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Evaluation of selected genotypes of bivoltine silkworm *Bombyx mori* L during different seasons of Kashmir

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Abstract
Success of silkworm breeding largely depends upon the initial selection of parents, their effective utilization in desirable combination followed by appropriate selection procedures. Silkworm breeders across the country contributed significantly to the development of many bivoltine breeds not only with improved economic parameters but also having suitability for variable climatic conditions. With this aim, the study was carried out to evaluate the performance of the nineteen bivoltine silkworm genotypes *viz*., Chaung Naung, Sanish-18(M), Pam 114, Pam 117, CSR2, CSR6, CSR26, CSR27, CSR47, S8, N5, SK-6, SK-7, B.Con-1, B.Con-4, Dun-6, Dun-22, APS-4 and APS-5 evolved/maintained by different breeding institutes of India. The evaluation of the selected genotypes was carried out for various traits during spring (May-June), summer (July-August) and autumn (August-September) season 2018 at Central Sericultural Research and Training Institute, Central Silk Board, Pampore, Kashmir. On the basis of the evaluation index values ranking, the high performing silkworm genotypes were identified for spring, summer and autumn seasons which will serve as breeding resource material for further identification of season-specific hybrids for Kashmir Division of J&K state. The study revealed that genotypes Pam 117, CSR 2 and CSR 27 performed better in all the three rearing seasons' *viz*., spring, summer and autumn.

Keywords: silkworm, evaluation, season-specific, Kashmir, evaluation index

1. Introduction
The pragmatic agro climatic diversification that is met within the Jammu & Kashmir state provides a sluice in a sericultural sense for delimiting the state as a whole into two distinct sericultural zones namely, Temperate Sericultural Zone and Sub-tropical Sericultural Zone. Whole of Kashmir Valley, Doda and Poonch Districts of Jammu division and the higher reaches of Udhampur and Rajouri come under Temperate Sericultural Zone. The districts of Jammu, Kathua, foot hills of Udhampur and Rajouri fall under the Sub-tropical Sericultural Zone. The present study was undertaken for temperate climatic conditions of Kashmir valley (Altitude Range: 1500-2000 m AMSL) which has the following climatic features.

- The average temperature in Kashmir is 13.4 °C (56 °F).
- The highest monthly average high temperature is 31 °C (88 °F) in July.
- The lowest monthly average low temperature is -2 °C (28 °F) in January & December.
- Kashmir's climate receives an average of 664 mm (26.1 in) of rainfall per year.
- On average there are 103 days per year with more than 0.1 mm (0.004 in) of rainfall (precipitation).
- The driest weather is in November when an average of 18 mm (0.7 in) of rainfall (precipitation) occurs across 4 days.
- The wettest weather is in March when an average of 104 mm (4.1 in) of rainfall (precipitation) occurs across 14 days.
- The average annual relative humidity is 68.7% and average monthly relative humidity ranges from 57% in June to 83% in January.
- Average sunlight hours range between 2.0 hours per day in January and 8.0 hours per day in July.

Kashmir due to its salubrious climatic conditions is ideal for bivoltine silkworm rearing but the average cocoon yield production is still around 45 kg/100 DFLs. Conventional breeding approaches employed during the last few decades have resulted in the development of many productive silkworm breeds which have significantly contributed in increasing the yield

potential in this region. Kashmir region has gradually increased the cocoon production by changing the hybrids from SH6 X NB4D2 to CSR2 X CSR4 to most recent CSR Double Hybrid (CSR2 x CSR27) X (CSR6 x CSR26). The performance of CSR double hybrid has remained very good with those farmers having adequate rearing space, sufficient leaf and follows the technological inputs. However, CSR double hybrid continues to suffer under adverse climatic conditions of temperature, humidity, poor leaf quality as well as inadequate rearing and management practices prevalent with the small and marginal farmers in the temperate region of Jammu and Kashmir. The temperate sericulture is being carried out under highly fluctuating environmental conditions and poor leaf quality [4].

