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Adoption of various mulberry plantation and silkworm rearing technologies in Jammu region

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Abstract
The introduction of new sericulture technology initiated the transformation of sericulture industry there by creating a large potential for increasing sericulture production in India. The productivity of sericulture depends on the extent to which farmers adopt new sericulture innovations. Adoption of improved technologies plays a major role in improving the productivity of any agriculture activity. Hence, the present study was conducted to know the extent of adoption of new technologies by the sericulture farmers in Jammu region which revealed that all three districts under study were cent percent rainfed. Overall, around 71 percent of respondents adopted recommended mulberry varieties. Farm yard manure was used by 19.11 percent of respondents. About 32 percent of respondents adopted recommended two prunings of mulberry in year. Disease and pest management was adopted by only 11 and 6 percent of the total respondents respectively. All the respondents reared recommended silkworm hybrid in both spring and autumn season. Only around 12 percent of respondents reared chawki worms. About 68 percent adopted either local grass/weed or pine tree leaves for spinning.

Keywords: Chawki, cocoon, mounting, mulberry, silkworm

Introduction
Cocoon is an intermediate product for silk production and it has a direct bearing on the quantitative and qualitative variation in silk production. Varying soil 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 reduce 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) [7]. This not only results in reduced productivity but even 95 percent 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) [7].

It is surprising to note that on one hand there has been a big technological breakthrough in the Jammu division due to research contribution of Sericulture Development Department, Division Sericulture SKUAST-Jammu and Central Silk Board, Miran Sahib and yet on the other hand cocoon production shows decline along with the mulberry wealth which also indicates downward trend inspite of the fact that good number of plants are planted year after year yet it can't be ignored that majority of the farmers have lost interest with mulberry raising, their planting and the silkworm rearing thereof. It is also equally true that, much importance has not been given to dissemination of technologies to the rearers and they still continue to raise cocoons through traditional methods of raising and as such do not adopt any package of practices which eventuates in decreased cocoon production/productivity and finally less remuneration thereby loss of interest from the rearers.

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 upl-iftment of rural population both socially and economically (Sreenivasa and Hiriyanna, 2014) [14]. So, many sericulture technologies have been developed and their recommendations have been made to improve the productivity and quality of cocoon at farmer's level (Kushwaha, 2013) [6]. Inspite 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 sericulture 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) [2]. 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.

With this background, a study was conducted to find out whether the technologies generated by various research institutes including Division of Sericulture SKUAST-Jammu and Central Silk Board, Miran Sahib have reached to the rearers and whether they have adopted these technologies.

Materials and Methods

Survey was conducted at district Ramban, Doda and Kishtwar in Jammu region. An interview in the form of questionnaire was prepared for recording various mulberry plantation and silkworm rearing technologies in each district during the year 2019-20. The questionnaire and interview was carefully designed and utilized in the study area and respondents were personally interviewed and adoption index of 10 mulberry plantation and 17 silkworm rearing technologies of 225 silkworm rearers were calculated and recorded. The adoption index (%) of a recommended technology was calculated using formula given by Mahimasanthi *et al.* (2016) [15]

$$\text{Adoption index} = \frac{\text{Farmers/respondents score}}{\text{Maximum possible score}} \times 100$$

Results

Adoption of mulberry plantation technologies

Mulberry varieties

49 percent of respondents adopted recommended varieties while remaining adopted both local as well as recommended varieties of mulberry. In district Doda (58.67%) of the respondents partially adopted both local as well as recommended variety whereas 41.33 percent of respondents fully adopted recommended varieties. In district Kishtwar, the no. of full and partial adopters recorded were 33.33 and 66.67 percent respectively. The overall adoption index of mulberry varieties in three districts was recorded as 0.71.

Type and season of mulberry plantation

In district Ramban 49.33 percent of total respondents adopted tree type of mulberry plantation and winter season as planting period. The no. of the respondents who fully adopted the practice in district Doda & Kishtwar were 41.33 and 33.33 percent respectively. The overall adoption index of tree type plantation in three districts was 0.41. Similar results were recorded in case of recommended season of plantation.

Pruning of mulberry trees

The data on the pruning of mulberry trees depicted that 40 percent of respondents adopted recommended methods of pruning in district Ramban followed by Doda (28%) and least in Kishtwar district (27%). The overall adoption index of pruning in mulberry was recorded as 0.32.

Application of manures, fertilizers and irrigation practices

None of the respondent adopted chemical fertilizers application and irrigation however farm yard manure application was applied by 21.33 percent the respondents in district Ramban followed by Kishtwar (20%) and least in district Doda (16%) and overall, only 19.11 percent applied FYM in mulberry plantation.

Disease and pest management measures

None of farmer adopted recommended plant protection measures against disease and pest. However 25.33 and 13.33 percent of the respondents in district Ramban adopted local methods of disease and pest control respectively. In district Kishtwar, 17.33 and 6.67 percent adopted partial or local methods of disease & pest management. In district Doda 24.67 and 14.67 percent adopted the local methods of disease and pest management. The overall adoption index of disease & pest management recorded in the three districts was 0.11 and 0.60 respectively.

