

**Original Research Article**

## **Analysis of Yield Gaps in cocoon production: A Cross Sectional Study in Jammu District**

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**Article Information:**

Received: 08 December 2025 | Revised: 09 January 2026 | Accepted: 10 January 2026 | Published: January 11, 2026

**Cite this article:**

Ravi Kant, Muzamil Fayaz Rather, Jyoti Thakur (2026). Analysis of Yield Gaps in cocoon production: A Cross Sectional Study in Jammu District *Public Health Open Journal*. 11(S1):47–57. doi.org/10.17140/PHOJ.11.S1.47

**Abstract**

The study on the yield gaps in cocoon production was taken up at farmer's level in Jammu district of Jammu & Kashmir UT. A total of 210 samples were drawn from three districts under study at random. The magnitudes of yield gaps were quantified and the possible reasons for such existence were reported. In the case of cocoon yield production, the gap was high in the local adopted group as compared to recommended/control group which was mainly due to higher adoption of recommended technologies and better allocation of resources. The study suggests that extension agents should educate the marginal farmers on the importance of adoption of recommended sericulture technologies to get higher benefits in sericulture.

**Keywords:** *yield gap, cocoon production, sericulture, silkworm rearing, Jammu.*

## 2. Introduction

The union territory of Jammu and Kashmir is world famous for producing quality bivoltine silk in the country due to its longer length, better strength and shine mainly because of conducive climatic conditions. Sericulture industry has been one of the main pillars of rural economy engaging people in a long chain of interdependent, specialized operations which provide a means of livelihood to a large section of people. Presently more than 27,000 families are associated with this industry and annually around 800 MT of cocoon is produced generating an annual income of about Rs.19 crore and the raw silk production of 146 MT. However out of total production of cocoons every year only 20–25 per cent is being consumed within the UT and the rest is exported. In UT of J&K, silkworm rearing has been practiced since long and it has established a name for its tabby silk, silk carpets and silk products. In view of its importance, government of J&K established sericulture as industry in 1898 for providing source of income and employment to large number of poor landless people. Among various sericulture states of India, J&K is the oldest silk rearing UT producing bivoltine silk and has around 5000 acres of land under mulberry plantation. Out of 20 districts, sericulture is practiced in 12 districts in 3159 villages which accounts for 46.74 per cent of the total number of villages (Economic Survey, J&K Govt. 2024–25).

The history of sericulture in Jammu region dates back to about hundred years with three distinct climatic zones viz., sub-tropical, intermediate and temperate. The major silk producing districts of Jammu region includes: Rajouri, Udhampur, Kathua, Doda, Kishtwar, Samba, Ramban and Reasi. Two commercial rearings are conducted i.e., one in spring (February–March) and other in autumn (August–September). The UT produced about 800 MT of cocoons during 2019–20 with income generation of about Rs 25.00 crore under pre-cocoon sector and an estimated Rs 30.00 crore under post-cocoon/yarn production excluding value additions in silken fabric/products sales (Dar *et al.*, 2024). Cocoon is an intermediate product for silk production and it has a direct bearing on the quantitative and qualitative variation in silk production. Varying edaphic and climatic conditions within the regions clubbed with different levels of economic conditions among the farming population and single crop system also affects the cocoon production resulting slow growth of sericulture development. Though cocoon production in Jammu division has increased to some extent in the recent past but still there is a wide gap between the actual yield obtained by the rearers and the production level actually possible with the available technology. Hence, the

bottleneck of the problem is to increase the cocoon output per unit of input and thereby reduces the gaps between achievable cocoon yield at field level. Nevertheless, to produce quality cocoons, farmers need to acquire knowledge about new technologies and also show interest to adopt such technologies in the field. It is observed that most of the farmers are reluctant to adopt recommended new technologies due to various socio-economic and biotic factors (Lakshmanan *et al.*, 1998). This not only results in reduced productivity but even 95 per cent of total cocoons produced by the farmers do not meet the quality standards. The farmers who do not adopt such technologies would generally lose higher income in sericulture and as such fetch low dividends (Lakshmanan, 1998). It appears unbelievable that with many technologies available in the shape of package of practices, booklets, leaflets, be it from rearing or mulberry cultivation point of view and the assistance being extended to rearers through Sericulture Development Department (Jammu & Kashmir Govt.) in the shape of rearing sheds or rearing kits, the rearers still continue to harvest less cocoon crop/ounce of seed and yield gap between the lab and land is still widening which is indeed a matter of concern. Sericulture plays a key role in the upliftment of rural population both socially and economically (Sreenivasa and Hiriyanna, 2014). So, many sericultural technologies have been developed and their recommendations have been made to improve the productivity and quality of cocoon at farmer's level (Kushwaha, 2013). In spite of well-developed extension network to transfer the technologies to the farmers, there is a wide gap in productivity of the cocoon between laboratory to land due to non or partial adoption of improved sericultural technologies. As a consequence farmer's are getting very low returns due to low productivity and poor quality of cocoons as compared to other agriculture crops and therefore looking for other crops or avenues for better income and proportionate return of their labour. There are many improved technologies developed in sericulture at a fast pace in the last three decades. Proper adoption of these modified and innovative technologies by the farmers is vital for obtaining higher and better yield and thereby reducing the yield gap in cocoon production. The success of any technology largely depends on its effective adoption and utilization in the field. Providing sericulture knowledge to farmers is the need of hour for changing their attitudes, skills and adoption level which are essential components of rural development (Gowda *et al.*, 1992). The gap between the potential and actual yield in mulberry culture is very wide. One of important factor is attributed to be ignorance and non-adoption of improved recommended

technologies. The productivity depends on the extent to which farmers adopt new technologies (Kumari *et al.*, 2006). Keeping in view the above mentioned facts, the present study entitled, “Analysis of Yield Gaps in cocoon production: A Cross Sectional Study in Jammu District” was taken with an aim to generate the basic information regarding the factors causing such gaps in cocoon production at the field level.

## Material & Methods

Seventy silkworm rearers from each district were adopted during spring rearing while in autumn the number varied. The study was conducted for a period of two years (2019 & 2020) during spring (March–April) and autumn (August–September) rearing season. Primary data of the respondents for recording various socio-economic parameters and adoption of improved mulberry plantation and silkworm rearing technologies in each district was collected by conducting an interview in the form of questionnaire. Wet & dry thermometer was used to record temperature and humidity in the rearing rooms of the respondents and disease incidence percentage was recorded in each district during spring and autumn seasons. Silkworm rearing was conducted in all the three districts wherein 35 potential farmers from each district were adopted and conducted rearing according to recommended rearing practice methods (P1) while 35 farmers from same district followed local rearing practice methods (P0). Various rearing parameters of each silkworm rearer were recorded. Within district package of practices versus season effect was studied between the recommended practice and the local practice. Similarly, package versus season versus location effect was also studied among each district between the recommended and the local farmers. Rearing data was analyzed using Multiple Factorial Design to study yield gap between the recommended and local methods at field level.

### 2.1.3 Silkworm rearing parameters recorded

#### 2.1.3.1 Bed spacing (worms/feet<sup>2</sup>)

It is calculated as the number of silkworms maintained in the bed space of one square feet.

#### 2.1.3.2 Fifth instar larval weight (g)

It is the average weight of ten mature larvae during fifth instar. It was calculated by weighing ten mature larvae on either third or fourth day of fifth instar selected randomly from the rearing shelf.

#### 2.1.3.3 Fifth instar larval duration (days/hrs)

It is the total time taken by the larva to complete fifth instar of life cycle. It is measured in days or hours.

#### 2.1.3.4 Disease incidence (%)

It refers to total number of diseased silkworms from each location of the district and was estimated for number of worms reared by the farmer. The crop loss was calculated in both spring and autumn seasons separately during 2019 & 2020. Diseased larvae depicting different microbial symptoms were collected and subjected to microscopic examination. The diseases were identified on the basis of external symptoms.

