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FEEDING EFFICIENCY OF ERI SILKWORM *Philosamia ricini* (H.) REARED ON DIFFERENT CASTOR GENOTYPES

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ABSTRACT
The ericulture is carried out throughout the year in traditional areas of eastern India because of the abundance of castor plants. It is an ideal subsidiary occupation for a large number of tribal populations. In India there exist few indigenous castor varieties traditionally cultivated by the farmers. In addition there are few hybrids recently developed and introduced to the farmers by the Directorate of Oilseeds Research, Rajendranagar, Hyderabad. These variable genotypes of castor provide an opportunity to evaluate their relative efficacy as silk yielding feed. The present investigation therefore aims to assess the feeding efficiency of eri silkworm fed with castor genotypes of traditional as well as hybrid (DCH-519, DCH-177, DCS-107, Jwala (48-1), Jyothi) variants with respect to the consumption, assimilation and conversion of the feed. The consumption, assimilation, assimilation efficiency and growth rate is significantly differed with castor genotypes and in instars. One way ANOVA was significantly differ in consumption, assimilation, and assimilation efficiency and growth rate of eri silkworm (*Philosamia ricini*) fed with leaves of different castor genotypes. The LSD analysis indicated significant difference in the mean values of food consumption, assimilation, assimilation efficiency and growth rate.

KEY WORDS: castor genotype, eri silkworm, consumption, assimilation, growth rate.

INTRODUCTION

Philosamia ricini (H.) is a domesticated species of a polyphagous Lepidopteran insect cultured for eri silk (ericulture). The ericulture is carried out throughout the year in traditional areas of eastern India because of the abundance of castor plants. It is an ideal subsidiary occupation for a large number of tribal populations. It can be reared indoors throughout the year to produce silk depending on the availability of the suitable host plants (Debraj *et al.*, 2003). Reddy *et al.* (2002) reported that, eri silkworm feeds over 29 species of host plants. However, the degree of preference with respect to the acceptance of the leaves, growth of the worm, development and cocoon yield vary. The quality of feed plays an important role in growth and development of the silkworm and ultimately on the economic traits of cocoons (Englemann, 1966). These reports focus mainly on the efficiency of the various host plants in rearing of eri. But among different plants, castor is the primary host plant of eri silkworm besides being an important oilseed producer (Naika *et al.*, 2003; Sannappa *et al.*, 2004). However, the effect of various castor genotypes on the rearing efficiency of the eri silkworm has not been investigated in depth. In India there exist few indigenous castor varieties traditionally cultivated by the farmers. In addition there are few hybrids recently developed and introduced to the farmers by the Directorate of Oilseeds Research, Rajendranagar, Hyderabad. These variable genotypes of castor provide an opportunity to evaluate their relative efficacy as silk yielding feed. The present investigation therefore aims to assess the feeding efficiency of eri silkworm fed with castor genotypes of traditional as well as hybrid variants with respect to the consumption, assimilation and conversion of the feed.

MATERIALS & METHODS

The castor varieties such as non-bloomy red (NBR), non-bloomy green (NBG) were collected from the local area (Sambalpur) and Jwala (48-1), Jyothi (BCS-9) and hybrids namely DCH-519, DCH-177, DCS-107 were procured from the Directorate of Oilseeds Research, Rajendranagar, Hyderabad. The seeds of the seven genotypes were planted during the last week of June in 2013 in Sambalpur University campus, Odisha, India which is located at latitude of 20.473°N and longitude of 85.891″ E and crop was raised as per recommended practices under rain fed condition. The Disease free layings (DFLs) of *Philosamia ricini* were collected from the Department of Sericulture Government of Odisha, Deogarh Unit. The lab and rearing appliances was disinfected with 2% formaldehyde. Then the DFLs were kept in temperature controlled room for hatching. Eri silkworm larvae were reared separately under laboratory conditions from first to fifth instar following the rearing techniques of (Jolly *et al.*, 1979; Sarkar, 1988). Five replicates with 50 worms of different instars each were taken for experiment. Known amount of castor leaves were given to each lot and the Leaf weight, weight of the remnant of the Leaf and Larval body weight were recorded. Fecal matter weight was taken in the early morning before the larvae were fed. These observations were recorded on fresh weight basis. The observation on feeding efficiency of eri silkworm such as food consumption, food assimilation, assimilation efficiency and growth rate of different instars were recorded and mean values were worked out and calculated as per Waldbaur, (1968) using abbreviations as follows.

