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Effect Of The Quality Of Mulberry Leaves *Morus alba* Against The Silkworm Nutrition Index *Bombyx mori* L. (Lepidoptera:Bombicidae)

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Abstract. Th leaf quality effect of mulberry (Morus alba) on nutrition index of silkworm (Bombyx mori L.) has been studied. This research was design according to Completely Randomized Design (CRD) with 2 treatments which are an unfertilized mulberry plant, and the fertilized mulberry plants with urea, triple super phosphate (TSP), nitrogen, phosphor, and potassium (NPP). Twenty times replications was applied for each treatment. The results showed that the leaf of fertilized mulberry plant is evidently increased the growth and the consumption rate on the conversion efficiency of instar III, the feed digestion of instar V, the efficiency of food conversion of instar IV and V, and the estimate of feed digested of instar IV with the number for each was 36% and 26%, 30%, 34% and 67%, 24%, respectively.

Keyword: Bombyx mori L., Morus alba, nutrition index

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1 Introduction

Silkworm (*Bombyx mori* L.) is a type of insect that has a high economic value for humans. This insect is a producer of silk fibers that are raw materials of silk in the field of textiles, surgical threads, parachutes with high quality, and can not be defeated by artificial silk fibers .According to [1], mulberry leaves are a single feed with a high level of palatability for *B. mori* L. In mulberry leaves there is a stimulating substance that is glucoside and silkworm refuse to eat the leaves of other plants because of the absence of these stimulant substances. Mulberry that has the potential to produce high productivity on silk is *Morus alba* because this type has the best nutritional content compared to other types of morus [2] To improve the results of the natural military industry needs to be improved the quality and quantity of mulberry leaves. One of the efforts made is by giving inorganic fertilizers namely urea fertilizer, triple super phosphate (TSP),

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nitrogen, phosphor and potassium (NPK) in the Morus alba mulberry plant. The fertilizer has an important role in plant growth so that later it can increase the nutritional index of silkworms [3]. The nutrient index is a value calculated to get a picture of what happens in an insect's body when an insect eats a particular type of food. Such efficiency will describe the response of insects [4].

2. Material and Methods

The research model used is experimental research with a complete randomized design (CRD) consisting of 2 treatments with 20 repeats. The treatment consists of mulberry plantsMorus alba that are fertilized and without fertilizer with the following symbols:

P1 = Fertilized, P2 = Without fertilizer

Mulberry planting land covering an area of 10 x 3 m in front of the Tridarma Forest of the University of Sumatera Utara was first cleared of grass. The land that has been cleared is divided into 2, namely fostered land and land without fertilizer each covering an area of 5 x 3 m, each land is processed using a hoe as deep as 30-50 cm and made with a height of 5-10 cm. Each treatment that is fostered and without fertilizer is made each 5 beds. The function of the bed is so that the growth of mulberry is more evenly distributed, facilitates the harvesting of leaves, made trenches as deep as ±30 cm. The function of the trenches is a place to accommodate puddles because mulberry rooting is not resistant to standing water. Mulberry cuttings of mulberry *M. alba* used are obtained from Kacinambung Village, Kabanjahe Subdistrict, Karo Regency, North Sumatra Province. The cuttings obtained are cut using a sharp machete so as not to injure the cuttings obtained. The length of mulberry cuttings is 20-25 cm with eye shoots of 4-5 pieces. One end of the cutting is cut slightly tapered ±1.5 cm and the other end flattens, then placed into plastic and wet with a little water, the next day the cuttings obtained are planted on each bed where each bed is planted 5 cuttings with a planting distance of 0.5 m [5].

Cuttings of mulberry plants that have been planted, treated. When any cuttings die, immediately replace them with new cuttings. In addition, the land is cleaned from weeds that interfere with the growth of mulberry plants and watering three times a week. Fertilization is done by sprinkling fertilizer around mulberry plants.