#### Disease incidence (%) =

$$\frac{\text{Number of diseased larva in a lot}}{\text{Total number of larva after 3<sup>rd</sup> moult in a lot}} \times 100$$

#### 2.1.3.5 Single cocoon weight (g)

Twenty five male and twenty five female cocoons were selected randomly from a given lot and weighed on a digital balance to determine average cocoon weight using the following formula:

#### Single cocoon weight =

$$\frac{\text{weight of 25 male cocoon (g) + weight of 25 female cocoon (g)}}{\text{Total number of cocoons (50)}}$$

#### 2.1.3.6 Single shell weight (g)

Twenty male and twenty five female cocoon shells were selected randomly from a given lot and weighed on a digital balance to determine average cocoon weight using the following formula:

#### Single shell weight (g) =

$$\frac{\text{weight of 25 male cocoon shells (g) + 25 female cocoon shells (g)}}{\text{Total number of cocoons (50)}}$$

#### 2.1.3.7 Shell ratio (%)

It is defined as average ratio twenty five male and twenty five female cocoon shell to that of average cocoon weight of the same cocoons per replicate and was calculated by the following formula:

#### Shell ratio (%) =

$$\frac{\text{Average weight (g) of 25 cocoon shells of each sex} \times 100}{\text{Average weight of same no. of cocoons of each sex}}$$

#### 2.1.3.8 Larval survival (%)

It is defined as the number of larvae that spun cocoon from a given lot of larva.

#### Larval survival (%) =

$$\frac{\text{No. of larva left at the end of fifth age}}{\text{Total no. larva retained after 3<sup>rd</sup> moult in a given lot}} \times 100$$

#### 2.1.3.9 Cocoon yield (Kg/ounce)

It is defined as the dry weight (Kg) of cocoon produced from an ounce of silkworm seed.

### 3. Result and Discussions

#### 3.1 Average fifth instar larval duration

During 2019 silkworm rearing season minimum average fifth instar larval duration was recorded in district Doda (7.55 days) followed by Ramban (7.58 days) and Kishtwar (7.68 days) while in 2020 rearing season it was recorded least in district Ramban (7.90 days) followed by Doda (7.91 days) and Kishtwar (7.94 days). However, seasonwise fifth instar larval duration was 7.24 and 7.90 days in case of autumn season while in spring it was recorded 7.98 and 7.93 days during 2019 and 2020 rearing seasons, respectively. Practice wise those rearers who adopted recommended package of practice obtained an average fifth instar larval duration of 7.57 and 7.71 days while others who adopted local methods recorded an average of 7.65 and 8.11 days during 2019 and 2020 rearing seasons respectively. C.D. at 5% depicted significant difference between the means of seasons, districts, practices and their interaction.

#### 3.2 Average weight of ten mature larvae (g)

During 2019 rearing season maximum average weight of ten mature larvae was recorded in district Ramban (43.19g) followed by Doda (39.40g) and minimum in Kishtwar (39.20g) and during 2020 rearing season it was recorded highest in district Kishtwar (45.82g) followed by Doda (43.67g) and Ramban (42.07g). However, season wise average weight of ten mature larvae was recorded 37.51g and 37.81g in autumn season while it was 43.69g and 49.90g during spring in 2019 and 2020 rearing seasons respectively. Practice wise those rearers who adopted recommended package of practice obtained an average weight as 44.56g and 43.85g while others who adopted local methods recorded on average of 36.64g and 37.24 g during 2019 and 2020 rearing season. C.D. at 5% depicted significant difference between the means of seasons, districts, practices and their interaction.

#### 3.3 Average bed spacing (worms per sq. ft) per farmer

During 2019 rearing season minimum average bed spacing was recorded in district Kishtwar (75.68 worms/sq.ft) followed by Doda (77.03 worms/sq.ft) and maximum in Ramban (77.56 worms/sq.ft) whereas during 2020 rearing season spacing was minimum recorded in district Doda (70 worms/sq.ft) followed by Kishtwar (74.50 worms/sq.ft) and minimum in Ramban (83.50 worms/sq.ft). However, season wise averaged spacing recorded in autumn season was 77.59 worms/sq.ft & 77.66 worms/sq.ft and it was 75.91 worms/sq.ft & 77 worms/sq.ft in spring season. Practice wise those rearers who adopted recommended package of practice obtained an average bed spacing of 69.04 worms/sq.ft. & 63.33 worm-

s/sq.ft while others who adopted local methods recorded on average bed spacing of 84.46 worms/sq.ft. & 91.33 worms/sq.ft during 2019 & 2020 rearing seasons respectively. C.D. at 5% depicted significant difference between the means of seasons, districts, practices and their interaction.

#### 3.4 Average larval survival (%)

In 2019, silkworm rearing season, maximum average larval survival (%) was recorded in district Ramban (81.88%) followed by Doda (79.13%) and minimum in Kishtwar (78.74%) during the year 2020 and during 2019 rearing season district wise maximum was recorded in district Kishtwar (82.58%) followed by Doda (82.01%) and minimum in Ramban (78.40%) However, season wise an average larval survival 85.50 per cent and 84.60 per cent was recorded in spring season and in autumn it was recorded as 74.32 and 77.40 per cent. Practice wise those rearers who adopted recommended package of practice obtained an average bed spacing of 86.57 per cent while others who adopted local methods recorded on average of 73.25 per cent. C.D. at 5% depicted significant difference between the means of seasons, districts, practices and their interaction.

#### 3.5 Average single cocoon weight (g)

During silkworm rearing in 2019, maximum average single cocoon weight was recorded in district Kishtwar (1.48g) followed by Ramban (1.45g) and least in Doda (1.40g) while in 2020 rearing season it was recorded highest in district Kishtwar (1.43g) followed by Ramban (1.41g) and Doda (1.37g). However, season wise average single cocoon weight of 1.53g and 1.47g was recorded in spring season and 1.36g and 1.35g in autumn during 2019 and 2020 rearing seasons, respectively. Practice wise those rearers who adopted recommended package of practice obtained an average single cocoon weight of 1.55g and 1.49g while others who adopted local methods recorded 1.33g and 1.32g during 2019 and 2020 rearing seasons respectively. C.D. at 5% depicted significant difference between the means of seasons, districts, practices and their interaction.

#### 3.6 Average single shell weight (g)

During silkworm rearing in 2019, maximum average single shell weight was recorded in district Ramban and Kishtwar (0.28g) followed by Doda (0.27g) while in rearing of 2020 season it was recorded highest in district Kishtwar (0.35g) followed by Ramban (0.33g) and Doda (0.28g). However, season wise average single shell weight was 0.31g and 0.31g in spring season and in autumn it was 0.25g and 0.26g during rearing season of 2019 and 2020 respectively. Practice wise

