Multiple Cocoon Crops module and its impact on Stabilization of Autumn Crop under Subtropical condition of North West India

Abstract

Limited number of cocoon crops is observed as a challenge for the economic viability of sericulture industry in North- Western India. Present study was conducted mainly to explore the possibility of multiple cocoon crops in North West India and expected that introduction of additional crop in between spring and autumn will force the pruning of mulberry trees before autumn crop hence, it will help in productivity improvement during autumn crop. A diagnostic study was conducted in 2018 to study the brushing dates and pruning schedule for three cocoon crop and assessment was made for impact on autumn crop through introduction of summer crop in between spring & autumn crop. Finally, silkworm hybrids $FC_1 \times FC_2$ & $SH_6 \times NB_4D_2$ was shortlisted for field trial of spring, summer and autumn season (2020) respectively from the evaluated hybrids during previous studies (2018 & 2019) at Regional Sericultural Research Station, Jammu (RSRS). The field trial was conducted with 9 selected rearers sponsored by Department of Sericulture, J&K & Himachal Pradesh and laboratory rearing was conducted at RSRS. Jammu. Three crop rearing schedule was followed with innovative approach for date of brushing, leaf harvesting, silkworm rearing & mounting of larvae. The outcome of the study leads to understand that change in brushing dates, rearing with shortlisted silkworm hybrids and use of improved rearing & mounting techniques can improve the cocoon productivity/100 DFLs in one hand and introduction of Summer crop in between spring & autumn crop can also improve the cocoon yield during autumn crop. Farmer's level study revealed that an average yield recorded during spring crop of about **70.67 Kg & 60.33 Kg/100 DFLs** in Jammu & HP whereas lab rearing at RSRS, Jammu recorded about **83.00 Kg/100 DFLs**. The average yield during summer crop was of about **44.40 Kg** & **35.35 Kg/100 DFLs** in Jammu & HP and lab rearing at RSRS, Jammu recorded about **51.87 Kg/100 DFLs** respectively. During autumn crop an average yield about **40.80 Kg** & **43.67 Kg/100 DFLs** was recorded at Jammu & HP and lab rearing at RSRS, Jammu recorded about **44.75 Kg/100 DFLs**. The impact of introduction by summer crop revealed that *per cent* yield gain over traditional field rearing from experimental field trial about **67.14 (%)** and **44.70 (%)** yield gain record in autumn season at Jammu division and Himachal Pradesh respectively.

Key words: *Multiple cocoon crops, Spring, Summer, Autumn, Jammu, Himachal Pradesh, Cocoon Yield*

Introduction

One crop success story and subsidiary nature of silk cocoon crops is major limiting factor for sericulture development in North Western India. Though efforts were made but except spring crop no other silk cocoon crop could be stabilized at farmer level. Isolated efforts were made at

farm and farmer level but so far not yielded desired results. Sericulture activities in North-Western region of India is depending upon two crops- spring and autumn only, of which autumn crop is yet to be stabilized at farmers level as a result about 75-80 (%) of the cocoon are being produced from spring crop only.

Jammu & Kashmir, Himachal Pradesh, Uttarakhand, Punjab and Haryana constitutes contributes the North Western sericulture zone of the country and known for exclusively bivoltine cocoon production, no doubt it has salubrious good climatic condition during spring rearing season for production of high quality bivoltine cocoons and there are very few pockets in the country which may be considered as natural home for bivoltine silk. However, it has certain limitations also. Only spring crop has the climatic advantages, Hence over decades the entire zones depends on this crop for its annual raw silk output. There are only two silk cocoon crops in vogue in this zone *i.e.* spring and autumn of which spring crop alone constitutes about 80 *per cent* (except Uttarakhand) of the annual cocoon production (Singh and Murali, 2019).