C = FG - FR, Where FG = Food given, FR= Food remnant and C = Food consumed
A = C - F, Where C = Food consumed, F = Fecal matter egested and A = Food Assimilated

$$\text{Assimilation efficiency AE (\%)} = \frac{\text{Mean body weightof larva}}{\text{Consumption}} \times 100$$

Growth Rate GR = G / TA
Where, G = Weight gain by larvae during feeding period
T = Duration of feeding (in days)
A = Mean weight of the larva during feeding period
Mean larval weight= (Final weight-Initial weight)/2 + Initial weight

The data obtained was also subjected to analysis of variance and the means obtained was compared by LSD at 5% level of significance. The average value of consumption, assimilation, and assimilation efficiency and growth rate of five instars were also calculated.

RESULTS AND DISCUSSION

Food consumption

Consumption of leaves of various castor genotypes (mg/g body weight) by eri silkworm larvae has been depicted in Figure 1. In various instars it was influenced by different castor genotypes. It was observed that the eri silkworm during 1st and 3rd instar larval stage mostly preferred NBG genotype i.e. 1491 and 7139 mg/g fresh weight respectively. But during 2nd instar larval stage the larvae preferred DCH-519 leaves over the other genotypes as they consumed 3949 mg/g fresh weight. Jwala leaves were mostly preferred during 4th instar (3286 mg/g f w) and 5th instar larval stage (1207 mg/g f w). One way ANOVA analysis (Table 3) also revealed significant difference in consumption of different castor leaves by eri silkworm (F=11.42, 125.81, 15.93, 244.21, 24.86 and $p<0.001$, for 1st, 2nd, 3rd, 4th and 5th instar larvae respectively). The LSD values for food consumption by different instars of eri silkworm larvae showed significant difference among different castor genotypes with few exceptions. The study of food consumption clearly indicates that it has been significantly affected by the quality of the leaves of different castor genotypes. The role of consumption of food by insect depends on nature of food, moisture content, fiber content, nutritional composition of leaves and phagostimulant nature of leaves (Jayaramaiah and Sannappa, 1998). On the other hand nutrition is a factor of paramount importance that regulates the growth, development and reproduction. Intake and growth targets are important to reach the functional optima of insects (Raubenheimer and Simpson, 1999). The suitability of host plant is determined through estimation of rate of ingestion, digestibility, conversion efficiency of food and growth rate of the animal (Englemann, 1966). The process of consumption, digestion and conversion efficiency in its broadest sense underline and link the physiological, behavioural, ecological and evolutionary aspects of insect life (Slanky and Scriber,1985). Further, EL-Shaarawy *et al*, (1975) reported that eri silkworm larvae ingested more leaves of bloomy red variety of castor than bloomy green variety. However, we observed the bloomy green variety was more preferred for consumption by 1st and 3rd instar larvae of eri silkworm. The climatic and edaphic factors might have influenced the nutrient content and fiber content of the castor genotypes, and thus indicated differential preference of castor genotypes leaves by different instars.

Food assimilation (mg/g body weight)

Food assimilated by eri silkworm larvae during different instars after consumption of various castor genotypes is shown in Figure 2. Maximum food assimilation was observed in case of 1st,2nd and 3rd instar larvae fed with NBG variety leaves (1250, 2830 and 7380 mg/g body fresh wt. respectively). However, the assimilation was maximum in 4th and 5th instar larvae reared with Jyothi variety (3140 and 1070 mg/g body fresh wt. respectively).
In the statistical analysis, one way ANOVA (Table 3) revealed that assimilation was significantly different for different instars reared in various castor genotypes (F=23.99, 207.72, 2.43, 14.53 and 373.75, $p<0.001$ for 1st, 2nd, 3rd, 4th and 5th instar respectively). Also the LSD analysis indicated significant difference in the mean values of food assimilation by eri silkworm larvae reared on different castor genotypes with few cases without significant difference in the mean values among few genotypes. Assimilation study revealed that the larvae fed with NBG leaves was highest but the larvae fed with NBR castor leaves were found to be more efficient (highest assimilation efficiency) in assimilating the leaves after consuming the same amount of leaves. This indicates that the quality of NBR leaves are most suitable for assimilation by eri silkworm larvae which has been reported by several authors (EL-Shaarwy *et al.*, 1975; Datta and Khaund, 2000).