**Table 1.** Average fifth instar larval duration (Days: hours)

| Year                                 | Seasons            | 2019                                                                                                                     |             |             | 2020                                                                                                                     |             |             |
|--------------------------------------|--------------------|--------------------------------------------------------------------------------------------------------------------------|-------------|-------------|--------------------------------------------------------------------------------------------------------------------------|-------------|-------------|
| Districts                            |                    | Practices                                                                                                                |             |             | Practices                                                                                                                |             |             |
|                                      |                    | P0                                                                                                                       | P1          | Sub Means   | P0                                                                                                                       | P1          | Sub Means   |
| <b>D1 Ramban</b>                     | <b>Spring (S1)</b> | 8.07                                                                                                                     | 7.78        | 7.93        | 8.28                                                                                                                     | 7.58        | 7.93        |
|                                      | <b>Autumn (S2)</b> | 7.27                                                                                                                     | 7.21        | 7.24        | 7.96                                                                                                                     | 7.77        | 7.87        |
|                                      | <b>Sub Means</b>   | <b>7.67</b>                                                                                                              | <b>7.50</b> | <b>7.58</b> | <b>8.12</b>                                                                                                              | <b>7.68</b> | <b>7.90</b> |
| <b>D2 Doda</b>                       | <b>Spring (S1)</b> | 8.06                                                                                                                     | 7.79        | 7.93        | 8.14                                                                                                                     | 7.66        | 7.90        |
|                                      | <b>Autumn (S2)</b> | 7.16                                                                                                                     | 7.20        | 7.18        | 7.96                                                                                                                     | 7.86        | 7.91        |
|                                      | <b>Sub Means</b>   | <b>7.61</b>                                                                                                              | <b>7.50</b> | <b>7.55</b> | <b>8.05</b>                                                                                                              | <b>7.76</b> | <b>7.91</b> |
| <b>D3 Kishtwar</b>                   | <b>Spring (S1)</b> | 8.06                                                                                                                     | 8.07        | 8.07        | 8.44                                                                                                                     | 7.45        | 7.95        |
|                                      | <b>Autumn (S2)</b> | 7.25                                                                                                                     | 7.33        | 7.29        | 7.90                                                                                                                     | 7.95        | 7.93        |
|                                      | <b>Sub Means</b>   | <b>7.66</b>                                                                                                              | <b>7.70</b> | <b>7.68</b> | <b>8.17</b>                                                                                                              | <b>7.70</b> | <b>7.94</b> |
| <b>Factor Means</b>                  | <b>Districts</b>   | <b>D1</b>                                                                                                                | <b>D2</b>   | <b>D3</b>   | <b>D1</b>                                                                                                                | <b>D2</b>   | <b>D3</b>   |
|                                      |                    | <b>7.58</b>                                                                                                              | <b>7.55</b> | <b>7.68</b> | <b>7.90</b>                                                                                                              | <b>7.91</b> | <b>7.94</b> |
|                                      | <b>Seasons</b>     | <b>S1</b>                                                                                                                | <b>S2</b>   |             | <b>S1</b>                                                                                                                | <b>S2</b>   |             |
|                                      |                    | <b>7.98</b>                                                                                                              | <b>7.24</b> |             | <b>7.93</b>                                                                                                              | <b>7.90</b> |             |
|                                      | <b>Practices</b>   | <b>P0</b>                                                                                                                | <b>P1</b>   |             | <b>P0</b>                                                                                                                | <b>P1</b>   |             |
| <b>CD (<math>p \leq 0.05</math>)</b> |                    | <b>7.65</b>                                                                                                              | <b>7.57</b> |             | <b>8.11</b>                                                                                                              | <b>7.71</b> |             |
|                                      |                    | Districts (D) = 0.01   Seasons (S) = 0.13<br>Practices (T) = 0.02   D×S = 0.11<br>D×T = 0.02   S×T = 0.13   D×S×T = 0.18 |             |             | Districts (D) = 0.02   Seasons (S) = 0.06<br>Practices (P) = 0.01   D×S = 0.09<br>D×P = 0.01   S×P = 0.07   D×S×P = 0.10 |             |             |

**Table 2.** Average weight of ten mature larvae (g)

| Year                                 | Seasons            | 2019                                                                                                                     |              |              | 2020                                                                                                                     |              |              |
|--------------------------------------|--------------------|--------------------------------------------------------------------------------------------------------------------------|--------------|--------------|--------------------------------------------------------------------------------------------------------------------------|--------------|--------------|
| Districts                            |                    | Practices                                                                                                                |              |              | Practices                                                                                                                |              |              |
|                                      |                    | P0                                                                                                                       | P1           | Sub Means    | P0                                                                                                                       | P1           | Sub Means    |
| <b>D1 Ramban</b>                     | <b>Spring (S1)</b> | 41.14                                                                                                                    | 51.57        | 46.36        | 38.55                                                                                                                    | 56.50        | 47.53        |
|                                      | <b>Autumn (S2)</b> | 35.75                                                                                                                    | 44.30        | 40.03        | 30.56                                                                                                                    | 42.68        | 36.62        |
|                                      | <b>Sub Means</b>   | <b>38.45</b>                                                                                                             | <b>47.94</b> | <b>43.19</b> | <b>34.56</b>                                                                                                             | <b>49.59</b> | <b>42.07</b> |
| <b>D2 Doda</b>                       | <b>Spring (S1)</b> | 40.22                                                                                                                    | 44.59        | 42.41        | 42.55                                                                                                                    | 52.80        | 47.68        |
|                                      | <b>Autumn (S2)</b> | 32.86                                                                                                                    | 39.93        | 36.40        | 33.66                                                                                                                    | 45.66        | 39.66        |
|                                      | <b>Sub Means</b>   | <b>36.54</b>                                                                                                             | <b>42.26</b> | <b>39.40</b> | <b>38.11</b>                                                                                                             | <b>49.23</b> | <b>43.67</b> |
| <b>D3 Kishtwar</b>                   | <b>Spring (S1)</b> | 36.93                                                                                                                    | 47.64        | 42.29        | 46.33                                                                                                                    | 62.66        | 54.50        |
|                                      | <b>Autumn (S2)</b> | 32.92                                                                                                                    | 39.32        | 36.12        | 31.80                                                                                                                    | 42.50        | 37.15        |
|                                      | <b>Sub Means</b>   | <b>34.93</b>                                                                                                             | <b>43.48</b> | <b>39.20</b> | <b>39.07</b>                                                                                                             | <b>52.58</b> | <b>45.82</b> |
| <b>Factor Means</b>                  | <b>Districts</b>   | <b>D1</b>                                                                                                                | <b>D2</b>    | <b>D3</b>    | <b>D1</b>                                                                                                                | <b>D2</b>    | <b>D3</b>    |
|                                      |                    | <b>43.19</b>                                                                                                             | <b>39.40</b> | <b>39.20</b> | <b>42.07</b>                                                                                                             | <b>43.67</b> | <b>45.82</b> |
|                                      | <b>Seasons</b>     | <b>S1</b>                                                                                                                | <b>S2</b>    |              | <b>S1</b>                                                                                                                | <b>S2</b>    |              |
|                                      |                    | <b>43.69</b>                                                                                                             | <b>37.51</b> |              | <b>49.90</b>                                                                                                             | <b>37.81</b> |              |
|                                      | <b>Practices</b>   | <b>P0</b>                                                                                                                | <b>P1</b>    |              | <b>P0</b>                                                                                                                | <b>P1</b>    |              |
| <b>CD (<math>p \leq 0.05</math>)</b> |                    | <b>36.64</b>                                                                                                             | <b>44.56</b> |              | <b>37.24</b>                                                                                                             | <b>43.85</b> |              |
|                                      |                    | Districts (D) = 1.77   Seasons (S) = 3.54<br>Practices (T) = 1.58   D×S = 1.12<br>D×T = 1.27   S×T = 1.33   D×S×T = 1.89 |              |              | Districts (D) = 1.62   Seasons (S) = 2.11<br>Practices (P) = 1.27   D×S = 1.18<br>D×P = 1.16   S×P = 1.28   D×S×P = 1.75 |              |              |

those rearers who adopted recommended package of practice obtained an average single cocoon weight of 0.34g and 0.35g while others who adopted local methods recorded on average single cocoon weight of 0.23g and during both the rearing season of 2019 and 2020. C.D at 5% depicted significant difference between the means of seasons, practices and non-significant for their interaction.

