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STUDY ON EFFECTS OF INTERCHANGING SOM, SOALU, MEZANKARI PLANTS ON LARVAL GROWTH OF MUGA SILKWORM

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Abstract-The Muga fabric is used by the Assamese people with pride, as it is considered almost a symbol of the state. As the prices of Muga cocoons and fabrics are comparatively high, Muga culture is considered to be highly remunerative agro-based industry in the state. The Muga silkworm being a versatile and unique species, needs to be protected from the different vagaries of nature. The State Sericulture Department, Assam and Central Silk Board, India have undertaken several developmental schemes and research programmes for upliftment of Muga silk industry. The present study has been undertaken with the objective to generate information on the effect of sole and interchange combinations (1st to 3rd instar in one plant and fourth to fifth instar in other) of Muga silkworm host plants viz., Som, soalu and Mezankari on rearing performance of the silkworm in respect of larval growth during Spring and Autumn season. Results revealed that food plants had significant effect on rearing of Muga silkworm. Among the food plants tested, the larval duration was shortest on Soalu followed by Som while it was longest on Mezankari. The larval weight was found to be highest on Soalu followed by Som and lowest on Mezankari which differed significantly from Som and Soalu. In case of the combinations, Som + Soalu and Soalu + Som performed equally good in terms of larval duration, full grown larval weight, mature larval weight. In case of combinations with Mezankari, shortest larval duration was recorded on Soalu + Mezankari. Som + Mezankari recorded lowest larval weight. Mezankari + Som recorded better larval weight. Autumn season was found to be better than that of Spring season in respect of larval duration. Study also found that Autumn was the best season crop in respect of larval weight. Mature larval weight was recorded significantly the highest from Soalu fed larvae. Thus, the present investigation indicates that Muga silkworm can be reared in different interchange combinations during the scarcity of major food plants for commercial production of Muga cocoons utilizing the host plants of secondary importance.

Key words- *Antheraea assamensis,* polyphagous insects, Som, Soalu, Mezankari, interchange of host plants, larval growth.

Introduction- Sericulture is a labour intensive agro-based industry which plays a prominent role in the rural economy. The history of sericulture industry in India is as old as Indian culture. India has a unique and distinctive place in the map of sericulture being the homeland of several sericigenous insects and the only country in the world producing four commercial types of natural

silks namely- Mulberry, Tassar, Eri and Muga. The culture provides whole time and part time occupation to more than 60 lakhs of people in the rural areas of the country.

The North Eastern Region of India occupies an important position on account of its unique faunal and floral wealth. Climate and environmental have made the fauna and flora of this region particularly distinctive. The congenial atmosphere in particular season has made the region the natural home for many varieties of insects, particularly certain sericigenous insects as well as their corresponding host plants. The hills and dales with an ideal environment are characteristic habitat for the fauna and the host plants. Therefore, the region can be called a biologist's or naturalist's paradise. The suitable atmosphere helps the healthy growth and development of sericulture industry, which covers mulberry, oak tassar, eri, Muga silkworm culture. Among these Muga silk is an exclusive prerogative of North Eastern Region of India and more particular in the Brahmaputra Valley of Assam and the adjoining foot hills. The famed, fabulous golden yellow and glorious Muga silk is the pride of Assam.

Muga silk industry has been playing an important role in the elevation of socio-economic conditions of the people of this region by alleviating unemployment and rural poverty. Its culture occupies an important place in the life and culture of the people of Assam. The Muga fabric is used by the Assamese people with pride as it is considered almost a symbol of the state. As the prices of Muga cocoons and fabrics are comparatively high, Muga culture is considered to be highly remunerative agro-based industry in the state. The Muga silkworm being a versatile and unique species needs to be protected from the different vagaries of nature. The State Sericulture Department, Assam and Central Silk Board, India have undertaken several developmental schemes and research programmes for upliftment of Muga silk industry.