Table 1. Mulberry Plant Fertilizing Dose

Type of Fertilizer	Nutrient Content	Content (%) Nutrient Element	Fertilization Dose (kg/ha)	Conversion of Fertilization Dose (kg/m^2)
Urea	N	46% N	210	0,32
TSP	P	36% P	100	0,15
N,P,K	N,P,K	16% N, 16% P, 16% K	260	0,39

[5]

Silkworm eggs are obtained from candiroto silkworm nursery center, Central Java.Eggs are put into white HVS paper, folded with carbon paper and arranged in a plastic basket until hatched. Newly hatched silkworms (instar I) are divided into two treatment groups, namely silkworms fed mulberry leaves whose plants are fertilized and not fertilized where each consists of 20 caterpillars and put into a petri dish that has previously been coated with wet wipes and base paper. Feeding is given three times a day, namely morning, afternoon and evening. At the end of instar I which is characterized by caterpillars stop eating and change cuticles (molting) where silkworm maintenance is cleaned by replacing base paper, lifting feces and the rest of the feed. The same is done at the beginning and end of instar II to instar V, but on instar III-V mulberry leaves M. alba given is no longer intact or with its branches. At the end of instar II the caterpillar that has stopped eating, placed individually separately on a petri dish until replacing the cuticle. After replacing the cuticle, the caterpillar enters the beginning of instar III and weighs its body weight. Mulberry leaf feed whose plants are fertilized and not fertilized before being given to silkworms is weighed first. The feed given to the silkworm instar III is 0.70 g / day. At the end of instar III which is marked by caterpillars have stopped eating and changed cuticles where silkworm maintenance is cleaned by replacing the base paper, lifting feces and the rest of the feed. At the end of instar III the silkworm weighed its weight. Feces and the rest of the feed produced by the caterpillars are then collected and dried in the oven at a temperature of 60 ° C to a constant weight. The same is done at the beginning and end of instar IV to instar V but the feed given to the instar IV silkworm is 2 g / day and instar V is 4 g / day.

The nutritional indexes of [6] used in this study are as follows:

a. The nutritional index of [6] is: Growth rate (GR).

$$GR = \frac{g}{\boldsymbol{tw}} \left(\frac{mg}{day}\right) \quad (1)$$

b. Consumption Rate/*CR*

$$CR = \frac{f}{\boldsymbol{tw}} \left(\frac{mg}{day}\right) \quad (2)$$

c. Efficiency of Conversion of Digested Food/*ECD*

$$ECD = \frac{g}{(\boldsymbol{f}-\boldsymbol{e})} x100 \quad (3)$$

d. Efficiency of Conversion of Ingested Food/*ECI*

$$ECI = \frac{g}{\boldsymbol{f}} x100 \quad (4)$$

e. Approximate Digesstibility/AD

$$ECI = \frac{(f-e)}{\boldsymbol{f}} x100 \quad (5)$$

Information:

G = Increase in larval weight during instar III-V,

E = The weight of fecal produced by larvae during instar III-V,

F = Weight of feed eaten by larvae during instar III-V,

T = Length of feeding period during instar III-V,

W = Average weight of larvae during instar III-V.

All of the above calculations are calculated in dry weight.
The average weight of the larvae during instar III-V, calculated based on

$$AW = \frac{early\ weight\ of\ silkworm + final\ weight\ of\ silkworm}{2} \quad (6)$$

All of the above calculations are calculated in dry weight.

The data obtained from each observation parameter (variable) is recorded and organized into table form. Quantitative data obtained, tested its meaning on the influence of treatment groups (independent variables) with the help of computer statistics program, namely statistical package for the social sciences (SPSS) release 16. The test sequence begins with the normality test, the homogeneity test. If the test results show $p<0.05$ then the data is transformed and continued with non-parametric tests. To see the difference of 2 treatments (controls and treatments) is done with the analysis of the T test (parametric, for $p>0.05$) or Mann-Whitney (non-parametric, for $p<0.05$)

3. Result and Disscusion.

a. Growth Rate (GR) of Silk Worms III, IV and V

The results of the calculation of the growth rate (GR) of instar III, IV and V silkworms given morusalba mulberry plants treated with fertilizer and without fertilizer can be seen in Figure 1.