Assimilation efficiency (%)

In case of insect larvae ingested feed has to be assimilated to increase the body mass. Assimilation efficiency of eri silkworm larvae reared on various castor genotypes has been illustrated in the Table -1. It was maximum with Jwala feed in case of 1st and fourth 4th instar (89.61 and 96.87 % respectively). However, the assimilation efficiency was maximum in 2nd instar larvae with DCH-519 feed (92.19 %). NBG feed shows maximum assimilation in 3rd and 5th instar (94.68 and 90.10 % respectively).
One way ANOVA (Table 3) indicated significant difference in assimilation efficiency by different instars in response to different castor genotypes feed (F=50.66, 42.47,14.03,58.48,278.50,$p<0.001$ for 1st ,2nd,3rd,4th and 5th instars respectively). Least significant difference showed that assimilation efficiency of the eri silk worm larvae with respect to different castor genotypes feed was significant except few cases. Assimilation study revealed that the larvae fed with NBG leaves was highest but the larvae fed with NBR castor leaves were found to be more

efficient (highest assimilation efficiency) in assimilating the leaves after consuming the same amount of leaves. This indicates that the quality of NBR leaves are most suitable for assimilation by eri silkworm larvae which has been reported by several authors (EL-Shaarwy *et al.*, 1975; Datta and Khaund, 2000).

Growth rate/instar

Rate of growth by the eri silkworm larvae with different castor genotype feed has been represented in the Table - 2.The wide variation in growth rate was observed when the larvae were reared in hybrid and local castor genotypes. The growth rate of 1st instar larvae was highest in larval feed DCS-107(0.65).In second instar growth rate was highest in case of larvae fed with Jyothi variety (0.52).Peak growth in 3rd instar larvae was seen in case of NBG feed (0.65).In case of 4th instar the eri silkworm growth rate was similar in DCH-519, NBG and NBR feed (0.41) and during 5th instar the growth rate of eri silkworm became slow in case of all types of feed but more growth rate was found in Jyothi variety feed (0.29).

One way ANOVA (Table 3) revealed significantly different growth rate in 1st instar at $p<0.01$($F=72.7$).The growth rate of 2nd instar in different feed was not significant. However, the growth rate of 3rd, 4th and 5th instars were significant at $p<0.05$($F=16.25$, 8.19 and 4.81 respectively). The least significant difference in the mean value of growth rate of eri silkworm reared on different castor genotypes was significant among different genotypes except few cases. Basaiah, (1988); Chandrappa, (2003); Sannappa *et al.*, (2002); Govindan *et al.*, (2005); Chandrashekhar *et al.*, (2013) observed that eri silkworms fed on different castor genotypes showed marked variation in growth rate. Similar to these findings in the present study growth rate of the eri larvae varied with the various castor genotypes. In our studies we have observed significant variation in the growth rates in the larval stages vis-à-vis the castor genotypes. Kedir *et al.*, (2014) observed that the difference in the Efficiency of Conversion (ECD) of nutrients to larval biomass with different feed was statistically insignificant. However, they observed the ECD to larval biomass was more in hybrid genotype feed when compared to local genotype. But in our observation in the sixth day of 5th instar, larval biomass was higher in case of eri silkworm fed with local variety (NBR) followed by DCS-107 and Jwala. It seems that the local climate and soil type was not suitable for yield of better quality feed of hybrid castor genotypes.