Weed management

None of the farmer adopted recommended weed control measures. Around 25 percent of the respondents in district Doda followed by Ramban (22.67%) and Kishtwar (20%) respectively adopted local methods of weed control. The overall adoption rate in all the three districts was 11.33 percent.

Table 1: Adoption index of various mulberry plantation methods in district Ramban

Mulberry plantation Technology	Full adopters	Partial adopters	Non adopters	Adoption score	Adoption index
Mulberry variety	37 (49.33)	38 (50.67)	0	112	0.75 (74.67)
Type of plantation	37 (49.33)	0	38 (50.67)	74	0.49 (49.33)
Planting season	37 (49.33)	0	38 (50.67)	74	0.49 (49.33)
Pruning	30 (40)	0	45 (60)	60	0.40 (40)
Irrigation	0	0	75 (100)	0	0 (0)
Fertilizer application	0	0	75 (100)	0	0 (0)
Use of FYM	16 (21.33)	0	59 (78.67)	32	0.21 (21.33)
Weed management	0	17 (22.67)	58 (77.33)	17	0.11 (11.33)
Disease management	0	19 (25.33)	56 (74.67)	19	0.13 (12.67)
Pest management	0	10 (13.33)	65 (86.67)	10	0.07 (6.67)

Values given in parenthesis are in percentages.

Table 2: Adoption index of various mulberry plantation methods in district Kishtwar

Mulberry plantation Technology	Full adopters	Partial adopters	Non adopters	Adoption score	Adoption index
Mulberry variety	25 (33.33)	50 (66.67)	0	100	0.67 (66.67)
Type of plantation	25 (33.33)	0	50 (66.67)	50	0.33 (33.33)
Planting season	25 (33.33)	0	50 (66.67)	50	0.33 (33.33)
Pruning	20 (26.67)	0	55 (73.33)	40	0.27 (26.67)
Irrigation	0	0	75 (100)	0	0 (0)
Fertilizer application	0	0	75 (100)	0	0 (0)
Use of FYM	15 (20)	0	60 (80)	30	0.20 (20)
Weed management	0	15 (20)	60 (80)	15	0.10 (10)
Disease management	0	13 (17.33)	62 (82.67)	13	0.09 (8.67)
Pest management	0	5 (6.67)	70 (93.33)	5	0.03 (3.33)

Values given in parenthesis are in percentages.

Table 3: Adoption index of various mulberry plantation methods in district Doda

Mulberry plantation Technology	Full adopters	Partial adopters	Non adopters	Adoption Score	Adoption index
Mulberry variety	31 (41.33)	44 (58.67)	0	106	0.71 (70.67)
Type of plantation	31 (41.33)	0	44 (58.67)	62	0.41 (41.33)
Planting season	31 (41.33)	0	44 (58.67)	62	0.41 (41.33)
Pruning	21 (28)	0	54 (72)	42	0.28 (28)
Irrigation	0	0	75 (100)	0	0 (0)
Fertilizer application	0	0	75 (100)	0	0 (0)
Use of FYM	12 (16)	0	63 (84)	24	0.16 (16)
Weed management	0	19 (25.33)	56 (74.67)	19	0.13 (12.67)
Disease management	0	18 (24)	57 (76)	18	0.12 (12)
Pest management	0	11 (14.67)	64 (85.33)	11	0.07 (7.33)

Values given in parenthesis are in percentages.

Table 4: Overall adoption index of various mulberry plantation methods

Mulberry plantation Technology	Adoption index in district Kishtwar	Adoption index in district Ramban	Adoption index in district Doda	Overall Adoption index
Mulberry variety	0.67 (66.67)	0.75 (74.67)	0.71 (70.67)	0.71 (70.67)
Type of plantation	0.33 (33.33)	0.49 (49.33)	0.41 (41.33)	0.41 (41.33)
Season of plantation	0.33 (33.33)	0.49 (49.33)	0.41 (41.33)	0.41 (41.33)
Pruning	0.27 (26.67)	0.40 (40)	0.28 (28)	0.32 (31.56)
Irrigation	0 (0)	0 (0)	0 (0)	0 (0)
Fertilizer application	0 (0)	0 (0)	0 (0)	0 (0)
Use of FYM	0.20 (20)	0.21 (21.33)	0.16 (16)	0.19 (19.11)
Weed management	0.10 (10)	0.11 (11.33)	0.13 (12.67)	0.11 (11.33)
Disease management	0.09 (8.67)	0.13 (12.67)	0.12 (12)	0.11 (11.11)
Pest management	0.03 (3.33)	0.07 (6.67)	0.07 (7.33)	0.06 (5.78)

