**Effect of spring Goshoeramimulberry leaf extract on secondcommercial cocoon crop under temperate climatic condition**


## Abstract

Nutrition plays an important role in silkworm rearing. It improves the growth, development, health and feed consumption, thereby improving the commercial traits.As reported, the mulberry leaf under Kashmir climatic condition during Summer/autumn season is nutritionally poor. In Kashmir Valley 90% ofsilkworm rearers mostly do rearing only once in a year *i.e*during spring season and lesser number of rearers goes for second rearing during summer/ autumn season because of less productivity and poor quality cocoon crops.Fortification of leaves by supplementing nutrients and using them for feeding the silkworm is a useful technique to increase their economic value. Several attempts have been made to enhance the cocoon yield and silk content through supplement of amino acids on mulberry leaf. However supplement of amino acids on mulberry leaf may not be economical and is not easily assessable to farmers. Silkworm, *Bombyx mori* L., is a monophagous insect that drives all required nutrients for its growth and development from mulberry leaf. Hence the present study was undertaken to study the efficacy of fortification of spring leaf extract of Goshoerami on growth and commercial traits of double hybrid FC1 ($CSR_6 \times CSR_{26}$) × FC2 ($CSR_2 \times CSR_{27}$) of silkworm *Bombyx mori* L. during second commercial rearing. The results showed, that application of aqueous extract of springmulberry leaffed silkworm larvae shows significantly higher in terms of body weight, cocoon weight, shell weight, yield andsilk filament length in all the treatments over the control.However the highest body weight (44.143 g/10) mature larval, Single cocoon weight (1.967g), single shell weight (0.471g), shell ratio percentage (23.921 %) and silk filament length(1,159.66 mtr) were recorded at 10% fortification. In order to promote the use of spring leaf extract for fortification among the silkworm rearers further studies are required in consultation with Department of Sericulture of the U T of Jammu and Kashmir.



Key words: Silkworm, Second crop, Goshoerami and Fortification.




**Introduction:**

"Sericulture is a cottage industry par excellence with its agriculture base, industrial super structure and labour intensive nature. It is remarkable for its low investment, quick and high returns, which make it an ideal industry or enterprise which fits well in to the socio-economic fabric of Jammu and Kashmir State. Therefore, Sericulture is highly recommended as one of the most effective tools for rural reconstruction with development of rural society. It is mainly due to its comparatively high profitability when compared to many other competing crops. The commercialization of only a single crop during spring rearing makes sericulture less remunerative at farmer's level. Over the years attempts are made and to commercialize the second cocoon crop (summer/autumn season)but have not been established on large scale

because of less production. which is not economically viable. during summer 10-15 percent farmers take up sericulture intemperate regions of Kashmir" (Sahaf*et al.* 2016).As there is scope for second crop at commercial level during autumn season (Farooq *et al*. 2006, Malik *et al.* 2009, Shivkumar *et al.* 2018), it is true to say that, non availability of desirable region/season specific silkworm breeds and adequate amount of mulberry leaf is also a constraint (Qadri et al., 2010). After pruning of mulberry in the month June the Goshoeramivariety has higher values of growth parameters and survival under rainfed conditions and could be recommended for mass multiplication in the rearing zones of Kashmir valley for popularization of the summer/ autumn crop(Qadri et al., 2010, Qadri et al., 2011. Apart, it is a well known fact that growth and development of silkworm and the economic characters of cocoons are influenced to a great extent by the nutritional contents of the leaves as food for silkworm.

