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Effects of different diets and temperatures on larval growth of the white-spotted flower chafer, *Protaetia brevitarsis* (Kolbe) (Coleoptera: Scarabaeidae)

Hong Geun Kim, Kwan-Ho Park, Seokhyun Lee, Kyu-Won Kwak and Ji-Young Choi

Applied Entomology Division, National Academy of Agricultural Science, RDA, Wanju-gun, Jeollabuk-do, 565-851, Republic of Korea

Abstract

The white-spotted chafer, *Protaetia brevitarsis* (Coleoptera: Scarabaeidae), is an economically important insect in Korea. Traditionally, it has been regarded as a medicine for preventing liver-related diseases and suppressing liver cancer. Recently, this beetle was enlisted as a temporal food ingredient by Korean Ministry of Food and Drug Safety. Therefore, this beetle is focused as a one of the important insects that are commercially reared and sold in Korea. As the economic importance of this beetle is growing, the suitable rearing conditions are needed for more detailed investigation. In this study, we compared three temperature conditions and two food additives, rice chaff and soybean cake, for its effects on the body weight change of third instar larvae of *P. brevitarsis.* Temperature is a major environmental factor that has tremendous effects on rearing insects. In additions, rice chaff and soybean cake are byproducts of other agricultural activities. Therefore, it is easy to get, and the price is comparatively low. However, they still have meaningful amount of nutrients. With four different kinds of feed and three temperature conditions on the third instar larvae of beetles, the body weight change was tracked for 14 wk. We concluded that 27.5°C is the optimal temperature to rear the third instar larvae among three temperatures (25, 27.5, and 30°C). Among four different feeds, conventional fermented oak saw dust with rice chaff and soybean cake was the best feed for larval weight gain during 14 wk. However, feed with soybean cake at 30 °C was the best condition for rearing *P. brevitarsis* larvae when temperatures and feeds were compared at the same time.

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Introduction

The white-spotted chafer, *Protaetia brevitarsis* (Coleoptera: Scarabaeidae), is a commercially reared insect that has four distinctive life stages – egg, larva, pupa, and adult stages. This holometabolous insect is distributed from the far-east Asia including Japan, Taiwan, Korea, and China to the parts of Europe (Cho, 1969). The adults are observed from the late June, and it is abundant in July in Korea (Kim *et al*., 2005). Depend on its habitat, adults were usually found once per year from May

***Corresponding author.**
Ji-Young Choi
Applied Entomology Division, National Academy of Agricultural Science (NAAS), RDA, 166, Nongsaengmyeong-ro, Iseo-myeon, Wanju-gun, Jeollabuk-do, 565-851, Republic of Korea
Tel: +82-63-238-2992 / FAX: +82-63-238-3833
E-mail: choijy7@korea.kr

to October, and they are gregarious and diurnal insects, and overwinters as a third instar larvae in the soil (Zhang, 1984). It has been known as a good traditional medicine for liver-related diseases especially liver cancer (Park *et al*., 1994; Kang *et al.*, 2001; Yoo *et al*., 2007). In addition, the white-spotted chafer was recently enlisted as a temporal food ingredient by Korean Ministry of Food and Drug Safety. Therefore, rearing this beetle has been growing in Korea, and this beetle is categorized as industrial insects because mass-rearing facilities were started from late 1990s. Based on these economic importance, producing better quality beetles is getting more important to increase the market value of this beetle.

Based on the diet, the larval growth rate of *P. brevitarsis* is varied (Kwon, 2009). Rice chaff and soybean cake are byproducts of agricultural activity and product process, so they have an economic advantages. However, they are still containing enough nutrition to support healthy insect production. To improve the quality of *P. brevitarsis* larvae, these two additives were added to the general feed for *P. brevitarsis* larvae, the fermented oak sawdust. In addition, as a major environmental factor, temperature has enormous effects from molecular level to ecological aspects of insects, an ectothermal animal (Zars, 2003). To find suitable rearing conditions for the white-spotted chafer, we made four different feeds with different combination of rice chaff and soybean cake with three temperature conditions. With these treatments, the body weight change of third instar larvae was compared.

Materials and Methods

Experimental Animals

The third instar larvae of *P. brevitarsis* (Coleoptera: Scarabaeidae) were collected from the laboratory colony that was established by purchasing from a commercial seller, Smurf Bugs Farm (Namyangju-gun, Kyeonggi-do, Republic of Korea), and a private seller (Hoengseong-gun, Gangwon-do, Republic of Korea). The purchased beetles were kept together to hybrid and to increase genetic diversity in the laboratory condition on the fermented sawdust at 25°C with ca. 40% humidity. From this laboratory colony, the third instar larvae were collected based on its head capsule size for this experiment.

