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Short Communication

Rearing *Pieris brassicae* (L.) (Lepidoptera: Pieridae) on Artificial Diets

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Abstract: Larvae of the large white butterfly *Pieris brassicae* (L.) were reared on four kinds of artificial diets, consisting of a multipurpose basic insect feed, plus either green juice powder or dried Japanese radish leaf powder as a preference material, in the laboratory. Each preference material was given at contents of 10 and 20%, by dry weight. No larvae died during the larval stage in all plots. However, the duration of larval development on the diet containing 10% green juice powder was 2 days longer than that of the control, reared on fresh kale leaves. The average of pupal weights reared on each diet was about 360–460 mg, and the percentage of adult emergence was 93.3–100%. The results made it clear that artificial diets consisting of a multipurpose basic insect feed, plus Brassica leaf powder as a preference material, were useful to rear the larval stage of the large white butterfly in the laboratory.
Key words: *Pieris brassicae*, rearing, artificial diet, green juice, Japanese radish

Introduction

Occurrence of the large white butterfly *Pieris brassicae* (L.) was detected in Hokkaido prefecture in 1996, and subsequent field surveys showed the butterfly to be distributed not only in Hokkaido but also in Aomori prefecture (Yokohama Plant Protection Station, 1997). Therefore, studies on susceptibility to some insecticides are conducted, to control the butterfly.

A large number of insects are needed to do these tests, and it is desirable to mass-rear them in a laboratory. This butterfly could be reared all year round on cabbage and kale leaves (David and Gardiner, 1952; David, 1957), and larvae could be reared successfully on a semi-synthetic diet containing a small amount of dried cabbage leaf powder (David and Gardiner, 1966). However, the occurrence of diseases on larvae was of concern when fresh leaves were used as diet, and preparation of this semi-synthetic diet was complicated. Therefore, we studied if a simple artificial diet, consisting of a multipurpose basic insect feed and dried Brassica leaf powder, was useful to rear the large white butterfly.

Materials and Methods

Insects

Egg masses of the large white butterfly on Brassica leaves, such as cabbage, Japanese radish, etc., were collected in Sapporo city in July 2002, and then transported to the Research Division of Yokohama Plant Protection Station. They were put into a plastic case (about 30×20×8 cm, 15×8 cm; the opening part of the lid was glued with fine mesh)

Table 1. The composition of artificial diets prepared.

Diet	Insecta F-II (g)	Green juice powder*1 (g)	Dried Japanese radish leaf powder*2 (g)	Distilled water (m*l*)
A	22.5	2.5	–	60
B	20.0	5.0	–	60
C	22.5	–	2.5	60
D	20.0	–	5.0	60
K (Cont.)*3	–	–	–	–

*1 Green juice powder was a marketed healthy drink commodity, made by freeze-drying organically grown kale leaves.
*2 Japanese radish was cultivated in a farm field. The main ribs were removed and the remainder was dried in a dry oven at 90℃ for 2 hours, followed by milling after rough crushing by hand.
*3 Diet K as a control was reared on fresh kale leaves that were cultivated in a laboratory.

and placed in a room at 25℃. At 5 days after hatching, 3rd instar larvae were reared on various diets.

Diets

Four kinds of artificial diets (Table 1) were prepared. A multipurpose basic insect feed (Insecta F-II; Nihon Nosan Kogyo Co., Ltd.) was used as the basic feed, and green juice powder or dried Japanese radish leaf powder, as a preference material, was added to it. The green juice powder was a marketed healthy drink commodity, made by freeze-drying organically grown kale leaves. Diets A and B contained 10 and 20% green juice powder, by dry weight, respectively. Dried Japanese radish leaf powder was made from Japanese radish leaves that were cultivated in a farm field. The main ribs were removed from fresh leaves; the remainder was dried in a dry oven at 90℃ for 2 hours, followed by milling with an electric mill after rough crushing by hand. Diets C and D contained 10 and 20% dried Japanese radish leaf powder, by dry weight, respectively.

Basic insect feed, preference material, and distilled water were mixed together. The mixture was put into a petri dish (9-cm diameter) and wrapped with plastic wrap. Then the petri dish, including the diet, was steamed for 20 minutes, followed by cooling down at room temperature. Diets were stored at 5℃ until use.

Diet K, as a control, was given fresh kale leaves that were cultivated in a laboratory.

Rearing

Twenty-five small plastic cases (about 8 cm diameter, 3×3 cm; the opening part of the lid was glued with fine mesh), each containing three larvae, were transferred to a temperature-controlled room (20±2℃, 16L8D, no humidity control), and they were divided into five plots randomly, with each plot consisting of five cases. A cake of each artificial diet (about 1.5×1.5×1.0 cm) was given to each plot, twice a week. When the diet was dried before a new cake was given, distilled water was dropped onto the diet. For diet K, as the control, one kale leaf (5–8 cm diameter) was given twice a week, initially. However, growing up to the last instar, 2 or 3 kale leaves were given every day, except for on

Table 2. Developmental period, pupal weight and adult emergence of *Pieris brassicae* on various diets.