The most important debated issue for the development of sericulture in North-West India is - can the number of silk cocoon crops will be increased, why the autumn crop is not stabilized at farmer level and is there a scope for third crop introduction between spring and autumn. It is evident from the recent cocoon production trends in the major cocoon producing states of North-West India (Anonymous, 2017a). During the year 2016-17 Jammu and Kashmir is the largest cocoon producing state of North-West India with a production of about produced 973.30 MT of bivoltine cocoon of which only 25.95 MT (2.66%) were produced during autumn crop (Anonymous, 2017b). Similarly in Himachal Pradesh the second largest cocoon producing state in the region, cocoon production during 2016-17 produced 236.55 MT of which only 35.40 (18%) were produced during autumn crop (Anonymous, 2017c). Condition is slightly better in Uttarakhand which produced 231.37 MT of cocoon of which 98.13 MT (42.41%) were produced during autumn crop. Yield /100 dfls during spring crop in J & K during 2016-17 was 39.41 Kg while during autumn it was only 26.95 Kg while in Himachal Pradesh it was 41.01 Kg during spring and 26 Kg during autumn (Anonymous, 2017d). The aim of the study was mainly to explore the possibility of multiple cocoon crops in North West India and expected that introduction of a crop in between spring and autumn will forced the prunning of mulberry trees before autumn crop hence, it will help in stabilization of autumn crop. Based on the study, the brushing dates and pruning schedule based on three cocoon crop was worked out and assessment was made for impact on autumn crop through introduction of summer crop in between spring & autumn crop.

Material and Methods

A preliminary workstudy during 2018, followed by was conducted at institute level investigation during 2019 was conducted to select suitable brushing dates for spring, summer and

autumn crop and suitable hybrid combination was shortlisted for all three crops using Mano index. Field trial was conducted by adopting three crops schedule with shortlisted hybrids were conducted with the farmers sponsored by Department of Sericulture (DOS) in two states under given location covering 5 potential sericulture districts of North West India. Spring, Summer and autumn crop was conducted with shortlisted hybrid *i.e.* $FC_1 \times FC_2$ for spring crop & $SH_6 \times NB_4D_2$ for summer & autumn crop respectively with new brushing date at Jammu and Himachal region with selected silkworm rearers at each location with actual rearing capacity of the farmers. Chawki reared worms were distributed and leaves used from the same trees for the three different seasons by adopting pruning from time to time (Table 1).

Table 1. Showing pruning and brushing schedule adopted during different seasons of the study

Season	Pruning schedule	Brushing schedule	
		Jammu Condition (J&K)	H.P
Spring	Shoot harvesting for **late age rearing during spring crop** leaving behind a shoot bearing leaf on each branch.	Early first week of March (1st of March)	Early 2nd week of March (5th-10th March
Summer	Shoot let harvesting for **late age rearing during summer crop** (June - July) adopting recommended method of monsoon pruning this will forced the adoption of pruning practice in between spring and autumn crop which is absent at present and a pre-requisite for success of autumn crop.	3rd week of June (Between 15-30th of June)	2nd week of June (10-15th of June)
Autumn	Apical harvesting of primary branches (above 3 feet crown on main branch) during autumn crop.	10-15th of September	1st week of September

Methodology

Farmer's level (DOS sponsored farmers in potential sericulture districts) rearing was conducted with proven technology and innovative approach, based on the outcome of experimental rearing conducted at RSRS, Miran Sahib, Jammu during previous years (2018 & 2019). Spring, summer and autumn field rearing was conducted during 2020 among DOS sponsored farmers (9 Nos) with shortlisted hybrid *i.e.* $FC_1 \times FC_2$ for spring crop & $SH_6 \times NB_4D_2$ for summer & autumn crop respectively (based on actual rearing capacity of the farmer) with overall technical and material support through RSRS, Jammu/State Sericulture Departments (DOSs) and Research Extension Centers (RECs) of CSB at identified location. DOS, J&K and DOS, HP sponsored three and six farmers respectively, thus total 9 farmers with the help of State Department of Sericulture/ Research Extension Centers of CSB in three different locations of

representative sericulture districts in Jammu province of Jammu & Kashmir and Himachal Pradesh where finally identified. Accordingly farmer level rearing during spring, summer and autumn crop in J&K and HP was conducted with five potential sericulture districts - Rajouri, Udhampur & Kathua in J&K and district Bilaspur and Kangra in Himachal Pradesh comprising 03 farmers from each location having rearing capacity up to 50 dfls/farmer & Control rearing (50 DFLs) for the shortlisted hybrid was conducted at RSRS, Miran Sahib, Jammu to assess research level yield and potential yield at rearer's level. The introduction of summer crop in between spring and autumn was studied and its impact on the autumn crop was analyzed. The hybrid seed was procured from SSPC, Prem Nagar, Dehradun and were incubated at RSRS, Jammu and REC, Ghumarwin (H.P) worms were distributed after second moult for each selected rearers.