"Thequality of food directly influences the growth and development of the silkworm and in turn quality and quantity of silk produced by them. Better the quality of leaves, greater are the possibilities of obtaining a good cocoon yield. The most important physiological factor in silkworm growth and silk production is nutrition. Normally, food plants contain all the biochemical constituents for the insects and their influence on the quality and quantity of silk fiber is considered to be very important. Supplement of nutrient is a recent technique and silkworms have ability to switch plant proteins to silk proteins for which number of artificial food can be supplied such as royal jelly, dietary proteins, amino acids, vitamin-B3 and these supplement helps in improving the qualities of silk fibre which can be used for yield enhancement in sericulture industry" (Aparupa 2015).Faruki (1998) reported that "*Bombyx mori* requires sugars, amino acids, protein, hormones ,minirals and vitamins for better production of cocoon crop".Nutritionally imbalanced diet reduces growth rate by imposing metabolic load. Silkworm is a monophagous insect that derives almost all the nutrients required for its growth and development from the mulberry leaf itself"(Nasreen *et al*., 1999). Though the nutrients are balanced in mulberry leaf, the quantity available is not sufficient for the larval growth during second commercial crop due tonon availability of adequate moisture contents ,nutrients ,variation in mulberry plant and its management

Among many other limiting factors for successful second cocoon crop, the poor quality of leaf is more important one whichvary in accordance with the mulberryvariety and the leaf yield considering the above facts andfactors, the cocoon productivity during second commercial silkworm rearing ismuch below the economic feasibility level in KashmirValley. Therefore, to ensure the stable second crop, it isvery pertinent that fortified mulberry leaves with some economically viable supplementing nutrients canbe used successfully under poor rearing conditions of thefarmers to increase cocoon yield and silk production during summer/autumn rearing. Hence, present experimental study has beendesigned to know the influence of fortification of spring mulberry leaf extract on second commercial silkworm rearing under temperate climatic condition of Kashmir.

MATERIALS AND METHODS:

The Bivoltine silkworm double hybrid FC1 ($CSR_6 \times CSR_{26}$) × FC2 ($CSR_2 \times CSR_{27}$) was used in this study. After incubation of eggs at 25 ± 1 temperatures and relative humidity of 80 ± 5%, Themass silkworm rearing was conducted as per package of practices of college of temperate Sericulture , SKUAST-Kashmir up to 3rd moult.After III moult, 1500 worms were randomly selected and distributed into six treatment groups of three replicates with 250 worms in each in a Completely Randomized Design (CRD).During the course of the present study the mulberry leaf used for second commercial rearing were supplemented with the aqueous extracts obtained from spring leaf and fed to the silkworms as per the following treatment combinations.

T1: Goshoerami leaf Extract @ 5% ,T2: Goshoerami leaf Extract @ 10%,T3: Goshoerami leaf Extract @ 15%, T4: Goshoerami leaf Extract @ 20%,T5: check only distilled water was used, T6: cheek without any treatment. The mulberry leaves supplemented with the above concentrations were fed to silkworms every day in first feedduring 4th and 5th instars

**Collection and preparation of spring leaf extracts:** The Goshoeramileaves were harvested from the mulberry garden of college of Temperate sericulture SKUAST-Kashmirduring the spring rearing season . Freshly collected leaves were washed with running tap water and rinsed with distilled water. The extracts were prepared by crushing in an electrically operated mixer by adding known quantity of distilled water on weight by volume basis (1:10 proportion). The crushed material was filtered through double layered muslin cloth and the filtrate was maintained as the stock solution. The stock solution was maintained in refrigeratortill second commercial silkworm rearing. During second commercial silkworm rearingevery time fresh dilution was prepared and sprayed on chopped mulberry leaveswith the help of automiseronce in a day from 4thinstar to 5thinstarand fed to silkworms..

**Observations recorded:**

The data was recorded as per the standard method for selected economic characters of silkworm *Bombyx mori* such as, larval weight (g), yield by number , Effective rate of rearing, single cocoon weight (g), single shell weight (g), shell ratio (%) and filament length.

