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Impact of Adoption of Improved Tasar Silkworm Rearing Technologies on Cocoons Production of Tasar Silkworm *Anthereae mylitta* D in Maharashtra

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Tasar culture is being practiced in Maharashtra since last 200 years by the tribal folks of four eastern districts of the state. However, the productivity of tasar cocoons in the state is hovering around average of 2000-4000 cocoons/100 Dfls (Disease Free layings) throughout the year against

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the norm of 6000 cocoons which might be due to the non-adoption or low adoption of improved tasar rearing technologies by the tasar silkworm rearers. Thus, present study was conducted to investigate the impact of adoption of improved tasar silkworm rearing technologies as a strategy for improving tasar cocoon production in the state. For the study, an "Ex Post Facto" research designed was used and 50 adopted seed cocoon rearers and 50 non-adopted seed cocoon rearers were selected through random sampling method. The results of the study showed that, during the Ist Crop of Daba TV rearing, the average cocoon yield of the farmers who have adopted the tasar silkworm rearing technologies ranged from 2907 to 3612 cocoons per 100 dfls while in case of non-adopter it ranged from 2316 to 2616 cocoons per 100 dfls. The overall improvement in cocoon yield in the technology adopted lots over that of control lot was ranged from 26.58 to 32.08 per cent. Similarly, during IInd crop rearing of Daba TV, the cocoon yield of the farmers who adopted the technology ranged from 3126 to 4123 cocoons per 100 dfls while in the control, it ranged from 2639 to 3493 cocoons per 100 dfls with the overall improvement ranged from 11.80 to 20.29 per cent. Moreover, during IIIrd crop rearing of Daba TV, the cocoon yield of the farmers who adopted the technology ranged from 5322 to 6487 cocoons per 100 dfls compared to non- adopted of technologies which ranged from 4006 to 5213 per 100 dfls. The paired t test showed that there was a significant improvement in cocoon yield due to the adoption of the improved tasar silkworm rearing technology by the adopted seed cocoon rearers in all three crops of Daba TV eco-race. Also, a significant improvement was noticed in the cocoon and shell weight in all the three crops of Daba TV. The study suggests that the effective technology transfer strategies should be developed and implemented in the state coupled with the suitable training programs so as to convince farmers about the benefits of adoption improved tasar silkworm rearing technologies.

Keywords: Impact; adoption; tasar silkworm; silk; seed cocoons; Maharashtra.

1. INTRODUCTION

The world-famous Indian Tasar silkworms, *Antheraea mylitta (Drury)*, have been reared by the aboriginal forest population for centuries in India. The word tasar has been derived from the Sanskrit word 'trasara' meaning, shuttle [1]. This wild silk-producing insect has high commercial value and is an important economic source for the indigenous tribe residents in the forest. The tasar silkworm-based sericulture is a forest-based industry run by the tribal communities as a key cash crop in the central and southern plateau of India [2]. This insect-based silk industry has gained importance because it provides an opportunity to utilize the vast natural resources with minimum investment and huge employment generation for the rural community and checks deforestation. It is vital for growing part of tribal culture and a means for revolutionizing the economic development of rural areas and the nation as a whole [3]. The tropical tasar culture is traditionally a agro-forestry practice to produce unique tasar silk by rearing a wild silk insect, *A. mylitta* Drury (Lepidoptera : Saturniidae), which provides livelihood, employment and economic support to several aboriginal families of Andhra Pradesh, Bihar, Chhattisgarh, Jharkhand, Orissa, Maharashtra, Madhya Pradesh, Uttar Pradesh, West Bengal state of the country [4,5].

