Noldus
Information Technology

Locomotor activity in parasitoid insects measured by EthoVision

Stefano Colazza, Ambra Clemente and Marzia Rosi

Using EthoVision for Animal Behavior Research

Because of their impact on insect populations, parasitoid wasps are widely used for the biological control of agricultural and forest pests. Co-evolution of parasitoids and their hosts has intimately linked the behavior of these natural enemies with the biology of phytophagous insects. Entomologists agree that effective utilization in pest control programs requires a detailed knowledge and comprehension of the behavioral relationships between the bitrophic system of parasitoid and host.

Video tracking

Until now, behavioral studies have been based on observations and laborious and error-prone manual measurement of the insect's reactions to internal or external stimuli. The arrival of automatic video tracking systems has given this discipline the possibility to move from description towards a more systematic way of data collection. The main innovation of these systems is the real-time processing of images captured by a video camera. This has overcome difficulties related to the small size of the subjects under study and allows long recording periods without intervention by the operator. This greatly reduces the occurrence of errors during data collection and summarization. Compared to traditional recording systems, video tracking systems make data collection more objective, speed up the statistical processing, and consequently facilitate the analysis of behavior in terms of its ecological significance.

Host finding by parasitoids

Parasitoid wasps reproduce by laying their eggs in or on other insects. In its daily activity, a female wasp is faced not only with the problem of food or mate finding, but also with the search for suitable hosts for the progeny. Many parasitoid species reach this goal by a space-time sequence (involving both flight and ambulatory movements) which orient them towards the host, mainly utilizing olfactory cues. The fitness of a searching wasp is a function of its host-finding ability; its efficiency as a biological control agent can thus be correlated to this behavior. The final step of host-location behavior is predominately performed by walking. Locomotory activity thus plays a major role in the life cycle of these insects.

Selection for improved quality

There is genetic variability in the walking behavior of some parasitoid populations (intra-population variability) and among strains of conspecifics (intra-specific variability). These genetic variations have been quantified with various parameters used to describe female walking, e.g. walking speed, turn angle, pause duration. These parameters could be used as a selection criterion to improve the quality of natural enemies, in terms of searching efficiency and parasitism rate, taking into account their genetic basis and link to efficiency. In fact, positive correlations have been found between differences in speed of travel among different parasitoid strains under laboratory conditions and field performance, as well as between the daily amount of walking activity and the number of eggs parasitized by a female.

Experimental approach

The parasitoid of this study is Trissolcus basalis, an egg parasitoid of Nezara viridula, a worldwide pest known as Southern Green Stink Bug. The main purpose of our research is to evaluate variations in response of T. basalis to host stimuli (in particular the sex pheromone produced by N. viridula males). The activity of females exposed to host odor was compared with that of a control group. Activity was measured in terms of locomotion parameters (trajectory, linear speed and turn angle) and daily activity rhythms. If these differences are confirmed, individual variability and genetic control of these characters will be checked. Genetic variability analysis requires a great number of observations on different subjects. The EthoVision system allows recordings of eight individuals at the same time. Using EthoVision at its highest potential, we used eight exposure chambers (6.4 cm3, insect:arena volume ratio about 1:21000) built on a plexiglass sheet, sandwiched between two glass sheets. Each arena is connected with an airflow system that creates an air stream (30 ml/min) into the chambers and through which we provide the olfactory stimulus. The setup is observed with a single monochrome CCD camera fitted with a 12.5-75mm/F1.8 zoom lens, under infrared light (950 nm, 108 led) to which insects are not sensitive.

The versatility of the system offers the possibility of sampling subjects at defined time intervals during the experiment, and varying experimental parameters for each observed insect. This provides long-term unattended observation during which it is possible to give evidence of possible individual variability in locomotion parameters and daily activity of parasitoids when exposed to host odors. This will hopefully help us to increase the success of biological pest control programs.

References

1. Bin, F.; Vinson, S.B.; Colazza, S. (1987). Responsiveness of Trissolcus basalis (Woll.) females (Hym.: Scelionidae) to Nezara viridula (L.) (Het.: Pentatomidae) in an olfactometer. Parasitoid Insects (Lyon, 7-10 Sept. 1987), Colloq. de l'INRA, 48, 15-16.
2. Colazza, S. (1993). Il comportamento degli insetti entomofagi studiato con l'aiuto di supporti informatici. Inform. Fitopatol., (7-8), 5-10.
3. Colazza, S.; Pompanon, F. (1994). Ritmo giornaliero dell'attività locomotoria degli adulti di Trissolcus basalis (Woll.) (Hymenoptera: Scelionidae). Atti XVII Congr. naz. it. Entomol. (Udine, 13-18 Giugno 1994), pp. 647-650.
4. Limburg, H.; Pak, G.A. (1991). Genetic variation in the walking behaviour of the egg parasite Trichogramma. Proc. 5th Workshop Quality Control of Mass-Reared Anthropods (Wageningen, 25-28 March 1991), pp. 47-55.
5. Pompanon, F.; Fouilliet, P.; Allemand R.; Boulétreau, M. (1993). Organisation temporelle de l'activité locomotrice chez les trichogrammes (Hym. Trichogrammatidae): variabilité et relation avec l'efficacité du parasitisme. Bull. Soc. zool. Fr. , 118, 141-148.
6. Vinson, S.B. (1994). Physiological interactions between egg parasitoids and their hosts. In: Biological Control with Egg Parasitoids (eds. E. Wajnberg & S.A. Hassan), pp. 201-217. CAB International.
7. Wajnberg, E. (1994). Intra-population genetic variation in Trichogramma. In: Biological Control with Egg Parasitoids (eds. E. Wajnberg & S.A. Hassan), pp. 245-271. CAB International.
8. Grayson, G.B. (1975). The Hampshire Child Pedestrian Accident Study. Department of the Environment, TRRL LR 668, Crowthorne.

Contact Information

Stefano Colazza Institute of Entomology, University of Perugia, Perugia, Italy.
E-mail: colazza@unipa.it