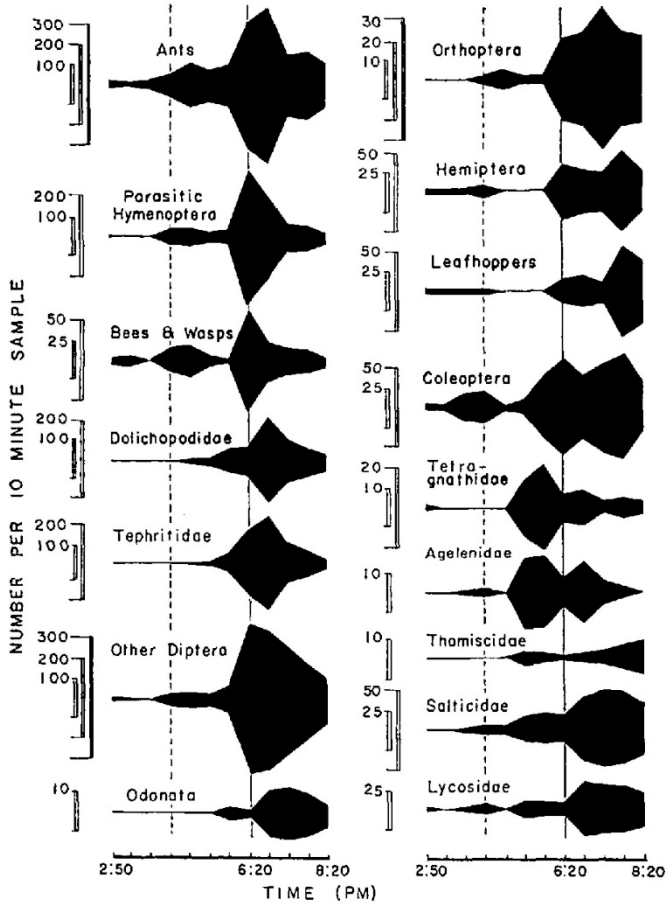

Figure 1. Number of arthropods taken in surface drift after an application of ULV malathion, Dawson County, Nebraska, 1970. Vertical dashed line is potential earliest time at which insects affected by treatment could have appeared at sample site; vertical solid line is time at which entire area upstream from sample site had been treated.

The bimodality in drift of Coleoptera seemed due to differences in the susceptibility of various families. Coccinellidae were extremely susceptible in other habitats. Of the total beetle drift before 5:50 p.m., 30% were Coccinellidae, whereas only 4% of the beetle drift after 7:20 p.m. were representatives of that family.

Only 14 western corn rootworm adults appeared in the drift, although this was the most common species in corn fields adjacent to the canal, and 95% control was achieved. While the mortality of southern corn rootworm, *D. undecimpunctata howardi* Barber, was very low in alfalfa, almost as many as (12) were collected in drift. This species, however, was far more abundant on vegetation overhanging the canal, and drift samples seemed highly selective for species living in that habitat. Many species abundant in cropland only a few feet removed from the canal, and known to have suffered high mortality, appeared in the drift in only low numbers.

These evaluations of drift samples are subjective because of a lack of information on the size of the area which contributed to the drift and populations within that area. Yet data from other habitats are useful in interpreting certain groups. The low number of Thomiscidae taken in drift corresponds with our inability to measure any mortality in alfalfa where these were the most common spiders collected. The much less common Tetragnathidae, however, suffered ca. 80% mortality in alfalfa and far outnumbered Thomiscidae in drift. The drift pattern of Agelenidae was very similar to that for Tetragnathidae and perhaps also indicates susceptibility. The bimodal drift patterns suggest a 30-min delay between time of potential contact with the insecticide and loss of coordination. The delay was greater for Lycosidae and Salticidae, but no conclusions can be drawn about their susceptibility because of lack of information on their abundance along the canal.

Any arthropod increasing in numbers in drift posttreatment (there were low numbers of many groups drifting pretreatment) must have some degree of susceptibility. The value of the method increases in direct proportion to the accuracy with which statements can be made about the abundance of species in the habitat from which the drift samples arise. Such information was not available in the reported study. The data suggest that the drifting insects were almost entirely from among those present on the immediate banks of the canal.

Note

1. Contribution no. 372, Department of Entomology, University of Nebraska. Published with approval of the Director as Paper no. 3642 in the Journal Series, Nebraska Agricultural Experiment Station, Lincoln. Received for publication June 7, 1973.

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