Egg Weight Variation Associated
with Female Age in *Pieris rapae
 crucivora* BOISDUVAL (Lepidoptera: Pieridae)\(^1,2\) 

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Although many studies have been made on fecundity and oviposition pattern of *Pieris rapae* (GOSsARD and JONES, 1977; SUZUKI, 1978; YAMA-
moto and OHTANI 1979; GILBERT, 1984), the variation in egg weight has not attracted much attention except for JONES et al. (1982).

From June to October, the larvae and pupae of *Pieris rapae crucivora* BOISDUVAL were collected in cabbage fields on the campus of Nagoya University, Nagoya, Aichi and in the Togo Experimental Farm of Nagoya University, Togo, Aichi. Larvae were reared on cabbage leaves in the laboratory. On the day of emergence, females were released in a field cage (3.6 × 3.6 × 1.8 (H) m) containing a number of males and mated with the males there. The next day, females were caged individually in plastic cages (18.5 (W) × 22.0 (L) × 34.0 (H) cm), and potted cabbage plants supplied for their oviposition sites. They were fed on a 5% honey solution twice a day. Since females were quiet while they fed, we assumed that they fed until they were satisfied. Their forewing lengths were measured using a slide caliper accurate to 0.1 mm.

Females were kept under a photoperiod condition of 16L:8D. For 12-hr within the 16-hr photophase, two 20-W fluorescent tubes were also lighted 5 cm above the cages to facilitate oviposition. During the 12-hr period ambient temperature and illumination inside the cages were 28±2°C and about 1,500 lux, respectively.

After the intensive illumination, eggs laid on cabbage leaves were removed using forceps. The wet weight of eggs was measured within 24 hr using a semi-micro-balance (CHO, M-20A) accurate to 1 μg. Dry weight of eggs was also measured after drying at 80°C for about two days. The number of eggs measured per female per day was 1 to 10 (average: 3.8) and the number of females examined was 36.

Egg weight was highly variable and the heaviest was more than twice as heavy in wet weight than the lightest one. Figure 1 shows the relationship between female age and wet weight of eggs; wet weight decreased with age (\(r^2=0.154, p<0.005\)). A similar tendency was seen in the relationship between female age and dry egg weight (\(r^2=0.064, p<0.01\)). However, the average egg weight did not seem to decrease after about the 10th day (Fig. 1), suggesting that there is a minimal weight.

Multiple regression equations of egg weight (\(y\) for wet weight and \(y'\) for dry weight) to female age (\(x_1\)) and forewing length (\(x_2\)) were calculated as,

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y = 50.2 - 1.19x_1 + 1.52x_2 \quad (R^2=0.173, p<0.005, n=1,109) \\
y' = 15.8 - 0.31x_1 + 0.32x_2 \quad (R^2=0.069, p<0.005, n=1,109)
\]

Multiple regression analyses showed that not only female age but also female size is influential on egg weight: larger females tend to lay heavier eggs than smaller females. However, the absolute value of the partial regression coefficient of female age (\(r_{x_1}\)) to egg weight was much larger than that of female size (\(r_{x_2}\)): \(r_{x_1} = -0.373 (p<0.001)\) and \(r_{x_2} = 0.152\)

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(p<0.001) for wet egg weight (y), and r² = 0.239 (p<0.001), r² = 0.075 (p<0.05) for dry egg weight (y). This suggests that age has a much greater effect on egg weight than size.

Jones et al. (1982) reported a similar relationship between egg weight and female age in a different subspecies, P. rapa r. L. The decrease in egg weight with female age was also reported in other lepidopteran insects (Harvey, 1977; Richards and Myers, 1980; Wiklund and Persson, 1983; Karlsson and Wiklund, 1984).

Generally, the decrease of egg weight is assumed to be due to the decrease in yolk size (e.g., Capinera et al., 1977). However, the adaptive significance of the variation in egg weight in P. rapae is not yet clear. Nakasuji and Kimura (1984) found a seasonal polymorphism of egg size in Parara guttata and suggested that laying larger eggs in autumn is adaptive because larvae of this season have to feed on tougher leaves of cogan grass than larvae emerging in spring. On the other hand, however, Karlsson and Wiklund (1984) reported that there was no significant difference in hatchability, length of larval period or survival rate of larvae between larger and smaller eggs in L. megera.

Additional data on fitness related parameters are needed to explain the relationship between egg weight and female age seen in P. rapae.

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REFERENCES


Statistical Analyses of Pheromone Trap Catches of the Summer Fruit Tortrix Adoxophyes orana fasciata WALSINGHAM (Lepidoptera: Tortricidae) in Apple Orchards

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In 1983, the Ishikawa Agricultural Cooperative Association of Hirotsuki City used pheromone traps to time spraying for the control of the first generation larvae of the summer fruit tortrix, Adoxophyes orana fasciata WALSINGHAM, in its affiliated orchards. About 270 ha of apple orchards were divided into two groups according to their administrative districts, Ishikawa and Osaka. Each district has nearly the same acreage of apple orchards, situated at the southern edge of the Tsugaru plain in Aomori Prefecture. Each group was subdivided into three subgroups mainly on the basis of their elevation and two private orchards were chosen from each subgroup to monitor the moth flight. The orchardists concerned counted the number of trapped male moths daily. Observations were initiated between May 15 and 18 depending upon the orchardists and were continued until June 5.

Using these data, daily percentages of the moth catches were calculated based on the total catches from May 18 to June 5. These are shown in Fig. 1 together with the total catches. For the sake of convenience, the orchards were numbered from 1 to 12 as explained in the figure. As no meteorological data were available for these orchards, data recorded at the Aomori Apple Experiment Station