Assam has a unique position in the Indian sericulture map, particularly in terms of Muga silk production. Assam produces more than 94 per cent of the Muga silk of the country. Presently about 39,000 families are engaged in rearing and production of Muga silk covering an acreage of 8,902 hectare of land under food plant cultivation in the state. There are about 15 Muga silk reeling units in Assam. In Assam, the Muga growing pocket lies mostly in Sivasagar, Dibrugarh, Tinsukia, Jorhat, Golaghat, Darrang, Sonitpur, Lakhimpur, Dhemaji, Goalpara and Kamrup districts (Deka, 2009).Assam contributes 95 % of total muga silk production in India. During the year 2010- 11 production of Muga silk in the state was 117 MT which registered an increase of 11 per cent over 2009-10 with production of 157 MT during 2017-18.

Muga silk is produced by the silkworm *Antheraea assama* Westwood (Saturniidae :Lepidoptera). The silkworm is polyphagous and thrives on various endemic plants mostly belonging to the family Lauraceae. Among them 'Som' (*Persea bombycina* Kost) and 'Soalu' (*Litsaea monopetala* Roxb) are most commonly utilized for rearing of Muga silkworm. Mezankari (*Litsaea cubeba* L), Dighloti (*Litsaea salicifolia* H), Chapa (*Michelia oblonga* W) etc. are secondary host plants and are used for Muga rearing when leaves of primary host plants are scarce.

Nutritional value of food plant either alone or in combination plays an important role on the larval growth and silk productivity. Different types of host plants may influence differently on food intake, efficiency of digestion, conversion and finally growth and development of insect. Literatures are available on the effect of different food plants and interchange combination in the field of eri culture (Joshi and Mishra, 1979; Devaiah *et al*. 1988; Hussain and Shahjahan, 1991) and on Oak tassar silkworm, *Antherae aproylei*, (Saraswat, 1979). However, literature on interchange effect of food plants on the performance of Muga silkworm is scanty. Therefore, the present study was undertaken with the objective to generate information on interchange effect of Muga silkworm host plants on rearing performance of the silkworm in respect of larval growth and duration in different seasons.

Methodology:

(a) Sample Type- Primary data

(b) Area- The present investigation on the "Effect of interchanging Som, Soalu, Mezankari plants on larval growth of Muga silkworm (*Antheraea assama*)" was conducted during 2010-2011. Experiments were carried out in the experimental field, Department of Sericulture, Assam Agricultural University, Jorhat.

(c) Duration/ Seasons- The experiments were conducted in two important commercial seasons viz., Spring (April-May, 2011) and Autumn (Sept-Oct, 2011).

Statistical Analysis- The experiment was laid out in Completely Randomised Design (CRD) for various estimation of larval growth of Muga silkworm. Each treatment was replicated three times. The determination of various treatments has been subjected to ANOVA in order to separate out all possible errors. The experimental errors found while observing the various effects was determined by calculating their respective F-values following Panse and Sukhatme (1989).

In case if the value of the variance is found to be significant, the value of the treatment mean which differed significantly is found out by calculating the critical difference (CD).

CD at 5% level of probability = S.Ed x $t_{0.05}$ for error degrees of freedom.

CD at 1% level of probability= S.Ed x $t_{0.01}$ for error degrees of freedom

$$S.Ed\pm = \sqrt{\frac{2\ \text{Error Mean Square}}{\text{Pooled number of replications}}}$$

The difference of the mean values which were found to be greater than their respective C.D values, were considered significant. While the mean values smaller than their respective C.D values, were considered non-significant.