Maharashtra is a non-traditional sericulture state for producing Mulberry silk however; tasar silk production is being practiced by the tribal folk since the time immortal in the eastern Vidarbha region of Maharashtra. In Maharashtra, tasar sericulture activities are mainly confined to the four districts of eastern Vidarbha; Gadchiroli, Chandrapur, Bhandara and Gondia [6,7]. Tasar culture can offer supplementary gainful employment for tribal compare to other sericulture activities. Continuous efforts of tribal people in rearing and supply of *A. mylitta* cocoons have provided momentum to the silk industries and thereby the production of raw silk has increased by 5.2 per cent during 2019-20 [8]. However, the insect pests, diseases and insectivores' birds appeared as major constraints in the production of healthy tasar cocoons under forest conditions [9]. The trend of tasar silk production in Maharashtra from last twenty years (Fig. 1) shows that the total tasar raw silk production of Maharashtra has shown a linear trend with the r^2 = 0.731with linear fitted curve and trend declined during 2019-20 to 19.1 MT. Similarly exponential fitter curve also shows the increasing trend with r^2 = 0.756. It also shows a dwindling trend in the raw silk production in the state. Also, as far as the average yield of cocoon production is concerned, it is hovering around 2500-3000 cocoons per 100 disease free laying

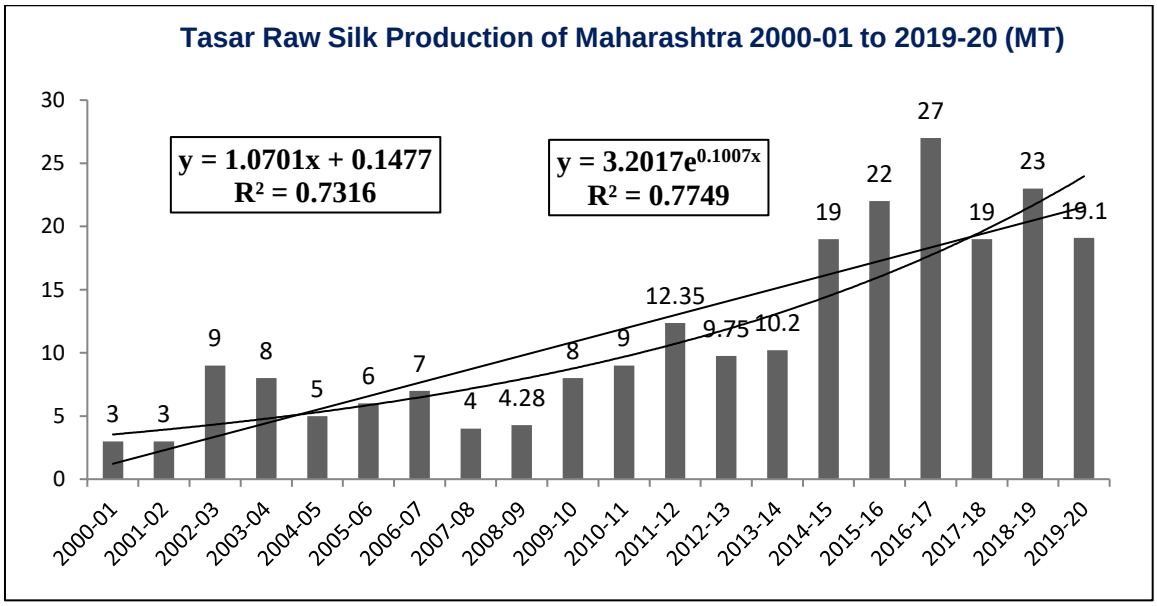

Fig. 1. Trends in tasar raw silk production of Maharashtra

Source: Author's calculation; annual reports of central silk board from 2000-01 to 2019-20

