Artificial Diets for Mass-Rearing of the Lesser Mulberry Pyralid,¹ *Glyphodes pyloalis* WALKER (Lepidoptera: Pyralidae)

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To establish the successive rearing method of the lesser mulberry pyralid, *Glyphodes pyloalis* WALKER, experiments were made with a commercial silkworm diet.

Addition of the juice of frozen mulberry leaves or young mulberry leaf powder into the artificial diet improved the diets, so that the larvae were arrested and reared in an open container. The pupal and adult yields on the improved diets were larger than those on the basic silkworm diet.

INTRODUCTION

Recently, the lesser mulberry pyralid, *Glyphodes pyloalis* WALKER (This species has been called erroneously as mulberry pyralid and corrected by INOUE, 1981.), has severely infested mulberry in some areas of Japan and Korea, giving a serious damage to silk production as insecticidal application to mulberry is not tolerated. Identification of the sex pheromone and its application would be an alternative solution for control and/or forecast occurrence of this insect. To this end, successive mass-rearing of the insect in the laboratory is a prerequisite.

NAKAMURA (personal communication) attempted to rear the species on an artificial diet for silkworms, *Bombyx mori* L. or cutworm, *Agrotis* spp. at the Sericultural Experiment Station, the Ministry of Agriculture, Forestry and Fisheries. However, the larvae strayed from the diet and therefore had to be confined in a closed container.

We recently found that the addition of juice or powder of young mulberry leaf into the commercial diet was effective in making larvae establish on the diet. This work reports the successful results of this insect on the diets.

MATERIALS AND METHODS

The larvae of the lesser mulberry pyralid, *Glyphodes pyloalis* WALKER, used for the experiments originated from the culture in the Sericultural Experiment Station in Tsukuba and were successively reared on mulberry leaves in our laboratory.

A deep petridish (9 cm diam. × 10 cm height) was lined inside with paraffin paper

¹ The authors named the lesser mulberry pyralid as the common English name of *G. pyloalis*.

Fig. 1. Oviposition container for the lesser mulberry pyralid moth. (a) paraffin paper liner smeared with mulberry leaf juice. (b) cotton pad soaked with sugar solution as food.

Fig. 2. Rearing of the lesser mulberry pyralid in a closed glass container (A) and a petridish (B).

smeared with mulberry juice. Five copulated females were placed in the petridish, provisioned with 5% sugar solution and allowed to lay eggs on the paraffin paper (Fig. 1). Five days after oviposition, the hatched larvae were carefully transferred onto a medium with a sable brush.

The rearing was done under $24 \pm 1^\circ\text{C}$, 60–80% R.H. and 15L–9D photoperiod, in which condition diapause is not induced (NAKAMURA, 1967).

Experiment 1. Rearing in the closed system. The meal powder for the silkworms, a commercial product of YAKULT Co. Ltd. (Tokyo, Japan), was used as the basal diet mainly composed of the dry powder of mulberry leaf, chlorella, soybean, inorganic salt mixture and antiseptics.

The diet was given to the larvae once each for the 1st to 3rd instar and once a day during the 4th and 5th instar periods. As shown in Fig. 2, the 1st to the 3rd instar larvae were reared in a closed container (10×8 cm) made of glass plates, and the 4th instar and thereafter in a petridish. Larval growth on the artificial diet was compared with the growth on mulberry leaves grown in autumn (October, 1983) or in spring (May, 1984). The diets were evaluated by recording the pupal and adult yields, larval and pupal periods, pupal weight and forewing length. The weighing of pupae was done individually 5 days after spinning.

Experiment 2. Rearing in the open system. Two different artificial diets based on the YAKULT-diet were prepared. One, designated as MJ, was a diet in which 30 ml of mulberry leaf juice (10 g frozen leaf equivalent) was added to 10 g of the basic diet powder. The juice was prepared by homogenizing frozen leaf in distilled water with an electric blender. The other, designated as SM, was the diet in which mulberry leaf powder of the basic diet was replaced with young mulberry leaf powder. The larvae were reared in a petridish from the 1st to the last instar. Other experimental procedures were the same as Experiment 1.