(d) Host Plants Selected: Three different types of host plants *viz*., Som, Soalu, Mezankari were selected for the present investigation. Brief description of the host plants are described below-

Som (*Persea bombycina* Kost)- Som is the principal host tree for raising the Muga silkworm for commercial cocoon production. The tree is a middle sized erect, non-deciduous tree (Plate 1) attaining the height of 20 metres when fully grown. The bark rough and grey, branches spreading slender rather spreading sideways. Leaves simple exstipulate, petiolate, alternate, entire obtuse upper surface glabrous, lower surface slightly silky and hairy along the midribs, lateral nerves 6-10 pairs entire margin, tip almost tapering, buds covered by scales, fruit-fleshy berry, globose, size : 6-7.5mm, inflorescence auxiliary, compound, raceme or panicles. Four main types of 'Som' are referred, i.e. 'Naharpatiya', Azarpatiya', 'Ampatiya' and 'Jampatiya'. Another type 'Bahpatiya' is often mentioned. Flowering: December-March and fruiting: March- May. (Chowdhury, 1981)

Soalu (*Litsaea monopetala* Roxb.)- Soalu is an erect middle sized non-deciduous tree (Plate 2) attaining a height of about 20 metres when fully grown. Tree is woody, bark rough brown, leaves simple, exstipulate, petiolate, alternate, entire, obtuse, upper surface glabrous, lower pubescent, usually rusty brown when dry. Nerve strongly beneath 8-30 cm long, petiole hairy, lateral veins 15-18. Inflorescence–umbel, flower-buds born on a common peduncle covered with a whorl of bracts forming involucre. Bracts usually five in two whorls, concave and tomentose, flower hypogynous, unisexual, perianth tube bell shaped, make flower-stamens 9-12 in three to four series, filaments densely ruithairy, anther-4 celled introse, female flower-carpel one, superior, ovary sessile at the base of the perianth tube. Style-slender, stigma small, ovule, solitary. Fruit fleshy, berry, oblong, Flowering: February-May, Fruiting: May-August (Chowdhury,1981).

Mezankari (*Litsaea cubeba* L.) - Mezankari is a small to middle sized deciduous tree (Plate 3). The tree is erect and delicate. The tree reaches a height of about 12 metres when fully grown. In an immature tree the stem is green. Its branches are fragile, leaf is tapering. The leaf emits a very fine smell. Fairly common in plains, it is abundant in hills upto an altitude of 1700 metres. The tree grows well in shade and prefers high land. The Mezankaritree withers and dies in water logged areas. It cannot withstand very strong sun and heavy rainfall. The tree grows better in hills slopes. Only healthy and vigorous larvae can thrive on Mezankarileaves. The tree has luxuriant growth in newly cleared virgin soil. The seed has a hard coat. (Chowdhury,1981)

(e) Interchange of host plants/Treatments: The worms were reared on the following and interchange combinations of the food plants selected for the study.

T_1: Som (first to fifth instar)

T_2: Soalu (first to fifth instar)

T_3: Mezankari (first to fifth instar)

T_4: Som (first to third instar) + Soalu (fourth to fifth instar)

T_5: Som (first to third instar) + Mezankari (fourth to fifth instar)

T_6: Soalu (first to third instar) + Som (fourth to fifth instar)

T_7: Soalu (first to third instar) + Mezankari (fourth to fifth instar)

T_8: Mezankari (first to third instar) + Som (fourth to fifth instar)

T_9: Mezankari (first to third instar) + Soalu (fourth to fifth instar)

(f) Source of seed: Disease free layings (DFLs) of Muga silkworm were collected from Central Muga Eri Research and Training Institute, Lahdoigarh, Jorhat, Assam to carry out the experiments.

(g) Incubation of eggs: The disease free layings collected were incubated at room temperature till hatching.

(h) Preparation for rearing: The rearing plots were cleaned properly by removing weeds etc below the plants. The dried leaves and twigs were removed. Ants and other insect pests' nests were destroyed and weeds were cleared in the plot properly. A band of straw with a little ash on the top areas was tied around the trunk of the tree at about 3-4 feet height from the base of the trunk to prevent the downward movement of larvae.

(i) Disinfection of rearing appliances: The rearing appliances such as Chaloni (bamboo sieve used for transferring larvae), Khora (bamboo basket for collection of mature worms), rearing net etc. were disinfected with 2 per cent formalin solution and dried properly.