(dfl) which might be due to the fact that farmers adopted age old traditional technologies of host plant management and rearing technologies [10]. A number of farmer's friendly tasar silkworm rearing new technologies have been innovated and developed by the scientists of Central Tasar Research and Training Institute, Ranchi, Jharkhand (India) which is boon for the development of Tasar silk industry in the state. However, without adoption of those technologies by the tasar silkworm rearers will not make the state prosper. Gedam et al [11] in their study of adoption gaps of improved tasar silkworm rearing technology in Maharashtra have reported that the major gaps in adoption were seen the practices such as Integrated Pest Management for the control of gall disease (91.67%), application of Farm Yard Manure (FYM) or vermi-compost @4 kg/plant or 2kg/plans twice in a year (87.50%) and foliar spraying of 1.5% urea twice @ 15 days' interval before 30 days of rearing (78.33%) and these were ranked 1st, 2nd and 3rd, respectively and the average gaps in adoption were to the tune of 52.71 per cent. More than 50 per cent gaps in adoption of the recommended technologies could be a major cause for the declining of the tasar silk production in the state. Hugar et al [12] in their study noticed that most of the tasar rearers take up rearing without technical packages and earn income in the range of Rs. 3,000 to Rs. 4,000/-, against income potential of over Rs. 10,000/-. The cause of adoption gaps might be due to the lack of knowledge and information about the improved tasar silkworm sericulture practices. Also, farmers might not be able to see the impact of adoption of the improved tasar silkworm technologies on the production of the cocoons. The famers adopt the technologies when they themselves see the results. On this back drop the study was planned to conduct to assess the impact of technology adoption on the production tasar silkworm cocoons and impact of adoption on the cocoon weight and shell of the tasar silkworm.

2. MATERIALS AND METHODS

For assessing the impact of adoption of improved tasar silk production technologies, the present investigation was carried out in Gadchiroli and Bhandara districts of Maharashtra. Three villages from Gadchiroli district and two villages from Bhandara districts were purposively selected for the study.

From each village 10 adopted seed cocoon rearers (ASR) and 10 non-adopted seed cocoon rearers (NASCR) were selected randomly totaling to 50 Adopted Seed Cocoon Rearers (ASCR) and 50 Non-Adopted Seed Cocoons Rearers or private rearers (NASR) with a total sample size of 100. Each Adopted Seed Cocoon Rearer was supplied 300 Disease Free Laying (Dfls) of Tasar silkworm of Dabha TV (Tri-Voltine) race for all the three crops from BSMTC,

Fig. 2. Map of Vidarbha Region of Maharashtra

Bhandara and rearings were conducted in outdoor condition on the foliages of *Terminalia tomentosa* and *Terminalia arjuna.* The non-adopted seed cocoon rearers were supplied 300 Dfls produced at BSM&TC, Bhandara through the District Sericulture Departments of respective districts. The Non-Adopted Seed Cocoon Rearers conducted rearing without adopting any rearing technology (control) while Adopted Seed Cocoon Rearers adopted the improved tasar silkworm rearing technologies (treatment) as detailed below:

1. Timely pruning and pollarding of the host plants as per recommendation
2. Spraying of Rogars@15 days interval for control of gall before 30 days of rearing
3. Disinfection of rearing field before and after rearing
4. Use of nylon nets or Chawki rearing
5. Application of vermi-compost @ 2kg/plant or 4 Kg of FYM /plant twice in a year
6. Foliar spray of 1.5% urea twice @15 days interval before 30 days of rearing
7. Spraying of Sodium Hypochlorite solution @0.01% as per recommendation
8. Spraying of Jeevan Sudha as per recommendation
9. Use of Liquid surface microbe (LSM) solution
10. Use of SM-5 as a micronutrients
11. Dusting of Lime and Bleaching powder mixture for maintaining the hygiene
12. Incubation of Eggs/DFLs in earthen pot

Also, the cocoon characteristics of all the three crops were assessed by taking the average of 10 cocoons weights from each group i.e. 50 tasar silkworm rearing technology adopters and 50 non-adopters tasar rearing farmers. The paired‘t’ test was administered to find out the relative impact of technology adoption.

3. RESULTS AND DISCUSSION

3.1 Impact of Adoption of Improved Tasar Silkworm Rearing Technologies on Cocoons Production During The First, Second and Third Crops

From the perusal of the Table 1 it can be seen that during the first crop rearing of Daba TV, the

cocoon yield of the farmers who have adopted the tasar silkworm rearing technologies ranged from 2907 to 3612 cocoons per 100 dfls while in case of non-adopter it ranged from 2316 to 2616 cocoons per 100 dfls. Similarly, the average cocoon production per 100 dfls was ranged from 3255.4 to 3421.8 for the rearers who have adopted the tasar silkworm rearing technologies whereas for non-adopter the cocoon production was ranged from 2497.4 to 2698.2. Moreover, the overall increase in cocoon yield in the technology adopted lots over that of control lot was ranged from 26.58 to 32.08 per cent. The paired't' test shows that there is significant improvement in the cocoon yield due to the adoption of improved tasar silkworm rearing technologies ($p<0.01$). The results of the study are in line with study conducted by Priyadarshini and Kumari [13] and Goswami et al [14].