Systematic breeding approaches adapted by various silkworm breeders in different sericulture advanced countries [6, 9, 5, 11, 7, 26, 3] have contributed to synthesize silkworm (*Bombyx mori* L) genotypes of desirable constitution and improvement of several quantitative and qualitative traits of economic value. The silk yield is contributed by more than 21 traits [26] and there exists inter - relationship between multiple traits in silkworm. Any efforts to improve the yield require consideration of the cumulative effect of the major traits which influences the silk yield. To judge the superiority of the silkworm breed, a common evaluation index method developed by Mano *et al*. [10] was found to be very useful in selecting potential parents for silkworm breeding programme. The evaluation index method of Mano *et al*. [10] was utilised in the present study for evaluating the potential of nineteen genotypes of silkworm during different seasons.

2. Materials and Methods

Nineteen silkworm genotypes *viz*., Chaung Naung, Sanish-18(M), Pam 114, Pam 117, CSR2, CSR6, CSR26, CSR27, CSR47, S8, N5, SK-6, SK-7, B.Con-1, B.Con-4, Dun-6, Dun-22, APS-4 and APS-5 from different silkworm breeding institutes were selected on the basis of their passport data of various economically important parameters. The details of the selected genotypes are presented in Table: 1.

The selected nineteen genotypes were reared during spring (May-June), summer (July-August) and autumn (August-September) season 2018 at Silkworm Breeding & Genetics Section, Central Sericultural Research and Training Institute, Central Silk Board, Pampore, Kashmir. The standard rearing techniques [8] were followed. The important quantitative and qualitative traits *viz*., fecundity, hatching percentage, larval duration (days), yield per 10,000 larvae by number, yield per 10,000 larvae by weight (kg), single cocoon weight (g), single shell weight (g), shell ratio (%), pupation rate (%) and filament length (m) were recorded in all the nineteen silkworm genotypes during spring, summer and autumn seasons of 2018. In each season, all the genotypes were reared following completely randomised design with three replications each and 250 larvae were maintained in each replication after 3rd moult. At the end of 5th instar, the spinning larvae were collected manually and mounted in plastic collapsible mountages. The evaluation index value was calculated for all the ten traits studied separately for each season. The evaluation index (EI) was ca1cuated as per the below mentioned procedure outlined by Mano *et al*. [10].

$$\text{Evaluation Index} = \frac{A - B}{C} \times 10 + 50$$

Where, A = Value obtained for a trait in a breed
B = Mean value of a trait of all the breed
C = Standard deviation of a trait of all the breeds
10 = Standard unit
50 = Fixed value

The evaluation index value for negative trait *viz*., larval duration and for rest of the traits was calculated separately. The index value obtained for the negative trait and rest of the traits was combined separately and the average EI value was obtained. The EI value fixed for the selection of breed is 50 or > 50 for positive traits and 50 or < 50 for negative traits. The breed which scored above the limit is considered to possess greater economic value.

3. Results and Discussion

Silkworm breeds and hybrids play a prominent role in deciding the silk output and quality. However, the problems with silkworm breeds have been many and vary in different sericultural regions of the country. India is a vast country with varying climatic conditions in different agro-climate zones. The agro climatic conditions of Kashmir division of Jammu & Kashmir state are totally different from the rest of the country and require special attention for development or identification of region and season specific breeds. Accordingly, the nineteen silkworm genotypes selected for the present study were reared during spring, summer and autumn season 2018 for identification of top ranking genotypes for a particular season. The important quantitative and qualitative traits *viz*., fecundity, hatching percentage, larval duration, yield per 10,000 larvae by number, yield per 10,000 larvae by weight, single cocoon weight, single shell weight, shell ratio, pupation rate and filament length were recorded. The data of spring, summer and autumn 2018 seasons is presented in Table: 2, 3 and 4 respectively.

The average data of each season was evaluated separately by utilizing the evaluation index method of Mano *et al*. [10]. The results obtained are in conformity with the result of earlier researchers like [12, 19, 20, 21, 22, 23, 24, 25, 4, 14, 15, 16, 17, 18, 1, 2]. The evaluation index values obtained on the data of spring, summer and autumn 2018 are presented in Table: 5, 6 and 7 respectively. The overall ranking of all the nineteen genotypes studied is represented in Fig. 1. Based on the average evaluation index value obtained during different seasons, the first six top ranking silkworm genotypes are presented hereunder.