### 3.7 Average shell ratio (per cent)

District wise, maximum average shell ratio during rearing of 2019 season was recorded in district Ramban (19.44%) followed by Doda (19.17%) and minimum in Doda (18.89%) while in 2020 it was maximum in district Doda (20.28%) followed by Ramban (20.14%) and Kishtwar (20.04%). However, season wise average single cocoon weight was 20.22 and 21.17 per cent in spring

**Table 3.** Average bed spacing (worms per sq. ft)

| Year                                 | Seasons            | 2019                                                                                                                                                           |              |              | 2020                                                                                                                                                           |              |              |
|--------------------------------------|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|--------------|
| Districts                            |                    | Practices                                                                                                                                                      |              |              | Practices                                                                                                                                                      |              |              |
|                                      |                    | P0                                                                                                                                                             | P1           | Sub Means    | P0                                                                                                                                                             | P1           | Sub Means    |
| <b>D1 Ramban</b>                     | <b>Spring (S1)</b> | 87                                                                                                                                                             | 69.50        | 78.25        | 102                                                                                                                                                            | 71           | 86.50        |
|                                      | <b>Autumn (S2)</b> | 83.26                                                                                                                                                          | 70.46        | 76.86        | 98                                                                                                                                                             | 63           | 80.50        |
|                                      | <b>Sub Means</b>   | <b>85.13</b>                                                                                                                                                   | <b>69.98</b> | <b>77.56</b> | <b>100</b>                                                                                                                                                     | <b>67</b>    | <b>83.50</b> |
| <b>D2 Doda</b>                       | <b>Spring (S1)</b> | 81.44                                                                                                                                                          | 69.26        | 75.35        | 90                                                                                                                                                             | 59           | 74.50        |
|                                      | <b>Autumn (S2)</b> | 88.36                                                                                                                                                          | 69.05        | 78.71        | 92                                                                                                                                                             | 55           | 73.50        |
|                                      | <b>Sub Means</b>   | <b>84.90</b>                                                                                                                                                   | <b>69.16</b> | <b>77.03</b> | <b>91</b>                                                                                                                                                      | <b>57</b>    | <b>74</b>    |
| <b>D3 Kishtwar</b>                   | <b>Spring (S1)</b> | 83.36                                                                                                                                                          | 64.92        | 74.14        | 80                                                                                                                                                             | 60           | 70           |
|                                      | <b>Autumn (S2)</b> | 83.38                                                                                                                                                          | 71.04        | 77.21        | 86                                                                                                                                                             | 72           | 79           |
|                                      | <b>Sub Means</b>   | <b>83.37</b>                                                                                                                                                   | <b>67.98</b> | <b>75.68</b> | <b>83</b>                                                                                                                                                      | <b>66</b>    | <b>74.50</b> |
| <b>Factor Means</b>                  | <b>Districts</b>   | <b>D1</b>                                                                                                                                                      | <b>D2</b>    | <b>D3</b>    | <b>D1</b>                                                                                                                                                      | <b>D2</b>    | <b>D3</b>    |
|                                      |                    | <b>77.56</b>                                                                                                                                                   | <b>77.03</b> | <b>75.68</b> | <b>83.50</b>                                                                                                                                                   | <b>74</b>    | <b>74.50</b> |
|                                      | <b>Seasons</b>     | <b>S1</b>                                                                                                                                                      | <b>S2</b>    |              | <b>S1</b>                                                                                                                                                      | <b>S2</b>    |              |
|                                      |                    | <b>75.91</b>                                                                                                                                                   | <b>77.59</b> |              | <b>77</b>                                                                                                                                                      | <b>77.66</b> |              |
|                                      | <b>Practices</b>   | <b>P0</b>                                                                                                                                                      | <b>P1</b>    |              | <b>P0</b>                                                                                                                                                      | <b>P1</b>    |              |
|                                      |                    | <b>84.46</b>                                                                                                                                                   | <b>69.04</b> |              | <b>91.33</b>                                                                                                                                                   | <b>63.33</b> |              |
| <b>CD (<math>p \leq 0.05</math>)</b> |                    | Districts (D) = 0.21    Seasons (S) = 1.03<br>Practices (T) = 1.39 $D \times S = 1.33$<br>$D \times T = 1.18$ $S \times T = 1.46$ $D \times S \times T = 1.79$ |              |              | Districts (D) = 0.18    Seasons (S) = 0.79<br>Practices (P) = 1.10 $D \times S = 0.21$<br>$D \times P = 1.07$ $S \times P = 1.28$ $D \times S \times P = 1.63$ |              |              |

**Table 4.** Average larval survival (%)

| Year                                 | Seasons            | 2019                                                                                                                                                           |              |              | 2020                                                                                                                                                           |              |              |
|--------------------------------------|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|--------------|
| Districts                            |                    | Practices                                                                                                                                                      |              |              | Practices                                                                                                                                                      |              |              |
|                                      |                    | P0                                                                                                                                                             | P1           | Sub Means    | P0                                                                                                                                                             | P1           | Sub Means    |
| <b>D1 Ramban</b>                     | <b>Spring (S1)</b> | 84                                                                                                                                                             | 92           | 88           | 77.17                                                                                                                                                          | 85.66        | 81.42        |
|                                      | <b>Autumn (S2)</b> | 66                                                                                                                                                             | 85.50        | 75.75        | 60.45                                                                                                                                                          | 90.33        | 75.39        |
|                                      | <b>Sub Means</b>   | <b>75</b>                                                                                                                                                      | <b>88.75</b> | <b>81.88</b> | <b>68.81</b>                                                                                                                                                   | <b>88</b>    | <b>78.40</b> |
| <b>D2 Doda</b>                       | <b>Spring (S1)</b> | 81.50                                                                                                                                                          | 87.50        | 84.5         | 80.33                                                                                                                                                          | 89.66        | 85           |
|                                      | <b>Autumn (S2)</b> | 64                                                                                                                                                             | 83.50        | 73.75        | 71.50                                                                                                                                                          | 86.55        | 79.03        |
|                                      | <b>Sub Means</b>   | <b>72.75</b>                                                                                                                                                   | <b>85.50</b> | <b>79.13</b> | <b>75.92</b>                                                                                                                                                   | <b>88.10</b> | <b>82.01</b> |
| <b>D3 Kishtwar</b>                   | <b>Spring (S1)</b> | 77.50                                                                                                                                                          | 90.50        | 84           | 82.20                                                                                                                                                          | 92.56        | 87.38        |
|                                      | <b>Autumn (S2)</b> | 66.52                                                                                                                                                          | 80.42        | 73.47        | 67.08                                                                                                                                                          | 88.50        | 77.79        |
|                                      | <b>Sub Means</b>   | <b>72.01</b>                                                                                                                                                   | <b>85.46</b> | <b>78.74</b> | <b>74.64</b>                                                                                                                                                   | <b>90.53</b> | <b>82.58</b> |
| <b>Factor Means</b>                  | <b>Districts</b>   | <b>D1</b>                                                                                                                                                      | <b>D2</b>    | <b>D3</b>    | <b>D1</b>                                                                                                                                                      | <b>D2</b>    | <b>D3</b>    |
|                                      |                    | <b>81.88</b>                                                                                                                                                   | <b>79.13</b> | <b>78.74</b> | <b>78.40</b>                                                                                                                                                   | <b>82.01</b> | <b>82.58</b> |
|                                      | <b>Seasons</b>     | <b>S1</b>                                                                                                                                                      | <b>S2</b>    |              | <b>S1</b>                                                                                                                                                      | <b>S2</b>    |              |
|                                      |                    | <b>85.50</b>                                                                                                                                                   | <b>74.32</b> |              | <b>84.60</b>                                                                                                                                                   | <b>77.40</b> |              |
|                                      | <b>Practices</b>   | <b>P0</b>                                                                                                                                                      | <b>P1</b>    |              | <b>P0</b>                                                                                                                                                      | <b>P1</b>    |              |
|                                      |                    | <b>73.25</b>                                                                                                                                                   | <b>86.57</b> |              | <b>73.12</b>                                                                                                                                                   | <b>88.88</b> |              |
| <b>CD (<math>p \leq 0.05</math>)</b> |                    | Districts (D) = 0.11    Seasons (S) = 3.03<br>Practices (T) = 1.22 $D \times S = 0.77$<br>$D \times T = 1.03$ $S \times T = 2.44$ $D \times S \times T = 3.12$ |              |              | Districts (D) = 0.02    Seasons (S) = 1.05<br>Practices (P) = 0.52 $D \times S = 0.33$<br>$D \times P = 1.05$ $S \times P = 1.11$ $D \times S \times P = 1.22$ |              |              |

season and in autumn it was recorded as 18.12 and 19.14 per cent during rearing season of 2019 and 2020, respectively. Practice wise those rearers who adopted recommended package of practice obtained an average shell ratio of 21.29 and 23.28 per cent while others who adopted local methods recorded on average shell ratio of 17.05 and 17.03 per cent. C.D. at 5% depicted significant difference between the means of seasons,

districts, practices and their interaction.