Values given in parenthesis are in percentages

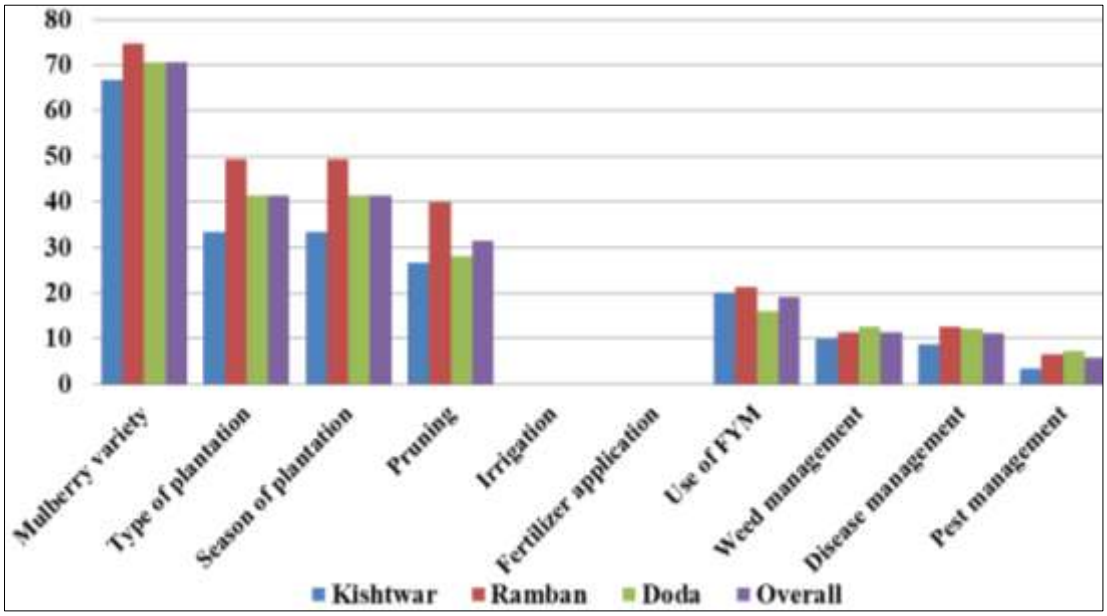

Fig 1: Overall adoption (%) of various mulberry plantation technologies

Adoption of silkworm rearing technologies

Adoption of silkworm hybrid

Cent percent respondents reared recommended double hybrid silkworm seed (FC1xFC2) procured either from CSB, Bangalore or SSPC, Vijaypura Karnataka and local silkworm seed production centres at Batote and Udhampur (Table no. 9,10,11 and 12).

Adoption of incubation black boxing and brushing

Only 16 percent of the respondents in district Ramban followed by Kishtwar (10.67%) and district Doda (8%) adopted incubation, black boxing and brushing practice of the silkworm eggs. The overall adoption index of the practice was 0.12.

Adoption of disinfection of rearing house &appliances

In district Ramban, 25.33 percent of the total respondents fully adopted followed by district Kishtwar (18.67%) and only 8 percent in district Doda. The overall adoption index of disinfection of rearing house and appliances by the respondents in three districts was 0.56.

Adoption of chawki worms

In district Ramban, 17.33 percent of the respondents reared chawki worms followed by Kishtwar (10.67%) and least in Doda (8%). Overall only 11.56 percent respondents in all the three districts adopted chawki worm rearing

Adoption of bed spacing

The recommended practice of bed spacing was adopted by 16 percent of the respondents in district Ramban followed by Doda (14.67%) and only 10.67 percent in the district Kishtwar. The overall adoption index of bed spacing was 0.57.

Adoption of leaf harvesting

Around 31 percent of respondents in district Ramban harvested leaf during recommended time followed by 20 percent in district Kishtwar and only 8 percent in Doda district. Overall, leaf harvesting during cooler hours was adopted by 60.67 percent of the farmers.

Adoption of leaf storage

District Ramban had the maximum respondents (34.67%) who followed the recommended method and stored their harvested leaf in wet gunny cloth bags whereas it was 13.33 percent in district Kishtwar and only 8 percent in Doda. The overall adoption index of leaf storage in all the three districts was 0.59.

Adoption of feeding frequency

Recommended number of feeds in chawki stage is 4 while frequency is 2 to 3 times in late age rearing. In district Ramban 20 percent of respondents adopted recommended method of three/four feeds per day followed by Doda (17.33%) and least in district Kishtwar (16%). The overall adoption index of feeding frequency in all the three districts was 0.59.

Adoption of bed disinfection

Use of lime or vijetha powder before and after moulting stage was recommended as bed disinfectant during rearing. In district Ramban, 22.67 percent of the total respondents adopted the recommended use of bed disinfection followed by 17.33 percent of the respondents in district Kishtwar and only 10.67 percent in district Doda. The overall adoption index of bed disinfection in all the three districts was recorded as 0.53.

Adoption of type of mountage

Recommended type of mountage includes any supporting material that is fully disinfected, uniform in shape, size and highly durable. In district Ramban, data pertaining to that 49.33 percent of the total respondents adopted plastic collapsible type of mountages followed by 40 and 33.33 percent in Doda and Kishtwar districts respectively. The overall adoption index for this parameter stood at 0.68.

