Ind. J. Plant Protection VI (1).

A NEW MEDIUM FOR MASS REARING OF THE SORGHUM STEM BORER, CHILO PARTELLUS SWINHOE (LEPIDOPTERA : PYRALIDAE) AND ITS USE IN RESISTANCE SCREENING*

K. V. SESHU REDDY & J. C. Davies
Cereal Entomologists
International Crops Research Institute for the Semi-Arid Tropics
Hyderabad.

ABSTRACT

Details are given of a diet which has been successfully used for several seasons at ICRISAT, Hyderabad, India, to produce large numbers of Chilo partellus Swinhoe. The larvae are used for field infestation of sorghum in resistance breeding work and for production of adults for pheromone studies The diet is based on Phaseolus bean and sorghum leaf powder and gives recoveries of 52 to 74 percent of moths from introduced freshly hatched larvae. The larvae and adults produced are normal. The technique is particularly useful since it allows large numbers of moths to be produced at the start of the rainy season when field population of Chilo partellus are low.

At the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), research is being conducted to locate and develop sources of resistance to insect pests. Although two cereal crops per annum can be grown and natural infestation levels can be moderately high in the post rainy season, it is necessary to maximise pest challenge in order to improve the chances of obtaining reliable readings on resistance levels. The stem borer, *Chilo partellus* Swinhoe is one of the serious pests of sorghum in India (Jotwani & Young, 1972) and lowland areas of Eastern Africa (Ingram, 1958), and is present and potentially important in other areas of the semi-arid tropics (SAT). For part of the year it is not convenient to rear the insect in fresh sorghum stalks in the laboratory. Sufficiently large numbers cannot be reared from field collections, particularly early in the season, to artificially infest plants under test for resistance in the field. A suitable diet medium and technique for the routine rearing, large numbers of larvae for infesting sorghum was developed.

*Approved as ICRISAT Journal Article No. 66 and released for publication.

REVIEW OF LITERATURE

A great deal of work has been done on the rearing of lepidopterous pest species (Keaster and Harrendorf 1965, Reed *et al, 1972*). Some work has also been done on the rearing of *C. partellus* particularly in India, with varying degrees of success (Dang *et al*, 1970; Lakshminarayana and Soto, 1971; Siddiqui and Chatterji, 1972). The diet developed by Siddiqui and Chatterji often with some modification, is commonly used in India. As difficulties were encountered using the original diet of Siddiqui and Chatterji for prolonged generation of moths, we modified the diet to meet the required needs.

MATERIAL AND METHODS

The modified diet (Table I) was prepared by mixing all the ingredients of fraction 'A' except the sorghum leaf powder (cultivar CSH-I), and water in a commercial blender for 1 to 2 min.

Table 1. Composition of the artificial diet used in rearing of *Chilo partellus* at ICRISAT.

	Ingredient	Quantity*
	Fraction 'A'	
1.	Water	2500.0 ml
2.	Rajmah powder**	548.0 gm
3.	Brewer's yeast	40.0 gm
4.	Sorbic acid	5.0 gm
5.	Vitamin E (20 Viteolin capsules)	5.2 gm
6.	Methyl para hydroxy benzoate	8.0 gm
7.	Ascorbic acid	13.0 gm
8.	Sorghum leaf powder	200.0 gm
	Fraction 'B'	
9.	Agar-Agar	51.0 gm
10.	Water	2000.0 ml
11.	Formaldehyde 40 percent	10.0 ml

* The Quantities used to prepare 15 jars of 360 gm each

** Rajmah is a cultivar of bean (*Phaseolus vulgaris*)

The sorghum leaves (of cultivar CSH-I) obtained from a 40 to 70 day-old-crop were washed thoroughly with tap water and then were sun dried. The well dried leaves were cleaned and were powdered in a grinder. The sorghum leaf powder was added to 2500.0 ml of water at 60-70°C and stirred for 2-3 min in a separate container. Subsequently this was added to the other ingredients in fraction 'A' and blended thoroughly for 3 min.

Fraction 'B' was prepared by heating the water to 95°C and adding agar agar. This hot agar solution was cooled to 70°C and then added to fraction 'A' in the blender, together with the formaldehyde solution and blended for 5 min. Later 360 gm of the diet mixture was poured into 15 plastic jars No. 7A* (13.5 x 11.0 cm) and allowed to cool for 2 to 3 hr.

METHOD OF REARING

The initial stock culture was established from eggs laid on butter paper in the breeding cage by moths which emerged from field collected stalks. The moths were fed on cotton wool dipped in water. The eggs were allowed to hatch and the 100 young larvae introduced in batches of 10 to 15 to the medium with a fine brush. Then the jars were fitted with a screw cap mounted with 80 gauge brass mesh. The diet has been found to be entirely satisfactory over the last 3 years and there have been no problems with insect pathogens or from reduced viability in the cultures. From time to time pupae are obtained from the field and the emerging moths introduced into the culture. Currently, sufficient larvae are produced to infest 8 ha in the field in both the rainy and post rainy seasons.