Table 1. Composition of four different feeds with two feed additives – rice chaff and soybean cake

Name of Feed	Composition
Control	100% Basic Feed
Control with Soybean Cake	90% Basic Feed + 10 % Soybean Cake
Control with Rice Chaff	90% Basic Feed + 10 % Rice Chaff
Control with Soybean Cake and Rice Chaff	90% Basic Feed + 5 % Soybean Cake + 5 % Rice Chaff

Feeds with Different Additives

The basic feed was fermented oak sawdust that was mixed with 60% of oak sawdust, 30% of wheat bran, and 10% of previous fermented oak sawdust to provide useful microbes that help fermentation. To test the effects of feed additives, we added rice chaff and/or soybean cake based on the Table 1. The rice chaff and soybean cake were mixed with fermented oak sawdust. After mixing it, the feed were fermented for one more month.

Rearing Condition and Experimental Design

The third instar larva was reared in a round petri dish (98 mm diameter X 15 mm depth) with enough designated feed. The rearing room was set as 25, 27.5 and 30°C with ca. 40% humidity and 12:12(L:D) light condition. We measured body weight and state of each larva, and changed feed once per a week. For each treatment, 10 individuals for the third instar larvae were maintained for 14 wk. It was enough time for the most of second instar larvae to pupate. Three replications for each treatment were conducted. Each of three biological replications, independent batches of different feeds and temperatures, consisted of ten technical replications. A technical replication was a set of 12 different treatments (four feeds X three temperatures). Averages and standard deviations of weight increase for each week, accumulated weight increase, and weight before pupation were calculated and compared each feed treatment to control feed with *t*-test and ANOVA analysis.

Results and Discussion

Larval weight gain was significantly different by rearing temperatures ($df = 2$; $F = 5.01$; $p = 0.0071$) and feed with four different combinations with soybean cake and rice chaff

Table 2. Results for ANOVA test with three temperatures and four feeds. Ten P. brevitarsis larvae per each treatment with three replication were analyzed for their larval weight gain for 14 wk

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Temperatures	2	2.03289556	1.01644778	5.01	0.0071
Feeds	3	2.00822000	0.66940667	3.30	0.0205
Temperatures X Feeds	6	2.55128667	0.42521444	2.10	0.0530
Error	348	70.54352667	0.20271128		

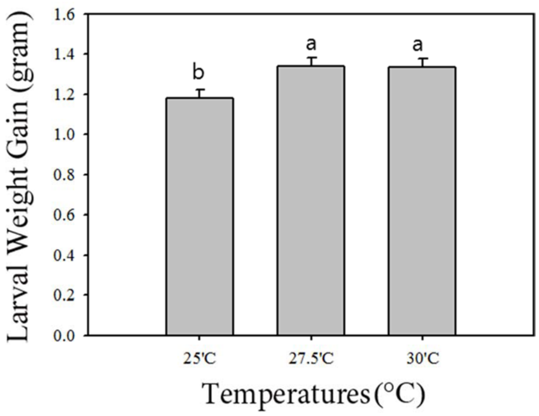

Fig. 1. Means and standard errors of final larval weight after 14-week rearing on three different temperatures (25, 27.5, and 30°C). The means and standard errors were tested at 95% confidence level by Least Significant Difference (LSD) test.

(df = 3; F = 3.30; p = 0.0205) when analyzed by ANOVA (Table. 2). However, the interaction between three rearing temperature and two feed ingredients did not show significant effect on the larval weight gain (df = 6; F = 2.10; p = 0.0530) when analyzed by ANOVA (Table. 2). When compared three temperature conditions, larvae grown at 25 °C (1.18 ± 0.48 g) gained significantly less weight than those at other temperatures: 27.5°C (1.34 ± 0.45 g) and 30 °C (1.33 ± 0.48 g) (Fig. 1). As the temperature increased, the larval weight gain is also increased.