Adoption of harvesting schedule

The recommended practice of harvesting cocoons is on 7^{th} or 8^{th} day after spinning. In district Doda, 25.33percent of respondents adopted the recommended practice of harvesting schedule, followed by 24 percent in district Ramban and least in district Kishtwar (14.67%). The overall adoption index of harvesting schedule of cocoons was 0.61.

Adoption of cocoon drying method
The recommended technique of drying the cocoons is use of cocoon drying machine or in the sun with black cloth covering. In district Doda, 8 percent of the respondents adopted recommended technique while others followed local practice both in district Ramban and Kishtwar. The overall adoption index stood at 0.51.

Adoption of cocoon sorting
Sorting of cocoon involves separation of defective cocoons from the healthy ones. The data highlighted that sorting of cocoon was adopted by 34.67 percent of the respondents in district Ramban followed by 21.33 percent in Kishtwar and 16 percent in Doda districts. The overall adoption index of the respondents adopting this practice was 0.24.

Adoption of deflossing of cocoons
The recommended way of deflossing cocoons is using the deflossing machine which was fully adopted only by 8 percent respondents in district Doda. None of the respondent followed recommended method in Ramban and Kishtwar districts. The overall adoption index of deflossing of cocoons was recorded 0.49.

Adoption of packing of cocoons
The recommended practice of packing cocoons is use of loose and well perforated cotton/gunny bag that provides proper space as well as aeration. 32 percent of the respondent in district Ramban followed by 21.33 percent in Kishtwar and only 16 percent in Doda districts adopted the recommended practice. The overall adoption index of technology was 0.62.

Adoption of transportation of cocoons
The recommended practice involves transporting the cocoons with proper spacing and preferably in cooler hours. In district Ramban, 46.67 percent of the respondents adopted the recommended time of transportation of cocoons followed by 26.67 percent in Kishtwar and 24 percent in Doda district. The overall adoption index of technology was recorded 0.66.

Table 5: Adoption index of various silkworm rearing technologies in district Kishtwar

Silkworm rearing Technology	Full adopters	Partial adopters	Non adopters	Adoption score	Adoption index
Silkworm hybrid	75 (100)	0	0	150	1 (100)
Incubation and Black boxing	8 (10.67)	0	67 (89.33)	24	0.11 (10.67)
Brushing	8 (10.67)	0	67 (89.33)	24	0.11 (10.67)
Disinfection of rearing house & appliances	14 (18.67)	61 (81.33)	0	89	0.59 (59.33)
Chawki rearing	8 (10.67)	0	67 (89.33)	16	0.11 (10.67)
Leaf harvesting	15 (20)	60 (80)	0	90	0.60 (60)
Leaf storage	10 (13.33)	65 (86.67)	0	85	0.57 (56.67)
Feeding frequency	12 (16)	63 (84)	0	87	0.58 (58)
Bed disinfection	13 (17.33)	62 (82.67)	0	88	0.59 (58.67)
Bed spacing	8 (10.67)	67 (89.33)	0	83	0.55 (55.33)
Use of mountages	25 (33.33)	50 (66.67)	0	100	0.67 (66.67)
Harvesting of cocoons	11 (14.67)	64 (85.33)	0	93	0.57 (57.33)
Cocoon sorting	16 (21.33)	0	59 (78.67)	32	0.21 (21.33)
Packing of cocoons	16 (21.33)	59 (78.67)	0	91	0.61 (60.67)
Deflossing	0	19 (25.33)	56 (74.67)	19	0.13 (12.67)
Cocoon drying	0	75 (100)	0	75	0.50 (50)
Cocoon transportation	20(26.67)	55 (73.33)	0	95	0.63 (63.33)

Values given in parenthesis are in percentages.

Table 6: Adoption index of various silkworm rearing technologies in district Ramban

Mulberry plantation Technology	Full adopters	Partial adopters	Non adopters	Adoption score	Adoption index
Mulberry variety	75 (100)	0	0	150	1 (100)
Type of plantation	12 (16)	0	63 (84)	24	0.16 (16)
Planting season	12 (16)	0	63 (84)	24	0.16 (16)
Pruning	19 (25.33)	56 (74.67)	0	94	0.63 (62.67)
Irrigation	13 (17.33)	0	62 (82.67)	26	0.17 (17.33)
Fertilizer application	23 (30.67)	52 (69.33)	0	98	0.65 (65.33)
Use of FYM	26 (34.67)	49 (65.33)	0	101	0.67 (67.33)
Weed management	15 (20)	60 (80)	0	90	0.60 (60)
Disease management	17 (22.67)	58 (77.33)	0	75	0.61 (61.33)
Pest management	12 (16)	63 (84)	0	87	0.58 (58)
Use of mountages	37 (49.33)	38 (50.67)	0	112	0.75 (74.67)
Harvesting of cocoons	18 (24)	57 (76)	0	93	0.62 (62)
Cocoon sorting	26 (34.67)	0	49 (65.33)	52	0.35 (34.67)
Packing of cocoons	24 (32)	51 (68)	0	99	0.66 (66)
Deflossing	0	30 (40)	45 (60)	30	0.20 (20)
Cocoon drying	0	75 (100)	0	75	0.50 (50)
Cocoon transportation	35 (46.67)	40 (53.33)	0	110	0.73 (73.33)

