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Studies on Mass Rearing and Field Release of *Tetrastichus hagenowii* and *Evania appendigaster* for the control of *Periplaneta americana*.

by

MARY PETER

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ABSTRACT

Studies were carried out to investigate the possibility of mass rearing the two oothecal parasitoids of Periplaneta americana: Tetrastichus hagenowii and Evania appendigaster for field release, with the objective of increasing the natural parasitism level among oothecae of P. americana.

The two species of parasitoids and P. americana: the host (for obtaining oothecae) were mass reared in the laboratory in specially constructed cages, during which certain aspects of their biology and parasitism were investigated, with a view to obtain the maximum number of parasitoids and their host.

Initial experiments on the release of parasitoids were carried out to find out (a) the best stage of parasitoid for release i.e. whether to release adult parasitoids or parasitized oothecae, (b) the best release ratio i.e. the minimum number of parasitoids needed in relation to the number of live oothecae present, for maximum parasitisation of oothecae. Field studies were carried out in places infested with cockroaches; such as dwelling houses, restaurants, store rooms, grocery shops and kitchen cupboards; where initially the natural level of parasitism of P. americana oothecae was determined. Subsequently

laboratory reared parasitoids (parasitized oothecae) were released at these sites in order to increase the level of natural parasitism.

The mass production of P. americana under laboratory condition, for obtaining oothecae, was relatively successful with a 17% mortality rate at hatching and 19% mortality during nymphal development (specially during instar 1 - 3). Fifty, P. americana oothecae, thus reared, finally yielded 190 males and 410 females, over a period of ten months. These females when held in batches of fifty with fifteen males, laid 40 - 50 oothecae every week and continued to do so for 390 days.

The longevity of laboratory reared, fed, adult female and male P. americana was 408.65 ± 11.6 and 207.95 ± 15.5 days respectively. Females commenced oothecal production 13.8 ± 0.8 days after the last moult and continued until their death. Females laid a total of 49.0 ± 1.25 oothecae/female during their entire adult life, with a peak oothecal production of 5 oothecae/month, during the 4th and 5th month of adult life. Continuous mating was found to be essential for maximum oothecal production as well as for the deposition of viable oothecae.

Mass production of the two parasitoid species under laboratory conditions resulted in a parasitism success of 96.7% for T. hagenowii and 96.2% for E. appendigaster and an emergence success of 94.5% and 95.7% respectively. The sex ratio among laboratory reared T. hagenowii and E. appendigaster was 1:3 (male:female). Under laboratory conditions, the mating success among the parasitoids, inferred on the basis of the sex of the progeny, was 91.5% for E. appendigaster and 95.0% for T. hagenowii.

E. appendigaster and T. hagenowii when reared under laboratory conditions produced 9 and 11 generations a year respectively, while P. americana produced only a single generation during the same period. Thus, the developmental period of E. appendigaster was 41.1 ± 0.2 days & that of T. hagenowii was 32.4 ± 0.3 days, while in P. americana the intra oothecal development lasted 39.51 ± 0.1 days and the 9 nymphal instars, 276.6 ± 1.9 days.

The longevity and fecundity of the two parasitoid species were significantly increased when fed. Although, mating had no effect on longevity or fecundity of the parasitoids, mated females produced both male and female progeny and unmated females, male progeny only, making both T. hagenowii and

E. appendigaster parthenogenetically arrhenotokus.

Studies carried out to maximise parasitism under laboratory conditions inferred that T. hagenowii is capable of successfully parasitizing only two oothecae, during its entire life time, during which a total of 82.8 ± 2.0 eggs are laid. E. appendigaster on the other hand with a maximum fecundity of 15.8 ± 0.4 is able to successfully parasitize about 13 oothecae during her life time. However, during parasitization, a single ootheca has to be exposed to E. appendigaster for not more than 30 minutes, in order to prevent superparasitism. In a superparasitized host, only a single egg will develop successfully into an adult parasitoid, while the remaining eggs/larvae are suppressed and destroyed. Under laboratory conditions, successful development and parasitization of both parasitoids occur in younger hosts or oothecae (0 - 15 days old) than in older (20 - 35 days old) oothecae.

Investigations on the best stage of parasitoid for release indicated that parasitized oothecae can be effectively and conveniently substituted for adult parasitoids. Placing of parasitized oothecae brought about significantly higher or similar levels of parasitism compared to the release of

an equivalent number of adult parasitoids. A simple but an effective method of distinguishing parasitized oothecae (>17 days old) from unparasitized oothecae (>17 days old) was developed, wherein by holding oothecae under an artificial light the pattern of opacity could be viewed.

Sampling of oothecae in cockroach infested buildings gave widely ranging natural parasitism levels. Except in kitchen cupboards where zero levels of parasitism were recorded, at all other locations surveyed, parasitism levels ranged from a minimum of 10% to a maximum of 50%.

A number of parasitoid - release ratios were tested in buildings infested with cockroaches. Of them, 2:1:1 ratio of host: T. hagenowii parasitized oothecae: E. appendigaster parasitized oothecae, gave a parasitism level of 96% under closed conditions (in closed rooms and cupboards) while a release ratio of 6:1:3 gave a maximum parasitism level of 87.5% in dwelling houses.

The parasitoid release ratio of 2:1:1 when applied to dwelling houses, kitchen cupboards, store rooms, grocery shops and restaurants resulted in high parasitism levels ranging from 90.8%-100.0%.This level of parasitism was maintained for a period of five months since the last release.

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