As far as the II crop rearing of Daba TV is concerned, the perusal of the Table2 shows that the cocoon yield of the farmers who had adopted the technology was ranged from 3126 to 4123 cocoons per 100 dfls while in case not adopter, it was ranged from 2639 to 3493 cocoons per 100 dfls. As far as the, average cocoon production was concerned, the yield of cocoon production was ranged from 3413.6 to 3653.4 cocoons per 100 dfls for the adopters of the recommended technologies while for the non-adopter it was ranging from 2951.4 to 3263.2. The overall improvement in cocoon yield was ranging from 11.80 to 20.29 per cent. The result of paired 't' test showed that there was significant improvement in the cocoon yield due to the adoption of improved tasar silkworm rearing technologies ($p<0.01$). The results of the study are in consonance with the result reported Priyadarshini and Kumari [13] and Goswami et al [14].

It can be seen from the Table 3. that, during III crop rearing of Daba TV, the cocoon yield of the farmers who adopted the technologies was ranged from 4613 to 6487 cocoons per 100 dfls while in the control lot, it was ranged from 4006 to 5213 cocoons per 100 dfls. As far as the overall production of cocoons is concerned, in case of adopter of the technology it was ranged from 5490.8 cocoons to 5923.8 cocoons per 100 dfls for the non-adopted of the technology. The overall improvement in the production was noticed to be in tune of 18.02 to 23.42 per cent. The result of the paired 't' test showed that there was significant improvement in the cocoon yield due to the adoption of improved tasar silkworm rearing technologies ($p<0.01$). The results of the study are in tune with results reported Priyadarshini and Kumari [13] and Goswami et al [14].

The increase in cocoon yield was noticed during all three crops of the Daba TV race. This might be due to the timely pruning and pollarding of the tasar silkworm host plants which is necessary to get the fresh and healthy leaves and to avoid the infestation of leaves with the gall disease. Similarly, spraying of Roger on the newly sprouted leaves of tasar host plants helps in management of gall disease of host plants. The severe infestation of gall disease makes the leaves unsuitable for feeding for the larvae thereby causing the low production of cocoons. Development of gall has a bearing on the photosynthetic activity of the plant. Net photosynthesis rate in healthy Arjun leaves was found to be significantly more than that of gall infected leaves [15]. Therefore, timely pruning and pollarding as well as adoption of Roger spray are must for the production of healthy leaves/foliage. Disinfection and maintenance of hygienic condition during rearing are essential factors for preventing occurrence of diseases. Sodium hypochlorite acts as a leave surface disinfectant [16]. It is effective against bacteria, viruses and fungi and its mode of action is similar to chlorine disinfectants. The efficacy of Sodium hypochlorite in controlling mortality due to bacterial and viral diseases has been reported in tasar and muga silkworms by Sahay et al [17]. and Singh et al [10]. Nylon net is an effective technology against the predatory insects and birds. Chandrashekharia et al [18] in their study reported that the average cocoon yield was substantially more when the early instar (1^{st} and 2^{nd}) silkworms were protected mechanically using nylon net under field conditions ($P<0.01$). The silkworms and its food plants are closely associated with each other for the production of silk. Many scientists have observed that the growth and development of silkworm are greatly influenced by the nutritional content of the leaf. The production of good cocoon is totally dependent on the quality of foliage used for the rearing. The spraying of 1.5% urea on the foliage of the host plants has led to increase in the production of quality leaves. Das et al [19] in their study reported that the foliar spray of nitrogen on *T. arjuna* plants not only improves the protein content of leaf but also increases the haemolymph protein of the larvae reared on treated plants thereby increased the quality of foliage.