As analyzing the effects of different feed additives, a feed with soybean cake and rice chaff showing the best effect on the larval weight gain (Fig. 2). However, the difference between the feed with soybean cake and rice chaff and the feed with soybean cake was not significantly different. However, the feed with rice chaff showed the least larval weight gain during 14-wk experiment. Even though the difference was not significant, adding rice chaff did not show meaningful effects on larval weight gain. The effects of different composition of feed on the larval weight gain of *P. brevitarsis* were reported (Kwon, 2009). In this experiment,

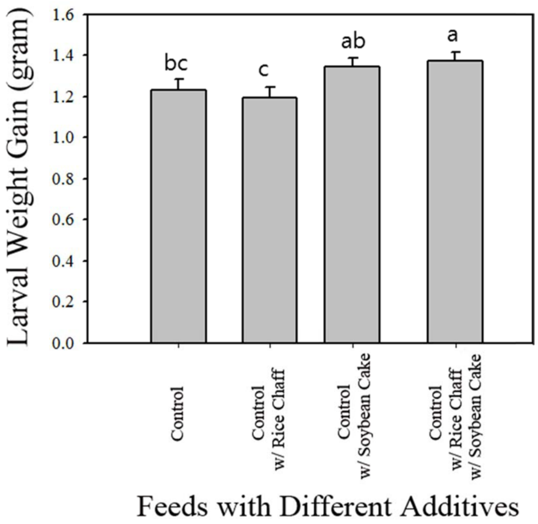

Fig. 2. Means and standard errors of final larval weight after 14-wk rearing on four different feed compositions. The means and standard errors were tested at 95 % confidence level by Least Significant Difference (LSD) test.

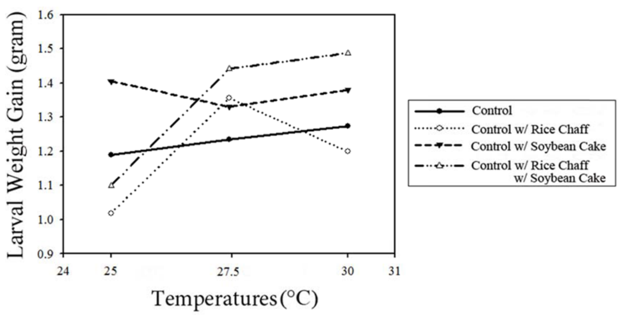

Fig. 3. Interaction between three temperatures (25, 27.5, and 30°C) and four feed compositions on the final larval weight gain for 14-wk rearing.

rice chaff showed negative effect when it was added to the control feed. However, it showed positive effects with 5 % of soybean cake. It might be compensate the nutritional balance between protein and carbohydrate.

When the interaction between rearing temperatures and different feed additives analyzed, the larval weight with control feed and feed with soybean cake was increased as the temperature increased from 25 to 30°C (Fig. 3). In addition, the larval weight with soybean cake and rice chaff at 27.5°C was lower than other two temperature condition, 25 and 30°C. Interestingly, the larval weight gain with rice chaff at 30°C compared to 27.5°C. These results showed that the larval weight gain is different by temperature as well as the feed additives.

With four different feeds and three temperature conditions, we concluded that larvae reared with soybean cake at 30°C showed the best result for the larval weight gain. However, the difference between the larval weight gain with soybean cake at 27.5 and at 30°C was not significant, but it requires lots of resources to keep 30°C. Therefore, we concluded that it is the best to rear *P. brevitarsis* larvae with conventional feed mixed with soybean cake at 27.5°C.

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References

Cho PS (1969) Illustrated encyclopedia of fauna & flora of Korea, Vol. 10. Insecta(II). Samhwa, Seoul. Korea. pp. 686-687.

Kang IJ, Chung CK, Kim SJ, Nam SM, Oh SH (2001) Effects of *Protaetia orientalis* (Gory et Perchlon) larva on the lipid metabolism in carbon tetrachloride administered rats. Appl Microsc, 31, 9-18.

Kim HG, Kang KH, Hwang CY (2005) Effect of some environmental factors on oviposition and developmental characteristic of *Protaetia brevitarsis* and *Allomyrina dichotoma*. Korean J Appl Entomol 44, 283-286.

Kwon O (2009) Effect of different diets on larval growth of *Protaetia brevitarsis seulensis* (Kolbe) (Coleoptera: Cetoniidae). Entomol Res 39, 152-154.

Park HY, Park SS, Oh HW, Kim JI (1994) General characteristics of the white-spotted flower chafer, *Protaetia brevitarsis* reared in the laboratory. Korean J Entomol 24, 1-5.

Yoo YC, Shin BH, Hong JH, Lee J, Chee HY, Song KS, Lee KB (2007) Isolation of fatty acids with anticancer activity from *Protaetia brevitarsis* larva. Arch Pharm Res 30, 361-365.

Zhang ZL (1984) Economic insect fauna of China. Fasc. 28. Coleoptera: larva of Scarabaeidae, Science Press, Beijing (in Chinese). 27-28.

Zars T (2003) Hot and cold in *Drosophila* larvae. Trends Neurosci 26, 575-577.