Values given in parenthesis are in percentages

Table 7: Adoption index of various silkworm rearing technologies in district Doda

Silkworm rearing technology	Full adopters	Partial adopters	Non adopters	Adoption Score	Adoption index (%)
Silkworm hybrid	75 (100)	0	0	150	1 (100)
Incubation and Black boxing	6 (8)	0	69 (92)	12	0.08 (8)
Brushing	6 (8)	0	69 (92)	12	0.08 (8)
Disinfection of rearing house& appliances	6 (8)	57 (76)	12 (16)	69	0.46 (46)
Chawki rearing	6 (8)	0	69 (92)	12	0.08 (8)
Leaf harvesting	6 (8)	69 (92)	0	85	0.57 (56.67)
Leaf storage	6 (8)	69 (92)	0	81	0.54 (54)
Feeding frequency	13 (17.33)	62 (82.67)	0	88	0.59 (58.67)
Bed disinfection	8 (10.67)	41 (54.67)	26 (34.67)	57	0.38 (38)
Bed spacing	11 (14.67)	64 (85.33)	0	86	0.57 (57.33)
Use of mountages	30 (40)	45 (60)	0	94	0.63 (62.67)
Harvesting of cocoons	19 (25.33)	56 (74.67)	0	94	0.63 (62.67)
Cocoon sorting	12 (16)	0	63 (84)	24	0.16 (16)
Packing of cocoons	12 (16)	63 (84)	0	87	0.58 (58)
Deflossing	6 (8)	12 (16)	57 (76)	24	0.16 (16)
Cocoon drying	6 (8)	69 (92)	0	81	0.54 (54)
Cocoon transportation	18 (24)	57 (76)	0	93	0.62 (62)

Values given in parenthesis are in percentages

Table 8: Overall Adoption index of various silkworm rearing technologies

Silkworm rearing Technology	Adoption index (%) of district Kishtwar	Adoption index (%) in district Ramban	Adoption index (%) in district Doda	Overall Adoption index (%)
Silkworm hybrid	1 (100)	1 (100)	1 (100)	1 (100)
Incubation and Black boxing	0.11 (10.67)	0.16 (16)	0.08 (8)	0.12 (11.56)
Brushing	0.11 (10.67)	0.16 (16)	0.08 (8)	0.12 (11.56)
Disinfection of rearing house & appliances	0.59 (59.33)	0.63 (62.67)	0.46 (46)	0.56 (56)
Chawki rearing	0.11 (10.67)	0.17 (17.33)	0.08 (8)	0.12 (11.56)
Leaf harvesting	0.60 (60)	0.65 (65.33)	0.57 (56.67)	0.61 (60.67)
Leaf storage	0.57 (56.67)	0.67 (67.33)	0.54 (54)	0.59 (59.33)
Feeding frequency	0.58 (58)	0.60 (60)	0.59 (58.67)	0.59 (58.89)
Bed disinfection	0.59 (58.67)	0.61 (61.33)	0.38 (38)	0.53 (52.67)
Bed spacing	0.55 (55.33)	0.58 (58)	0.57 (57.33)	0.57 (56.88)
Use of mountages	0.67 (66.67)	0.75 (74.67)	0.63 (62.67)	0.68 (68.03)
Harvesting of cocoons	0.57 (57.33)	0.62 (62)	0.63 (62.67)	0.61 (60.67)
Cocoon sorting	0.21 (21.33)	0.35 (34.67)	0.16 (16)	0.24 (24)
Packing of cocoons	0.61 (60.67)	0.66 (66)	0.58 (58)	0.62 (61.56)
Deflossing	0.13 (12.67)	0.20 (20)	0.16 (16)	0.49 (48.67)
Cocoon drying	0.50 (50)	0.50 (50)	0.54 (54)	0.51 (51.33)
Cocoon transportation	0.63 (63.33)	0.73 (73.33)	0.62 (62)	0.66 (66.22)