(j) Brushing of larvae: On the day of hatching, small twigs of the food plants selected bearing tender leaves were placed over the hatched larvae in the egg boxes. The newly hatched larvae on crawling to the twigs were brushed on the respective food plants separately. The larvae were reared en masse in each of the control batch of sole host plants for subsequent rearing with different interchange combinations of the host plants.

(k) Transfer of larvae: When the foliage of a plant is consumed, the larvae crawl along the trunk of the trees and such larvae were transferred to another plant having sufficient leaves with the help of chaloni.

In case of interchange combinations, the larvae were transferred after 3rd instar to the respective host plants of interchange combination and reared upto 5th instar.

(l) Care during rearing: During rearing, the larvae were kept under constant supervision against pest and predators. The host plants were individually covered with nylon nets to protect from natural enemies.

Observations:

Larval duration: Time requirement of the maturity of silkworm from the date of hatching was recorded as larval duration in days.

Larval Weight: The weight of the full grown larvae was recorded treatment wise before defecation of the last excreta. The weight of the mature worms was also recorded after passing out of last excreta by the worms.

Experimental findings:

The results of the experiment have been depicted under the following heads in the form of tables and figures.

Larval growth parameters- Results on the effect of food plants and their interchange combinations on different larval growth parameters such as larval duration, full grown larval weight, mature larval weight and effective rate of rearing are presented under the following heads.

(a) Larval Duration-The data on larval duration of Muga silkworm reared on different sole food plants and interchanging them are presented in (Table 1). Results revealed that there was significant difference ($p<0.05$) in the larval duration among the three host plants and their interchange combination. The shortest larval duration was recorded in T_2 (24.00 days) followed by T_1 (24.17 days) and longest larval duration was recorded in T_3 (26.17 days). Among the combinations, shortest larval duration was recorded in T_4 (23.50 days), followed by T_6 (24.17 days), T_5 (26.17 days), and lowest larval duration was recorded in T_9 (27.00 days) which was found statistically at par with T_7 and T_8.

The two seasons were found to have significant effect on the larval duration of Muga silkworm irrespective of host plant combination. The longer larval duration was recorded in autumn season (26.38 days) than in spring season (24.89 days).

The interaction effects due to season and host plant combinations were found to be significant. The shortest larval duration was recorded in spring season in T_4 (21.00 days) and longest larval duration was recorded in T_9 (29.00 days) in autumn season.

(b) Full Grown Larval Weight- Data presented in Table 2, showed the full-grown larval weight of Muga silkworm reared on three different sole food plants and interchanging combinations of Som, Soalu and Mezankariplant. Significant difference ($p<0.05$) was observed in the full-grown larval weight of Muga silkworm. The highest larval weight was recorded on T_2 (12.95 g) followed by T_1 (12.10 g) and lowest larval weight was recorded on T_3 (9.26g). Among the combinations the highest larval weight was recorded in T_4 (12.58 g) which was statistically at par with T_6 (12.58 g) followed by T_8 (11.18 g), which was found statistically at par with T_5 (11.09 g), T_9 (10.86 g) and lowest was recorded in T_7 (10.73 g).

Irrespective of host plant combination, seasons were found to have significant effect on the full-grown larval weight of Muga silkworm. The higher larval weight was recorded in autumn season (11.73 g) than in spring season (11.23 g).

The interaction effects due to season and host pant combinations were found to be significant. The highest full grown larval weight was observed in T_2 (13.63 g) in autumn season and lowest full grown larval weight was observed in T_3 (8.83 g) in spring season.

(c) Mature Larval Weight- The data on mature larval weight (Table 3) revealed that there was significant difference ($p<0.05$) in the mature larval weight of Muga silkworm among the three host plants and their interchange combination. The highest mature larval weight

was recorded in T_2 (9.98 g) followed by T_1 (9.01 g) and lowest was recorded in T_3 (6.21 g). Among the combinations the highest mature larval weight was recorded in T_4 (9.51 g) followed by T_6 (9.46 g), T_8 (8.19 g) which was found statistically at par with T_5 (8.10 g) and lowest mature larval weight was recorded in T_9 (7.71 g) with was found statistically at par with T_7 (7.61 g).