Table 1. Impact of adoption of technologies on cocoon production during 1st crop of Dabha TV per 100 Dfls

Village	Adopter / Non-adopter	Nos. of Tasar cocoons produced by the Tasar Silkworm Rearers										't' value
		1	2	3	4	5	6	7	8	9	10	
Deloda	Adopter	3250	3481	3506	3389	3487	3289	3185	3094	3373	3267	20.332**
	Non-adopter	2390	2809	2646	2545	2707	2542	2693	2395	2703	2584	
	% Improvement	35.98	23.92	32.50	33.16	28.81	29.39	18.27	29.19	24.79	26.43	
Bodhada	Adopter	3426	3356	3389	3083	3249	3441	3343	3489	3319	3596	17.502**
	Non-adopter	2669	2554	2558	2319	2765	2691	2557	2515	2521	2573	
	% Improvement	28.36	31.40	32.49	32.95	17.50	27.87	30.74	38.73	31.65	39.76	
Devulgaon	Adopter	3412	3456	3357	3219	3396	3018	3416	3479	3455	3416	26.219**
	Non-adopter	2614	2695	2612	2451	2605	2271	2804	2716	2610	2426	
	% Improvement	23.39	22.02	22.19	23.86	23.29	24.75	17.92	21.93	24.46	28.98	
Nishti	Adopter	3452	3363	3612	3274	3215	3218	3246	3019	2907	3067	13.581**
	Non-adopter	2761	2622	2584	2316	2413	2416	2419	2381	2482	2465	
	% Improvement	20.02	22.03	28.46	29.26	24.95	24.92	25.48	21.13	14.62	19.63	
Sonka	Adopter	3569	3421	3284	3312	3456	3497	3461	3517	3326	3374	16.710**
	Non-adopter	2916	2811	2840	2706	2709	2680	2606	2633	2621	2611	
	% Improvement	22.39	21.70	15.63	22.39	27.57	30.49	32.81	33.57	26.90	29.22	
Overall	Adopter	3421.8	3415.4	3429.6	3255.4	3360.6	3292.6	3330.2	3319.6	3276.0	3344.0	59.518**
	Non-adopter	2670.0	2698.2	2648.0	2497.4	2639.8	2520.0	2615.8	2528.0	2587.4	2531.8	
	% Improvement	28.16	26.58	29.52	30.35	27.31	30.66	27.31	31.31	26.61	32.08	

*Table value of "t" at 5% = 1.83, and at 1% = 2.82, * 5% level of significance ** 1% level of significance*

Table 2. Impact of adoption technologies on cocoon production during 2nd crop of Dabha TV per 100 dfls

Village	Adopter / Non-adopter	Nos. of cocoons produced by the tasar silkworm rearers										"t" value
		1	2	3	4	5	6	7	8	9	10	
Deloda	Adopter	3748	3802	4123	3621	3561	3326	3415	3259	3811	3704	17.170**
	Non-adopter	3214	3152	3493	3026	2996	2639	2849	2946	3143	3059	
	% Improvement	16.61	20.62	18.04	19.66	18.86	26.03	19.87	10.62	21.25	21.09	
Bodhada	Adopter	3126	3256	3324	3289	3317	3189	3258	3269	3351	3316	12.528**
	Non-adopter	2869	2804	3165	3024	2968	2856	2948	2948	3043	3059	
	% Improvement	8.96	16.12	5.02	8.76	11.76	11.66	10.52	10.89	10.12	8.40	

