SENTINEL COLONIES OF DIAMOND-BACK LARVAE FOR EARLY SEASON DETECTION OF PARASITES

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Of the 700,000-odd species of in-ects so far recognized by science ome suspect that there may be a illion or more), a great many make eir livings from original sources, for xample by sucking blood or plant ices, chewing hair, wool, or stored ood products, feeding on dung or arrion, chewing a wide variety of liage, collecting nectar and pollen, or oring in plant stems or tree trunks. But ose species that live by feeding on ther insects as parasites or predators umerically exceed those living by most ther principal means. There are ughly 100,000 species of the Order ymenoptera (bees and wasps) and of ese a very large number are parasitic predaceous on other insects. Diptera lies of certain families) are the other reat specialists in parasitism. Some arasitic species are so closely adapted and associated with their hosts that ey form an exclusive, integrated host-rasite complex. Bertha armyworm nd its principal parasite, a menopteran, seem to be an example such a complex.

The author's own interest in rasitism is a narrow one, stemming om his former concern with the amondback moth (an annual immi-ant into our latitudes) and its larvae *lutella xylostella* (L.) Lepidoptera: lutellidae), and the factors affecting its undance in our rapeseed, or as we y nowadays, our canola fields. rasitism turned out to be one of those ctors.[1] Two small hymenopterans ere involved, *Microplitis plutellae* ues., of the family Braçonidae, and *Diadegma insularis* (Cress.), family Ichneumonidae; you may have read about a few of the larger species of the latter. Adults of both species are too small to attract popular attention, so they have no common names. The adaptations of these parasites to the size and life cycle of the small host diamondback larva is close: one host supports one parasite larva to its maturity, and the emergence of the adult stages of the successive generations is concurrent. As the host larva matures, the parasite larva emerges (finishing off the host of course) and spins its own cocoon. *M. plutellae* forms a brown, oval cocoon about the size of a small grain of wheat. This adheres to whatever surface (leaf, stem, etc.) the host larva was on when the parasite emerged. *D. insularis* emerges and spins up inside the loosely woven cocoon that the host larva had intended (so to speak) to use for itself. Many of the pupae inside the cocoons of *M. plutellae* quickly transform to adults and emerge, and probably all those of *D. insularis* do so. They come out and fly in time to go to work on the closely following next generation of diamondback larvae. Next time diamondback larvae are abundant, sweep up a hundred or so and rear them in a cage. You will probably get not only diamondback pupae, followed by moths, but cocoons of both parasites, soon too followed by their adults.

The first generation of diamondback larvae is often confined, at the beginning of the season, to weed mustards such as flixweed, a winter annual, and volunteer canola. The larvae at this stage are often scarce, and yet a high percentage of them are parasitized. High percentage parasitism in a low population is not thought of as normal, so why this? It was suspected that the adult parasites, particularly *M. plutellae*, might be present and waiting when the first diamondbacks of the season hatched.

To investigate this, I developed a method suggested by the "sentinel chicken flock" idea.[3] This involves the periodic testing of blood samples from chickens in these flocks for the presence of antibodies developed in response to western equine encephalitis inoculated by the bites of mosquito carriers. In my adaptation, a hundred or so tiny diamondback larvae were counted out onto canola plants supported in a greenhouse pot. These "colonies" were then exposed in the open at ground level for three or four days, and retrieved and replaced. The retrieved colonies were isolated in cages, and incubated in a greenhouse for sufficient time for the diamondback larvae to mature and any parasites to emerge. All insect material was then identified and counted. Since the exposures were begun before any insect activity in the spring, the dates of first appearance in the field of the parasites could be known with a precision of three or four days.

Experiments using the technique described above were carried out during the period 1971-75 inclusive, at four stations in Saskatchewan: Saskatoon, Watson, Melfort, and Aylsham, totalling 13 station-years (not every station was used during each of the five years). Dates of arrival of immigrant diamondback moths were being watched for at the same time by other means. The technique is regarded as having worked reasonably well. Retention of host larvae was commonly about 60 per cent, except in cases of an early season frost that killed the plants. Chicken wire cages were adopted to protect th plants from hares at times when ther was no other succulent vegetation. Aft the presence of parasites was fir detected by means of the sentin colonies, colonies successively expos ed nearly always continued to sho parasitism.

As a generalization, *M. plutellae* wa commonly first detected during the latte half of May, and *D. insularis* during th first half of June. Percentage parasitisr in the recovered insect material wa sometimes up to about 90 percent, bu varied widely and averaged about 5 percent. Larvae exposed in the colonie could become parasitized, particularl by *M. plutellae*, before naturally occur ring host larvae became available. Th evidence for the presence of *M plutellae* prior to that of naturally occur ring host larvae was therefore quit strong; their readiness would explain th high percentage parasitism in the firs collectible host larvae of the seasor Later, it was shown that *M. plutellae* ha adaptations, i.e. diapause in part o each pupal generation, and cold hardi ness, that could permit it to overwinte locally, and that it in fact did so. Usually, but not invariably, *M. plutellae* was detected before *D. insularis*; th latter has no known adaptations fo wintering in our climate. It is therefor thought to be an annual immigrant, bu this is not certainly known.

How do tiny wasp-like adult parasite home in on an isolated cluster o *Brassica* sp. plants carrying an infesta tion of host larvae? Are there so many o them that orientation and flight from a considerable distance is not necessary Do they just drift along on the breeze and bump into the plants more or les on the basis of random encounter? I something attracts them, even from a short distance of a few m, is it the plant or the host larvae on the plants? O perhaps more logically, first the plants and then the larvae? Experiments have not been designed and performed to btain answers to these questions; there night be ingenious persons out there who could think of ways to do it. The apability of an insect to orient toward n attractant source can be very great, s we have known for some time from e very general phenomenon of the action of male moths to a unique sex ttractant released by females of the ame species.

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[2] PUTNAM, L. G. 1978. Diapause and cold hardiness in *Microplitis plutellae*, a parasite of the larvae of the diamondback moth. Can. J. Plant Sci. 58 (3):911-913.

[3] RAINEY, M. B., G. V. WARREN, A. D. HESS, and J. S. BLACKMORE. 1978. A sentinel chicken shed and mosquito trap for use in encephalitis field studies. Mosquito News 22(4):337-342.

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