In the summer season, from April to May, to ensure the survival of the culture and allow sufficient larvae to be available to infest very early sown sorghum, it is necessary to keep cultures in an air conditioned room at temperature 28 $\pm$ 2°C and relative humidity 50 to 60 percent.

EFFICACY OF THE DIET

To check on the efficacy of the diet over time, tests have been conducted using larvae obtained from eggs laid from field collected moths. Ten jars were set up each with 100 larvae. Observations were made on larval development time, pupal period, emergence of moths, sex ratio, longevity of adults, fecundity and percentage of viable eggs.

---

* The plastic jars were obtained from Kumar Plastics Co., 63, Sutar Chawl, Bombay-2,

RESULTS

Observations on development of *Chilo partellus*

The data obtained on the recovery of *Chilo partellus* adults from the artificial diet are given in Table 2. The range and development time larva to adult was 32 to 49 days, which was convenient for ensuring staggering of moth and egg production. The mean recovery of adults was 59 percent with a range from 52 to 74 percent. The sex ratio was close to 1 : 1. In general, males started emerging first from cultures.

Table 2. Observations on the development of *Chilo partellus* on the artificial diet.

Larvae released on 26-9-78 @ 100 larvae/jar

Jar No.	No. of days for adult emergence		Total No. of adults emerged	Total No. of	
	Minimum	Maximum		Males	Females
1	33	48	59	28	31
2	33	49	59	28	31
3	33	47	52	29	23
4	32	49	54	30	24
5	33	49	60	36	24
6	32	47	54	23	31
7	33	49	58	32	26
8	32	49	74	31	43
9	33	49	60	26	34
10	34	49	58	25	33
			Total	288	300

The preoviposition period ranged from 1 to 3 days with an average of 1.5 days (Table 3). An average of over 16 egg masses was laid per female. Eggs were laid over a period of 1 to 5 days and most of them hatched in 6 days. The mean longevity of male and female moths was 5.7 and 4.1 days respectively. The maximum number of eggs laid by an individual female was 693 and the minimum 177, with an average of 495 eggs per female.

Table 3. Observations on oviposition and fecundity of *Chilo partellus* reared on artificial diet at ICRISAT Centre, September-October, 1978.

S. No of the pair	Preovi-position period (in days)	No. of egg masses/ female	Total No. of eggs/ female	No. of eggs Fertile	No. of eggs Unfertile	Ovipo-sition period (in days)	Incuba-tion period (in days)	Longevity of adults Male	Longevity of adults Female
1	2	14	476	414	62	2	6	7	3
2	1	25	671	632	39	4	6	6	4
3	1	32	538	481	57	4	6	4	4
4	2	10	473	351	122	3	6	3	5
5	2	14	611	596	15	3	6	5	4
6	1	10	486	468	18	3	6	5	3
7	1	13	609	570	39	3	6	7	4
8	1	13	499	484	15	3	6	4	4
9	1	15	434	350	84	4	6	5	4
10	1	19	635	625	10	4	6	5	5
11	2	18	576	571	5	3	6	Missing	4
12	3	7	338	177	161	1	6	4	4
13	1	17	642	470	172	4	6	8	4
14	2	8	578	564	14	3	6	7	4
15	1	31	716	693	23	4	6	5	5
16	2	17	550	522	28	3	6	9	4
17	1	16	559	513	46	5	6	6	5
18	2	18	462	434	28	2	6	7	3
Total	27	297	9853	8915	938	58	108	97	73
Mean	1.5	16.5	547.4	495.3	52.1	3.2	6	5.7	4.1

COST OF PRODUCTION AND UTILIZATION OF EGGS AND LARVAE

The cost of producing one kg of diet is approximately Rs. 5.00 or $ 0.63* (Table 4). As approximately 90 pairs of moths are obtained from one kg of diet, is equivalent to 6 paise or 0.75 cents for a pair of moths, or approximately 500 eggs. Therefore, the cost of 83 eggs or larvae is one paise or 0.13 cents and cost of infesting 12 to 16 plants twice is about 2 paise or 0.25 cents, as the standard input of *Chilo* larvae is 5 to 7 per plant.

Table 4. Cost of production of one kg of *Chilo partellus* artificial diet.

S. No.	Name of the ingredient	Cost	
		Rs. P	US $
1.	Rajmah powder	0.60	0.075
2.	Sorghum leaf powder	0.05	0.006
3.	Yeast tablets	0.33	0.041
4.	Methyl paraben	0.01	0.001
5.	Ascorbic acid	0.60	0.075
6.	Sorbic acid	0.19	0.023
7.	Vitamin E Capsules	0.50	0.062
8.	Formaldehyde	0.01	0.001
9.	Agar-Agar	1.94	0.242
10.	Establishment and Labour	0.77	0.096
	Total	5.00	0.622

METHOD OF FIELD INFESTATION

About 250 black-head stage *Chilo* egg masses (laid on butter paper) are placed in plastic jars containing 180 gm of sterilised finger millet seed. The seed having been previously sterilised at 121°c and 15 lb pressure for half-an-hour. When the larvae hatch, the butter paper strips are removed from the plastic containers, as the larvae disperse through the finger millet seed which acts as a carrier. The seed with larvae is subsequently transfered gently into the plastic container of a modified "*CYMMIT*" dispenser (House, 1977).

