SOUTHWESTERN CORN BORER, *DIATRAEA GRANDIOSELLA*, PERFORMANCE ON THREE ARTIFICIAL DIETS

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PERFORMANCE ON THREE ARTIFICIAL DIETS

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CHAPTER I

INTRODUCTION

The study of the southwestern corn borer, Diatraea grandiosella (Dyar), a major pest of corn in the southern United States (Henderson and Davis, 1969), is often facilitated by laboratory rearing; and artificial diets have been developed for this purpose. Keaster and Harrendorf (1965) modified the wheat germ diets of Adkisson et al. (1960) and Vanderzant et al. (1962) to a medium suitable for rearing southwestern corn borers. Since then, other workers (Bailey and Chada, 1968; Jacob and Chippendale, 1971; Davis, 1976) have also utilized wheat germ diet variations in southwestern corn borer rearing programs, and a version of the diet is commercially available for these insects from Bio-Serv, Inc., Frenchtown, New Jersey.

In the present study, southwestern corn borer performance on a modification of the diet used by Jacob and Chippendale (1971) has been compared with that on a lima bean diet (Burton, 1969; Shorey et al. 1965) and a CSM (corn, soy flour, milk solid blend) diet (Burton, 1970), which have both been used extensively in rearing other lepidopterous insects. As the latter two diets require fewer ingredients, are more easily formulated, and are more economical than the wheat germ diet, their successful utilization by the southwestern corn borer could be an asset in rearing these insects.

CHAPTER II

MATERIALS AND METHODS

DIET PREPARATION - The ingredients of all three diets are listed in Table 1. The wheat germ and CSM diets were prepared by first mixing the agar with the water indicated in Table 1 and bringing the solution to a boil, then combining this with the other ingredients in a 1 liter Osterizer blender and mixing thoroughly on high speed. In formulating the bean diet, the beans were covered with water, brought to a boil, and simmered until softened. Unabsorbed cooking water was retained and included in the total amount needed for the diet, and the beans and additional water were blended on high speed till homogenous in texture. From this point, preparation of the bean diet proceeded as described for the other two diets above.

Immediately following preparation, each diet was dispensed into 30 ml. plastic cups set into five cardboard trays (25 cups per tray) under a laminar flow clean work bench wiped with 10% Chlorox. The diet was allowed to cool and solidify; then each cup of diet was pierced with forceps to provide entry holes for the larvae. The trays of diet were stored in plastic bags at 4 degrees Celsius for no more than five days before use.

REARING PROCEDURES - Two first instar southwestern corn borer larvae were transferred to each cup of diet with a small artist paint brush cleaned in 10% Chlorox, and the infested cups were fitted with

TABLE 1

THE COMPOSITION PER LITER OF THE THREE ARTIFICIAL DIETS STUDIED

Ingredient	Amount	Ingredient	Amount	Ingredient	Amount	Ingredient	Amount
Casein	44 g	Beans	105 g	CSM	188 g	Wheat germ oil	3 ml
Sucrose	23 g	Wheat germ	50 g	Torula yeast	15 g	Formaldehyde (10%)	4 ml
Wheat germ	28 g	Torula yeast	32 g	Ascorbic acid	4 g	Water	500 ml
Salt mix[1]	9 g	Ascorbic acid	3 g	Methyl paraben	2 g	Agar	20 g
Ascorbic acid	5 g	Methyl paraben	2 g	Sorbic acid	1.5 g	Water for agar	500 ml
Alphacel	5 g	Sorbic acid	1.5 g	Formaldehyde (10%)	4 ml		
Na alginate	5 g	Formaldehyde (10%)	4 ml	Water	500 ml		
B-sitosterol	2 g	Water	400 ml	Agar	20 g		
Locust bean gum	3 g	Agar	20 g	Water for agar	400 ml		
Sorbic acid	1.5 g	Water for agar	400 ml				
Methyl paraben	2 g						
Vitamins[1]	25 ml						
Choline chloride (10%)	19 ml						
KOH (4 M)	5 ml						

[1] Jacob and Chippendale (1971)

paperboard caps. Fifty cups were infested per day for five days a week throughout the study.

The southwestern corn borer colony was maintained in a small room held at approximately 25 degree Celsius, with a 16 hour photoperiod operating to prevent diapause (Chippendale and Reddy, 1973). Relative humidity was uncontrolled; but the trays of larvae were held in plastic bags for the first week, where moisture from the diet kept the humidity quite high. The trays were transferred to a plastic-lined, enclosed shelf, which provided moderate humidity, for a second week before being set on an open shelf where the larvae completed their development under less humid conditions. This procedure insured against desiccation of diet and larvae, while simultaneously deterring biological contamination, which sometimes became a problem during extended periods of high humidity.

After the larvae had pupated, the sexes were separated and placed in 4 liter ice cream cartons till their emergence as adults. At that time, the newly emerged male and female moths used in the study were paired and placed in 500 ml. paper cups. The cups were lined with waxed paper as a substrate for oviposition and were covered with cheesecloth held in place by a rubber band. The remaining moths were released into wire mesh cages around which waxed paper was wrapped. The moths rested on the mesh and oviposited through it onto the waxed paper. Egg-covered strips of paper were placed in large desiccators lined with damp paper towels to provide humidity.