### 3.8 Grasserie disease incidence (per cent)

During 2019 silkworm rearing season, district wise maximum incidence of grasserie disease was recorded in Doda (12.15%) followed by Kishtwar (11.44%) and Ramban district (10.41%) while maximum incidence of 10.55 per cent grasserie disease was recorded in Doda fol-

**Table 5.** Average single cocoon weight (g)

| Year                                 | Seasons            | 2019                                                                                                                     |             |             | 2020                                                                                                                     |             |             |
|--------------------------------------|--------------------|--------------------------------------------------------------------------------------------------------------------------|-------------|-------------|--------------------------------------------------------------------------------------------------------------------------|-------------|-------------|
| Districts                            |                    | Practices                                                                                                                |             |             | Practices                                                                                                                |             |             |
|                                      |                    | P0                                                                                                                       | P1          | Sub Means   | P0                                                                                                                       | P1          | Sub Means   |
| <b>D1 Ramban</b>                     | <b>Spring (S1)</b> | 1.39                                                                                                                     | 1.68        | 1.54        | 1.36                                                                                                                     | 1.59        | 1.48        |
|                                      | <b>Autumn (S2)</b> | 1.29                                                                                                                     | 1.43        | 1.36        | 1.30                                                                                                                     | 1.39        | 1.35        |
|                                      | <b>Sub Means</b>   | <b>1.34</b>                                                                                                              | <b>1.56</b> | <b>1.45</b> | <b>1.33</b>                                                                                                              | <b>1.49</b> | <b>1.41</b> |
| <b>D2 Doda</b>                       | <b>Spring (S1)</b> | 1.36                                                                                                                     | 1.57        | 1.47        | 1.35                                                                                                                     | 1.48        | 1.42        |
|                                      | <b>Autumn (S2)</b> | 1.26                                                                                                                     | 1.39        | 1.33        | 1.29                                                                                                                     | 1.36        | 1.33        |
|                                      | <b>Sub Means</b>   | <b>1.31</b>                                                                                                              | <b>1.48</b> | <b>1.40</b> | <b>1.32</b>                                                                                                              | <b>1.42</b> | <b>1.37</b> |
| <b>D3 Kishtwar</b>                   | <b>Spring (S1)</b> | 1.42                                                                                                                     | 1.71        | 1.57        | 1.39                                                                                                                     | 1.61        | 1.50        |
|                                      | <b>Autumn (S2)</b> | 1.28                                                                                                                     | 1.49        | 1.39        | 1.24                                                                                                                     | 1.49        | 1.37        |
|                                      | <b>Sub Means</b>   | <b>1.35</b>                                                                                                              | <b>1.60</b> | <b>1.48</b> | <b>1.32</b>                                                                                                              | <b>1.55</b> | <b>1.43</b> |
| <b>Factor Means</b>                  | <b>Districts</b>   | <b>D1</b>                                                                                                                | <b>D2</b>   | <b>D3</b>   | <b>D1</b>                                                                                                                | <b>D2</b>   | <b>D3</b>   |
|                                      |                    | <b>1.45</b>                                                                                                              | <b>1.40</b> | <b>1.48</b> | <b>1.41</b>                                                                                                              | <b>1.37</b> | <b>1.43</b> |
|                                      | <b>Seasons</b>     | <b>S1</b>                                                                                                                | <b>S2</b>   |             | <b>S1</b>                                                                                                                | <b>S2</b>   |             |
|                                      |                    | <b>1.53</b>                                                                                                              | <b>1.36</b> |             | <b>1.47</b>                                                                                                              | <b>1.35</b> |             |
|                                      | <b>Practices</b>   | <b>P0</b>                                                                                                                | <b>P1</b>   |             | <b>P0</b>                                                                                                                | <b>P1</b>   |             |
| <b>CD (<math>p \leq 0.05</math>)</b> |                    | <b>1.33</b>                                                                                                              | <b>1.55</b> |             | <b>1.32</b>                                                                                                              | <b>1.49</b> |             |
|                                      |                    | Districts (D) = 1.02   Seasons (S) = 0.11<br>Practices (T) = 0.13   D×S = 0.10<br>D×T = 0.11   S×T = 0.12   D×S×T = 0.16 |             |             | Districts (D) = 0.05   Seasons (S) = 0.13<br>Practices (P) = 0.15   D×S = 0.11<br>D×P = 0.13   S×P = 0.10   D×S×P = 0.18 |             |             |

**Table 6.** Average single shell weight (g)

| Year                                 | Seasons            | 2019                                                                                                           |             |             | 2020                                                                                                             |             |             |
|--------------------------------------|--------------------|----------------------------------------------------------------------------------------------------------------|-------------|-------------|------------------------------------------------------------------------------------------------------------------|-------------|-------------|
| Districts                            |                    | Practices                                                                                                      |             |             | Practices                                                                                                        |             |             |
|                                      |                    | P0                                                                                                             | P1          | Sub Means   | P0                                                                                                               | P1          | Sub Means   |
| <b>D1 Ramban</b>                     | <b>Spring (S1)</b> | 0.25                                                                                                           | 0.39        | 0.32        | 0.24                                                                                                             | 0.36        | 0.30        |
|                                      | <b>Autumn (S2)</b> | 0.19                                                                                                           | 0.30        | 0.25        | 0.21                                                                                                             | 0.33        | 0.26        |
|                                      | <b>Sub Means</b>   | <b>0.22</b>                                                                                                    | <b>0.35</b> | <b>0.28</b> | <b>0.23</b>                                                                                                      | <b>0.35</b> | <b>0.28</b> |
| <b>D2 Doda</b>                       | <b>Spring (S1)</b> | 0.25                                                                                                           | 0.35        | 0.30        | 0.25                                                                                                             | 0.37        | 0.31        |
|                                      | <b>Autumn (S2)</b> | 0.20                                                                                                           | 0.28        | 0.24        | 0.21                                                                                                             | 0.29        | 0.25        |
|                                      | <b>Sub Means</b>   | <b>0.23</b>                                                                                                    | <b>0.35</b> | <b>0.27</b> | <b>0.23</b>                                                                                                      | <b>0.33</b> | <b>0.28</b> |
| <b>D3 Kishtwar</b>                   | <b>Spring (S1)</b> | 0.24                                                                                                           | 0.37        | 0.31        | 0.25                                                                                                             | 0.41        | 0.33        |
|                                      | <b>Autumn (S2)</b> | 0.21                                                                                                           | 0.29        | 0.25        | 0.19                                                                                                             | 0.32        | 0.26        |
|                                      | <b>Sub Means</b>   | <b>0.23</b>                                                                                                    | <b>0.33</b> | <b>0.28</b> | <b>0.22</b>                                                                                                      | <b>0.37</b> | <b>0.30</b> |
| <b>Factor Means</b>                  | <b>Districts</b>   | <b>D1</b>                                                                                                      | <b>D2</b>   | <b>D3</b>   | <b>D1</b>                                                                                                        | <b>D2</b>   | <b>D3</b>   |
|                                      |                    | <b>0.28</b>                                                                                                    | <b>0.27</b> | <b>0.28</b> | <b>0.33</b>                                                                                                      | <b>0.28</b> | <b>0.35</b> |
|                                      | <b>Seasons</b>     | <b>S1</b>                                                                                                      | <b>S2</b>   |             | <b>S1</b>                                                                                                        | <b>S2</b>   |             |
|                                      |                    | <b>0.31</b>                                                                                                    | <b>0.25</b> |             | <b>0.31</b>                                                                                                      | <b>0.26</b> |             |
|                                      | <b>Practices</b>   | <b>P0</b>                                                                                                      | <b>P1</b>   |             | <b>P0</b>                                                                                                        | <b>P1</b>   |             |
| <b>CD (<math>p \leq 0.05</math>)</b> |                    | <b>0.23</b>                                                                                                    | <b>0.34</b> |             | <b>0.23</b>                                                                                                      | <b>0.35</b> |             |
|                                      |                    | Districts (D) = ns   Seasons (S) = 0.03<br>Practices (T) = 0.09   D×S = ns   D×T = ns<br>S×T = ns   D×S×T = ns |             |             | Districts (D) = 0.01   Seasons (S) = 0.03<br>Practices (P) = 0.05   D×S = ns   D×P = ns<br>S×P = ns   D×S×P = ns |             |             |