Village	Adopter / Non-adopter	Nos. of cocoons produced by the tasar silkworm rearers										"t" value
		1	2	3	4	5	6	7	8	9	10	
Devulgaon	Adopter	3558	3661	3785	3849	3896	3947	3486	3569	3587	3615	11.222**
	Non-adopter	2987	2944	3241	3315	3159	2986	3021	3029	3126	3214	
	% Improvement	19.12	24.35	16.78	16.11	23.33	32.18	15.39	17.83	14.75	12.48	
Nishti	Adopter	3596	3649	3651	3806	3859	3854	3596	3660	3687	3659	15.043**
	Non-adopter	3028	3301	3260	3309	3254	3259	3254	3211	3274	3218	
	% Improvement	18.76	10.54	11.99	15.02	18.59	18.26	10.51	13.98	12.61	13.70	
Sonka	Adopter	3369	3421	3384	3395	3415	3420	3460	3311	3416	3456	13.929**
	Non-adopter	3038	3109	3157	3053	3244	3017	3159	2995	3153	3211	
	% Improvement	10.90	10.04	7.19	11.20	5.27	13.36	9.53	10.55	8.34	7.63	
Overall	Adopter	3479.4	3557.8	3653.4	3592.0	3609.6	3547.2	3443.0	3413.6	3570.4	3550.0	21.676**
	Non-adopter	3027.2	3062.0	3263.2	3145.4	3124.2	2951.4	3046.2	3025.8	3147.8	3152.2	
	% Improvement	14.87	16.334	11.804	14.150	15.562	20.298	13.164	12.774	13.414	12.66	

*Table value of "t" at 5% = 1.83, and at 1% = 2.82, * 5% level of significance ** 1% level of significance*

Table 3. Comparative impact of adoption of technologies on cocoon production during 3rd crop of Dabha TV per 100 dfls

Village	Treatment / Control	Nos. of cocoons produced by the tasar silkworm rearers										"t" value
		1	2	3	4	5	6	7	8	9	10	
Deloda	Adopter	5723	5810	5512	5436	5482	5516	5620	5723	5461	5647	30.79**
	Non-adopter	4723	4706	4513	4562	4423	4459	4516	4695	4623	4461	
	% Improvement	21.17	23.46	22.14	19.16	23.94	23.70	24.45	21.90	18.13	26.59	
Bodhada	Adopter	6012	5823	5951	5813	5881	5761	5963	5874	5764	5947	55.24**
	Non-adopter	5061	4903	5046	4914	5017	4854	5010	5011	4863	4903	
	% Improvement	18.79	18.76	17.93	18.29	17.22	18.69	19.02	17.22	18.53	21.29	
Devulgaon	Adopter	5916	5739	5930	6167	6369	6233	6487	6371	5482	5437	10.64**
	Non-adopter	4909	4923	4908	4827	4839	4853	4726	4725	4681	4591	
	% Improvement	17.02	14.22	17.23	21.73	24.02	22.14	27.15	25.84	14.61	15.56	
Nishti	Adopter	5863	5713	5719	5520	5451	5322	5629	5891	6068	4957	12.82**
	Non-adopter	4922	4769	5019	4816	4633	4455	4706	4721	4571	4006	
	% Improvement	16.05	16.52	12.24	12.75	15.01	16.29	16.40	19.86	24.67	19.18	
Sonka	Adopter	6105	5809	5827	5706	5755	5658	5422	5409	5513	5466	42.56**
	Non-adopter	5213	5042	5034	4913	4876	4815	4736	4562	4696	4613	
	% Improvement	17.11	15.21	15.75	16.14	18.03	17.51	14.48	18.57	17.40	18.49	

Village	Treatment / Control	Nos. of cocoons produced by the tasar silkworm rearers										"t" value
		1	2	3	4	5	6	7	8	9	10	
Overall	Adopter	5923.8	5778.8	5787.8	5728.4	5787.6	5698.0	5824.2	5853.6	5657.6	5490.8	42.07**
	Non-adopter	4965.6	4868.6	4904.0	4806.4	4757.6	4687.2	4738.8	4742.8	4686.8	4514.8	
	% Improvement	19.30	18.70	18.02	19.18	21.65	21.57	22.90	23.42	20.71	21.62	

*Table value of "t" at 5% = 1.83, and at 1% = 2.82, * 5% level of significance ** 1% level of significance*

