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Research Article

Seed Maintenance, performance evaluation and multiplication of Eri Silk Worm Strain sat different seasons in Sidama national region state, Ethiopia

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Abstract

The rearing performance of different eco-races of eri silkworm were undertaken in Sidama region during 2018 to 2021). In this experiment Eri Marked, Eri Green, Eri 3.4 and eri yellow was analyzed by the following parameters viz. hatching (%), larval weight (g), larval duration and total life cycle (d), larva weight, single cocoon weight (SCW) , larva survivability and disease incidence. Thus, different silkworm strains showed statistical significant silkworm characteristic ranges in different locations which include egg hatchability (62.61% to 89.00%), larval duration (20.67days to 25.83 days), total life cycle duration (50.49 days to 74.00 days), single weight of larva (4.427 grams to 8.155 grams), effective rate of rearing (60.11% to 93.67%), single cocoon weight (1.848 grams to 2.903 grams), single shell weight (0.251 grams to 0.418 grams) and silk ratio (13.06 to 15.05%). However, a Vietnamese eri silkworm strain known by Eri-3.4 have showed an outstanding performance compared to other strains in all the locations especially in cocoon parameters. Therefore, it is recommended for future research and development efforts on eri silkworms in Ethiopia.

Keywords: Eri silkworm strains; rearing performance; cocoon

Introduction

Sericulture is an agro-based industry. It is the process of obtaining the natural silk fiber through silkworm rearing, which can be practiced in varying agro-climatic conditions, and is suited to different production systems [3, 14]. Many studies indicated that sericulture industry has enormous advantages for sustainable developments of any country. The industrial and commercial uses of silk contributed to the silkworm promotion all over the world especially in developing nations [1]. Historically, sericulture was introduced for the first time, into China by Hoshomin, the Queen of China. Later, it was introduced to rest of the world. Today, the top five silk producing countries in the world are China, India, Japan, Brazil and Thailand [4]. In Africa, silk has been used for textiles for about thousands of years [6] and sericulture has a history of more than 30 years in East Africa. The potential of the African indigenous silk moth species for wild silk production has been well documented in Nigeria [7, 9], Uganda [10] and Kenya [11] and other central and southern African countries. Currently, International Centre of Insect Physiology and Ecology (ICIPE, Nairobi, Kenya) is playing a central role in sericulture development in Africa including Ethiopia [8]. Sericulture is the farming of silkworms (Bombyxmori), for the production of raw silk [2] from domesticated insect called silk moth. Moreover, silkworm is the common name for the silk-producing larva of any of several species of moths; which used by the cottage and small scaleindustry as well as big silk industry. Silk is “the queen of fibers” because it is a smooth,shining, very soft, lustrous, fabulous, strong and durable and unique natural protein fiberproduced by silkworms [5, 10]. There are more than 3000 silkworm strains available all over the world [11]. The domesticated silk moth, which feed on mulberry leaves belongs to the family *Bombycidae* and is known as *Bombyxmori*. However, other economically important silk moths like eri silk moth (*Samia Cynthia ricini*), tasar silk moth (*Anthereamylitta*) and muga silk moth (*Anthereaassama*) belong to the family Saturniidae. Taxonomically, Silkworms belongs to Phylum: Arthropoda, Order: Lepidoptera, and Family: Bombycidae, Saturnidae, Lasiocampidae, Thaumetopoidae [12].

There are 19 species of *Samia* comprising of domesticated and wild counterparts. The domesticated erisilkworm has 26 ecostrains and 6 strains presently being maintained and utilized for evolving improved breeds for increasing the quality and productivity of eri raw silk [14]. For the last two decades several works had been done and documented on the silkworm rearing management, silkworm varietal development, feed plants improvements, worm and feed plants diseases managements at Melkassa research center. It is important to introduce and strengthen those technology to the end users in order to diversify exportable or import substitution items; to create sustainable raw material source for local industries; to create jobs for people including women and youth; to reduce migration of people from rural to urban areas; and also to incorporate the bi-products in to the plantation fields and also in the feeds of animals like poultry & fish [13, 19].