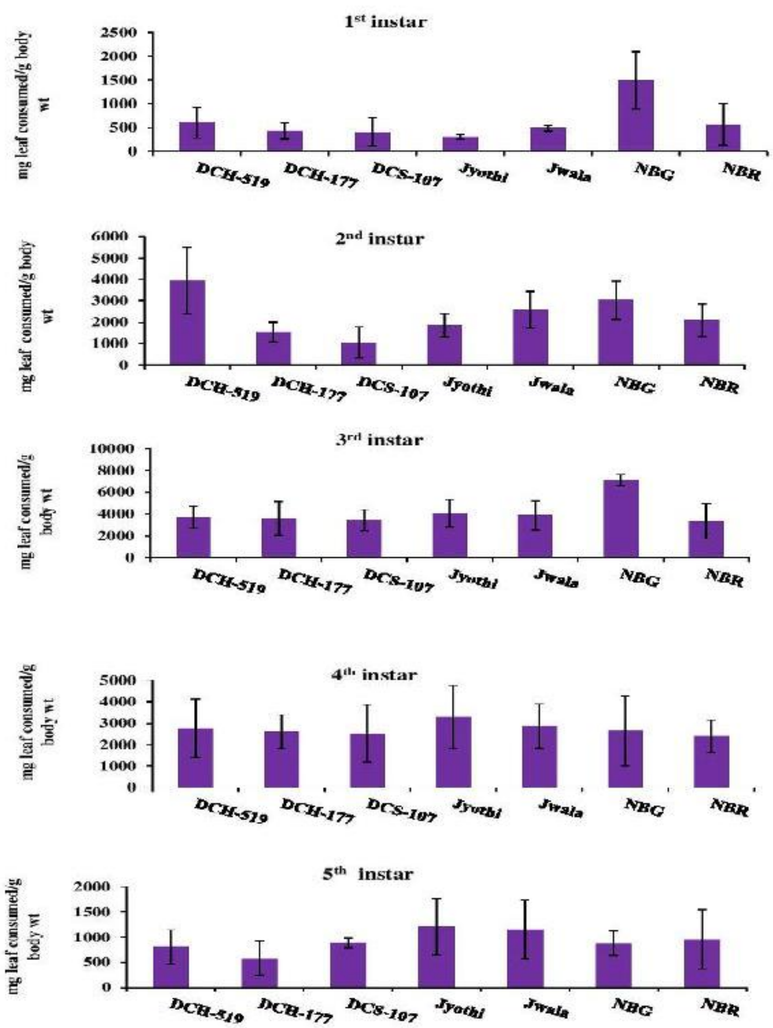

FIGURE 1: Castor leaves consumed (mg /g body fresh wt /day) by eri silkworm (*Philosamia ricini*) larvae in different instars.($C = FG – FR$)

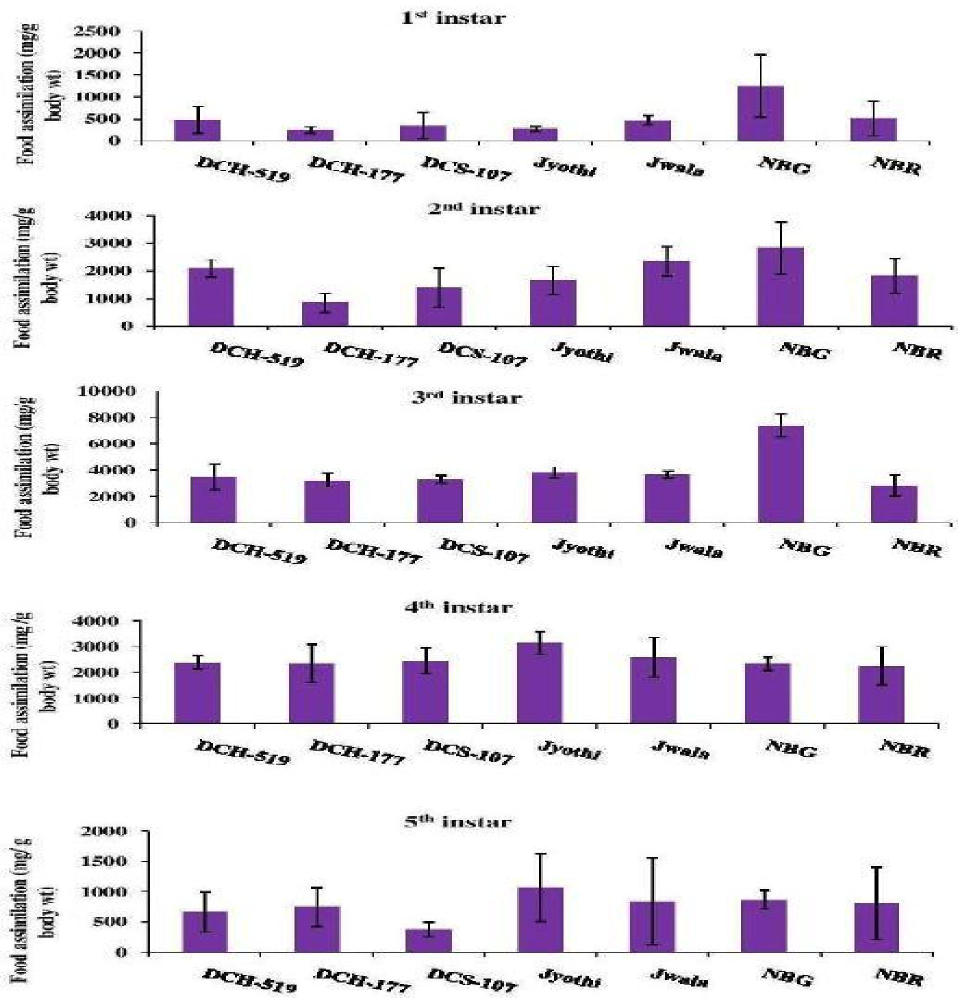

FIGURE 2 : Assimilation (mg/g body weight/day) of eri(*Philosamia ricini*) silkworm larvae reared on various castor genotypes.