Table 4. Impact of technology adoption on cocoon weight of Dabha TV ecorace

Crop	Adopter / Non-Adopter	Cocoon Weight (in grams)										"t" value
		1	2	3	4	5	6	7	8	9	10	
Crop-I	Adopter	10.90	10.60	11.02	10.60	10.70	11.01	11.10	10.50	10.20	10.12	10.28**
	Non-adopter	10.10	09.92	10.12	10.01	09.23	09.65	09.87	09.82	09.12	09.15	
	% Improvement	07.92	06.85	08.89	05.89	15.93	14.09	12.46	06.92	11.84	10.60	
Crop -II	Adopter	10.15	10.79	10.92	10.63	11.03	10.41	10.51	11.02	10.42	10.61	09.67**
	Non-adopter	09.25	09.24	09.53	09.71	09.92	09.58	09.19	09.85	09.84	10.00	
	% Improvement	09.73	16.77	14.59	09.47	11.19	08.66	14.36	11.88	05.89	06.10	
Crop-III	Adopter	10.90	10.54	10.63	10.56	10.65	10.59	10.61	10.61	10.42	10.42	17.16*
	Non-adopter	10.02	09.80	09.81	09.82	09.85	10.01	10.11	09.80	09.88	09.58	
	% Improvement	08.78	07.55	08.35	07.54	08.12	05.79	04.95	08.27	05.47	08.77	
Overall	Adopter	10.65	10.64	10.86	10.60	10.79	10.67	10.74	10.71	10.35	10.38	15.35**
	Non-adopter	09.79	09.65	09.82	09.85	09.67	09.75	09.72	09.82	09.61	09.57	
	% Improvement	08.78	10.26	10.59	07.62	11.66	09.47	10.46	09.03	07.63	08.54	

*Table value of "t" at 5% = 1.83, and at 1% = 2.82, * 5% level of significance ** 1% level of significance*

Table 5. Impact of technology adoption on shell weight of Dhaba TV ecorace

Crop	Adopter / Non-Adopter	Shell Weight (in grams)										"t" value
		1	2	3	4	5	6	7	8	9	10	
Crop-I	Adopter	1.21	1.23	1.25	1.11	1.10	1.12	1.15	1.19	1.22	1.24	23.30**
	Non-adopter	1.11	1.12	1.15	1.01	1.01	1.05	1.04	1.09	1.11	1.12	
	% Improvement	9.01	9.82	8.70	9.90	8.91	6.67	10.58	9.17	9.91	10.71	
Crop-II	Adopter	1.15	1.19	1.11	1.09	1.09	1.18	1.12	1.11	1.12	1.21	09.11**
	Non-adopter	1.05	1.10	1.09	1.01	1.01	1.10	1.02	1.01	1.06	1.08	
	% Improvement	9.52	8.18	1.83	7.92	7.92	7.27	9.80	9.90	5.66	12.04	
Crop-III	Adopter	1.28	1.23	1.24	1.34	1.23	1.32	1.32	1.19	1.29	1.19	15.57**
	Non-adopter	1.08	1.09	1.12	1.16	1.09	1.11	1.12	1.08	1.09	1.05	
	% Improvement	18.52	12.84	10.71	15.52	12.84	18.92	17.86	10.19	18.35	13.33	
Overall	Adopter	1.21	1.22	1.20	1.18	1.14	1.21	1.20	1.16	1.21	1.21	21.81**
	Non-adopter	1.08	1.10	1.12	1.06	1.04	1.09	1.06	1.06	1.09	1.08	
	% Improvement	12.35	10.27	7.14	11.32	9.97	11.04	12.89	9.75	11.35	12.00	

*Table value of "t" at 5% = 1.83, and at 1% = 2.82, * 5% level of significance ** 1% level of significance*