Most of the silkworm seed supply for the south and sidama region is under taking by Hawassa Agricultural Research center which is maintained, valute and multiplied in the sericulture laboratory of the center. Maintenance and Provision of healthy, high yielding silkworm seeds for small scale farmers and commercial production is very critical to harvest robust silk cocoon yield. So, disease free and high yielding silkworm seeds was maintained, evaluate and multiplied to serve as a source of seed for users. Therefore, the purpose of this work is to maintain, produce & distributes disease free high yielding eri silkworm seeds to users.

Materials and Methods

The study was conducted in Hawassa Agricultural Research center sericulture laboratory from 2018 to 2022. The fertile cocoon stocks of eri-silk worm were obtained from Melkasssa Agricultural Research center. The eggs under four eri silk worm races (Eri-Marked, Eri Green, Eri 3.4 and eriyellow) were prepared. The cocoons produced under four race of each generation were utilized to continue their offspring successively. The disease free laying of eri silkworm for varied lines were prepared by crossing parents based on pupae and shell weights of male and females. The cocoon stocks of subsequent progenies of four lines were maintained separately and prepared disease free laying's during different season.

Sum of 300 worms of each eco-race in three replicates were maintained separately in wooden trays. The tender leaves of castor (*Samiacynthiaricini*) were fed four times a day until the larvae reach III in star stage and semi tender leaves and mature leaves were fed when they were IV and V in star stage. Ambient temperature and relative humidity of the experimental chamber was recorded using thermo-hygrometer. Cocoon harvesting was carried out after fifth and six day of spinning. The rearing performance of each eco-race was assessed by the following parameters viz. hatching (%), larval weight (g), larval duration and total life cycle (d), larva weight, single cocoon weight (SCW), larva survivability and disease incidence.

The data recorded on different parameters in the study were subjected to statistical analysis. One-way analysis of variance (ANOVA) were run and Tukey's student test (HSD) at 5% level of significance will used to make mean separation, whenever significant results will encountered.

Result and Discussion

Hatching percentage (%)

Hatching percentage showed significant variation on different rearing seasons. Egg hatchability of eri silkworm strains to larval stage ranged from 62.608% to 89.0%. However, significant variation ($p<0.05$) in egg hatchability among eri silkworm strains was observed only during 2018. In 2018, higher egg hatchability (75.665%) was recorded in Eri-3.4 strain followed by Eri-Yellow (72.998%) and Eri-Green (71.330%). The least egg hatchability was recorded on Eri-Marked strain (62.608%). Similar findings carried out by [17, 20] confirmed such differences among eri silkworm strains. In addition, Singh et al. (2011) carried out study on morphological characters of eco races and six strains of eri silk worm and found out variations in their rearing performance, and recommended Yellow Zebra as the best strain in terms of rearing performance, which is not introduced to Ethiopia until today.

Treatments	Rearing years			
	2018	2019	2020	2021
Eri-3.4	75.665 a	80.000 a	82.333 a	82.000 a
Eri-Yellow	72.998 ba	77.333 a	83.223 a	85.500 a
Eri-Green	71.330 b	79.833 a	83.447 a	82.500 a
Eri-Marked	62.608 c	79.000 a	80.667 a	89.000 a
CV	3.9567	1.862258	4.007033	5.612477

Table 1: Variations in egg hatchability among eri-silkworm strains in different rearing years.

Larval weight (g)

Weight of a single matured silkworm larva was significantly different among eri silkworm strains at all the locations except in the year of 2021. The result showed that larval weight was significantly highest in Eri-3.4 strain during 2018 (6.60 g). This strain had better larval weight during2019 and 2020 compared to other strains. The lowest larval weight was obtained from Eri-Yellow strain (4.63 g) during 2019 rearing period [10, 21]. noted that the larval weight was 7.6 g on tapioca [11]. Observed the larval weight was 7.38 g on castor and 6.45 g on Eri-3.4 strain.

Treatments	Rearing years			
	2018	2019	2020	2021
Eri-3.4	6.60a	6.13a	5.38a	5.60a
Eri-Yellow	8.15a	4.63b	5.35b	7.16a
Eri-Green	6.40b	5.12b	5.38ba	7.28a
Eri-Marked	6.25b	5.49b	5.12c	7.04a
CV	10.24	8.267	2.21	6.08

Table 2: Variations s in larval weight (in grams) of different eri silk worm strains.