Diet	No. of 3rd instar inoculated	Days for 50% of tested insects to reach each stage from hatching (day)			Average weight of pupae* (mg±95% C.L.)	Adult emergence (%)
		5th instar	Pupa	Adult		
A	15	16	25	41	361.8±19.3a	93.3
B	13	16	23	38	398.0±20.9b	100
C	15	15	22	37	447.5±11.1c	100
D	15	16	23	38	457.9±12.7c	100
K (Cont.)	15	15	23	38	318.5±14.4d	100

* There were significant differences at 1% level between different characters by Tukey–Kramer HSD test.

weekends, because these leaves were consumed in a short time.

After all larvae in each plot were pupated, they were removed from the case and taped down to cardboard using double-faced tape. These pupae were put into an acrylic desiccator (about 20×20×15 cm).

Observation

Each plot was observed every day, except on weekends, and the numbers of molt, pupation, and adult emergence were recorded. The day after pupation was completed in each plot, all pupae were weighed individually.

Results and Discussion

The results are shown in Table 2. With diet B, 15 larvae were tested, but two deaths were observed on the day after inoculation. These dead larvae were not included in the data, because they might have been mishandled at inoculation.

There was no larval death during the larval stage for all of the diets, and only one death was observed at the pupal stage for diet A. Days required for growth into the 5th instar larvae, pupal, and adult stages from hatching were 15, 23, and 38 for diet K, respectively. Days required for growth into pupal and adult stages for diet C were one day earlier than for diet K, and the same days for diet A were 2 and 3 days later than for diet K. GARDINER (1985) reported that durations of larval and pupal stages of *Pieris brassicae* at 20℃ were 18.5 and 14 days. The durations of larval and pupal stages in this study were 3.5–6.5 and 1–2 days longer than GARDINER reported.

In pupal weight, the average for diet K was 318.5 mg. The averages for diets C and D were more than 440 mg, and this value was about 1.4 times the average for diet K. The averages of diets A and B were about 360 and 400 mg, which were smaller than for diets C and D. Tukey–Kramer HSD testing showed significant differences ($p < 0.01$) between each diet, excluding between diets C and D. According to DAVID and GARDINER (1966), both averages of pupal weight, which were reared on cabbage leaves and semi-synthetic diet containing 1.4%, by weight, of dried cabbage leaf powder, were 351 mg, and also the average of pupal weight was more than 410 mg when larvae were reared on fresh green leaves of cabbage. These results could not be compared directly with the result of this

study, but all of the diets in this study were acceptable for rearing.

Adult emergence of 100% was observed with the four diets, except for diet A, which had 93.3%. DAVID and GARDINER (1966) suggested that larval feeding, the pupal survival rate, and normal adult emergence were affected by the content of glucoside in diets. In this study, the duration of larval development was prolonged, but there were no problems with larval and pupal survival, or adult emergence.

These results made it clear that artificial diets consisting of a multipurpose basic insect feed, plus Brassica leaf powder as a preference material, were useful to rear the larval stage of the large white butterfly in the laboratory.

References

DAVID, W. A. L. (1957) Breeding *Pierris brassicae* L. and *Apanteles glomeratus* L. as experimental insects. *Proc. Z. PflKrankh.* **64**: 572–577.

DAVID, W. A. L. and B. O. C. GARDINER (1952) Laboratory breeding of *Pierris brassicae* L. and *Apanteles glomeratus* L. *Proc. R. Ent. Soc. Lond.* (*A*) **27**: 54–56.

DAVID, W. A. L. and B. O. C. GARDINER (1966) Rearing *Pierris brassicae* (L.) on Semi-synthetic Diets with and without Cabagge. *Bull. Ent. Res.* **56**: 581–592.

GARDINER, B. O. C. (1985) *Pieris brassicae*. In: Handbook of Insect Rearing Vol. III (P. SINGH and R. F. MOORE, eds.), Amsterdam: Elsevier Science Publishers B. V., pp. 453–457.

Yokohama Plant Protection Station (1997) Pest Information **51**: 4–5. (in Japanese)

和 文 摘 要

人工飼料によるオオモンシロチョウの飼育

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オオモンシロチョウの幼虫を汎用昆虫飼育基礎飼料と嗜好性材料としての青汁粉末または乾燥大根葉粉末からなる 4 種類の人工飼料により実験室で飼育した。それぞれの嗜好性材料の含有量は、乾燥重量の 10 及び 20%とした。いずれの飼料でも幼虫期の死亡はなかった。しかし、幼虫の発育期間は新鮮なケールの葉で飼育した対照区よりも 10%の青汁粉末を含む飼料で 2 日長くなった。それぞれの人工飼料から得られた蛹の平均体重は約 360～460 mg であり、成虫の羽化脱出率は 93.3～100%であった。以上の結果、汎用昆虫飼育基礎飼料と嗜好性材料としてのアブラナ属植物の葉の粉末からなる人工飼料は、オオモンシロチョウの幼虫を室内飼育するのに有用であることがわかった。