Results and Discussion

The results of the field trial investigation at Jammu (J&K) and Himachal Pradesh with DOS sponsored rearers during spring, summer and autumn (2020) season were presented here under:

From the present study the results observed revealed that during spring rearing when brushing was done on 01.03.2020 and the chawki reared worms were distributed to each location on 10.03.2020 having 50 DFLs per rearer. In Jammu region of J&K cocoon yield is varied ranging from 58 Kg to 78 Kg /100 dfls. Actual yield recorded was about 76, 78 and 58 Kg/100 DFLs for at Lamberi (Rajouri Dist.), Majalta (Udhampur Dist.) and Dharamakot (Kathua Dist.) region respectively at Jammu division and average yield was recorded as **70.67 Kg/100 DFLs** whereas in at Himachal Pradesh cocoon yield was in range recorded from 36 to 74 Kg/100 dfls having actual yield of about 71, 36 and 74 Kg/100 DFLs for at Soi, Panol and Naswal region of Bilaspur Dist., Himachal Pradesh and average yield was about **60.33 Kg/100 DFLs.** The control batch reared at RSRS, Jammu under laboratory conditions achieved recorded yield was about **83 Kg/100 DFLs** (Table 2). The filament length was recorded about 974.00 mtrs, denier (2.59), Renditta (2.14), Reelability (84.45%), Raw silk (32.11%) and Neatness (95.00) at farmers level whereas at control batch rearing, filament length was recorded about 855.00 mtrs, denier (2.34), Renditta (2.83), Reelability (74.86%), Raw silk (35.72%) and Neatness (90.00) respectively for the trial conducted during Spring season (2020) (Table 3).

$SH_6 \times NB_4D_2$ was shortlisted for summer season from the evaluated hybrids during previous studyyears (2018 & 2019) and brushed on 29.06.2020 and 28.06.2020 at Jammu & Ghumarwin (H.P) respectively. The chawki reared worms were distributed to each location on 12.07.2020 (Lamberi, Rajouri Dist.), 13.07.2020 (Dharmakot, Kathua Dist.) and 14.07.2020 (Majalta, Udahmpur Dist.) in Jammu division whereas Bilaspur region (H.P) worms were distributed on 07.07.2020 having 50 DFLs per rearer. The yield recorded was about 44, 44 and 45.20 Kg/100 DFLs for at Lamberi (Rajouri Dist.), Majalta (Udhampur Dist.) and Dharamkot (Kathua Dist.) region respectively with average yield of about **44.40 Kg/100 DFLs** at Jammu division whereas 17, 16.67 and 14.60 Kg/100 DFLs atfor Soi, Panol and Naswal region of

Bilaspur Dist., Himachal Pradesh and 42.60, 74.40, 46.80 Kg/100 DFLs at for Sanot region (3 rearers) of Kangra Dist. Himachal Pradesh with average yield of about **35.35 Kg/100 DFLs** was recorded. The control batch reared at RSRS, Jammu recorded yield was about **51.87 Kg/100 DFLs** (Table 4). The farmers conducting silkworm rearing in summer season harvest mulberry leaves bloomed after spring crop harvest.

The result of the present study is in accordance with the results observedobtained at North Kashmir during summer season (2006) (Farooq *et al.,* 2007). Further, at the time of implementation of cluster development programme in Kashmir valley, summer crops were also undertaken in Tral and Bandipora clusters. The results obtained from cluster silkworm rearers were better (Aslam *et al.,* 2016) than the results obtained in North Kashmir (Farooq *et al.,* 2007). A comparative study with 33 cluster and 30 non cluster silkworm rearers was conducted in Tral area during summer season (2015) and it was observed revealed that the cluster farmers who have adequate infrastructure have harvested with an average cocoon yield 33.72 Kg/100 DFLs whereas non cluster farmers have harvested 7.95 Kg/100 DFLs in the same area (Aslam *et al.,* 2016). The reasons behind the better results of cluster farmers may be the infrastructure developed under the programme and helped them to adopt the technologies as per the recommended package of practices (Aslam *et al.,* 2016).