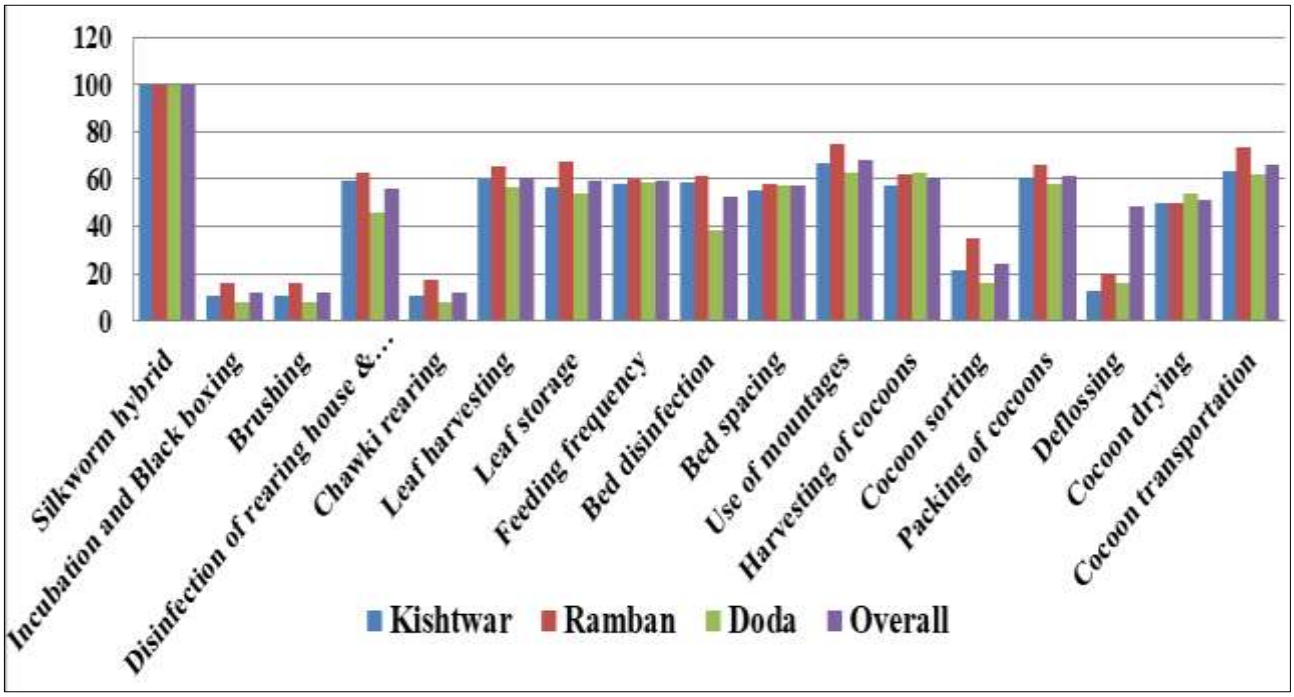

Fig 2: Overall adoption (%) of various silkworm rearing technologies

Discussion and Conclusion

The success of bivoltine silkworm rearing mainly depends on the quality of mulberry leaf. In present study 30.67 percent of the respondents in three district Ramban followed by Kishtwar (20%) and only 8 percent were adopting the recommended package of plucking leaves in cooler hours. The data on feeding frequency during non chawki indicated that 20 percent of respondents in district Ramban followed by Doda (17.33%) and district Kishtwar (16%) were feeding silkworms three to four times per day. The adoption of lesser number of feedings per day resulted into susceptibility of worms to disease due to weakness and low cocoon yield. All the respondents followed feeding of chopped leaves during chawki stages and entire leaf/shoot in late age. In present investigation, 66.67 percent of respondents in district Kishtwar followed by Doda (60%) and Ramban (50.67%) adopted either local grass/weed or pine tree leaves for spinning of cocoons while as others reared the silkworms in plastic collapsible mountages. Mounting material has a direct impact on the quality of cocoons and it influences the size, shape, grade of cocoons and price in cocoon market. Only 8 percent of respondents in district Doda were following the recommended package of stifling of cocoons in cocoon drying machine while rest of the respondents used either black cloth covering or direct drying of cocoons in the sun. This variable also has a direct effect on price during auctioning of cocoons. The results of present study are in consonance with the findings of Singh and Himantharaj (2008) [13], Krishnamoorthy and Radhakrishnan (2012) [5] and Lyaqet (2015) [10].

Disinfection of rearing house and appliances is the pre-requisite for success of silkworm rearing. In present study, 56 percent of respondents in all the three districts adopted disinfection of rearing house while in district Ramban (25.33%) followed by Kishtwar (18.67%) and only 8 percent of total respondents in district Doda followed recommended method of disinfection of rearing house and appliances while rest of the respondents of three districts either partially disinfected the rearing house or simply kept their rearing trays in sun without spraying any disinfectant. All of the respondents reared recommended hybrid in both spring and autumn season. Only 11.56 percent of respondents reared chawki worms while as remaining percentage of respondents reared non-chawki worms. The disease incidence observed was more in rearing of respondents having non-chawki worms and was maximum in district Doda. Though the respondents were possessing knowledge of bed cleaning and bed spacing but practically only 22.67 percent in district Ramban followed by Kishtwar (17.33%) and only 10.67 percent were adopting recommended schedule of bed disinfection which directly influenced the disease incidence and low crop production. The observations are closely in consonance with the findings of Krishnamoorthy and Radhakrishnan (2012) [5] and Lyaqet *et al.* (2016) [9]. The reasons for partial/non-adoption of recommended technologies could be lack of knowledge, high labour requirement, continuing on traditional practice and beliefs and financial constraints as majority of respondents were marginal rearers. The solutions for those problems are to be provided to these farmer groups through practical training, motivation towards acceptance of new ideas/technologies and participated in various extension activities conducted by research personnel and extension agents. Most of the respondents adopted improper or partial disinfection of rearing room and appliances although cent percent were provided with chemical disinfectant. This could be due to low level of knowledge or lack of training attained by the respondents as only 36 percent were reported to be trained and financial constraints faced by the farmers to construct a separate rearing house were found to be a major constraint. This is in line with the results of Hiriyanna *et al*. (2002) [3]. As a result they rear their silkworms in dwelling houses which essentially is a rearing cum dwelling house. Presence of heavy inoculums load and hesitation of some rearers for conducting pre and post disinfection might have also resulted in mortality of worm and thus reduced productivity. Majority of the respondents were unaware of the use of basic inputs in silkworm rearing and allied operations. Only around 24 percent of the total respondents (Table 4) had a well maintained and recommended separate rearing house, just 11.56 percent maintained optimum temperature & humidity in rearing room, bed disinfection was adopted by 52.67 percent respondents, cocoon sorting was very poorly adopted and recommended adoption rate was 24 percent and only about 16.22 percent of the respondent adopted deflossing of cocoons.

