

Project Concluded: Final Report

Improving Efficacy of Sterile Insect Technique for Mexican Fruit Fly and Mediterranean Fruit Fly

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During 2004-2005 our research focused on several areas. The first was testing a new gel- based diet developed to take the place of the agar sugar block diet used to feed adult Tephritid flies prior to sterile insect technique (SIT) releases. Unfortunately, the gel formulation was deficient in protein which resulted in production of adults that were not efficient in producing pheromone or attracting females (Figures 1, 2). Formulation of the gel diet with additional protein, needed to improve reproductive competence, yielded an inconsistent formulation. Additionally, the gel diet was expensive and labor intensive to formulate. As such the gel diet was judged a poor substitute for the agar/sugar blocks.

Our second objective was to assess the efficacy of hormone therapy in field cage studies using the Mexican fruit flies. These studies are used as an indicator of field success for SIT studies. We found that untreated 6-day-old males had a much lower relative performance index and a significantly higher isolation index (Figures 3, 4). There was no difference in the relative performance index or isolation index between hormone treated 6-day-old males and mature males. Therefore, the hormone treatment was effective in making 6-day-old males mate as effectively as 12-day-old mature males in the field cage studies. We conclude from this that treatment with the hormone significantly improves the ability of sterile male Mexican flies to mate with wild females.

Another area in which we conducted studies was to determine the effect of incorporation of hormone on male flies held in mass rearing conditions. In these studies we employed PARC boxes, commonly used to hold flies prior to release. Addition of protein + hormone (methoprene) to the agar diet significantly decreased the age at which males became sexually mature as indicated by ability to attract females (Figure 5) and in amount of pheromone produced; and, in mating studies only males fed the hormone plus protein mated on day 4 (other males did not begin to mate until day 8). Additionally, the data showed that addition of protein or methoprene or both to the agar/sugar diet had no effect on longevity of flies. We also conducted flight tunnel studies and pheromone production studies to determine if the combination of protein + methoprene was better than adding either protein or methoprene alone (Figure 6). As such we conclude that hormone therapy can be incorporated into mass rearing and holding protocols effectively.

Finally, we have conducted studies using two strains of the Mediterranean fruit fly to determine if hormone therapy would be effective for this species. The first strain was the Vienna 8 TSL strain produced the IAEA in Seibersdorf, Austria where tests were conducted. All males of this strain became sexually mature by the second day after eclosion. Including hormone therapy into rearing had no effect on accelerating reproductive development. At this time we do not believe that the benefits of hormone therapy will overcome the cost of incorporation into rearing protocols, and thus we do not recommend it for the Vienna 8 TSL strain.

The other Medfly strain was the TSL strain was produced at El Pino, Guatemala and shipped to

Florida where the experiments were conducted. These males took 5-6 days to become mature when fed the agar/sugar diet that did not contain protein. Incorporation of 10% protein into the agar/sugar diet resulted in release of more pheromone released and these males were attractive to sterile females earlier age than were their untreated counterparts (Figure 7). Adding methoprene to the agar/sugar/protein diet improved sexual signaling even more (Figure 7). Additionally, males fed sugar-agar-protein-Methoprene diets were far more effective in attracting females of the Mediterranean fly than were either of the other diets (Figure 8).

SUMMARY:

Over the life of our research program, we have demonstrated that sterile males of Mexican, West Indian, Caribbean flies and at least one strain of sterile Mediterranean fly are dramatically affected by addition of both protein and the juvenile hormone analog methoprene into the diet fed to adults prior to release. Our results show that without protein, males fail to compete effectively and produce little pheromone at any age. Protein is required for males in order to produce pheromone which is critical to mating success. However, protein does not cause significant acceleration reproductive maturity. Acceleration of reproductive maturity is achieved by incorporation of methoprene into the diet.

As a consequence we believe the therapeutic technique of including protein and methoprene into adult diets for sterilized males of the *Anastrepha* species and Mediterranean fruit fly from the El Pino facility has significant potential for improving efficacy of the Sterile Insect Technique. However, a cost/benefit analysis needs to be conducted in which the cost of incorporation of methoprene into the diet is calculated. At a minimum, it is strongly recommended that protein be added to the adult diets for all species. A protein substitute composed of whey protein has been tested and found to be effective as a substitute for the expensive brewers yeast hydrolysate currently used as protein in the adult fly diet. This whey protein is significantly less expensive and equally nutritious.

Contact Citrus Research Board for figures.