The seasons were found to be significant effect on the mature larval weight of Muga silkworm. The mature larval weight was found to be higher in autumn season (8.69 g) than in spring season (8.15 g).

The interaction effect due to season and host plant combinations was found to be significant. The highest mature larval weight was found to be in T_2 (10.61 g) in autumn season and lowest mature larval weight was found to be in T_3 (5.91 g) in spring season.

Table 1. Effect of interchanging host plants and rearing seasons on larval duration (days) of Muga silkworm

Host plant combination	Effect of Season		
	Spring	**Autumn**	**Mean**
T_1	23.67	24.67	24.17
T_2	24.67	23.33	24.00
T_3	27.00	25.33	26.17
T_4	21.00	26.00	23.50
T_5	25.33	27.00	26.17
T_6	22.33	26.00	24.17
T_7	28.00	28.00	28.00
T_8	27.00	27.67	27.33
T_9	25.00	29.00	27.00
Mean	24.89	26.33	
		SEd±	**CD (5%)**
Host plant combination		0.68	1.37

Season	0.32	0.65
Host plant combination X Season	0.96	1.94

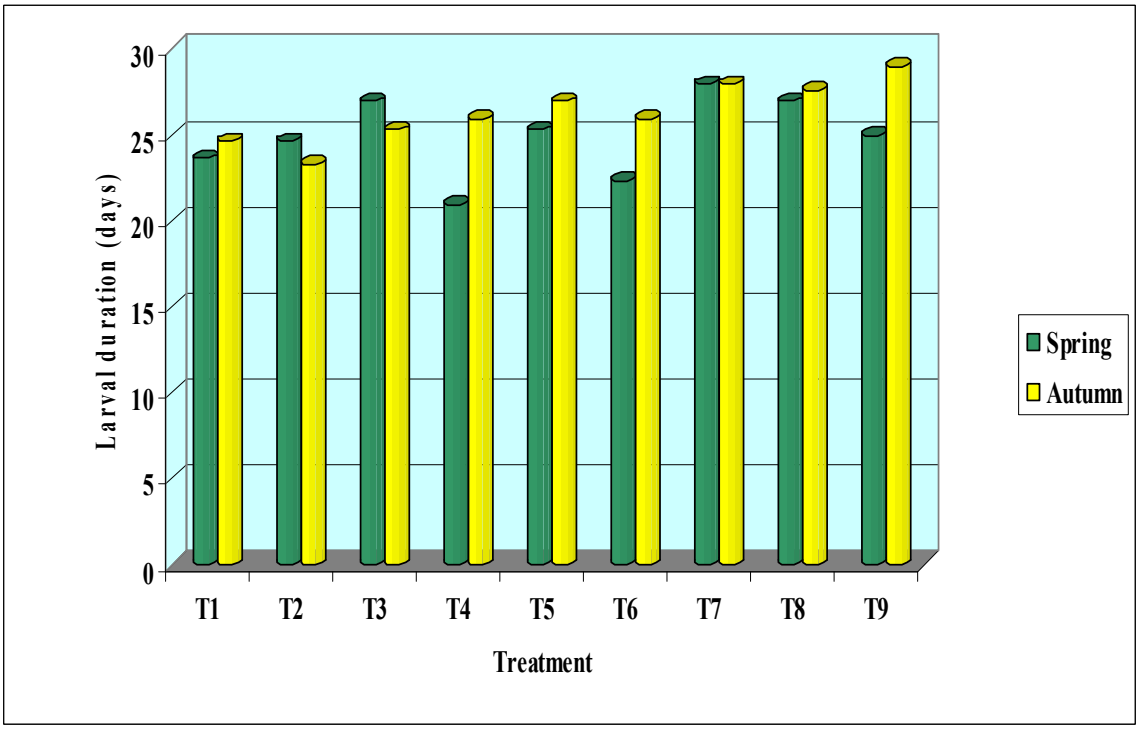

Fig 1. The above graph shows the larval duration of ***Antheraea assama*** **during spring and autumn season**.