Similar results were agreement with Singh and Singh (2012) reported observed that successful trial of summer crop was conducted in Himachal Pradesh where 2000 dfls of PM×CSR2 was reared at farmers level and an average yield of about 45 Kg/100 dfls were obtained during July 2010, where organized mulberry plantation was developed in 2006 were used utilized for silkworm rearing.

Similarly a diagnostic study was conducted at Regional Sericultural Research Station Jammu in 2018 to explore the possible possibility of introduction of a third crop in between spring and autumn with selection of suitable hybrid and brushing date for summer rearing under sub-tropical condition of Jammu. Hybrid selection was made after evaluating the pool of silkworm hybrid developed at different institutes. Brushing was ascertained after brushing the silkworm eggs at different dates and hybrids were evaluated according to evaluation index for desired economic parameters for both quantity and quality based on evaluation index developed by Mano *et al.* (1993). Hybrids showing the index value above 50 were shortlisted. First brushing was conducted on 10th of June 2018 with eight hybrids and shortlisted hybrids were are $FC_1 \times FC_2$, $D \times O_2$, $D \times O_3$ and $SH_6 \times NB_4D_2$ whereas Nine hybrids were was reared during second brushing of summer season (2018), brushed on 25.06.2018. The hybrids showing the index value above 50 were shortlisted as $PM \times FC_2$, PM×CSR2, $SH_6 \times NB_4D_2$, SK6×SK7 and $D \times O_3$. Based on the study promising silkworm hybrid and suitable date of brushing for introduction of additional summer crop under sub-tropical condition has been workout by Singh and Murali (2019).

From present study investigation, the post cocoon parameters data observed revealed that, the average filament length was recorded about 725.33 mtrs, denier (2.54), Renditta (3.44),

Reelability (75.48%), Raw silk (29.46%) and Neatness (89.67) at Jammu division whereas at Himachal Pradesh the average filament length was recorded about 752.00 mtrs, denier (2.26), Renditta (3.66), Reelability (69.81%), Raw silk (27.72%) and Neatness (94.67) respectively for the field trial conducted during Summer season (2020) and the control batch rearing at RSRS, Jammu the filament length was recorded about 825.00 mtrs, denier (2.62), Renditta (2.95), Reelability (78.27%), Raw silk (34.12%) and Neatness (93.00) (Table 5). The results were in accordance with summer rearing conducted at RSRS, Jammu (2018), the post cocoon parameters data revealsobserved that, the filament length was highest in $FC_1\times FC_2$ (979 mtrs) and lowest was recorded in SK6×SK7 (461.00 mtrs) whereas reelability was maximum in D×O3 (87.00%) and lowest in SK6×SK7 (66.00%). The renditta on dry cocoon was recorded lowest in $FC_1\times FC_2$ (2.65) and maximum was recorded in D×O3 (3.68) whereas neatness was recorded highest in $FC_1\times FC_2$ (98.00%) and lowest was recorded in D×O2 and B.con 1× B.con 4 (93.00%). The raw silk *per cent* was maximum in $FC_1\times FC_2$ (38.10%) and lowest was recorded in D×O3 (27.46%) (Singh and Murali, 2019).