Rank	Spring	Summer	Autumn
1st	CSR 27	CSR 26	Pam 117
2nd	Pam 117	CSR 2	CSR 27
3rd	Pam 114	Pam 117	CSR 2
4th	CSR 26	CSR 27	CSR 47
5th	CSR 2	DUN 22	S 8
6th	S 8	DUN 6	Pam 114

Table 1: Characteristic Features of the 19 Bivoltine Genotypes studied

S	Genotypes	Donor Institute	Larval Marking	Cocoon Colour	Cocoon Shape	S#	Genotypes	Donor Institute	Larval Marking	Cocoon Colour	Cocoon Shape
1	Chaung Naung	CSR&TI Pampore	Marked	White	Oval	11	N 5	CSR&TI Mysore	Marked	White	Constricted
2	Sanish 18 (M)	CSR&TI Pampore	Marked	White	Constricted	12	SK 6	CSR&TI Berhampur	Plain	White	Constricted
3	Pam 114	CSR&TI Pampore	Plain	White	Oval	13	SK 7	CSR&TI Berhampur	Plain	White	Constricted
4	Pam 117	CSR&TI Pampore	Plain	White	Constricted	14	B.Con-1	CSR&TI Berhampur	Plain	White	Constricted
5	CSR 2	CSR&TI Mysore	Plain	White	Oval	15	B.Con-4	CSR&TI Berhampur	Plain	White	Constricted
6	CSR 6	CSR&TI Mysore	Marked	White	Constricted	16	DUN 6	RSRS Dehradun	Plain	White	Oval
7	CSR 26	CSR&TI Mysore	Marked	White	Constricted	17	DUN 22	RSRS Dehradun	Marked	White	Constricted
8	CSR 27	CSR&TI Mysore	Plain	White	Oval	18	APS 4	APSSRDI, Hindupur (AP)	Plain	White	Constricted
9	CSR 47	CSR&TI Mysore	Plain	White	Constricted	19	APS 5	APSSRDI, Hindupur (AP)	Plain	White	Oval
10	S 8	CSR&TI Mysore	Plain	White	Oval						

Table 2: Comparative Rearing Performances of the Silkworm Genotypes during spring 2018

Genotypes	Fecundity (No)	Hatching (%)	Larval Duration (Days)	Yield/10,000 Larvae By Number	Yield/10,000 Larvae By Weight (kg)	Single Cocoon Weight (g)	Single Shell Weight (g)	Shell Ratio (%)	Pupation Rate (%)	Filament Length (m)
Chaung Naung	468	91.52	26.17	9480	13.90	1.64	0.33	20.18	92	840
Sanish 18 (M)	472	94.22	26.17	9800	14.52	1.65	0.33	20.06	95	804
Pam 114	427	95.41	26.13	9740	15.34	1.74	0.36	20.57	95	910
Pam 117	474	94.01	26.00	9760	15.57	1.76	0.37	21.02	96	930
CSR 2	468	89.57	26.00	9740	15.08	1.71	0.38	22.08	88	950
CSR 6	446	79.86	25.96	9320	14.60	1.74	0.37	21.28	90	865
CSR 26	497	92.28	26.25	9640	14.94	1.72	0.36	21.17	93	945
CSR 27	573	97.07	26.25	9600	14.72	1.70	0.38	22.16	95	960
CSR 47	470	90.90	26.60	9360	13.70	1.64	0.34	20.80	89	855
S 8	521	96.81	26.60	9620	14.51	1.68	0.34	20.30	92	870
N 5	533	95.55	26.60	9660	13.90	1.61	0.32	19.63	94	825
SK 6	428	93.66	26.17	9640	13.63	1.58	0.31	19.30	93	801
SK 7	514	94.98	26.25	9640	13.54	1.57	0.31	19.75	92	795
B.Con-1	475	94.90	25.90	9620	13.46	1.57	0.30	18.85	94	739
B.Con-4	526	92.58	26.25	9600	14.58	1.69	0.31	18.10	93	798
DUN 6	465	91.90	26.17	9600	14.14	1.64	0.33	20.12	95	850
DUN 22	527	94.03	26.25	9700	14.07	1.62	0.33	20.15	94	865
APS 4	439	95.43	26.00	9600	14.10	1.64	0.33	19.88	94	824
APS 5	496	95.02	26.42	9640	13.49	1.57	0.31	19.49	95	830
Mean	485.21	93.14	26.22	9618.95	14.30	1.66	0.34	20.26	93.11	855.58
SD	39.25	3.78	0.21	122.29	0.64	0.06	0.03	1.02	2.18	60.45

