PHENOTYPIC EXPRESSIONS OF POLYGENES IN
MUSCIDIFURAX RAPTORELLUS [HYM. : PTEROMALIDAE],
A SYNANTHROPIC FLY PARASITOID

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The precise phenotypic measurements, percent multiple oviposition and the number of parasitoids developed per host, can be used to assess quantitative genetic variation governing multiple oviposition and development in the muscoid Diptera parasitoid, Muscidifurax raptorellus Kogan & Legner. Evidence for polygenic control was based on the significance of correlations between expected genomic content and behavioral expression. Data accumulated from 8 oviposition days seem sufficient to measure accurately polygenic expression in this species.

KEY-WORDS : Polygenes, Muscidifurax, Hymenoptera, muscoid diptera.

In the synanthropic muscoid Diptera parasitoid, Muscidifurax raptorellus Kogan & Legner, inheritance of quantitative behavior associated with gregarious oviposition (> one individual developed per host) and fecundity is accompanied by some unique extranuclear influences which cause changes in the oviposition phenotype of females prior to the production of their progeny. Males are able to change a female’s oviposition phenotype upon mating, by transferring an unknown substance (Legner, 1987, 1988, 1989a). It appears as if a proportion of the genes in the female are phenotypically plastic and can change expression under the influence of substances in the male seminal fluid (Legner, 1988, 1989a). The intensity of this response is different depending on the genetic composition of the male and female. Full expression occurs in the F1 female (Legner, 1989a).

There is an obvious interinvolvement of a chemical legacy and genomic change in this species (Legner, 1987, 1988, 1989b), although no satisfactory explanation exists for the precise way in which the magnitude of behavioral change in mated females is correlated with the genotypes of the male and female (Legner, 1989a). This discovery in M. raptorellus has opened questions into the nature of polygenic loci. The ability of the male substance to “switch” a proportion of loci on or off in the female suggests active and inactive stages for such loci. Polygenic loci generally are thought to be occupied by genes coded for a fixed kind of expression (Wright, 1968).

Because males, within their own generation, are capable of activating in their female mating partners, a part of the species' genetic make-up, it was suggested that natural selection in this system should be accelerated, not having to wait to act on traits expressed only the progeny after chromosomal inheritance (Legner, 1987, 1988). Thus, not only may Muscidifurax haploid males provide a means for the rapid elimination of unfavorable genes
as suggested for such organisms by Dobzhansky (1941), but they may serve to quicken the pace of natural selection for both nonlethal undesirable and desirable characteristics (Legner, 1988).

For biological control, greater importance may be placed on liberated male parasitoids during mass release strategies which seek to seasonally accelerate and increase the magnitude of parasitism. It may be possible for such males to convey certain desirable racial characteristics directly to unmated females already resident in the environment. Additionally, hybridization phenomena associated with inheritance of multiple oviposition behavior may produce new desirable genetic combinations with higher fecundities than either parent, but which still retain high host searching capacity (Legner, 1988).

These findings dictate that all behavior studies involving female Hymenoptera must consider immediate genomic influences from male partners. Further research into this parasitoid system should provide unique opportunities for understanding quantitative inheritance and pathways to genomic change and genetic improvement of parasitic insects for biological control. However, the techniques employed to assess phenotypic expression of multiple oviposition behavior are labor intensive, requiring 16 daily provisions of age and size classed hosts (Legner, 1987, 1988). This study was designed to refine measurements of polygene expression utilizing several behavioral traits that are demonstrated daily during the parasitization process.

MATERIALS AND METHODS

The inheritance of multiple oviposition was followed in separate cohorts of 10 1-day-old females of the Chilean and Peruvian populations of *M. raptorellus*. Females were isolated in screened polystyrene vials (4-cm³), with a basal area of 7 cm². They remained virgins or were mated for one day to ≤ 1-day old males secured at random from mass cultures. Backcrosses of the 1st, 2nd and 3rd orders were made to randomly chosen males from the 2 populations. Each female was supplied daily with 20-24 to 30 h-old puparia of *Musca domestica* L. (6.4 ± 0.5 mm × 2.8 ± 0.2 mm), distributed randomly over the vial base. Flies were reared to pupation using commercial CSMA® medium. Parasitoid cultures were in their 6th generation when studies began.

Host puparia were exposed to parasitoids for 24 h at 25.5 ± 1 ºC, 55 % RH, and a 13L:11D photoperiod of ca. 269 lux irradiance at table level. Light was supplied by fluorescent lamps. Puparia were then incubated separately in gelatin capsules (10 by 25 mm) for the emergence of parasitoid and host progeny. Unemerged puparia were dissected to detect aborted parasitism, which averaged < 5 %, giving credibility to adult parasitoid emergence data.

Total parasitoid progeny, gregarious ovipositions and number of parasitoids developed per each gregarious oviposition, were recorded for each female for 16 days, or about half the life expectancy in the described environment.

The proportion of hosts in which parasitoids oviposited more than one egg, and developed gregariously, and associated phenotypic variances were estimated from each population by the response of individual replicate females. Because in Hymenoptera hybrid males do not occur together with hybrid females in their F₁ generation, the F₂ generation was produced by backcrossing males issuing from F₁ females to F₁ females, through a staggering of generations. These haploid males of course were not all hybrid. But at least 8 genetic loci are believed to be active in this system, as judged by the continued display of gregarious oviposition in cohorts that had been diluted to 1/8 th of the Chilean (gregarious) parent's genome through a series of backcrosses to Peruvian (solitary) males (Legner, 1987,