When the sorghum plants meant for borer resistance screening are 21 to 25 days old, the larvae are introduced into the leaf whorls with the dispenser. For each stroke of the dispenser 0.2 gm of finger millet seed along with 5 to 7 larvae will fall down into the leaf whorl of the plant.

*U S $ 1 = Rs. 8 approximately and one rupee = 100 paise

Generally each test line is of 2.25 m length with a plant population of 20 to 25 and replicated three or four times. One week after the first infestation another dose of larvae is introduced into the same plants. With this technique we are able to get 100 percent of plants with leaf damage and dead hearts in certain lines. Further, this method of infestation is found to be very rapid and in one hour one person can easily infest about 1800 plants.

Counts are taken on the leaf damage and dead hearts produced at one, three and five weeks after the second infestation. At harvest, stem splitting is carried out noting the length of the stem tunnelled, number of bored nodes, number of larvae and pupae, number of harvestable heads and their grain weight. This technique enables us to identify lines with resistance.

DISCUSSION

The diet suggested by Siddiqui and Chatterji (1972) has been modified by replacement of wheat atta by sorghum leaf powder. This modified diet has been found to be extremely efficient in allowing a stock culture of *Chilo partellus* to be maintained for more than six months. Moths produced are fecund and over four seasons of work with only a minimal input of field collected moths no degeneration of the cultures has been observed. In general the number of infertile eggs produced per egg mass was low. Of all the diets tested at ICRISAT this one is by far the most satisfactory, all others tested gave much lower recoveries of adult moths and rapid degeneration of the culture in several instances. Most of the ingredients are readily available locally and preparation of the diet is easy. Normally, 5380 gms of diet, sufficient to make up 15 jars is produced at a time. Each of these jars produces an average of 60 moths and there is no difficulty in ensuring an adequate and continuous supply of eggs and larvae for field infestation. The early production of larvae in the rainy season is important since a delay in sowing of the sorghum results in heavy attacks of sorghum shoot fly, *Atherigona soccata* Rond., which makes assessment of resistance to *C. partellus* difficult and chancy. The adult moths produced from the diet have also been successfully used in pheromone studies in the field for several seasons (Seshu Reddy *et al* in preparation).

REFERENCES

DANG KAMALESH, ANAND MOHINI and JOTWANI, M.G. (1970). A simple improved diet for mass rearing of sorghum stem borer *Chilo zonellus* (Swinhoe). *Indian J. Ent.* 32: 130-133.

HOUSE, L.R. (1977). Personal Communication.

INGRAM, W.R. (1958) THE lepidopterous stalk borers associated with graminae in Uganda. *Bull. Ent. Res.* 49 : 367-383.

JOTWANI, M.G. and YOUNG, W.R. (1977). Recent developments on chemical control of insects pests of sorghum, pp. 377-398. *Sorghum in Seventies* Ed. Rao N.G.P. and House, L.R. Oxford & IBH Publishing Co., New Delhi.

KEASTER, A.J. and HARRENDORF, K. (1965). Laboratory rearing of South Western corn borer *Zaediatraea grandiosella* Dyar on wheat germ medium. *J. Econ. Ent.* 58: 923-924.

LAKSHMINARAYANA, K. and SOTO, P.E. (1971). A technique for mass rearing of sorghum stem borer *Chilo zonellus*. *Sorghum Newsletter* 14 : 41-42.

REED, G.L., SHOWERS, W.B., HUGGANS, J.L. and CARTER, S.W. (1972) Improved procedures for mass rearing the European corn borer. *J. Econ. Ent.* 65: 1472-1476.

SESHU REDDY, K. V., DAVIES, J. C. BEEVOR, P. S. and NESBITT, B.F. Field studies on the synthetic pheromones of *Chilo partellus* Swinhoe (Lepidoptera ; Pyralidae) in Andhra Pradesh (in preparation).

SIDDIQUI, K.H. and CHATTERJI, S.M. (1972). Laboratory rearing of the maize stem borer, *Chilo zonellus* Swinhoe (Crambidae : Lepidoptera) on a semi-synthetic diet using indigenous ingredients. *Indian J. Ent.* 34: 183-185.

Authors wish to record thanks to their technical staff, particularly to Mr G. S. Rao and Mr. Y. V. Reddy; and to Dr. William Reed Pulse Entomologist, ICRISAT for going through the manuscript.