RESULTS AND DISCUSSION

Experiment 1

The yields of pupae and adults on the different diets are shown in Table 1. The pupation percentage (B/A) on the YAKULT-diet was 47.5%, while those on mulberry leaves were 47.0% (in autumn) and 70.0% (in spring). The percentage of adult-emergence was about the same in the different diets. There was a difference in the yields between the autumn and spring lots on mulberry leaves, which was considered to occur from the different nutritional and physical properties of the leaves. The pupal weight and forewing length of adults on the YAKULT-diet were inferior to those on mulberry leaves (Table 2). The fecundity and longevity of adults on this artificial diet differed little from those on mulberry leaves, though the data are not shown here. On the mulberry leaves, the growth period from hatching to emergence took 29 to 32 days, while the growth on the YAKULT-diet was 3 to 6 days longer (Table 3).

From these results, the YAKULT-diet appeared to be suitable for the successive rearing of the lesser mulberry pyralid. Young larvae, however, have a tendency to escape from this diet, and therefore must be reared in a closed container. Insect pests of mulberry like the fall webworm, *Hyphantria cunea* DRURY and the longicorn beetle, *Psacotha hilaris* PASCOE can be reared on the artificial silkworm diet (MUKAIYAMA,

Table 1. Yields of the lesser mulberry pyralid reared on mulberry leaves and three different diets

Diets	Inoculated larvae (A)	Pupae (B)	B/A (%)	Adults (C)	C/A (%)	C/B (%)
Mulberry leaves	300 ^a	141	47.0	130	43.3	92.5
	200 ^b	140	70.0	135	67.5	96.4
YAKULT	200	95	47.5	85	42.5	89.4
MJ	200	118	59.0	111	55.5	94.1
SM	200	126	63.0	121	60.5	96.0

^a Autumn culture.

^b Spring culture.

Table 2. Pupal weight and forewing length of the lesser mulberry pyralid reared on mulberry leaves and three different diets

Diets	Pupal weight (mg) ^{a, b}		Forewing length (mm) ^{a, b}	
	Male	Female	Male	Female
Mulberry leaves	36.4±0.8 ^c	39.0±0.9	10.8±0.1	11.2±0.1
	37.9±0.1 ^d	39.6±0.6	10.6±0.1	11.0±0.1
YAKULT	32.9±0.9	35.4±0.9	10.6±0.1	10.9±0.1
MJ	33.9±0.8	35.8±1.2	10.1±0.1	10.3±0.2
SM	37.1±0.6	38.6±1.6	10.4±0.1	10.6±0.1

^a Mean±S.E.

^b 30–60 insects were measured.

^c Autumn culture.

^d Spring culture.

Table 3. Larval and pupal periods of the lesser mulberry pyralid reared on mulberry leaves and three different diets

Diets	Sex	Larval periods (days) ^{a, b}	Pupal periods (days) ^{a, b}
Mulberry leaves	Male	15.5±0.3 ^c	16.9±0.3
	Female	15.8±0.3	16.6±0.3
	Male	16.4±0.1 ^d	13.0±0.2
	Female	16.6±0.1	12.9±0.2
YAKULT	Male	15.5±0.4	19.0±0.4
	Female	16.0±0.5	19.6±0.5
MJ	Male	15.9±0.2	13.7±0.2
	Female	16.5±0.4	14.2±0.3
SM	Male	15.7±0.3	13.5±0.2
	Female	16.3±0.3	13.9±0.2

^a Mean±S.E.^b 41–76 insects were measured.^c Autumn culture.^d Spring culture.

1966) or on a semi-synthetic diet containing no mulberry leaf powder (SUGIYAMA, 1969; EMORI, 1975). Therefore, the tendency of lesser mulberry pyralid larvae to escape from the artificial diet appeared that there are some differences in feeding mechanism on the mulberry leaves even among insect pests of the same host plant.

Experiment 2

Two different diets were prepared to improve larval establishment on artificial diet under the open system of a petridish. MJ and SM in Tables 1, 2 and 3 show better results than the YAKULT-diet of Experiment 1.

The results on the SM-diet were better than those on the MJ-diet. This may be attributed to the size of SM-diet powder, i.e., the SM-diet powder used young mulberry leaves was finer than the MJ-diet powder. The hatchability of eggs on these diets differed little from that on the natural diet, data not shown. With these results, the SM-diet appeared to be the most suitable for the successive laboratory rearing of the lesser mulberry pyralid.

It is therefore of interest to determine what components of mulberry juice or young mulberry leaves arrest the lesser mulberry pyralid larvae on these artificial diets.

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