The reasons for low production might be the lack of separate rearing houses coupled with leaf shortage. Non/partial availability of basic infrastructure like cocoon storage seems to be the major reason responsible for low productivity as around percent respondents produced below 56 kg of cocoons per ounce of silkworm seed which is the national average (Baqual *et al*. 2015) [1]. The low level of technology adoption during rearing period results in great loss of final produce due to mortality of larvae and formation of flimsy and deformed cocoons. Low level of mass media exposure, extension contact and change proneness are also equally responsible for both low production and productivity of cocoons. Oveall only about 12% of rearers had adopted incubation, black- boxing and brushing and were highly trained. They were provided separate rearing house and were residing in close vicinity of the department while as about 88 percent of the respondents (Table 4) were non-chawki rearers. Chawki rearing was adopted by only 12 percent of the respondents as one of the improved rearing technology. Overall recommended method of bed disinfection using lime & vijetha was found low among the respondents (52.67%).Overall cent percent respondents had adopted bivoltine double hybrid FC1×FC2 procured from CSRTI-Mysore. About 60.67 percent of the rearers had adopted mounting which included either plastic collapsible mountages or locally available pine leaves or weed grass or combination of either. Only 8 percent of the respondent used recommended way of stifling the cocoon using cocoon dryer while others opted partial or local methods of direct sun drying or with black cloth covering. A very low no. of respondents in district Doda (8%) deflossed cocoons using recommended method because of high labour and time consumption involved. The farmers were aware that the cocoon price depends on its quality which in turn depends on the effective utilization of mounting method. Meenal & Rajan (2007) [11] had also reported high adoption of mounting method by farmers of Tamil Nadu and Andhra Pradesh respectively. The studies of Lakshmanan *et al.* (1998) [7], Saratchandra (2000) [12] and Kanimozhi (2001) [4] also found that lack of awareness to a certain technology results in non-adoption of the technology.

Around 41.33 percent of respondents planted the tree type mulberry and plantation was done in winter season and the remaining percent of the respondent were dependent either on

department or the fellow farmers or some of them even had to purchase. The respondents who planted mulberry, about 73 percent of those adopted the recommended variety of mulberry while the remaining planted local varieties. None of the respondent adopted fertilizer application but farm yard manure was used by 19.11 percent of total respondents. All the districts under study were cent percent rainfed. Since the areas under study were hilly areas, so tree type of mulberry plantation in scattered fashion was observed. About 21 percent of respondents adopted recommended way of two prunings of mulberry in year, once in march–april before spring rearing and the other in July-August after spring harvest. Weed management was adopted partially or locally (21.34%) which included physical methods of hoeing with sickle.

Mulberry cultivation technology mainly involves adoption of various recommended practices involved in mulberry plantation and farm management such as mulberry variety, type of plantation, season of plantation, pruning, application of fertilisers, use of farm yield manure, irrigation, weed management, disease & pest management etc. The recommended varieties for the area under study were Goshoerami, Ichinose, Tr-10, China white, Sujanpur etc. Overall adoption index of the recommended variety was 72.67 percent while the remaining percent of respondents adopted local variety which may have increased the leaf requirement per ounce of the silkworm and decreased the quality of leaf. Tree type of plantation and winter season was adopted by cent percent of the respondents. Pruning involves trimming of excess lateral branches in order to give the plant desired shape and structure for healthy growth of leaves. In temperate and subtropical areas top pruning once after spring harvest is recommended. The overall adoption index of recommended method of pruning in the study area was only 20.67 percent (Table 5, 6 & 7). None of the respondent adopted fertiliser application whereas farm yard manure was adopted by only 19.11 percent of the total respondents. This may be due to high cost. Weed management involved partial adoption practices mainly physical methods of cutting the weed. This may be due to high cost of weedicides and lack of knowledge of its application.

