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RESEARCH ON THE STERILITY METHOD OF TSETSE FLY CONTROL OR ERADICATION

FIFTH PROGRESS REPORT (July 1965-January 1966)

ENTOMOLOGY RESEARCH DIVISION AND ARC OF CENTRAL AFRICA

Previous reports have dealt with studies conducted by either the Entomology Research Division or the Agricultural Research Council of Central Africa. Because these separate investigations are becoming more interwoven, this report combines the results of all the work conducted under Pasa 3-8.

Before discussing the research, however, it should be noted that the severe transportation difficulties experienced with U. S. vehicles have been alleviated by replacement with Land Rovers. These vehicles are common in Rhodesia and thus both parts and experienced mechanics are readily available. The installation of a radio-telephone at the Chirundu field station has eased our communication problems, but this type of equipment has not proved as reliable as had been hoped. Although the major building program has now been completed, minor construction continues for research or access to field stations. In addition to the Chirundu field station the team is now operating at the ARC Kariba field station and at a substation on the edge of Lake Kariba near Long Island, which is the proposed site for the first sterile male release trial.

Work during the period covered by this report has involved the extension of previously reported investigations concerning the biology and reproductive behaviour of tsetse flies, chemosterilization of tsetse flies, and the concentration of tsetse flies in their natural habitat. Of the new investigations initiated during the period, the most important concerns development of cages for tsetse fly rearing investigations and preliminary studies of the tsetse fly population on Long Island.

Chemosterilization research has been aimed at filling in the gaps in our knowledge of the effects of the sterilants on tsetse flies. Glossina pallidipes, available only seasonally, has been sterilized by wind tunnel exposures to tepa and metepa. The permanence of sterility and the competitiveness of G. pallidipes males sterilized by wind tunnel or contact exposures have not yet been determined. However, in an intensive program involving several hundred separate test cages, contact and wind tunnel exposures to tepa or metepa have been sufficiently screened to demonstrate permanent sterility in G. morsitans males of various ages without affecting longevity or sexual aggressiveness. Because these conclusions are based solely on laboratory investigations, we have expanded our research endeavors to obtain information on the behavior of sterile G. morsitans males under field conditions. Males sterilized with tepa either in the wind tunnel or by contact exposure have been released in the field. In unreplicated trials these males dispersed normally. In field cage tests males treated by contact exposure to tepa or by gamma irradiation were equal to untreated males in their ability to find and mate with virgin females. Males sprayed in the wind tunnel with tepa appeared less effective than untreated males.

Further laboratory studies on reproductive behavior have demonstrated that the fecundity of G. morsitans females is reduced if the males are immature when placed in the mating cage - even though the males remain with the females long after sexual maturity has been attained. Although females have demonstrated the ability to accept more than one mating, it appears that second matings may be relatively infrequent if there is a
sufficient time interval between mating opportunities. Males, on the other hand, will mate with several females. However, our studies have shown that the males tend to become infertile after the fourth or fifth mating. Information derived from these and previous investigations conducted on reproductive behavior will be utilized in a new colonization attempt in the laboratory. The existing G. morsitans laboratory colony has not yet been improved enough to be self-sustaining, although it is now over one year old.

The primary effort in tsetse colonization continues at the Chirundu field station, where several approaches are being attempted. Survival in small field cages (8 X 12 X 24 feet) improved during the winter months—a time when temperatures are more favorable to tsetse fly survival. In these tests flies emerging from pupae and then placed in the cage survived better than field-collected adult flies, possibly because of the handling involved and the unknown age of field-captured adults.

Investigations have commenced on survival of tsetse flies in a large (100 X 100 X 10 feet) cage situated in suitable tsetse fly habitat. The naturally occurring resting and larviposition sites have been supplemented with artificial sites and attempts are being made to improve the environment still further in order to increase the life span of the flies. Cattle serve as hosts for the flies in this cage, and the longest period for which a fly is known to have survived in the cage is 19 days. The trials completed to date have been carried out in the most adverse season from the standpoint of fly survival.

Alternatives to screen cages are being investigated. Cavity type cement construction blocks have been used to make the walls of a smaller cage with screen fastened on the outside. It is hoped that the cool cavities in the walls will provide suitable shelter and/or larviposition sites for the flies. When water is dripped onto the cement block evaporative cooling occurs and it has been possible to maintain the temperatures within the range tolerated by tsetse flies in spite of extreme temperatures outside.

A controlled environment building has been constructed which is large enough to contain an 8 X 10 X 15 ft. cage. It should be possible in this building to provide optimum temperature and humidity conditions. Investigations will be directed towards providing suitable host animals and improving methods of feeding flies in order to achieve satisfactory pupal production.

Work continues in an attempt to build up tsetse fly density in suitable habitat by means of a permanently introduced food supply, in the form of tethered cattle. This test has been done for several months and no G. morsitans concentration has yet occurred. However, a build-up of G. pallidipes was apparent, but was of a transient nature. An additional scheme, involving free-roaming cattle in a large paddock situated in optimum tsetse fly habitat, is being initiated.

Approximately 10,000 pupae have been collected at Chirundu. Records of pupal sites are maintained and the majority of pupae collected during the hot, dry season were found in antbear holes. As a possible guide to the preparation of artificial pupal sites, studies of the orientations of antbear holes have been continued. It appears that pupae may occur in antbear holes facing in any direction, provided that the requirements of soft soil and deep burrows are met.
The reproductive status of G. morsitans females in the natural population is being determined by ovarian dissection. Age determination based on ovarian development is being compared with age determinations based on wing fray. An insemination rate of 87% has been found in these females, with all of the unspermsed females being young adults which have not yet been through the first reproductive cycle.

Investigations of the diurnal variations in tsetse fly activity have confirmed results obtained by other investigators and indicate the optimum hours during which G. morsitans and G. pallidipes populations should be sampled. Monitoring of the tsetse fly population in the research area by standard flyround techniques indicated a higher maximum density in 1965 than in 1964, but the reason for the difference is obscure.

Observations have begun on Long Island, which has been proposed as the site for the first sterile male release trial. In August the 1.8 square mile island harbored an estimated 8,300 males per square mile. Migration studies conducted from August through November indicated that the island was isolated from the mainland tsetse fly population. These studies are continuing throughout the seasons to obtain further information on population density, migrational habits and reproductive status of tsetse flies in the Long Island area. This information is essential for determining the optimum time for the initiation of the sterile release program.

The following papers are a direct result of this project:

Published


Submitted for publication

Dame, David A and Hugh R. Ford. Effect of the chemosterilant tepa on Glossina morsitans Westwood.