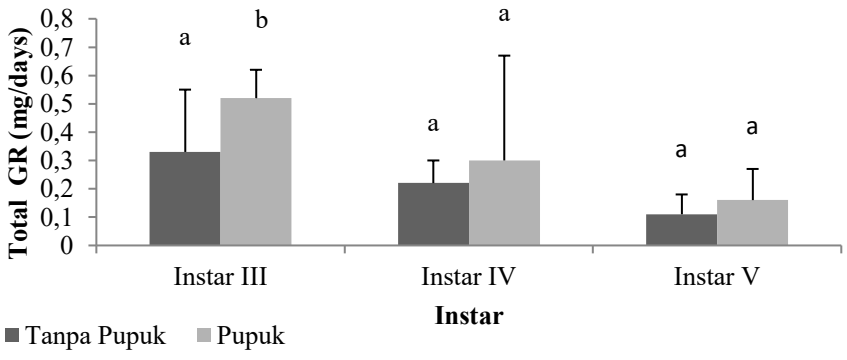

Figure 1. Average growth rate of silkworms (*Bombyx mori* L.) given mulberry leaves (*Morus alba*) with fertilizer-treated and unsalted during instar III, IV and V

The growth rate (GR) of instar III silkworms that consume mulberry leaves M.alba without fertilizer is 0.33 mg / day lower than silkworms that consume mulberry leaves that are fertilized with a growth rate of 0.52 mg / day (Figure 1). The growth rate (GR) of instar IV silkworms for

those who consume mulberry leaves without fertilizer is 0.22 mg / day is lower than silkworms that consume mulberry leaves that are fertilized with a growth rate of 0.30 mg / day. The growth rate (GR) of instar V silkworms for those who consume mulberry leaves without fertilizer is 0.11 mg / day is lower than silkworms that consume mulberry leaves that are fertilized with a growth rate of 0.16 mg / day. From the data it is seen that the growth rate on Instar III differs markedly ($p<0.05$), while instar IV and V have no real effect. This is because in the instar the rate of consumption increases, but the growth rate decreases. According to [6], variations in the amount and proportion of nutrients in their diet (e.g. protein, carbohydrates, and various other elements) can directly affect growth and reproduction.

b. Consumption Rate (CR) of Instar SilkWorms III, IV and V

The results of the calculation of the rate of consumption (CR) of silkworms instar III, IV and V given mulberry plants M. alba treated with fertilizer and without fertilizer can be seen in Figure 2

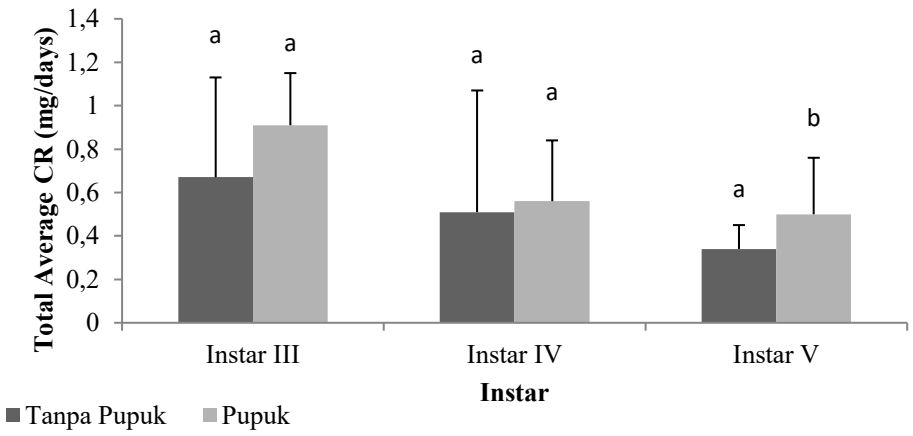

Figure 2.Average rate of consumption (CR) of silkworms (*Bombyx mori* L.) given mulberry leaves (*Morus alba*) with fertilizer-treated and unsussty during instar III, IV andV

The average consumption rate (CR) of instar III silkworms that consume mulberry leaves M. alba without fertilizer is 0.67 mg / day lower than silkworms that consume mulberry leaves that are fertilized with an average consumption rate (CR) of 0.91 mg / day. The average consumption rate (CR) of instar IV silkworms for those who consume mulberry leaves without fertilizer is 0.51 mg / day is lower than silkworms that consume mulberry leaves that are fertilized with an average consumption rate (CR) of 0.56 mg / day. The average consumption rate (CR) of instar V silkworms for those who consume mulberry leaves without fertilizer is 0.34 mg / day lower than silkworms that consume mulberry leaves that are fertilized with a consumption rate of 0.50 mg / day. In instar III and IV the rate of consumption in mulberry leaves M. alba fertilized is no different from real ($p>0.05$) with mulberry without fertilizer. According to [7], silkworms will eat as much as possible in the period of large caterpillars, then will accumulate excess energy in fat

that will be stored in the fat body. These reserves are very important for preparation during the strengthening.

c. Ingested Feed Conversion Efficiency (ECD) of Instar Silkworms III, IV and V

Th e results of the calculation of the conversion efficiency of digested feed (ECD) of instar III, IV and V silkworms given the mulberry plant M. alba treated with fertilizer and without fertilizer can be seen in Figure 3.