lowed by Kishtwar (9.83%) and least in Ramban (7.71%) during silkworm rearing conducted in 2020. Season-wise incidence of grasserie disease was highly significant and it was maximum during autumn (14.74%) and minimum in spring (7.93%) in 2019 while it was maximum during autumn (12.66%) and minimum in spring (6.07%) in 2020. Practice wise those rearers who adopted recommended methods recorded a low grasserie incidence. On an average it was 4.92% for

those rearers who adopted recommended methods while local method adopters recorded comparatively much higher incidence of 17.75 per cent during 2019 season while it was recorded 17.32 per cent in 2020 rearing season and 0.41 per cent for those who adopted recommended package and those who adopted local methods respectively during 2020 rearing seasons. C.D. at 5% depicted significant difference between means of seasons, practices, districts and their interactions.

**Table 7.** Average shell ratio (%)

| Year                                 | Seasons            | 2019                                                                                                                                                           |              |              | 2020                                                                                                                                                           |              |              |
|--------------------------------------|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|--------------|
| Districts                            |                    | Practices                                                                                                                                                      |              |              | Practices                                                                                                                                                      |              |              |
|                                      |                    | P0                                                                                                                                                             | P1           | Sub Means    | P0                                                                                                                                                             | P1           | Sub Means    |
| <b>D1 Ramban</b>                     | <b>Spring (S1)</b> | 17.99                                                                                                                                                          | 23.21        | 20.60        | 17.65                                                                                                                                                          | 22.64        | 20.15        |
|                                      | <b>Autumn (S2)</b> | 15.57                                                                                                                                                          | 20.97        | 18.27        | 16.54                                                                                                                                                          | 23.74        | 20.14        |
|                                      | <b>Sub Means</b>   | <b>16.78</b>                                                                                                                                                   | <b>22.09</b> | <b>19.44</b> | <b>17.10</b>                                                                                                                                                   | <b>23.19</b> | <b>20.14</b> |
| <b>D2 Doda</b>                       | <b>Spring (S1)</b> | 18.38                                                                                                                                                          | 22.29        | 20.34        | 18.25                                                                                                                                                          | 25           | 21.63        |
|                                      | <b>Autumn (S2)</b> | 15.87                                                                                                                                                          | 20.14        | 18.01        | 16.54                                                                                                                                                          | 21.32        | 18.93        |
|                                      | <b>Sub Means</b>   | <b>17.13</b>                                                                                                                                                   | <b>21.22</b> | <b>19.17</b> | <b>17.40</b>                                                                                                                                                   | <b>23.16</b> | <b>20.28</b> |
| <b>D3 Kishtwar</b>                   | <b>Spring (S1)</b> | 17.78                                                                                                                                                          | 21.63        | 19.71        | 17.99                                                                                                                                                          | 25.47        | 21.73        |
|                                      | <b>Autumn (S2)</b> | 16.67                                                                                                                                                          | 19.46        | 18.07        | 15.20                                                                                                                                                          | 21.48        | 18.34        |
|                                      | <b>Sub Means</b>   | <b>17.23</b>                                                                                                                                                   | <b>20.55</b> | <b>18.89</b> | <b>16.60</b>                                                                                                                                                   | <b>23.48</b> | <b>20.04</b> |
| <b>Factor Means</b>                  | <b>Districts</b>   | <b>D1</b>                                                                                                                                                      | <b>D2</b>    | <b>D3</b>    | <b>D1</b>                                                                                                                                                      | <b>D2</b>    | <b>D3</b>    |
|                                      |                    | <b>19.44</b>                                                                                                                                                   | <b>19.17</b> | <b>18.89</b> | <b>20.14</b>                                                                                                                                                   | <b>20.28</b> | <b>20.04</b> |
|                                      | <b>Seasons</b>     | <b>S1</b>                                                                                                                                                      | <b>S2</b>    |              | <b>S1</b>                                                                                                                                                      | <b>S2</b>    |              |
|                                      |                    | <b>20.22</b>                                                                                                                                                   | <b>18.12</b> |              | <b>21.17</b>                                                                                                                                                   | <b>19.14</b> |              |
|                                      | <b>Practices</b>   | <b>P0</b>                                                                                                                                                      | <b>P1</b>    |              | <b>P0</b>                                                                                                                                                      | <b>P1</b>    |              |
|                                      |                    | <b>17.05</b>                                                                                                                                                   | <b>21.29</b> |              | <b>17.03</b>                                                                                                                                                   | <b>23.28</b> |              |
| <b>CD (<math>p \leq 0.05</math>)</b> |                    | Districts (D) = 0.09    Seasons (S) = 1.81<br>Practices (T) = 0.17 $D \times S = 0.11$<br>$D \times T = 0.13$ $S \times T = 0.16$ $D \times S \times T = 1.32$ |              |              | Districts (D) = 0.06    Seasons (S) = 1.03<br>Practices (P) = 0.14 $D \times S = 0.13$<br>$D \times P = 0.12$ $S \times P = 0.15$ $D \times S \times P = 0.87$ |              |              |