During autumn season field trial, $SH_6\times NB_4D_2$ was shortlisted from the evaluated hybrids during previous study seasons (2018 & 2019) and brushed on 08.09.2020 and 06.09.2020 at Jammu & Ghumarwin respectively. The chawki reared worms were distributed to each location on 17.09.2020 (Lamberi, Rajouri Dist. & Majalta, Udhampur Dist.) and 16.09.2020 (Dharamkot, Kathua Dist.) at Jammu division whereas Bilaspur region (H.P) worms were distributed on 15.09.2020 having 50 DFLs (20000 worms) per rearer. The yield recorded was about 41, 37 and 44.40 Kg/100 DFLs at for Lamberi (Rajouri Dist.), Majalta (Udhampur Dist.) and Dharmakot region (Kathua Dist.) respectively at Jammu division and having average yield about **40.80 Kg/100 DFLs** whereas 46.70, 47.90 and 47.40 Kg/100 DFLs at for Soi, Panol and Naswal region of Bilaspur, Himachal Pradesh and 39.50, 39.80, 40.70 Kg/100 DFLs at for Sanot region (3 rearers) of Kangra dist., Himachal Pradesh with average yield of about **43.67 Kg/100 DFLs** was recorded for Himachal Pradesh. The control batch reared at RSRS, Jammu recorded yield was about **44.75 Kg/100 DFLs** (Table 6). The average filament length was recorded about 768.67 mtrs, denier (2.40), Renditta (3.01), Reelability (76.28%), Raw silk (27.31%) and Neatness (94.33) at Jammu division whereas Himachal Pradesh the average filament length was recorded about 775.33 mtrs, denier (2.35), Renditta (3.42), Reelability (73.28%), Raw silk (25.96%) and Neatness (95.33) respectively for the field trial conducted during autumn season (2020) and the control rearing at RSRS, Jammu the filament length was recorded about 879.00 mtrs, denier (2.62), Renditta (3.15), Reelability (88.38%), Raw silk (33.26%) and Neatness (93.00) (Table 7).

New date of brushing has been assessed which suggest that Spring crop in the region needs to be preponed by a week over the traditional date(s), Summer crop can be conducted in the month of June between 2^{nd} to 4^{th} week and autumn crop to be postponed by a week over the traditional date of brushing specially in two major sericulture states *i.e.* Jammu region (Sub tropical) of J & K and Himachal Pradesh respectively (Singh and Murali, 2019).

Impact on autumn crop by introduction of summer crop

Measured in terms of *per cent* gain over existing practices after diffusions of knowledge & innovation and introduction of summer crop in between spring & autumn crop.

The average yield recorded by rearers at in Jammu division of J&K during autumn season was about 40.80 Kg and HP was recorded about 43.67 Kg/100 dfls respectively. The *per cent* yield gain over traditional field rearing from experimental field trial revealed that **67.14 (%)** and **44.70 (%)** gain record in autumn season at Jammu division and Himachal Pradesh in the same area respectively (Table 8).

The summer crop is completed in the month of July last and fresh leaf is available for next autumn crop after harvesting the leaf during summer rearing, it was sort of forced pruning which otherwise is not done before autumn crop. This had helps in improvement in autumn silkworm crop performance and those farmers who are not opting for mulberry pruning after spring crop should take summer crop and sericulture becomes more remunerative.

Conclusion: The findings of study leads to understand the performance & evaluation of ruling new bivoltine & ICB hybrids under the rearing conditions of North West India especially at RSRS, Jammu a hotspot for hybrid evaluation in North India. Hybrid evaluation and short listing of hybrids procured form different R&D institutes of CSB for multiple cocoon crops (Spring, Summer and Autumn) has been done first time and evaluated hybrids can be utilized for future rearing programmes by DOSs of the region.

A crop is possible between traditional spring and autumn crop in the form of summer crop and thus three crop schedules has been workout instead of two. Summer crop has positive impact on the autumn crop because of pruning was adopted/forced before autumn crop to improve mulberry leaf quality. Pruning and harvesting technology as advocated by the institute is also got validated. Overall knowledge & outcome has been shared through virtual mode & in the form of PPT among officers and field functionaries of DOS J&K, Himachal Pradesh and Punjab.

New date of brushing has been assessed which suggest that Spring crop in the region needs to be preponed by a week over the traditional date(s), Summer crop can be conducted in the month of June between 2nd to 4th week and autumn crop to be postponed by a week over the traditional date of brushing specially in two major sericulture states *i.e.* Jammu region (Sub tropical) of J & K and Himachal Pradesh.