## RESULTS AND DISCUSSION

Pic. 1 Goshoerami leaf extractPic 2. Spraying of extract on mulberry leaves

Pic 3.Feeding of fortified leaf to 5$^{th}$ age larvae Pic 4. Cocoon formation on rearing Trays

Table 1. Seasonal variation of some Chemical composition of mulberry leaf(Goshoerami).

| s.no. | Attributes | Percentage |
|---|---|---|
| 1 | Moisture content Spring | 72.93 |
| 2 | Moisture content Summer | 60.21 |
| 3 | Total protein Spring | 18.50 |
| 4 | Total protein Summer | 13.60 |
| 5 | Total sugars Spring | 4.15 |
| 6 | Total sugars Summer | 2.30 |
| 7 | Carbohydrates Spring | 11.20 |
| 8 | Carbohydrates Summer | 9.88 |

Values represent mean of triplicate determination

The results of chemical compositions of mulberry leaf are presented in Table -1. The values obtained of spring mulberry Composite leaf samples comprising of coarse, mediumand tender leaves for moisture, total protein, total sugars and total carbohydrates were 72.93%, 18.50%, 4.15%, 11.20% and 60.21%.13.60%, 2.30% 9.88% for spring and summer leaf respectively.. The seasonal variation of moisture, total protein, total sugars and total carbohydrates are in harmony with the results of Shivashankar M. (2015) who reported maximum moisture content in fresh leaf during spring season of different mulberry verities compared to autumn season. Higher moisture content in mulberry leaves is known to increase the amount of ingestion and digestion ability of silkworm as moisture acts as olfactory and gustatory stimulant (Ito, 1963). High leaf moisture content have a positive influence on the growth and development of silkworm. The present investigation clearly indicates that the less moisture percentage during summer seasons is one of the factor for poor crop.



Table 2 Mean performance of different treatment ( data pooled over three years of same seasons i.e. 2019,2020 and 2021)

| Treatments | Larval wt. of 10 mature larvae (g) | No. of cocoons harvested | ERR% | Av. Single Cocoon Wt. (g) | Av. Single Shell.Wt (g) | SR %age | Av Single cocoonFilament length(m) |
|---|---|---|---|---|---|---|---|
| T1: Goshoerami leaf Extract @ 5% | 42.740 | 242.667 | 97.467 | 1.893 | 0.417 | 21.981 | 1,032.111 |
| T2: Goshoerami leaf Extract @ 10% | 44.143 | 245.333 | 98.133 | 1.967 | 0.471 | 23.921 | 1,159.66 |
| T3: Goshoerami leaf Extract @ 15% | 44.104 | 246.333 | 98.533 | 1.961 | 0.460 | 23.442 | 1,109.333 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| T4: Goshoerami leaf Extract @ 20% | 41.339 | 244.667 | 97.867 | 1.892 | 0.407 | 21.402 | 1,014.778 |
| T5: Control without any treatment | 40.233 | 239.667 | 95.867 | 1.869 | 0.400 | 21.354 | 1,008.778 |
| T6 Control with distilled water | 40.561 | 240.000 | 96.000 | 1.874 | 0.404 | 21.736 | 1,025.444 |
| C.D. | 0.994 | 1.199 | 0.757 | 0.030 | 0.013 | 0.577 | 15.589 |

The average Larval wt. of 10 mature larvae (g) of different treatments i.e., T1, T2, T3, T4 ,T5 and T6 were found to be42.740g , 44.143g,44.104g, 41.339g,40.233g and 40.561gduring summer season. Significant differences were found among the different treatment groups .The larval weight of 10 mature larvaeof T1 showed significantly ($p \leq 0.05$) higher body weight compared to T3, T4 , T5 and T6 treatment groups..The larval weight of 10 mature of T4 and T5 did not differ each other. However the T6 was at pare with the T 5. In the present study the fortification of silkworm diet during summer season with aqueous extract of spring leas has improved the growth up to 10% level. The significant increase in larval weight when compared to control might be attributed to the enhancement of bio-availability of nutrients for digestion and conversion resulting in robust growth of the silkworm larvae. The present findings are in pipeline with the findings of (Radjabi*et al.* 2009),who reported that the fortifications of silkworm diet with certain levels may be effective for improved growth, but a higher level of supplementation does not have positive effect on silkworm growth and development.