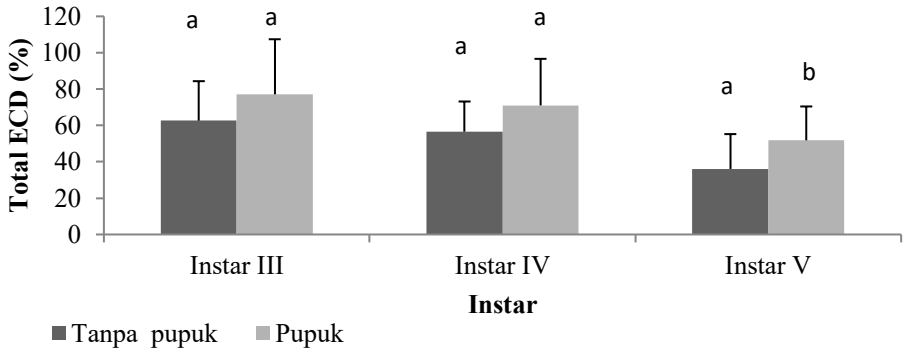

Figure 3. The average ecd value of silkworms (Bombyx mori L.) given mulberry leaves (Morus alba) with fertilizer-treated and unsanctioned during instar III, IV and V.

The efficiency value of digested feed conversion (ECD) in the mulberry leaves of M. alba fertilized is higher than that of the unsalted M. alba mulberry leaves although statistically in instar III and IV are no different from real ($p>0.05$). According to [8], the amount of metabolic energy required by silkworms is reflected in the low conversion efficiency of digested feed, while in instar V differs markedly ($p<0.05$). ECD values are influenced by factors such as metabolic rate, vitamin deficiency, and other nutritional imbalances [9].

d. Efficiency of Conversion of Edible Feed (ECI) Of Instar SilkWorms III, IV and V

The results of the calculation of the conversion efficiency of edible feed (ECI) of instar III, IV and V silkworms given the mulberry plant M. alba treated with fertilizer and without fertilizer can be seen in Figure 4.

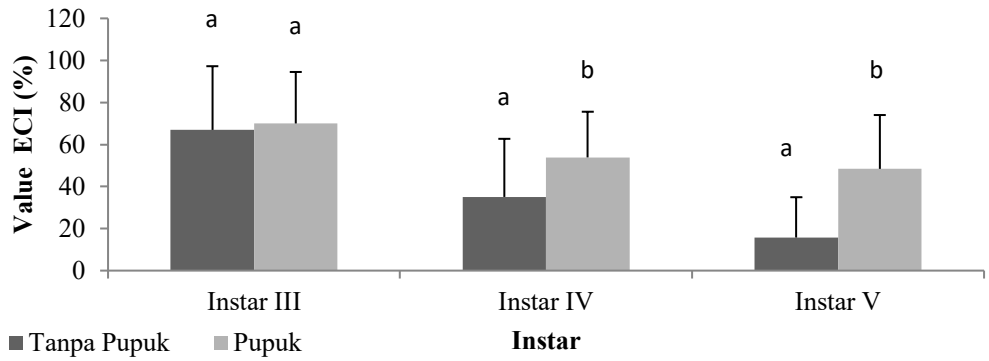

Figure 4. The average conversion of feed consumed (ECI) of silkworms (*Bombyx mori* L.) that are given mulberry leaves (*Morus alba*) with fertilizer-given and unsalted treatment during instar III, IV and V.

The efficiency of the conversion of edible feed (ECI) of instar III silkworms for those who consume mulberry leaves without fertilizer is 66.95% lower than silkworms that consume mulberry leaves that are fertilized with a feed conversion value of 70%. The efficiency of the conversion of edible feed (ECI) of instar IV silkworms for those who consume un pupukmless mulberry leaves is 35.05% lower than silkworms that consume fertilizerd mulberry leaves with an edible feed conversion value of 53.85%. The efficiency of the conversion of edible feed (ECI) of instar V silkworms for those who consume un pupukmless mulberry leaves is 15.75% lower than silkworms that consume mulberry leaves that are fertilized with a feed conversion value of 48.4%.