3.2 Impact of Adoption of Improved Tasar Silkworm Rearing Technologies on the Cocoon Weight and Shell Weight

The data presented in the Table 4. clearly reveals that the cocoon weights during the first, second and third crop rearing was ranged from 10.12 to 11.10 gram, 10.15 to 11.03 grams and 10.42 to 10.90 gram, respectively, in case of adopter of the technology while in case non-adopter it was ranged from 09.12 to 10.12 grams, 09.19 to 09.85 grams and 09.58 to 10.11 grams, respectively. The improvement in the cocoon weights during all the three crops was ranged from 06.92 to 15.93 per cent, 06.10 to 14.59 per cent and 04.95 to 08.78 per cent, respectively. The overall cocoon weight was from the range of 10.35 to 10.86 grams for adopters of the technology whereas it was 09.57 to 09.85 grams in case of the non-adopters of the technology. The overall improvement in the cocoon weight was ranged from 7.62 per cent to 11.66 per cent. The paired 't' test shows that there was significant improvement in the cocoon weight due to the adoption of improved tasar silkworm rearing technologies ($p<0.01$). Similarly, from the perusal of the Table 5, it can be seen that the shell weight of the cocoons was ranged from 1.10 to 1.25 grams, 1.09 to 1.21 grams and 1.19 to 1.34 grams during the first, second and third crops rearing, respectively, for the technology adopter while it was ranged from 1.10 to 1.15 grams, 01.01 to 1.10 grams and 1.05 to 1.16 grams, during the first, second and third crops rearing, respectively in case of the non-adopted of technology rearers. The improvement in the shell weight during all the three crops was in the range of 6.67 to 10.71 percent, 5.66 to 12.04 per cent and 10.19 to 18.92 per cent, respectively. As far as the average shell weight of all the three crops is concerned, it was in the range of 1.18 to 1.21 grams for the adopter of technology while it was ranged from 1.04 to 1.10 grams for the non-adopters of the technology. The overall improvement in shell weight was to the tune of 7.14 per cent to 12.89 per cent. The paired 't' test shows that there was significant improvement in the shell weight due to the adoption of improved tasar silkworm rearing technologies ($p<0.01$). The results of the studies are in line with study conducted by Priyadarshini and Kumari [13] and Goswami et al [14]. Chaudhuri et al [20]. Who reported that the larvae fed with 1.5% urea-treated leaves performed best with respect to rearing and cocoon parameters with 34.7 per cent E.R.R. followed by 3 per cent micronutrient treatment which showed 29 per cent E.R.R as against control [21].

4. CONCLUSION

The results of the present study show that the adoption of the recommended technologies is effective in increasing the cocoon production in all three crops of the Daba TV race. Similarly, production data when compared between the technology adopters and non-adopter's by administering the Student's "t" test reveals that the cocoon production of the ten farmers in each village were significantly higher than the of non-adopter during all these three crops which conclude that the adoption of the technology significantly increased cocoon production in the region. Therefore, suitable extension and communication strategies should be formulated and implemented for the effective transfer of recommended tasar silkworm technologies so that these technologies should be percolated to all the tasar silkworm rearers for increasing the cocoon production in the state. Similarly, the result demonstration should also be made available to the tasar silkworm rearers so that their perception about the technology would positively affect which would ultimately leads to the adoption of technology. Moreover, suitable training about the technology should also be imparted to the rearers. Gedam et al [22] in their study of 'impact of training on knowledge, adoption and rearing performance of tribal tasar silkworm (*Antheraea mylitta. D*) rearers of Maharashtra' found that there was a significant impact on knowledge gain and adoption level ($p<0.05$) post-training with the average difference of 34.30 per cent and 27.40 per cent, respectively. As far as the rearing performance was concerned, the hatching percentage and effective rate of rearing showed an improvement of 17.32 per cent and 36.66 per cent, respectively; whereas cocoon yield was improved by 1179 cocoons per 100 dfls. Similarly the annual income of tasar silkworm rearers was improved by Rs.2358/- per 100 dfls. The 't' test of significance showed that there was significant improvement in the hatching percentage, effective rate of rearing, cocoon yield per 100 dfls and annual income per 100 dfls ($p<0.05$) post-training. Therefore, arranging the suitable training program for the tasar silkworm rearers of the region is very essential. Moreover, the extension activities should be taken up in such a way that the farmers should get convinced about the benefits of following improved techniques. BAIF [23] has implemented a project

"Implementation of Tasar sericulture livelihood initiatives" in Chandrapur and Gadchiroli districts of Maharashtra and found that the productivity of cocoons has been increased by adopting a project approach. Thus, project mode approach should also be adopted so that tribal tasar silkworm rearers could understand the importance of the technology adoption and its impact on the cocoon yield and income generation.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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