Silkworm rearing involves adoption of various recommended package of practice in order to get better cocoon yield. Technologies such as adoption of recommended silkworm seed, disinfection of rearing house and appliances with recommended quality & quantity of disinfectant, incubation, black boxing, brushing, proper bed spacing, bed disinfection, proper feeding, care during moult, maintenance of temperature & humidity, proper ventilation and disposal of diseased larvae, instar wise leaf selection, use of wet gunny cloth for storing leaf, use of rearing kit, leaf harvest during cooler hours, maintenance of leaf requirement per ounce, timely harvest of cocoons, cocoon sorting, proper packing of cocoons in gunny bags, use of plastic collapsible mountages, proper deflossing and drying of cocoons in cocoon drying machine. Among the various technologies related to silkworm rearing methods adoption of bivoltine double hybrid silkworm FC1× FC2 was cent percent adopted in all the three districts. This may be due the fact that areas under study fall in bivoltine areas or temperate/subtropical type of climate which is favourable for rearing of the double hybrid. Only around 12 percent of total respondents reared chawki worms. This may be due the fact that these rearers were in close vicinity of the department offices and were highly trained and potential producers while the other rearers were from far flung areas. Recommended/full adoption was recorded highest in use of mountages (40.89%) followed by cocoon sorting (24%), packing of cocoons (23.11%), harvesting of cocoons (21.33), leaf harvesting (19.56%), leaf storage (18.67%), feeding frequency (17.78%), disinfection of rearing house and rearing appliances (17.33%), bed disinfection (16.89%), bed spacing (13.56%), cocoon drying (2.67%) and 2.67 percent in deflossing (Table 5, 6, 7 & 8).

Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

1. Baqual MF, Kamili AS, Mir MA, Mir SA, Saleem S, Verma GR. Impact of mass media exposure and innovation proneness on cocoon production. Journal of Experimental Biology and Agricultural Sciences. 2015;3(5):454-457.
2. Gowda SLR, Naika KV, Jayaramaiah KM. Equipping sericulture farmers for rural developinent. Journal of Rural Reconstruction. 1992;25(2):53-62.
3. Hiriyanna Swamy TP, Kumaresan P, Vijaya Prakash NV. Comparative economics of bivoltine hybrids with multi× bivoltine hybrid cocoon production. Indian Journal of Sericologia. 2002;41(1):38-40.
4. Kanimozhi VC. Awareness, Knowledge and adoption behaviour of IVLP farmers: An ex-post facto analysis, M.Sc, Thesis, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu; c2001.
5. Krishnaswamy TS, Radhakrishnan S. Study on Knowledge and adoption of new sericulture technologies among small mulberry farm size holders of Udumalpet and Krishnagiri areas in Tamil Nadu. Indian Journal of Sericulture. 2012;51(1):50-58.
6. Kushwaha RV, Singhvi NR. Extent of adoption of improved sericulture practices by the sericulturists of Budhana district of Maharashtra. Agriculture Update. 2013;8(3):469-471.
7. Lakshmanan S. Adoption of technological innovations and productivity behavior of sericulture in Tamil Nadu. An econometric analysis. Ph.D. thesis. University of Mysore, Mysore, India; c1998.
8. Lakshmanan S, Mallikarjuna B, Raj RJ, Jayaram H, Devi RGG. Studies on adoption of sericulural innovationa at farmers' level in Tamil Nadu: An Empirical Analysis. Indian Journal of Sericulture. 1998;37:1, 44-47.
9. Lyaqet A, Kher SK, Slathia PS, Bali RK, Kumar M, Bakshi P. Knowledge level of silkworm rearers of Jammu division of Jammu and Kashmir State. Indian Journal of Extension Education. 2016;52(1&2):65-68.
10. Lyaqet A. Status and prospects of sericulture in Jammu division of Jammu and Kashmir state, Ph.D. thesis, Sher-e-Kashmir University of Agricultural Sciences & Technology of Jammu, J&K, India; c2015.
11. Meenal R, Rajan RK. Impact of socio-economic characters of sericulturists on knowledge adoption and cocoon production in Tamil Nadu. Indian Journal of Sericulture. 2007;46(1):49-51.
12. Saratchandra B. Role of extension in popularizing improved sericulture technologies in different regions of India. Sourvenir, National Conference on Strategies for

Sericulture Research And Development, November 16-18, Central Sericulture Research and Training Institute, Mysore, India; c2000. p. 53-54.
13. Singh A, Himantharaj MT. A study on constraints faced in mounting practices and factors influencing the cocoon quality among farmers in three southern states. Journal of Experimental Zoology. 2008;11(2):267-271.
14. Sreenivasa T, Hiriyanna. A study on the factors influencing adoption of new technologies in non-traditional sericulture area of Chitradurga district, Karnataka. Global Journal of Biology, Agriculture and Health Sciences. 2014;3(1):239-243.
15. Mahimasanthi A, Daniel A, Sivaprasad V. Extent of adoption of drought management technologies in mulberry sericulture in southern dry zone of Tamil Nadu. International Journal of Tropical Agriculture. 2016;34(1):95-102.