Larval duration and Total life cycle (d)

The overall larva duration ranged from 20.667 days to 25.833 days. Larval duration of eri-silkworm strains showed significant difference only during 2021. During 2021 rearing period, the shortest larval period was observed in Eri-3.4 strain /21.0 days/ compared to the other strains. On the other hand, duration of the total life cycle generally ranged from 50.48 days to 67.5 days. However, statistically significant total life cycle duration was recorded during 2019year where Eri Green strain exhibited the shortest duration of 56.5 days. The results are more or less similar with the reports of [11, 16] who revealed that the larval duration was 19.25 and 20.50 day. The variations noticed among the genotypes might be attributable to the fact that, these genotypes vary in the composition of foliar nutrients, which in turn contribute for differences in larval weight.

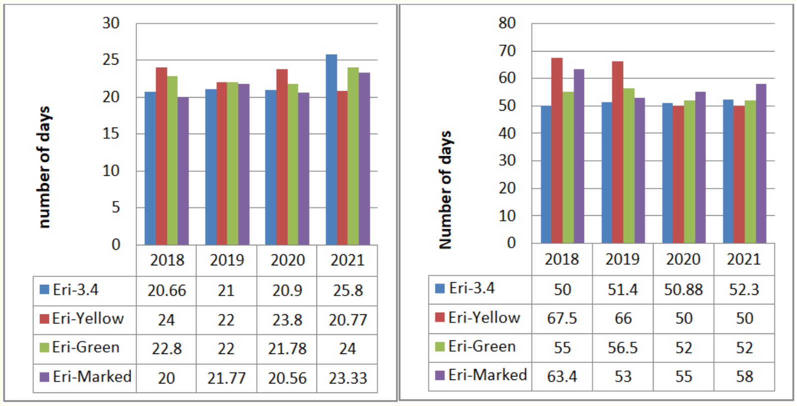

Figure 1: Figure showing larval duration and Total life cycle (d).

Single cocoon and shell weight

With respect to cocoon traits, maximum and significantly different single cocoon weight was recorded for Eri-3.4 strain during 2018 (2.639 g). The lowest cocoon weight (1.848 g) was obtained from Eri-Yellow strain during 2019. In addition, eri silkworm strains showed variation in their single cocoon shell weight in different years. The highest was 0.418 g from EriGreen strain during 2021 but, the lowest was 0.251 g from Eri-Yellow strain in 2019 (Table 3). These differences are justifiable in that rearing performance of silkworms is affected by ecological, biochemical, physiological and quantitative characters, which influence growth and development, quantity and quality of silk they produce in different geographical locations [2, 15, 22].

Treatments	Rearing years							
	2018		208		2020		2021	
	Single cocoon weight (g)	Single shell weight (g)	Single cocoon weight (g)	Single shell weight (g)	Single cocoon weight (g)	Single shell weight (g)	Single cocoon weight (g)	Single shell weight (g)
Eri-3.4	2.639a	0.3721a	2.335a	0.3185a	2.642a	0.3890a	2.569b	0.3393b
Eri-Yellow	2.407b	0.3334b	1.848b	0.2507b	2.540b	0.3823a	2.903a	0.3840ba
Eri-Green	2.438b	0.3362b	2.061b	0.26ba	2.344c	0.3243b	2.893ba	0.4180a
Eri-Marked	2.480ba	0.3471b	2.055b	0.289ba	2.259c	0.3343b	2.813ba	0.3907ba
CV	5.3318	5.7475	6.5508	11.9039	1.9443	3.0062	6.2720	9.6453

Table 3: cocoon performance in different eri silk worm strains during different years.

Larva survivability and Disease incidence

Significantly highest (94.00%) larval survivability was observed on Eri-3.4 followed Eri-Marked (90.00%) and Eri-Green (85.00%). While, lowest larval survivability (58.00%) was observed on Eri-yellow (Table 3). The observations on disease incidence revealed that, the lowest disease incidence (8.50%) was recorded on Eri-3.4 followed by Eri-Marked (11.50%). However, the highest disease incidence recorded on Eri-Green (39.50%). One reason for the reduction in their productive performance in some strains might be elevated ambient temperatures, which induce heat stress [14, 18].

