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

Abstract

The present study was conducted mainly to explore the possibility of multiple cocoon crops in North West India and expected that introduction of the additional crops in between spring and the autumn will force the pruning of mulberry trees before autumn crop hence, it will help in productivity improvement during the autumn crop. 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 an innovative approach for date of brushing, leaf harvesting, silkworm rearing & mounting of larvae. The outcome of the study leads to understanding 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 the 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 labrearing at RSRS, Jammu recorded about **83.00 Kg/100 DFLs**. During summer crop 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 of about **40.80Kg**&**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 the introduction by summer crop revealed that *per cent* yield gain over traditional field rearing from experimental field trials about **67.14 (%)** and **44.70 (%)** yield gain records in the 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 the subsidiary nature of silk cocoon crops is a major limiting factor for sericulture development in North Western India. Though efforts were made except spring crop no other silk cocoon crop could be stabilized at the farmer level. Isolated effortswere made at the farm and farmer level but so far have not yielded desired results. Sericulture activities in the North-Western region of India are depending upon two crops- spring and autumn only, of which autumn crop is yet to be stabilized at farmer's level as a result about 75-80 (%) of the cocoon are being produced from spring crops only.

"Jammu &Kashmir, Himachal Pradesh, Uttarakhand, Punjab and Haryana contributesto the North Western sericulture zone of the country and are known for exclusivelybivoltine cocoon production, no doubt it has good climatic condition during the spring rearing season for production of high quality bivoltine cocoons and there are very few pockets in the country which

may be considered as a natural home for bivoltine silk. 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 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 the farmer level and whether is there a scope for a 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 973.30 MT of a 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 the autumn crop (Anonymous, 2017c). Condition is slightly better in Uttarakhand which produced 231.37 MT of the 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 the autumn it was only 26.95 Kg while in Himachal Pradesh it was 41.01 Kg during spring and 26 Kg during the 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 between spring and the autumn will force the prunning of mulberry trees before the autumn crop hence, it will help in stabilization of autumn crop. Based on the study, the brushing dates and pruning schedule on three cocoon crop was worked out and an assessment was made for impacton the autumn crop through introduction of summer cropsin between the spring & autumn crop.

MATERIAL AND METHODS

A preliminaryworkduring 2018was conducted at institute level investigation during 2019 to select suitable brushing dates for spring, summer and autumn crop and suitablehybrid combination was shortlisted for all three cropsusing the Mano index. Field trial were conducted by adopting three crops schedule with shortlisted hybrids with the farmers sponsored by the 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 withnew brushing date at Jammu and Himachal region with selected silkworm rearersat each location with actual rearing capacity of the farmers. Chawki reared worms were distributed and leaves were 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 will forced the adoption of pruning practice in between spring and autumn crop which is absent at present and a pre-requisite for the 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 the main branch) during the 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 the identified location. DOS, J&K and DOS, HP sponsored three and six farmers respectively, thus total 9 farmers with the help of the 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". (Singh and Murali, 2021).The hybrid seed was procured from SSPC, Prem Nagar, Dehradunand

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) seasons were presented here:

From the present study the results revealed that during spring rearing 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 the Jammu region of J&K cocoon yield is varied from 58 to 78Kg /100 dfls. The actual yield recorded was about 76, 78 and 58 Kg/100 DFLs at Lamberi (Rajouri Dist.), Majalta (Udhampur Dist.) and Dharamakot (Kathua Dist.) regions respectively at Jammu division and the average yield was recorded as **70.67 Kg/100 DFLs** whereas at Himachal Pradesh cocoon yield was in recorded from 36 to 74 Kg/100 dfls having an actual yield of 71, 36 and 74 Kg/100 DFLs 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 yield was about **83 Kg/100 DFLs**(Table 2).

The result of the present study is in accordance with the results observedat North Kashmir during the summer season (2006) (Farooq*et al.,* 2007). "Further, at the time ofimplementation of the cluster development program 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 theTral area during summer season (2015) and it was revealed that the cluster farmers who have adequate infrastructure have harvested with an average cocoon yield of 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 in agreement with Singh and Singh (2012) observed that successful trial of summer crop was conducted in Himachal Pradesh where 2000 dfls of PM×CSR2 was reared at farmer's level and an average yield of about 45 Kg/100 dfls was obtained during July 2010, where organized mulberry plantation was developed in 2006 were utilized for silkworm rearing.

Similarly a diagnostic study was conducted at Regional Sericultural Research Station Jammu in 2018 to explore the possible introduction of a third crop in between spring and autumn with a selection of suitable hybrid and brushing date for summer rearing under the Sub-tropical condition of Jammu. The 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 the evaluation index for desired economic parameters for both quantity and quality developed by Mano *et al.* (1993). "Hybrids showing an index value above 50 were shortlisted. The first brushing was conducted on 10th of June 2018 with eight hybrids and the shortlisted hybrids were $FC_1 \times FC_2$, $D \times O_2$, $D \times O_3$ and $SH_6 \times NB_4D_2$ whereas Nine hybrids were reared during the second brushing of the summer season (2018), brushed on 25.06.2018. The hybrids showing an 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).

"A new date of brushing has been assessed which suggest that the 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 the 2nd to 4th week and the autumn crop to be postponed by a week over the traditional date of brushing especially 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.

During summer crop the yield recorded 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** and the average yield recorded by rearers at Jammu division of J&K during the autumn season was at 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 records in the autumn season at Jammu division and Himachal Pradesh in the same area respectively (Table 3).

"The summer crop is completed in the month of July last and fresh leaf is available for the next autumn crop after harvesting the leaf during summer rearing, it was a sort of forced pruning which otherwise is not done before the autumn crop. This had helps in the improvement of 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".(Singh and Murali, 2021).

Conclusion: The findings of the study lead 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 from different R&D institutes of CSB for multiple cocoon crops

(Spring, Summer and Autumn) has been done the first time and evaluated hybrids can be utilized for future rearing programs 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 pruning was adopted/forced before the 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 suggests that the 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 the 2nd to 4th week and the 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 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	