From the results of the research obtained that the efficiency value of the conversion of feed eaten (ECI) in mulberry leaves M. alba that is fertilized is higher than the leaves of mulberry M. alba without fertilizer although statistically instar III is not real difference ($p>0.05$), while in instar IV and V differs markedly ($p<0.05$). According to [3], stated that the consumption of larval feed increased rapidly from instar IV to instar V, this is associated with the formation of silk glands.

e. Estimated Digested Feed (AD) Instar SilkWorm III, IV and V

The results of the calculation of the estimated digested feed (AD) of instar III, IV and V silkworms given the mulberry plant M. alba treated with fertilizer and without fertilizer can be seen in Figure 5.

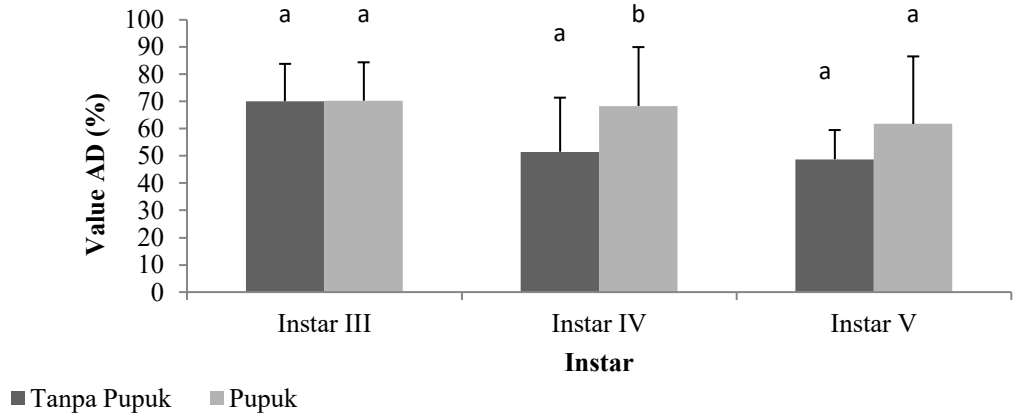

Figure 5. The average estimated digested feed (AD) of silkworms (*Bombyx mori* L.) that are given mulberry leaves (*Morus alba*) with fertilizer-nourished and unsusureed treatment during instar III, IV and V.

The estimated digested feed (AD) of instar III silkworms for those who consume mulberry leaves without fertilizer is 70.1% lower than silkworms that consume mulberry leaves that are fertilized

with an estimated value of feed they digest by 70.3%. The estimated digested feed (AD) of instar IV silkworms for those who consume mulberry leaves without fertilizer is 51.55% lower than silkworms that consume mulberry leaves that are fertilized with an estimated value of digested feed of 68.35%. The estimated digested feed (AD) of instar V silkworms for those who consume mulberry leaves without fertilizer is 48.8% lower than silkworms that consume mulberry leaves that are fertilized with an estimated value of feed they digest by 61.75%. From the data it is seen that instar III and V are no different real, ($p>0.05$), while in instar IV is different real ($p<0.05$). According to [6], the estimated value of digestion (AD) is influenced by several factors, namely the rate of food travel through the intestines and the content of digestible matter.

f. Instar SilkWorm Nutrition Index Value Pattern III, IV and V on GR and CR Given Mulberry Leaves M. alba Treated With Fertilizer and Without Fertilizer

The results of calculations of the nutrient index of silkworms instar III, IV and V in GR and CR given mulberry plants M. alba treated with fertilizer and without fertilizer can be seen in Figure 6.

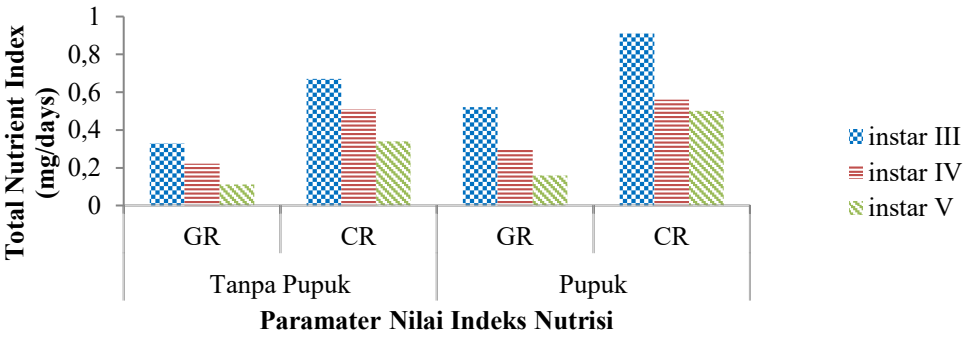

Figure 6.Average pattern of slikworn nutrient index values on GR and CR given mulberry leaves (*Morus alba*) during instar III, IV and V treated with fertilizer and without fertilizer