Supplementation of silkworm diets during summer season with spring leaf aqueous extract of Goshoerami mulberry leaves significantly ($p \leq 0.05$) increased the cocoon yield, effective Rate of Rearing (ERR) cocoon weight, , shell weight and shell ratio percentage(table 2). The highest Cocoon yield and Effective Rate of Rearing (ERR %) were found in T3 i.e at 15% fortification and the lowest cocoon yield and ERR % were observed in T5 i.e control without any treatment. The data presented in table 2 clearly indicated that, the cocoon weight (**1.967g)**, shell weight (**0.471g)** and shell ratio percentage (**23.921 %)** were found maximum in T3 i.e at 10% fortification and minimum in T5 ( control without any treatment) i.e.**1.869g, 0.400g and 21.354% of** cocoon weight , shell weight and shell ratio percentage respectively.

The significant improvement in cocoon traits could be due to improved nutrition of leaf due to fortification which is utilized by worms, silkworms becoming stronger and tolerant to diseases.

These results are in line with the findings of , Gayathri *et al*. (2006), , Sridevi (2003), Jeyapaul *et al*. (2003).Who reported better ERR, cocoon weight, pupal weight, shell weight and cocoon shell ratio from fortification of silkworm diet with different medicinal botanical plant extracts.

Significantly($p \leq 0.05$) the longest silk filament length (1,159.66m) was recorded at Treatment 2 ( containing 10% fortification of aqueous extract of spring mulberry leaf) followed by T3 (1,109.333m) and the lowest (1,008.778m) filament length was recorded in treatment 5 **(** control without any treatment).The results clearly indicated, that supplementation of spring leaf extract have direct influence on the cocoon productivity and silk content during summer season under temperate climatic conditions of Kashmir.The positive effects of nutritional supplementation on the economic traits of silkworm were very well documented by few researchers viz. Kabila *et al.* (1994), Nirwani andKaliwal (1998), Etebari (2002), Radjabi *et al.* (2009).Rajashekaragouda *et al.* (1997) reported longest silk filament of 873 m due to supplementation of 20% *Parthenium* leaf extract. This has been further confirmed by Murugan *et al.* (1999) who found an increased filament length when mulberry leaves fortified with aqueous extracts of botanicals.

**Conclusion:**

The present findings, evaluated clearly demonstrated the significant role of aqueous extract of spring leaf supplemented on mulberry leaf in increasing the yieldattributing parameters of popular Bivoltine double hybrid FC1 ($CSR_6 \times CSR_{26}$) × FC2 ($CSR_2 \times CSR_{27}$)of silkworm *Bombyx mori* L., maximum at 10% fortification. Hence this cheap, easily assessable to farmers fortification of spring mulberry leaf aqueous extract need to be popularize in the field for economically viable summer/ autumn crop.

**References:**

Aparupa B. 2015. Nutritiona supplement and its effect on mulberry silkworm *Bombyx mori* L. *International Journal of Innovative Research in Science, Engineering and Technology* **4**(8): 6961-6962.

Etebari K. 2002. Effect of enrichment of mulberry leaves (*Morus alba*) with some vitamins and nitrogenous compounds on some economic traits and physiological characters of silkworm. *M. Sc Thesis*, Isfahan University of Technology, Isfahan, Iran. 150.

Farooq M, Singh T P, Nooruddin, Rufaie Z H, Baqual M and Dar H U. 2006. Second commercial crop to make sericulture a more profitable in Kashmir. Proceedings of regional Seminar on Prospects and Problems of Sericulture as are economic enterprise in North West India. 275-276.

Faruki SI, 2005. Effect of pyridoxine on the reproduction of the mulberry silkworm *Bombyx mori*L.(Lepidoptera: Bombycidae). Inv. SURV.J.2: 28-31.