Table 2. Interchange effect of host plants on full grown larval weight (g) of Muga silkworm during spring and autumn season

Host plant combination	**Effect of Season**		
	Spring	**Autumn**	**Mean**
T_1	12.19	12.01	12.10
T_2	12.27	13.63	12.95
T_3	8.83	9.68	9.26
T_4	12.35	12.80	12.58

T_5	10.58	11.60	11.09
T_6	12.51	12.65	12.58
T_7	10.80	10.66	10.73
T_8	10.64	11.72	11.18
T_9	10.89	10.83	10.86
Mean	11.23	11.73	
		SEd±	**CD (5%)**
Host plant combination		0.30	0.61
Season		0.14	0.29
Host plant combination X Season		NS	NS

NS= Non Significant

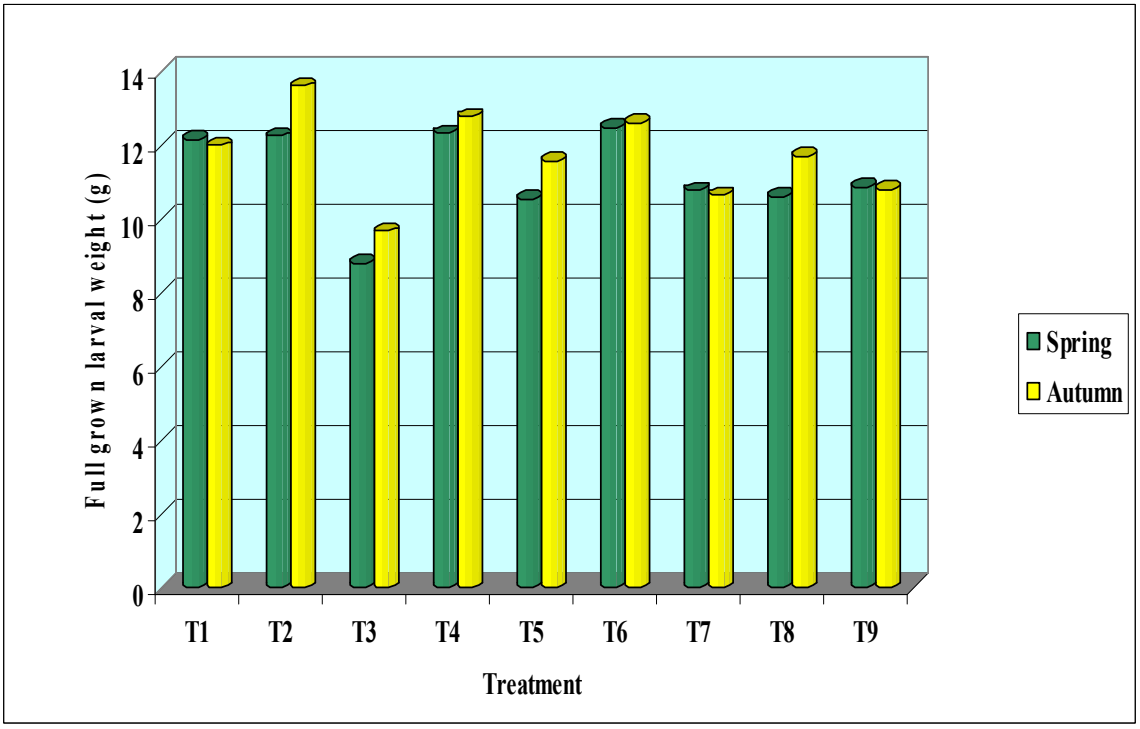

Fig.2. The above graph shows the full grown larval weight of ***Antheraea assama*** during spring and autumn season.

