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Pritam SINGH[1]·[2]), G. C. UNNITHAN[1]) & A. G. L. DELOBEL [1]·[3]): *An artificial diet for sorghum shootfly larvae.*

KEY WORDS: Sorghum shootfly — *Atherigona soccata* — Artificial diet — Rearing method.

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The sorghum shootfly, *Atherigona soccata* Rondani (Diptera, Muscidae) is a serious pest of seedling sorghum in South Asia and Africa (Young, 1981). The larvae feed on the growing point within the central leaf-sheath of sorghum seedlings and tillers, causing "dead-hearts". Larval growth and development are completed within the infested shoot, and only one larva can survive in a seedling or tiller. Loss in grain yield due to shootfly damage is reported to be high, especially in late-planted and high-yielding sorghums (Rai *et al.*, 1978).

The ecology, behaviour, physiology and insect-host-plant relationship of the sorghum shootfly, and sorghum resistance against shoot-

fly have been the subjects of detailed investigation for the past few years at ICIPE. The progress of this research often has been hampered by the lack of an adequate number of insects for experimental purposes. As yet, no satisfactory method for laboratory rearing of the sorghum shootfly has been developed. It has not been possible to rear sufficient numbers of insects by the method of Soto & Laxminarayana (1971) using sorghum seedlings under cages.

Results obtained using artificial diets for sorghum shootfly developed in India (Dang *et al.*, 1971; Sukhani & Jotwani, 1979) also have been not satisfactory as less than 5% of the larvae became adults, and these were abnormal. At ICIPE, flies for experimentation have been obtained by collecting 3rd-instar larvae from infested plants in the field. Subsequent larval development and pupation are completed in a diet composed of agar, casein, cellulose powder, yeast, sorghum leaf powder and water. This method, however, has been unsatisfactory as it is primarily dependent on the naturally occurring shootflies, is labour intensive, inefficient and uneconomical. Considering the importance of the sorghum shootfly, the need existed to develop a rearing method, using an artificial diet, which could be adapted for mass-rearing the pest. Reported here is the development of a satisfactory artificial diet for rearing shootfly larvae to the adult stage.

The main ingredients of the diet are shredded tissue paper, brewer's yeast, vitamin-free casein and water. Several combinations of these were evaluated. The composition of the best diet, hereafter referred to as KCY-1 is as follows: shredded Kleenex(R) tissue paper (white) (Hygiene Products Ltd., Kenya) 50 g; vitamin-free casein (ICN Nutritional Biochemicals, Cleveland, U.S.A.) 15 g; Brewer's yeast (Red Seal Laboratories, Auckland, New Zealand) 20 g; Nipagin (methyl-p-hydroxybenzoate) (J. T. Baker Chemical Co.) 0.75 g dissolved in 3 ml 75% ethyl alcohol; and distilled water 200 ml.

The correct texture of the diet, which is extremely important for the establishment of the newly hatched larvae, was achieved by shredding the tissue paper in a Sanyo(Tm) blender (model SA 139E) at speed 1 (slow) and 2 (medium) for 1 min each. The tissue paper was then mixed in a Kenwood Major (Tm) mixer with 150 ml distilled water at slow speed (speed 1) for 1 min; casein was added and mixed at speed 2 (1.5 min), yeast at speed 3 (1.5 min), nipagin at speed 3 (2 min); finally, 50 ml distilled water were added and mixed at high speed (speed 5) for 2 min. The diet was stored in glass jars covered with aluminium foil and kept in the refrigerator at 9° until used.

5—8 g diet was placed in 75 × 25 mm glass vials for larval rearing. Strips of sorghum leaves with 10—30 sorghum shootfly eggs from the laboratory colony were placed on the diet; eggs were 30—36 hr old and hatched 12—18 hr later. The vials were closed with plastic caps with pinholes and kept in an environmental chamber (Warren-Sherer(Tm) model CEL 255-6) and maintained at 26 ± 1°, 12 hr photophase and 60 ± 10% RH. The next morning, the number of eggs hatched was counted and the leaf pieces with unhatched eggs removed. Growth and development of the larvae were monitored by daily observation. Pupae were weighed within 24 hr after pupation and kept in sterile sand for adult emergence in the environmental chamber.

So far 2 generations have been reared on this diet. Duration of larval and pupal periods, pupal weight, % survival to pupal and adult stages of shootflies reared on artificial diet (KCY-1) and on sorghum seedlings (CSH-1 hybrid) are shown in Table I. Diet-reared adults appeared normal and produced viable

TABLE I

Development of the sorghum shootfly on artificial diet and on the natural host

Diet and temperature	No. 1st-instar larvae	Larval period[2] (days ± SD)	Pupal period[3] (days ± SD)	Pupal weight (mg $\bar{x}$ ± SD)	Survival to pupa (%)	Survival to adult (%)
KCY-1, 26°	212	13.2 ± 0.2a	7.3 ± 0.2a	6.5 ± 1.6a	57.8	53.0
Natural host[1] (CSH-1 sorghum seedling), 25°	314	12.9 ± 0.4b	8.8 ± 0.2b	5.3 ± 1.4b	63.6	55.1
Same[1], 30°	251	10.1 ± 0.4c	7.5 ± 0.1c	4.7 ± 1.2b	62.0	53.4

[1] Individual seedlings infested with one newly hatched larva each. Mean times for: [2] 50% pupation, and [3] 50% adult emergence. Figures followed by same letter not significantly different from each other at 0.05 level.

eggs. At 27.5 ± 2.5°, the diet-reared ♀♀ laid an average 130.2 eggs and lived for 35.8 ± 10.6 days (N = 14). About 76% of the eggs hatched. Sukhani & Jotwani (1979) obtained an average 17.5, 18.6 and 29.0 eggs per ♀ for shootflies reared on a yeast-agar diet, banana pulp diet and black gram diet, respectively.

Further improvement of the diet, optimum temperature conditions, amount of diet required, cannibalism among larvae, fecundity, longevity, and behaviour of successive generations of the diet-reared flies, as well as development of a mass-rearing method are under investigation.

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