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Table 2. Average Data Recorded during Spring Field trial for the Hybrid, $FC_1 \times FC_2$ through Shelf Rearing (2020) at different places of Jammu & Himachal Pradesh and Control rearing at RSRS, Jammu

Name of Location	Date of incubation	Date of brushing	H (%)	Date of distribution	Wt. of 10 Mature Larvae (g.)	5th Instar Larval Period (D:H)	Total Larval Period (D:H)	Actual Yield (Kg)	Av. Yield / 100 DFLs	SCW (g)	SSW (g)	SR (%)
		Jammu Division (J&K)										
Lamberi, (Rajouri)	21.02.2020	01.03.2020	94.33	10.03.2020	55.00	6.00	29.00	38.00	76.00	1.90	0.40	21.04
Majalta, (Udhampur)	21.02.2020	01.03.2020	94.33	10.03.2020	56.00	6.19	31.00	39.00	78.00	1.763	0.393	22.29
Dharamkot, (Kathua)	21.02.2020	01.03.2020	94.33	10.03.2020	58.00	8.02	29.12	29.00	58.00	1.70	0.348	20.47
Avg.			**94.33**		**56.33**	**6.23**	**29.20**	**35.33**	**70.67**	**1.79**	**0.38**	**21.27**
		Himachal Pradesh										
Soi (Bilaspur)	21.02.2020	01.03.2020	90.00	10.03.2020	54.00	10.08	32.04	35.50	71.00	1.81	0.40	22.09
Panol (Bilaspur)	21.02.2020	01.03.2020	90.00	10.03.2020	50.00	10.08	32.04	18.00	36.00	1.80	0.39	21.66

Naswal (Bilaspur)	21.02.2020	01.03.2020	90.00	10.03.2020	56.00	10.08	32.04	37.00	74.00	1.81	0.40	22.09
Avg.			**90.00**		**53.33**	**10.08**	**32.04**	**30.17**	**60.33**	**1.81**	**0.40**	**21.95**
				Control Rearing (Lab condition)								
RSRS, Jammu	21.02.2020	01.03.2020	94.33	10.03.2020	52.00	7.16	27.03	41.50	83.00	1.84	0.38	20.28
Avg.			**94.33**		**52.00**	**7.16**	**27.03**	**41.50**	**83.00**	**1.84**	**0.38**	**20.28**

Note: No. of DFLs distributed: 50 DFLs; No. of Farmers covered: 9; H-Hatching

Table 3. Showing post cocoon parameters (Dry cocoon) recorded for $FC_1 \times FC_2$ (2020) trial rearing during spring (2020) at Field and Control batch at RSRS, Miran Sahib, Jammu

Location	AFL (mtr)	Deneir	Renditta	Reelability (%)	Raw Silk (%)	Neatness
	Jammu Division					
Farmers level	974.00	2.59	2.14	84.45	32.11	95.00
	Control batch rearing					-
RSRS, Jammu	855.00	2.34	2.83	74.86	35.72	90.00
Avg.	**914.50**	**2.47**	**2.49**	**79.66**	**33.92**	**92.50**
SD±	**84.15**	**0.18**	**0.49**	**6.78**	**2.55**	**3.54**

Note: AFL – Average filament length; SD-standard deviation

Table 4. Average Data Recorded during Summer Field trial for the Hybrid, $SH_6 \times NB_4D_2$ through Shelf Rearing (2020) at different places of Jammu & Himachal Pradesh and Control batch at RSRS, Jammu