Gayathri, T.V., M. Vijayendra, K.C. Narayanaswamy, G. Manjunath and G.T.N. Venkatesh, 2006. Influence of enriched mulberry leaves with plant extracts on economic traits of *Bombyx*

*mori* L. Proceedings of the National Conference of New Strategies in Sericulture Research and Development of Sericulture Indian Perspective, March 9-10, 2006, Bangalore, India, pp: 73-.
Ito, T. (1963) Nutrition in Silkworm. *Indian Journal of Sericulture*, 1:15-17.
Jeyapaul, C., C. Padmalatha, and A.J.A. Ranjith Singh, 2003. Effect of plant extracts on nutritional efficiency in mulberry silkworm, *Bombyx mori* L. Indian J. Seric., 42: 128-131.

Kabila V, Subburathinam K M and Chetty J S. 1994. Growth and economic characters of silkworm, *Bombyx mori* L. On feed enriched with neutralized aspartic acid. *Indian Journal of Sericulture* **33**: pp80-81.
Malik M A, Kamili A S, Sofi A M, Malik G N, Sabahat A and Bhat S A. 2009. Second commercial silkworm rearing in Kashmir –A ray of hope, *Indian Silk* **9**: 10-11.

Murugan, K., D. Jeyabalan, N. Senthilkumar, S.S. Krishna and N. Sivaprakasam, 1999. Growth promoting effects of plant compounds on silkworm. Proceeding of the National Seminar on Tropical Sericulture, December 28-30, 1999, Bangalore, 107-108

Nasreen, A., G.M. Cheema and M. Ashfaq, 1999. Rearing of ilkworm *Bombyx mori* L. on alternate food plants. Pak. J. Biol. Sci., 2:843-845.

Nirwani R B and Kaliwal B B. 1998. Effect of thiamine on commercial traits and biochemical contents of the fat body and haemolymph in the silkworm *Bombyx mori* L. *Sericologia***38**:639-646.
Qadri S,Farhat Iqbal , Mir M.R , Malik M.A, Sabhat A. and Malik F.A,2010,Comparative Suitability of some Popular Mulberry (morus spp.) genotypes for second cocoon crop under Kashmir climatic conditions, International Journal of Agricultural and Statistical Sciences 6 (2), 457-460
Qadri S,Farhat Iqbal , Malik M.A, Sabhat A and Malik F.A. 2010. Adoption of improved Sericultural practices by Sericulturists in border area of Kashmir*International Journal of Agriculture Statistics and Sciences 6 (1), 197-201*

Qadri S,Farhat Iqbal , Sheikh N.D, Malik M.A, Baqual M.F, Mir M.R and Sabhat A. ,2011, Performance of Mulberry Saplings in foot hills of Kashmir, Propagated through cuttings under Polyhouse conditions ,*International journal of Agricultural and Statistical Sciences 7 (1), 125-130*
Radjabi R, Ebadi R, Mirhoseini S Z and Nair S. 2009. Effects of feeding alanine-enriched mulberry leaves on the economic characters of silkworm *Bombyx mori* (Lepidoptera: Bombycidae). *Formosan Entomologist* **29**: 73-78.

Rajashekaragouda, R., M. Gopalan, S. Jayaraj and N. Natarajan, 1997. Field performance of plant extracts on mulberry silkworm, *Bombyx mori* L. Entomon, 22: 235-238.

Sahaf K A, Bhat S A and Mir Nisar A. 2016. Sericulture in North-west India with special reference to temperate region- problems and prospects. National seminar on sericulture development in temperate region: Problems and prospects. pp 34-38.

ShivashankarM.2015 ,Study on leaf moisture status of some Mulberry varieties as influenced by Foliar spray of Paras (Mulberry garden)*International Journal of Current Microbiology and Applied Sciences* Vol. 4 pp. 1200-1206

Shivkumar, Bharath K N, Mir N A, Shakeel A, Ravindra M A and Ghosh M K. 2018. Studies on improvement of quantitative traits of the silkworm, *Bombyx mori* L. during autumn under temperate climatic conditions of Kashmir. *Journal of Entomology and Zoology Studies* **6**(4): 677-682

Sridevi, G., 2003. Effect of mulberry leaves fortified with medicinal botanicals on the performance of mulberry silkworm, *Bombyx mori* L. M.Sc. Thesis, University of Agricultural Sciences, Bangalore, India.