During all stages of their life cycle, the southwestern corn borers on each diet were segregated from those on the other diets. In this way, the eggs from one generation provided the basis for a second

generation reared on the same respective diet; the data in this study was collected for two generations.

DATA COLLECTION - Southwestern corn borer performance was compared on wheat germ, bean, and CSM diets by evaluating larval stage duration, pupal weights, fecundity, percent egg hatch, female moth longevity, and the number of spermataphores per female moth. Larval stage duration was determined by dating cups of larvae when first infested and checking mature larvae daily until pupation occurred. All larvae that pupated were included in this portion of the study. The remainder of the data collection incorporated equal numbers of insects from each diet, and quantities mentioned hereafter in this section refer to the number of insects evaluated per diet during each of the two generations covered by the study.

Seventy-five pupae of each sex were weighed on a Mettler analytical balance accurate to 0.1 mg. This was done four days after pupation, as younger pupae were softer and more easily damaged by handling. Following adult emergence and mating, fecundity was assessed for forty female moths by counting the eggs laid by each mated moth during its life span. The longevity of these moths was also recorded; and after death, dissections determined the number of spermataphores present. Groups of one hundred eggs were cut from egg-covered waxed paper and placed in each of seven 30 ml. plastic cups, fitted with paperboard caps, and stored in a desiccator containing damp paper towels. The percent egg hatch was determined by the eggs that did not hatch.

CHAPTER III

RESULTS AND DISCUSSION

Table 2 compares the average values of all parameters measured for southwestern corn borers on each of the three diets. The larval stage of insects on CSM diet was extended by one day compared to those on the wheat germ diet and the bean diet. Both male and female pupae weighed more when reared on bean diet or CSM diet than when grown on wheat germ diet, and this difference was highly significant ($P = 0.01$). Significantly more eggs ($P = 0.01$) were laid by moths from CSM diet and bean diet as compared to wheat germ diet, and eggs laid by moths from the former two diets had a significantly higher ($P = 0.01$) hatch. Longevity of the adult females and the number of spermataphores present in the female moths differed very little among the three diets. Larval mortality on all three diets was rare and nearly always due to secondary microbial contamination, and the incidence of adults with deformed wings was negligible.

No decline in southwestern corn borer performance was observed on any diet over the two generations during which the study was conducted or through 5 successive generations following the study. The information collected, particularly pupal weights, indicate that all three diets met the nutritional requirements of this insect, including the need established by Reddy and Chippendale (1972) for protein, B-vitamins, choline chloride, and inorganic salts, and by Chippendale and

TABLE 2

MEAN VALUES (± SD) OF VARIOUS PARAMETERS MEASURED FOR SOUTHWESTERN CORN BORERS ON THREE ARTIFICIAL DIETS

	Wheat Germ Diet	Bean Diet	CSM Diet
Duration of Larval State in Days	23.9 ± 1.9	24.1 ± 1.1	25.2 ± 1.4
Weight of Male Pupae in Grams	$0.1120 \pm 0.0200_a$ [1]	$0.1320 \pm 0.0260_b$	$0.1304 \pm 0.0025_b$
Weight of Female Pupae in Grams	$0.1459 \pm 0.0300_a$	$0.1844 \pm 0.0360_b$	$0.1795 \pm 0.0330_b$
Number of Eggs Laid Per Female Moth	$213.1 \pm 64.6_a$	$290.0 \pm 63.5_b$	$290.8 \pm 51.2_b$
Percent of Eggs Hatched	93.0 ± 4.6	95.8 ± 2.0	95.4 ± 2.1
Life Span of Female Moths in Days	3.7 ± 0.5	4.0 ± 0.4	4.0 ± 0.2
Number of Spermataphores Per Female Moth	1.2 ± 0.4	1.1 ± 0.4	1.1 ± 0.3

[1] Values in the same row followed by different subscripts were significantly different at the 0.01 level according to Duncan's Multiple Range Test.

Reddy (1972) for linoleic acid and B-sitosterol. While those nutrients were provided in the wheat germ diet by supplements of casein, a salt mixture, a vitamin mixture, choline chloride, and wheat germ oil, no such additions were necessary for bean diet and CSM diet.

The data obtained from this study strongly suggests that southwestern corn borers can be reared successfully on bean diet and CSM diet. Performance on both diets was significantly superior in several aspects to performance on the wheat germ diet normally used in rearing these insects. The larger pupae, more fecund moths, and higher percent egg hatch resulting from bean diet and CSM diet, in addition to the ease of preparation and economy of these diets, indicates their potential value in southwestern corn borer rearing programs.

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Abstract: Southwestern corn borer, Diatraea grandiosella, performance was compared on wheat germ, bean and CSM diets by determining larval stage duration, pupal weights, fecundity, percent egg hatch, female moth longevity and the number of spermataphores per female moth. Pupal weights, fecundity, and percent egg hatch were significantly higher on bean and CSM diets than on wheat germ diet. Other parameter measurements were nearly the same for all diets. The results indicate the potential value of bean diet and CSM diet in southwestern corn borer rearing programs.

ADVISER'S APPROVAL