Table 3.Interchange effect of host plants on mature larval weight (g) of Muga silkworm during spring and autumn season

Host plant combination	Effect of Season		
	Spring	Autumn	Mean
T_1	9.10	8.92	9.01
T_2	9.36	10.61	9.98
T_3	5.91	6.51	6.21
T_4	9.23	9.79	9.51
T_5	7.68	8.52	8.10
T_6	9.24	9.68	9.46
T_7	7.46	7.75	7.61

T_8	7.76	8.62	8.19
T_9	7.60	7.81	7.17
Mean	8.15	8.69	

	SEd±	CD (5%)
Host plant combination	0.19	0.38
Season	0.09	0.18
Host plant combination X Season	0.27	0.54

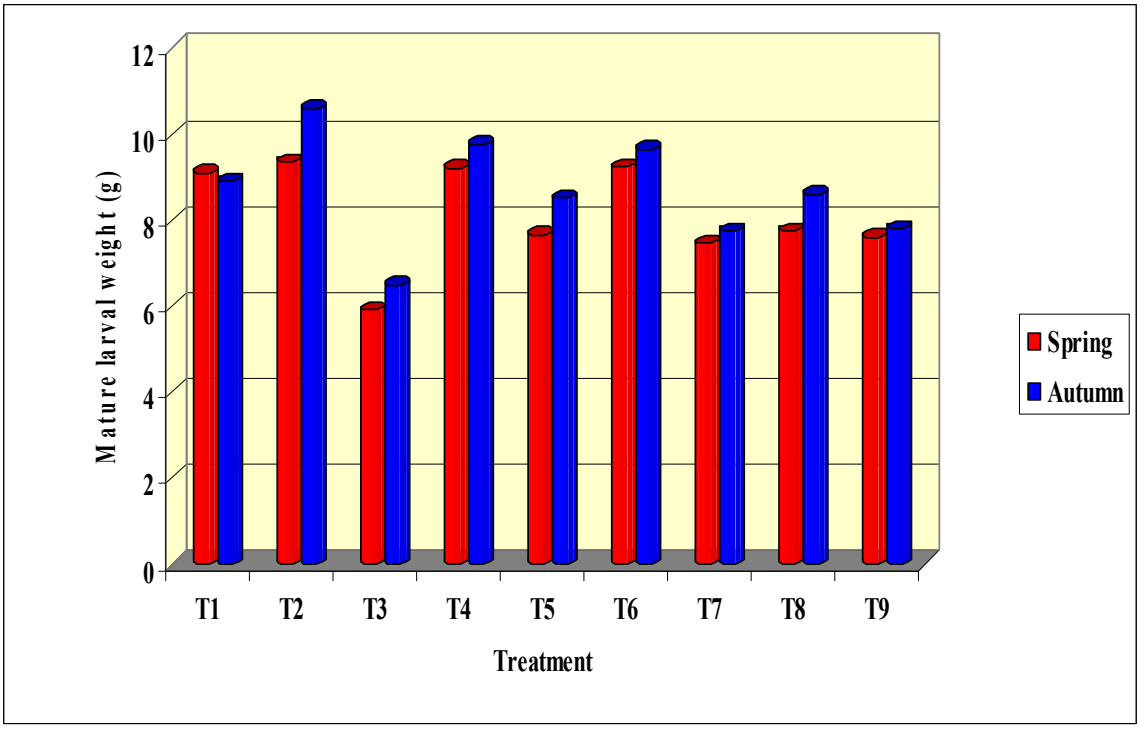

Fig. 3. The above graph shows the mature larval weight of ***Antheraea assama*** during spring and autumn season.