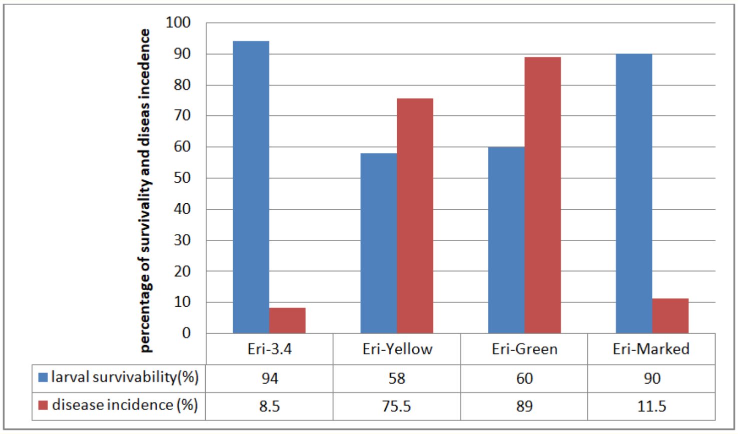

Figure 2: Variability of different eri silkworm strains in larva survivability and disease incidence.

Trends of multiplication and utilization of eri silk worm strain seeds at farmer's level

Understanding the importance of silk industry in sidama region, tremendous efforts have been made by Melkassa Agricultural research center with the collaboration of Hawassa agricultural research center, from time to time for the development of the sector. Silkworm rears are motivated towards sericulture by providing them many facilities. It is because of this, that cocoon production has once again showed a positive trend especially Shebedinoworedas. it is also obvious that there are rears in SNNPR as well as in Sidama region who have really touched the partial targets of production of cocoon in of sericulture activities. The numbers of farming households engaged in sericulture production have increased from 40 in 2018 to 250 in the current year (2021). Analysis of data reveals interesting regional variations in respect of cocoon production in the region. In 2018-21 cocoon production in Sidama region was 1000 kg /annum. The maintenance and multiplication seed of eri silkworm under different parental lines over varied rearing seasons for optimal exploitation of cocoon production and productivity. The study infers that the systematic selection pressure through generations, genetic combination with selected parents and genetic gain of desired traits in the direction wanted with optimal genotype.

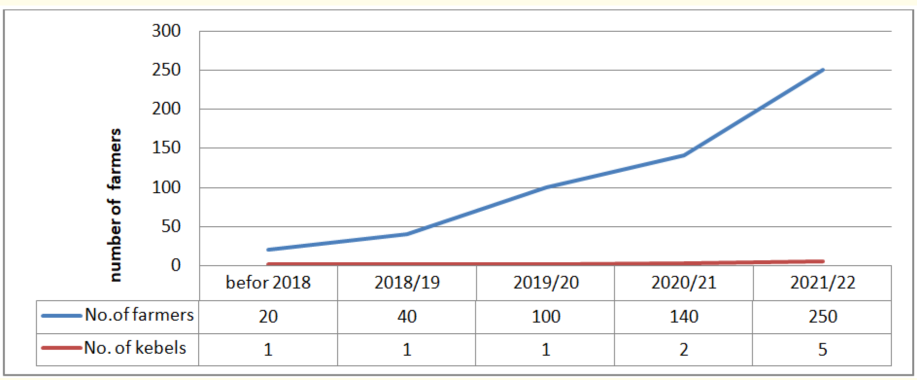

Figure 3: Trends of farmers engaged in sericulture production in sidama region.

Conclusion and Recommendation

In the present study, some of the characters like hatching percentage, larval duration, larval weight, cocoon yield, single cocoon weight, shell weight, shell ratio percentage, showed significant differences among the eri silkworm strains and are of great importance in the field of sericulture. These characters of economic parameters are not only controlled by genes, but also known to be influenced by different climatic factors such as temperature and relative humidity. The results of present study showed that the Eri-3.4 showed better adoptability than other eco-races to the condition in different rearing period and suitable for sidama climatic conditions for rearing. As a result, it is now recommended to be reared in bulk and to be utilized for research and development efforts on eri silkworms in Ethiopia. On the other hand, aa cocoon weight recorded from the present study is lower compared to recent international findings. Therefore, further research and improvement works should be carried out on eri silkworm strains to achieve better productivity.

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Conflict of Interest

The authors declare no conflict of interest.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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