Name of location	Date of incubation	Date of brushing	H (%)	Date of distribution	Wt. of 10 Mature Larvae (g.)	5th Instar Larval Period (D:H)	Total Larval Period (D:H)	Actual Yield (kg)	Av. Yield / 100 DFLs	SCW (g)	SSW (g)	SR (%)
		Jammu Division (J & K)										
Lamberi, (Rajouri)	26.06.2020	29.06.2020	91.80	07.07.2020	45.03	7:00	24:00	22.00	44.00	1.819	0.351	19.29
Ramkot, (Udhampur)	26.06.2020	29.06.2020	91.80	07.07.2020	45.00	7:04	24:00	22.00	44.00	1.560	0.310	19.24
Barnoti, (Kathua)	26.06.2020	29.06.2020	90.00	07.07.2020	44.00	7:02	26:00	22.60	45.20	1.600	0.300	18.75
Avg.			**91.20**		**44.68**	**7:02**	**24:16**	**22.20**	**44.40**	**1.66**	**0.32**	**19.09**
		Himachal Pradesh										
Soi (Bilaspur)	25.06.2020	28.06.2020	90.00	07.07.2020	40.00	7:10	27:00	8.50	17.00	1.570	0.270	17.20
Panol (Bilaspur)	25.06.2020	28.06.2020	90.00	07.07.2020	38.00	7:10	27:00	8.34	16.67	1.580	0.270	17.15
Naswal (Bilaspur)	25.06.2020	28.06.2020	90.00	07.07.2020	36.00	7:10	27:00	7.30	14.60	1.560	0.260	17.05
Sanot (Kangra)	27.06.2020	30.06.2020	95.00	09.07.2020	56.00	7:10	26:10	21.30	42.60	1.92	0.350	18.23
Sanot (Kangra)	27.06.2020	30.06.2020	95.00	09.07.2020	60.00	7:13	26:08	18.60	74.40	1.88	0.340	18.08
Sanot (Kangra)	27.06.2020	30.06.2020	95.00	09.07.2020	58.00	7:12	26:11	11.70	46.80	1.72	0.310	18.02
Avg.			**92.50**		**48.00**	**7:11**	**26:17**	**12.62**	**35.35**	**1.71**	**0.30**	**17.62**
		RSRS Jammu (Control Batch)										

RSRS, Jammu	26.06.2020	29.06.2020	91.80	-	55.00	5:20	23:03	25.93	51.87	1.650	0.315	19.02
Avg.			**91.80**		**55.00**	**5:20**	**23:03**	**25.93**	**51.87**	**1.650**	**0.315**	**19.02**

Note: No. of DFLs distributed: 50 DFLs; No. of Farmers covered: 9; H-Hatching

Table 5. Showing post cocoon parameters (Dry cocoon) recorded for summer (2020) trial rearing at Field and Control batch at RSRS, Miran Sahib, Jammu

Location	AFL (mtr)	Deneir	Renditta	Reelability (%)	Raw Silk (%)	Neatness
	Jammu division					
Lamberi (Rajouri)	639.00	2.38	3.45	75.98	29.16	93.00
Majalta (Udhampur)	849.00	2.73	3.15	72.61	32.07	93.00
Dharamakot (Kathua)	688.00	2.52	3.73	77.85	27.14	83.00
Avg.	**725.33**	**2.54**	**3.44**	**75.48**	**29.46**	**89.67**
	Himachal Pradesh					
Soi (Bilaspur)	772.00	2.31	3.33	70.55	30.23	93.00
Panol (Bilaspur)	735.00	2.29	3.84	67.83	26.50	93.00
Naswal (Bilaspur)	749.00	2.18	3.82	71.04	26.43	98.00
Avg.	**752.00**	**2.26**	**3.66**	**69.81**	**27.72**	**94.67**
	Control batch rearing					
RSRS, Jammu	825.00	2.62	2.95	78.27	34.12	93.00
Overall Avg.	**751.00**	**2.43**	**3.47**	**73.45**	**29.38**	**92.29**
SD±	**73.36**	**0.20**	**0.35**	**3.99**	**2.96**	**4.50**

Note: AFL – Average filament length; SD-standard deviation

Table 6. Average Data Recorded during Autumn Field trial for the Hybrid, $SH_6 \times NB_4D_2$ through Shelf Rearing (2020) at different places of Jammu & Himachal Pradesh and Control batch at RSRS, Jammu