**Table 8.** Average incidence of grasserie (%)

| Year                                 | Seasons            | 2019                                                                                                                                                           |              |              | 2020                                                                                                                                                           |              |              |
|--------------------------------------|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|--------------|
| Districts                            |                    | Practices                                                                                                                                                      |              |              | Practices                                                                                                                                                      |              |              |
|                                      |                    | P0                                                                                                                                                             | P1           | Sub-Means    | P0                                                                                                                                                             | P1           | Sub-Means    |
| <b>D1 Ramban</b>                     | <b>Spring (S1)</b> | 14                                                                                                                                                             | 1.5          | 7.75         | 7.41                                                                                                                                                           | 0.55         | 3.98         |
|                                      | <b>Autumn (S2)</b> | 21.69                                                                                                                                                          | 4.46         | 13.08        | 20.23                                                                                                                                                          | 2.65         | 11.44        |
|                                      | <b>Sub Means</b>   | <b>17.85</b>                                                                                                                                                   | <b>2.98</b>  | <b>10.41</b> | <b>13.82</b>                                                                                                                                                   | <b>1.60</b>  | <b>7.71</b>  |
| <b>D2 Doda</b>                       | <b>Spring (S1)</b> | 12.76                                                                                                                                                          | 5.27         | 9.02         | 14.00                                                                                                                                                          | 0.96         | 7.48         |
|                                      | <b>Autumn (S2)</b> | 23.56                                                                                                                                                          | 7            | 15.28        | 25.79                                                                                                                                                          | 1.44         | 13.62        |
|                                      | <b>Sub Means</b>   | <b>18.16</b>                                                                                                                                                   | <b>6.14</b>  | <b>12.15</b> | <b>19.90</b>                                                                                                                                                   | <b>1.20</b>  | <b>10.55</b> |
| <b>D3 Kishtwar</b>                   | <b>Spring (S1)</b> | 12                                                                                                                                                             | 2.02         | 7.01         | 13                                                                                                                                                             | 0.50         | 6.75         |
|                                      | <b>Autumn (S2)</b> | 22.50                                                                                                                                                          | 9.23         | 15.87        | 23.50                                                                                                                                                          | 2.33         | 12.92        |
|                                      | <b>Sub Means</b>   | <b>17.25</b>                                                                                                                                                   | <b>5.63</b>  | <b>11.44</b> | <b>18.25</b>                                                                                                                                                   | <b>1.42</b>  | <b>9.83</b>  |
| <b>Factor Means</b>                  | <b>Districts</b>   | <b>D1</b>                                                                                                                                                      | <b>D2</b>    | <b>D3</b>    | <b>D1</b>                                                                                                                                                      | <b>D2</b>    | <b>D3</b>    |
|                                      |                    | <b>10.41</b>                                                                                                                                                   | <b>12.15</b> | <b>11.44</b> | <b>7.71</b>                                                                                                                                                    | <b>10.55</b> | <b>9.83</b>  |
|                                      | <b>Seasons</b>     | <b>S1</b>                                                                                                                                                      | <b>S2</b>    |              | <b>S1</b>                                                                                                                                                      | <b>S2</b>    |              |
|                                      |                    | <b>7.93</b>                                                                                                                                                    | <b>14.74</b> |              | <b>6.07</b>                                                                                                                                                    | <b>12.66</b> |              |
|                                      | <b>Practices</b>   | <b>P0</b>                                                                                                                                                      | <b>P1</b>    |              | <b>P0</b>                                                                                                                                                      | <b>P1</b>    |              |
|                                      |                    | <b>17.75</b>                                                                                                                                                   | <b>4.92</b>  |              | <b>17.32</b>                                                                                                                                                   | <b>1.41</b>  |              |
| <b>CD (<math>p \leq 0.05</math>)</b> |                    | Districts (D) = 0.03    Seasons (S) = 0.06<br>Practices (T) = 0.02 $D \times S = 0.04$<br>$D \times T = 0.05$ $S \times T = 0.01$ $D \times S \times T = 0.09$ |              |              | Districts (D) = 0.02    Seasons (S) = 0.03<br>Practices (P) = 0.01 $D \times S = 0.05$<br>$D \times P = 0.03$ $S \times P = 0.01$ $D \times S \times P = 0.07$ |              |              |

### 3.9 Flacherie disease incidence (per cent)

Maximum incidence of flacherie disease was recorded in Doda (2.61%) followed by Kishtwar (1.38%) and least in Ramban (0.58%) during 2019 rearing season. In 2020 rearing season, maximum incidence of grasserie disease was observed in Doda (0.83%) followed by Kishtwar (0.33%) and Ramban (0.33%). Season wise incidence of flacherie disease was maximum during au-

tumn (1.72% and 0.64%) and minimum in spring (1.30 and 0.36%) during 2019 & 2020, respectively. Practice wise, overall those rearers who followed recommended package of practice observed an incidence of only 0.20 and 0.12 per cent while those who adopted local methods recorded an incidence of 2.86 and 0.88 per cent during 2019 and 2020 rearing seasons respectively. C.D at 5% depicted, significant difference between means

**Table 9.** Average incidence of flacherie (%)

| Year                                 | Seasons            | 2019                                                                                                                     |             |             | 2020                                                                                                                     |             |             |
|--------------------------------------|--------------------|--------------------------------------------------------------------------------------------------------------------------|-------------|-------------|--------------------------------------------------------------------------------------------------------------------------|-------------|-------------|
| Districts                            |                    | Practices                                                                                                                |             |             | Practices                                                                                                                |             |             |
|                                      |                    | P0                                                                                                                       | P1          | Sub-Means   | P0                                                                                                                       | P1          | Sub-Means   |
| <b>D1 Ramban</b>                     | <b>Spring (S1)</b> | 0.50                                                                                                                     | 0           | 0.25        | 0                                                                                                                        | 0           | 0           |
|                                      | <b>Autumn (S2)</b> | 1.50                                                                                                                     | 0.33        | 0.92        | 1.26                                                                                                                     | 0.05        | 0.66        |
|                                      | <b>Sub Means</b>   | <b>1</b>                                                                                                                 | <b>0.17</b> | <b>0.58</b> | <b>0.63</b>                                                                                                              | <b>0.03</b> | <b>0.33</b> |
| <b>D2 Doda</b>                       | <b>Spring (S1)</b> | 5.25                                                                                                                     | 0           | 2.63        | 2.15                                                                                                                     | 0           | 1.08        |
|                                      | <b>Autumn (S2)</b> | 4.68                                                                                                                     | 0.50        | 2.59        | 0.50                                                                                                                     | 0.66        | 0.58        |
|                                      | <b>Sub Means</b>   | <b>4.97</b>                                                                                                              | <b>0.25</b> | <b>2.61</b> | <b>1.33</b>                                                                                                              | <b>0.33</b> | <b>0.83</b> |
| <b>D3 Kishtwar</b>                   | <b>Spring (S1)</b> | 1.70                                                                                                                     | 0.33        | 1.02        | 0                                                                                                                        | 0           | 0           |
|                                      | <b>Autumn (S2)</b> | 3.50                                                                                                                     | 0           | 1.66        | 1.33                                                                                                                     | 0           | 0.67        |
|                                      | <b>Sub Means</b>   | <b>2.6</b>                                                                                                               | <b>0.17</b> | <b>1.38</b> | <b>0.67</b>                                                                                                              | <b>0</b>    | <b>0.33</b> |
| <b>Factor Means</b>                  | <b>Districts</b>   | <b>D1</b>                                                                                                                | <b>D2</b>   | <b>D3</b>   | <b>D1</b>                                                                                                                | <b>D2</b>   | <b>D3</b>   |
|                                      |                    | <b>0.58</b>                                                                                                              | <b>2.61</b> | <b>1.38</b> | <b>0.33</b>                                                                                                              | <b>0.83</b> | <b>0.33</b> |
|                                      | <b>Seasons</b>     | <b>S1</b>                                                                                                                | <b>S2</b>   |             | <b>S1</b>                                                                                                                | <b>S2</b>   |             |
|                                      |                    | <b>1.30</b>                                                                                                              | <b>1.72</b> |             | <b>0.36</b>                                                                                                              | <b>0.64</b> |             |
|                                      | <b>Practices</b>   | <b>P0</b>                                                                                                                | <b>P1</b>   |             | <b>P0</b>                                                                                                                | <b>P1</b>   |             |
| <b>CD (<math>p \leq 0.05</math>)</b> |                    | <b>2.86</b>                                                                                                              | <b>0.20</b> |             | <b>0.88</b>                                                                                                              | <b>0.12</b> |             |
|                                      |                    | Districts (D) = 0.06   Seasons (S) = 0.02<br>Practices (T) = 0.04   D×S = 0.05<br>D×T = 0.03   S×T = 0.02   D×S×T = 0.07 |             |             | Districts (D) = 0.03   Seasons (S) = 0.01<br>Practices (P) = 0.03   D×S = 0.06<br>D×P = 0.02   S×P = 0.01   D×S×P = 0.09 |             |             |

