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REARING THE LARVAE OF DACUS ZONATUS* IN MEDIA WITH INEXPENSIVE AND READILY AVAILABLE AGRICULTURAL BYPRODUCTS†

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Abstract. Certain low-cost ingredients were found to be satisfactory, in combination with wheat shorts, for rearing the larvae of *Dacus zonatus* (Saunders). The flies were reared successfully for 3 consecutive generations when sugarcane bagasse or rice husk was substituted partially for the standard wheat shorts in the larval medium, but mango sawdust, also evaluated in combination with wheat shorts, was not effective. Molasses was found to be as satisfactory as granulated sugar in the larval diet.

Qureshi *et al.*[1] reported a semisynthetic larval diet based on wheat shorts, brewer's yeast, sugar, agar, nipagin, and hydrochloric acid which was found to be satisfactory for rearing *Dacus zonatus* (Saunders). Since several of these ingredients are expensive, experiments were conducted to explore the possibility of using less expensive carriers in the medium than wheat shorts, and also seeking a substitute for sugar in the larval diet. The results obtained with sugarcane bagasse, rice husk, mango sawdust, and molasses are reported in this paper.

Materials and Methods

Adult flies were from laboratory stock cultures reared as larvae on the standard wheat shorts medium and maintained at 27±2°C, 65±5% R.H., and photoperiod of 9 hr/day with ambient light available in the laboratory.The flies were held in wire-gauze cages measuring 23×23×30 cm and provided with sugar, water, and type M hydrolyzed protein (Nutritional Biochemicals Corp., Cleveland, Ohio, U.S.A.). Eggs were collected in cylindrical plastic domes from these stock flies and seeded on the various experimental larval media.

The compositions of the test larval media are given in Table 1. For the preparation of these diets, all ingredients of a particular medium, except agar and hydrochloric acid, were blended together. The agar was dissolved in boiling water, cooled, to 56°C and then added to the blended ingredients followed by the hydrochloric acid. The entire mixture was then blended thoroughly again for 2–3 min until smooth. Each medium was then adjusted to pH 4.5 and poured into enamel trays (22.6×17.6×2.5 cm) with a strip of toilet tissue placed on top of the medium, and ca. 5,000 aggs were seeded on the tissue. There were 10 replications for each treatment and duration of egg-hatch/larval-development period, per cent pupal recovery, pupal weight, and per cent adult emergence from each diet were noted. In addition, longevity and oviposition observations of adult flies were made for each medium, using 25 pairs of adults replicated 3 times.

Results and Discussion

All of the larval media prepared and evaluated provided the desired texture for adequate larval tunneling. Also, adult flies were reared successfully from each of the larval diets for 3 consecutive generations with the exception of mango sawdust formulations which were reared for 2 generations only due to pressure of other studies. Variations in the length of egg-hatch/larval-development period, size of pupae, per cent adult emergence, preoviposition period, per cent egg fertility and adult longevity of the F_1 generation did not differ significantly for any of the diets (Table 2). However, while pupal weight was similar for almost all of the experimental larval media, rice husk '2' and sawdust '2' showed erratic increases (Table 2). Also there was variation in fecundity in some diet combinations.

Some differential effectiveness of the various diets on larval development was noted, as evidenced by pupal recovery. When larvae were grown on wheat shorts diluted with bagasse, for example, subsequent pupal recovery was 51.1, 47.8, and 41.8% for 25, 50, and 75% dilutions as compared with 69.3% from 100% wheat shorts (Table 2). However, this apparent variation in pupal recovery from different wheat short–bagasse combinations was insignificant at 1% level. When rice husk was substituted for 25% of the wheat shorts, pupation of 55.7% occurred but this was reduced significantly to 42.3% when the proportion of rice husk was increased to 75%. Mango sawdust was generally unsatisfactory. Three of the four mango sawdust–wheat shorts formulations gave significantly lower yields of pupae as compared with identical percentages of bagasse and rice husk substitutions.

Molasses may be used instead of sugar. We found that molasses gave equal recovery of pupae when compared with sugar in all of the respective groupings and for each of the different diet combinations.

The wheat shorts larval diet gave a pupal recovery of 69.3% for *D. zonatus*[1] while pupal recovery was less with the byproduct substitutions than with wheat shorts alone. However, the quality of pupae recovered was comparable with that obtained from the 100% wheat shorts diet.

*Diptera : Tephritidae.