Name of location	Date of incubation	Date of brushing	H (%)	Date of distribution	Wt. of 10 Mature Larvae (g.)	5th Instar Larval Period (D:H)	Total Larval Period (D:H)	Actual Yield (kg)	Av. Yield / 100 DFLs	SCW (g)	SSW (g)	SR (%)
		Jammu Division (J & K)										
Lamberi, (Rajouri)	31.08.2020	08.09.2020	88.91	17.09.2020	42.00	7:02	25:05	20.500	41.00	1.729	0.342	19.80
Majalta (Udhampur)	31.08.2020	08.09.2020	88.91	17.09.2020	42.00	8:21	24:00	18.500	37.00	1.513	0.265	17.51
Dharmakot (Kathua)	31.08.2020	08.09.2020	88.91	16.09.2020	43.00	8:06	28:03	22.200	44.40	1.620	0.290	17.90
Avg.			**88.91**		**42.33**	**8:02**	**25:19**	**20.40**	**40.80**	**1.62**	**0.30**	**18.40**
		Himachal Pradesh										
Soi (Bilaspur)	31.08.2020	06.09.2020	90.00	15.09.2020	47.00	7:22	24:04	23.350	46.70	1.75	0.315	18.00
Panol (Bilaspur)	31.08.2020	06.09.2020	90.00	15.09.2020	46.00	9:22	26:04	23.950	47.90	1.80	0.325	18.06
Naswal (Bilaspur)	31.08.2020	06.09.2020	90.00	15.09.2020	47.00	8:22	25:04	23.700	47.40	1.80	0.324	18.00
Sanot (Kangra)	31.08.2020	07.09.2020	90.00	17.09.2020	-	8:00	26:00	19.75	39.50	1.68	0.30	17.86
Sanot (Kangra)	31.08.2020	07.09.2020	90.00	17.09.2020	-	8:00	26:00	19.90	39.80	1.70	0.30	17.94

Sanot (Kangra)	31.08.2020	07.09.2020	90.00	17.09.2020	-	8:00	26:00	20.35	40.70	1.72	0.31	18.02
Avg.			**90.00**		**46.67**	**8:11**	**25:14**	**21.83**	**43.67**	**1.74**	**0.31**	**17.98**
		Control Batch rearing										
RSRS, Jammu	31.08.2020	08.09.2020	88.91		47.00	6:09	22:04	22.376	44.75	1.654	0.303	18.41
Avg.			**90.00**		**47.00**	**6:09**	**22:04**	**22.376**	**44.75**	**1.654**	**0.303**	**18.41**

Note: No. of DFLs distributed: 50 DFLs; No. of Farmers covered: 9; H-Hatching

Table 7. Showing post cocoon parameters (Dry cocoon) recorded for $SH_6 \times NB_4D_2$(2020) trial rearing at Field and Control batch during autumn (2020) at RSRS, Miran Sahib, Jammu

Location	AFL (mtr)	Deneir	Renditta	Reelability (%)	Raw Silk (%)	Neatness
	Jammu Division					
Lamberi (Rajouri)	728.00	2.43	2.37	75.32	30.69	93.00
Majalta(Udhampur)	764.00	2.36	3.15	80.28	31.89	95.00
Dharamkot (Kathua)	814.00	2.41	3.50	73.24	19.35	95.00
Avg.	**768.67**	**2.40**	**3.01**	**76.28**	**27.31**	**94.33**
	Himachal Pradesh					
Soi (Bilaspur)	780.00	2.49	3.06	75.04	32.86	98.00
Panol (Bilaspur)	698.00	2.22	3.87	70.11	25.97	93.00
Naswal (Bilaspur)	848.00	2.35	3.33	74.68	19.05	95.00
Avg.	**775.33**	**2.35**	**3.42**	**73.28**	**25.96**	**95.33**
	Control Batch					
RSRS, Jammu	879.00	2.62	3.15	88.38	33.26	93.00
Overall Avg.	**787.29**	**2.41**	**3.20**	**76.72**	**27.58**	**94.57**
SD	**64.41**	**0.12**	**0.46**	**5.96**	**6.21**	**1.81**

Note: AFL – Average filament length; SD-standard deviation

Table 8. Showing Per cent yield gain by Experimental field trial V/s Traditional field trial during autumn season (2020)

Particulars	Autumn season (2020) Average Yield (Kg)	Yield gain over traditional rearing (%)
	Jammu division	
Experimental field trial	40.80	**67.14**
Traditional field trial	24.41	
	Himachal Pradesh	
Experimental field trial	43.67	**44.70**
Traditional field trial	30.18	