Participation of irradiated Anopheles arabiensis males in swarms following field release in Sudan

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Abstract

BACKGROUND: The success of the SIT depends on the release of large numbers of sterile males, which are able to compete for mates with the wild male population within the target area. The processes of colonisation, mass production and irradiation may reduce the competitiveness of sterile males through genetic selection, loss of natural traits and somatic damage. In this context, the capacity of released sterile Anopheles arabiensis males to survive, disperse and participate in swarms occurring at varying distances from the release site was studied using mark-release-recapture techniques.

METHODS: In order to assess their participation in swarms, irradiated and marked laboratory-reared male mosquitoes were released 50, 100 or 200 m from the known site of a large swarm on three consecutive nights. Males were collected from this large swarm on subsequent nights. Over the three days a total of 8,100 males were released. Mean distance travelled (MDT), daily probability of survival and estimated population size were calculated from the recapture data. An effect of male age at the time of release on these parameters was observed.

RESULTS: Five per cent of the males released over three days were recaptured. In two-, three- and four-day-old males, MDT was 118, 178 and 170 m, and the daily survival probability 0.95, 0.90 and 0.75, respectively. From the recapture data on the first day following each release, the Lincoln index gives an estimation of 32,546 males in the natural population.

DISCUSSION: Sterile An. arabiensis males released into the field were able to find and participate in existing swarms, and possibly even initiate swarms. The survival probability decreased with the age of male on release but the swarm participation and the distance travelled by older males seemed higher than for younger males. The inclusion of a pre-release period may thus be beneficial to male competitiveness and increase the attractiveness of adult sexing techniques, such as blood spiking.

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Polyandry in the medfly - shifts in paternity mediated by sperm stratification and mixing

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Abstract

BACKGROUND: In the Mediterranean fruit fly (medfly), Ceratitis capitata, a highly invasive agricultural pest species, polyandry, associated with sperm precedence, is a recurrent behaviour in the wild. The absence of tools for the unambiguous discrimination between competing sperm from different males in the complex female reproductive tract has strongly limited the understanding of mechanisms controlling sperm dynamics and use.

RESULTS: Here we use transgenic medfly lines expressing green or red fluorescent proteins in the spermatozoa, which can be easily observed and unambiguously differentiated within the female fertilization chamber. In twice-mated females, one day after the second mating, sperm from the first male appeared to be homogenously distributed all over the distal portion of each alveolus within the fertilization chamber, whereas sperm from the second male were clearly concentrated in the central portion of each alveolus. This distinct stratified sperm distribution was not maintained over time, as green and red sperm appeared homogeneously mixed seven days after the second mating. This dynamic sperm storage pattern is mirrored by the paternal contribution in the progeny of twice-mated females.

CONCLUSIONS: Polyandrous medfly females, unlike Drosophila, conserve sperm from two different mates to fertilize their eggs. From an evolutionary point of view, the storage of sperm in a stratified pattern by medfly females may initially favour the fresher ejaculate from the second male. However, as the second male’s sperm gradually becomes depleted, the sperm from the first male becomes increasingly available for fertilization. The accumulation of sperm from different males will increase the overall genetic variability of the offspring and will ultimately affect the effective population size. From an applicative point of view, the dynamics of sperm storage and their temporal use by a polyandrous female may have an impact on the Sterile Insect Technique (SIT). Indeed, even if the female’s last mate is sterile, an increasing proportion of sperm from a previous mating with a fertile male may contribute to sire viable progeny.

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