The nutritional index in *B. mori* L. with the administration of M. alba is given higher fertilizer compared to without fertilizer. It is generally seen that the nutritional index consisting of GR and CR is higher in instar III larvae than instar III larvae. This is because instar III larvae require more optimal growth compared to instar IV and V larvae, so instar III larvae need more food. According to [3], instar III larvae require not so hard leaves, many contain water, carbohydrates, and proteins that will encourage the rate of growth. IV-V larvae require feed with a high protein content useful for accelerating the growth of silk glands but with low water content. The provision of Urea, TSP and NPK fertilizers in mulberry plants causes the nutritional content in the form of protein and water content in mulberry leaves to be high so that silkworms consume more mulberry leaves that are fertilized. According to [6], the growth of silkworms will remain optimal even though the food source is limited.

g. Pattern values of silkworm nutrition index iii, IV and V in ECD, ECI and AD given mulberry leaves M. alba treated with fertilizer and without fertilizer

The results of calculations of the nutritional index of Silkworms Instar III, IV and V in ECD, ECI and AD given mulberry leaves M. alba treated with fertilizer and without fertilizer can be seen in Figure 7.

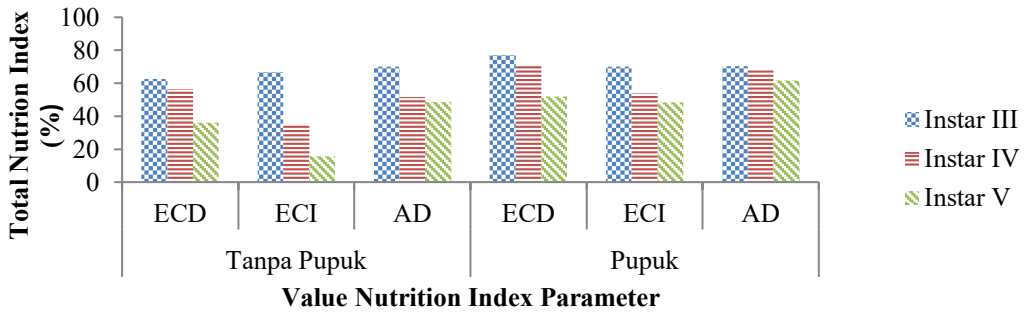

Figure 7. Average pattern of index values of silkworm nutisi instar III, IV and V in ECD, ECI and AD given mulberry leaves (*Morus alba*) treated with fertilizer and without fertilizer

The nutritional index in *B. mori* L., which consists of ECD, ECI and AD with *M.alba*, is higher than without fertilizer. According to [3], fertilization is one of the largest non-fertilizer factors in the instar III silkworm while the smallest ECD value is in the silkworm instar V. The efficiency of the conversion of digested feed indicates the feed is assimilated to grow as metabolic energy. According to [10], ECD values describe the proportion of food assimilation between biomass production and respiration values as well as other factors thought to influence ECD values including the amount and rate of metabolism associated with (1) growth rate and duration of development, (2) the degree of food storage to growth, (3) catabolism of excess nutrients, (4) the production, maintenance and use of detoxification enzymes, (5) production of metabolic water and metabolic heat. The ECI value in fertilizer treatment and without fertilizer is the largest in the instar III silkworm while the smallest ECI value is in the silkworm instar V. This is because the instar III silkworm utilizes food for growth to the stages of adult caterpillars while the instar V silkworm is mostly used for metabolic processes and for silk synthesis. The value of AD on fertilizer treatment and without fertilizer is greatest in the silkworm instar III while the smallest AD value is in the silkworm instar V. This is allegedly because the instar III silkworm chooses young leaves to eat while instar IV and V prefer to eat leaves that are old or somewhat old.

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