TABLE 1: Assimilation efficiency (%) of eri silkworm larvae reared on various castor genotypes (Mean ±SD)

Instars	DCH-519	DCH-177	DCS-107	Jyothi	Jwala	NBG	NBR
First	75.19 ±2.44	66.27 ±2.96	81.48 ±1.56	72.26 ±3.78	89.61 ±0.78	75.38 ±3.08	86.80 ±2.36
Second	92.19 ±2.58	65.43 ±5.54	87.60 ±0.82	86.28 ±2.00	87.66 ±1.12	90.55 ±3.39	87.43 ±3.47
Third	93.06 ±0.85	92.55 ±0.73	90.41 ±0.36	93.25 ±0.49	94.25 ±0.40	94.68 ±1.65	93.44 ±0.52
Fourth	85.95 ±2.13	93.33 ±0.21	91.51 ±0.64	95.25 ±0.39	96.87 ±0.17	93.01 ±0.78	92.52 ±0.16
Fifth	78.60 ±1.92	81.52 ±0.57	63.05 ±1.86	84.35 ±0.65	84.28 ±0.87	90.10 ±0.97	74.59 ±0.14

TABLE 2 : Growth rate of eri silkworm larvae reared on various castor genotypes (Mean±SD).

Castor genotypes	First instar	Second instar	Third instar	Fourth instar	Fifth instar
DCH-519	0.47±0.00 (26.2%)	0.51±0.12 (99%)	0.45±0.03 (642.6%)	0.41±0.05 (1514.2%)	0.26±0.00 (18162.6%)
DCH-177	0.61±0.21 (24.4%)	0.47±0.01 (82.8%)	0.36±0.01 (545.8%)	0.29±0.01 (938.2%)	0.25±0.01 (14342.2%)
DCS-107	0.65±0.00 (93.2%)	0.37±0.15 (97.6%)	0.37±0.01 (893.4%)	0.37±0.01 (3169%)	0.26±0.01 (20137%)
Jyothi	0.62±0.00 (19.74%)	0.52±0.02 (118.2%)	0.48±0.02 (641.2%)	0.39±0.01 (799.4%)	0.29±0.05 (17207%)
Jwala	0.63±0.04 (19.6%)	0.50±0.01 (118.8%)	0.44±0.10 (769.8%)	0.37±0.06 (1614.8%)	0.27±0.01 (21998.4%)
NBG	0.46±0.00 (20.3%)	0.46±0.01 (50.8%)	0.65±0.29 (452.6%)	0.41±0.04 (3477%)	0.23±0.01 (9335.4%)
NBR	0.64±0.02 (28.24%)	0.44±0.02 (47.6%)	0.43±0.01 (1739.6%)	0.41±0.02 (1741.2%)	0.28±0.01 (25328.2%)

TABLE 3: One way ANOVA of consumption, assimilation, assimilation efficiency%, growth rate/day of eri silkworm larvae reared on various castor genotypes.

Instars	Consumption	Assimilation	Assimilation efficiency %	Growth/day
First instar	11.42*	23.99**	50.66**	72.68**
Second instar	125.81***	207.72***	42.47**	2.07^{NS}
Third instar	15.93*	2.43*	14.03*	16.25*
Fourth instar	244.21***	14.53*	58.48**	8.19*
Fifth instar	24.86**	373.75***	278.50***	4.81*

*indicates Significant at 0.05 **indicates Significant at 0.01 *** indicates Significant at 0.001 ^{NS} Not significant

CONCLUSION

Feeding efficiency of eri silkworm with regard to different castor genotypes revealed that there is significant variation among them from first to fifth instar. Further work on biochemical composition of leaves and eri silkworm fed with these castor genotypes can give a clear view regarding the quality of local and hybrid genotypes.

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