**Table 10.** Average cocoon yield (Kg)

| Year                                 | Seasons            | 2019                                                                                                                     |              |              | 2020                                                                                                                     |              |              |
|--------------------------------------|--------------------|--------------------------------------------------------------------------------------------------------------------------|--------------|--------------|--------------------------------------------------------------------------------------------------------------------------|--------------|--------------|
| Districts                            |                    | Practices                                                                                                                |              |              | Practices                                                                                                                |              |              |
|                                      |                    | P0                                                                                                                       | P1           | Sub-Means    | P0                                                                                                                       | P1           | Sub-Means    |
| <b>D1 Ramban</b>                     | <b>Spring (S1)</b> | 22.37                                                                                                                    | 48.50        | 35.44        | 21.90                                                                                                                    | 35.50        | 28.70        |
|                                      | <b>Autumn (S2)</b> | 10.40                                                                                                                    | 23.66        | 17.03        | 11.64                                                                                                                    | 9.55         | 10.59        |
|                                      | <b>Sub Means</b>   | <b>16.39</b>                                                                                                             | <b>36.08</b> | <b>26.23</b> | <b>16.77</b>                                                                                                             | <b>22.53</b> | <b>14.53</b> |
| <b>D2 Doda</b>                       | <b>Spring (S1)</b> | 25.88                                                                                                                    | 36.33        | 31.11        | 24.28                                                                                                                    | 31.75        | 28.15        |
|                                      | <b>Autumn (S2)</b> | 11.18                                                                                                                    | 22.50        | 16.84        | 12.14                                                                                                                    | 13.66        | 12.90        |
|                                      | <b>Sub Means</b>   | <b>18.53</b>                                                                                                             | <b>29.42</b> | <b>23.97</b> | <b>18.21</b>                                                                                                             | <b>22.71</b> | <b>20.46</b> |
| <b>D3 Kishtwar</b>                   | <b>Spring (S1)</b> | 22.74                                                                                                                    | 39.33        | 31.04        | 24.36                                                                                                                    | 36.33        | 30.35        |
|                                      | <b>Autumn (S2)</b> | 11.36                                                                                                                    | 24           | 17.68        | 10.84                                                                                                                    | 14.66        | 12.75        |
|                                      | <b>Sub Means</b>   | <b>17.05</b>                                                                                                             | <b>31.67</b> | <b>24.36</b> | <b>17.60</b>                                                                                                             | <b>25.50</b> | <b>21.55</b> |
| <b>Factor Means</b>                  | <b>Districts</b>   | <b>D1</b>                                                                                                                | <b>D2</b>    | <b>D3</b>    | <b>D1</b>                                                                                                                | <b>D2</b>    | <b>D3</b>    |
|                                      |                    | <b>26.23</b>                                                                                                             | <b>23.97</b> | <b>24.36</b> | <b>14.53</b>                                                                                                             | <b>20.46</b> | <b>21.55</b> |
|                                      | <b>Seasons</b>     | <b>S1</b>                                                                                                                | <b>S2</b>    |              | <b>S1</b>                                                                                                                | <b>S2</b>    |              |
|                                      |                    | <b>32.53</b>                                                                                                             | <b>17.18</b> |              | <b>25.73</b>                                                                                                             | <b>12.08</b> |              |
|                                      | <b>Practices</b>   | <b>P0</b>                                                                                                                | <b>P1</b>    |              | <b>P0</b>                                                                                                                | <b>P1</b>    |              |
| <b>CD (<math>p \leq 0.05</math>)</b> |                    | <b>17.32</b>                                                                                                             | <b>32.39</b> |              | <b>17.53</b>                                                                                                             | <b>23.58</b> |              |
|                                      |                    | Districts (D) = 0.05   Seasons (S) = 0.02<br>Practices (T) = 0.03   D×S = 0.08<br>D×T = 0.06   S×T = 0.07   D×S×T = 0.13 |              |              | Districts (D) = 0.01   Seasons (S) = 0.02<br>Practices (P) = 0.01   D×S = 0.05<br>D×P = 0.03   S×P = 0.05   D×S×P = 0.09 |              |              |

of seasons, practices, districts and their interactions.

### 3.10 Average cocoon yield (Kg/oz.)

During silkworm rearing season of 2019, overall maximum cocoon yield of 26.23 Kg/oz. per farmer was recorded in district Ramban followed by Kishtwar (24.36 Kg/oz.) and minimum in Doda (23.97 Kg/oz.) and during 2020 rearing season overall maximum cocoon yield

was recorded in district Kishtwar (21.55 Kg/oz.) followed by Doda (20.46 Kg/oz.) and least in Ramban (14.53 Kg/oz.). However, season wise cocoon yield was 17.18 Kg/oz and 12.08 Kg/oz. in case of autumn season while in spring the cocoon yield was 32.53 Kg/oz and 25.73 Kg/oz. during 2019 and 2020 rearing seasons, respectively. Practice wise those rearers who adopted recommended package of practice obtained an aver-

age cocoon yield of 32.39 kg/oz. and 23.58 kg/oz. while others who adopted local methods recorded on average of just 17.32 Kg/oz. and 17.53 kg/oz. during 2019 and 2020 rearing seasons. C.D at 5% depicted significant difference between the means of seasons, districts, practices and their interaction.

Silkworm rearing was conducted according to recommended package of practice along with potential and local silkworm rearers in each district and potential rearers recorded better results in all the rearing and reeling parameters undertaken for study. A wide gap in the cocoon yield was recorded for season and method of practice adopted. This gap may be due to various factors in the form of various biotic and abiotic factors that hindered the potential cocoon production. The gap in seasonal production of cocoon may be due to variations in various abiotic factors such as temperature and humidity, leaf availability, shortage of seed etc and biotic factors like prevalence of various pests and diseases. High temperature and humidity during autumn rearing in subtropical areas of district Doda and Ramban leads to higher incidence in diseases mainly grasserie and flacherie. Those rearers who adopted local methods of rearing recorded higher incidence of disease in autumn as well as spring. Occurrence of diseases especially in autumn has a direct relationship with various rearing conditions prevailing in rearer's dwelling type of rearing houses especially irregularities in maintenance of microclimatic conditions and hygiene which leads to outbreak of these diseases. In the present study, grasserie incidence was significantly high in district Doda particularly in autumn season (23.56%) followed by district Kishtwar (22.50%) and Ramban (21.69%). The results of present study confirmed the high prevalence of grasserie in Jammu region as reported by Singhal *et al.* (2003), Illahi and Nataraju (2007) and Balvenkatasubbaiah *et al.* (2014). The major factors responsible for multiplication of high incidence of grasserie disease were rearing of silkworms in dwelling houses where effective disinfection prior to rearing and proper maintenance of hygienic conditions during month long rearing is not practically possible. The observations are in accordance with statement of Rao *et al.* (1995). Fluctuations in temperature during rearing period disturb the physiological conditions of silkworms and make them prone to flacherie infection. In the present study, incidence of flacherie was uneven and it was recorded maximum in district Doda during autumn season. This was due to non-maintenance of optimum temperature in bed and overcrowding of larvae. These observations are in accordance with findings of Vijaykumari *et al.* (2001). Adoption of faulty methods of rearing mainly feeding

of unhealthy and insufficient mulberry leaf, improper disinfection of rearing house and rearing appliances, overcrowding of silkworms, improper bed disinfection during moulting period, improper cocoon harvesting, use of default mountages, improper cocoon drying, use of improper packing material, cocoon transportation during day hours and non-adoption of cocoon sorting.

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