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TABLE 1. LARVAL DIETS OF WHEAT SHORTS IN COMBINATION WITH BAGASSE, RICE HUSK, MANGO SAWDUST AND MOLASSES IN VARYING PROPORTIONS.

Ingredients	Larval diet (g)*											
	Wheat shorts only (standard diet)	Wheat shorts with byproducts as noted in varying (indicated as '1', '2', '3' and '4') proportions										
		Bagasse				Rice husk				Mango sawdust			
		1	2	3	4	1	2	3	4	1	2	3	4
Wheat shorts	100	75	50	50	25	75	50	50	25	75	50	50	25
Bagasse		25	50	50	75								
Rice husk						25	50	50	75				
Mango sawdust										25	50	50	75
Sugar	33	33	33		33	33	33		33	33	33		33
Molasses				25				25				25	

*Plus agar (3·5 g); brewer's yeast (17·0 g); nipagin (0·5 g); hydrochloric acid 1N (20 ml) and water (400 ml) except bagsase'4'—450 ml water (requires more wetting agent).

TABLE 2. REARING DATA FROM EXPERIMENTAL LARVAL DIETS.

Larval diet–wheat shorts plus indicated filler in 4 proportions*	Pupal development†					F_1 generation**					
	Pupal recovery (%)	Pupal weight (mg)	Pupal size		Adult emergence (%)	Egg larval period (day)	Adult preoviposition period (day)	No. of eggs/female	Egg hatch (%)	Adult longevity (day)	
			Length (mm)	Width (mm)						Male	Female
Bagasse											
1	51·1	11·1	4·9	2·1	94·8	8·0	10·3	279·3	80·0	41·1	48·8
2	47·8	11·6	5·0	2·0	93·8	8·8	12·6	257·6	82·3	45·5	49·1
3	51·7	11·1	5·0	2·0	95·3	8·7	12·6	227·9	79·2	39·5	45·5
4	41·8	11·2	4·9	1·9	93·4	8·3	11.6	205·7	80·3	40·3	44·9
Rice husk											
1	55·7	12·3	5·3	2·5	95·5	8·1	11·0	218·5	79·0	43·3	47·1
2	49·3	13·1	5·1	2·4	95·8	8·6	11·0	208·0	74·5	40·6	51·6
3	45·4	11·6	4·8	2·1	93·9	8·2	12·6	235·5	88·6	38·1	47·3
4	42·3	11·6	4·9	2·3	95·1	8·6	11·0	203·0	75·0	39·4	50·6
Mango sawdust											
1	40·7	12·6	5·1	2·2	93·8	8·5	12·3	219·3	74·0	45.5	50·3
2	29·5	13·8	5·1	2·2	94·7	8·4	10·0	191·8	82·2	44·4	47·8
3	29·1	12·6	4·9	2·0	93·6	8·7	12·0	164·3	81·6	39·1	49·5
4	27·8	12·5	4·9	2·0	93·1	8·8	10·3	172·0	77·0	42·6	45·6
LSD (0·01)	12·3	1·5	NS	NS	NS	NS	NS	51·6	NS	NS	NS
Standard (wheat shorts) diet‡	69·3±1·3	12·9±0·2	—	—	93·5±1·3	9·3±0·4	14·2±1·8	212·1±15·3	77·9±2·4	48·8±1·8	56·3±2·1

* Total ingredients and proportions of byproducts given in Table 1. † Each value is a mean of 10 replications. ** Each value is a mean of 3 replications (25 pairs).
‡ Reported by Qureshi *et al.*[1]

Other workers have studied the possible substitutions of inexpensive byproducts in larval media for different species. Monro,[2] for example, tried pine sawdust, dried cellulose pulp, dried-maize stalks, wheat bran, wheat germ, solvent-extracted cotton seed, and dried extracted sugar beet in semisolid larval diets in the mass rearing of the Mediterranean fruit flies, *Ceratitis capitata* (Wiedemann). He reported that all of these larval diets resulted in at least 50% pupal recovery.

Our studies have shown that sugarcane bagasse or rice husk can be used in combination with wheat shorts for the successful larval rearing of *D. zonatus*, and with no deleterious effects on subsequent adults. Also, molasses was found to be as satisfactory as the more expensive refined sugar. The discovery of the effective use of these less expensive materials should reduce the cost of rearing *D. zonatus*, and possibly other fruit flies.

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