Discussion- Muga silkworm is an economically important species and feeds on a wide range of food plants. The present investigation had been undertaken to evaluate the rearing performance of Muga silkworm *Antheraea assama* on sole and interchange combinations of three different host plants viz. Som (*Persea bombycina)*, Soalu (*Litsaea monopetala)* and Mezankari (*Litsaea cubeba)* in two important commercial seasons viz., spring and autumn. The criteria that had been

considered during the investigation period were larval duration and larval weight. The present study reveals that rearing of Muga silkworm on different host plants and interchanging them had significant effect on larval growth and duration of the Muga silkworm. Among the sole food plants used, the shortest larval duration was recorded on Soalu followed by Som where it was recorded longest on Mezankari. Bordoloi (1999) also reported the similar findings while studying the growth and cocoon parameters of the silkworm with Som, Soalu, dighloti and Mezankari. Regarding larval weight, highest weight was found on Soalu which did not differ significantly from Som. Rajaram and Samson (2000) worked on different types of diet of Dighloti, Mezankari, Som and Soalu leaves on the rearing of Muga silkworm *Antheraea assama*, reported that highest larval weight was found on Soalu. The lowest larval weight was found on Mezankari which differed significantly from Som and Soalu.

Among the interchange combination Som + Soalu and Soalu + Som performed equally good in case of larval duration and larval weight. It may be due to feeding of Som leaves from first to third instar and interchanged with Soalu from fourth to fifth instar which is also easily fed by Muga silkworm larvae. In case of combinations with Mezankari, the larval duration was significantly longest on Soalu + Mezankari. This may be due to the reluctance of the larvae to feed Mezankari leaves after feeding Soalu in the early instars. Mezankari+Som was found to be better in case of larval weight which differed significantly from Mezankari + Soalu. In respect of larval duration spring season was found to be better than autumn season. The larval duration was found to be shorter in Spring season. The longer larval duration was recorded in autumn season which might be due to decrease of temperature.

Conclusion-With a view to find out the effect of different food plants *viz*., Som, Soalu, Mezankari and interchanging them on larval growth and cocoon parameters of Muga silkworm *Antheraea assama*, a study was carried out in the experimental field, Department of Sericulture, Assam Agricultural University, Jorhat during Spring and Autumn season 2010-2011. The findings of the investigation are summarized below:

- Food plants had significant effect on larval growth of Muga silkworm.
- The worms reared on Soalu had significantly higher full grown larval weight and mature larval weight than worms reared on Som.
- Mezankari appeared to be inferior than Som and Soalu considering the larval growth.
- Interchange of food plants during rearing had significant effect on larval growth of Muga silkworm.
- The larvae reared with interchange combination on Som + Soalu and Soalu + Som did not have much effect on larval duration of Muga silkworm compared to Som and Soalu control with significantly better larval weight and mature larval weight compared to that of Soalu control alone.

- Among the combinations with Mezankari, Mezankari + Som performed better in terms of larval weight.
- Autumn season was found to be better than that of Spring season except for larval duration.

From the study it is evident that the two food plants Som and Soalu performed equally well in respect of larval parameters. However, the performance of Mezankari was poorer compared to that of Som and Soalu. Combinations of Som + Soalu and Soalu + Som was found to be the best. But when combinations are done with Mezankari, better performance was recorded on Mezankari + Soalu. Thus, it can be concluded that Muga silkworm can be reared in different interchange combinations during the scarcity of major food plants for commercial production of Muga cocoons utilizing secondary host plants. This work may be further extended to adjudge the quality of silk produced by appropriate research in the post cocoon technology sector.

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Appendix

List of Figures

Plate 1. *Persea bombycina* Kost.
A primary host plant of *Antheraea assama*

Plate 2. *Litsaea monopetala* Roxb.
A primary host plant of *Antheraea assama*

Plate 3. *Litsaea cubeba* L.
A secondary host plant of *Antheraea assama*

Plate 4. Muga larvae on *Persea bombycina*

Plate 5. Muga larvae on *Litsaea monopetala*

Plate 6. Muga larvae on *Litsaea cubeba*