Table 3: Comparative Rearing Performances of the Silkworm Genotypes during summer 2018

Genotypes	Fecundity (No)	Hatching (%)	Larval Duration (Days)	Yield/10,000 Larvae by Number	Yield/10,000 Larvae by Weight (kg)	Single Cocoon Weight (g)	Single Shell Weight (g)	Shell Ratio (%)	Pupation Rate (%)	Filament Length (m)
Chaung Naung	578	91.35	24.02	9580	13.91	1.64	0.33	19.82	93	790
Sanish 18 (M)	512	86.78	23.96	9480	13.61	1.63	0.31	19.08	92	812
Pam 114	512	93.45	23.96	9620	14.46	1.69	0.34	20.12	95	897
Pam 117	513	93.65	23.96	9640	14.44	1.69	0.36	21.36	94	910
CSR 2	507	94.51	23.96	9360	14.86	1.78	0.38	21.35	93	920
CSR 6	415	94.48	23.96	8900	12.66	1.63	0.35	21.23	85	870
CSR 26	447	92.23	23.96	9480	15.55	1.83	0.39	21.04	93	925
CSR 27	532	94.38	23.96	9380	13.98	1.68	0.35	20.83	92	980
CSR 47	396	89.54	24.17	8840	12.79	1.65	0.35	20.91	86	900
S 8	547	90.00	23.96	9060	14.01	1.75	0.36	20.63	87	910
N 5	463	91.02	23.96	9260	13.57	1.66	0.35	20.78	87	870

SK 6	553	95.75	24.17	9530	14.32	1.57	0.32	20.13	93	825
SK 7	527	94.32	23.95	9560	15.17	1.55	0.32	20.32	94	810
B.Con-1	513	88.73	24.07	9460	14.75	1.75	0.31	17.43	92	780
B.Con-4	501	90.29	23.96	9300	15.55	1.87	0.35	18.50	91	775
DUN 6	556	93.23	23.96	9600	14.23	1.67	0.35	20.66	94	875
DUN 22	513	92.30	24.07	9600	14.28	1.68	0.37	21.79	93	850
APS 4	519	94.77	23.96	9260	13.72	1.57	0.32	20.45	91	840
APS 5	512	94.90	23.96	9460	14.09	1.60	0.33	20.31	93	850
Mean	506.11	92.40	24.00	9387.89	14.21	1.68	0.34	20.35	91.18	862.58
SD	46.46	2.46	0.07	236.70	0.78	0.09	0.02	1.06	3.02	55.60

Table 4: Comparative rearing performances of the silkworm genotypes during autumn 2018

Genotypes	Fecundity (No)	Hatching (%)	Larval Duration (Days)	Yield/10,000 Larvae by Number	Yield/10,000 Larvae by Weight (kg)	Single Cocoon Weight (g)	Single Shell Weight (g)	Shell Ratio (%)	Pupation Rate (%)	Filament Length (m)
Chaung Naung	608	96.04	25.09	9580	12.86	1.53	0.31	20.49	93	750
Sanish 18 (M)	548	95.13	25.94	9480	12.54	1.51	0.30	19.50	94	775
Pam 114	522	94.20	24.32	9640	13.14	1.55	0.31	20.16	95	850
Pam 117	541	95.35	24.48	9600	13.36	1.58	0.32	20.46	95	880
CSR 2	524	93.72	25.13	9200	13.26	1.64	0.35	21.10	91	905
CSR 6	517	94.34	25.13	8780	10.96	1.45	0.31	21.44	84	812
CSR 26	533	94.96	25.28	9140	13.39	1.66	0.33	20.07	90	905
CSR 27	523	94.12	25.00	9360	13.41	1.63	0.33	20.58	92	920
CSR 47	579	95.39	25.13	9100	13.75	1.71	0.35	20.63	87	830
S 8	354	91.79	25.94	9440	13.44	1.61	0.37	22.99	91	920
N 5	408	92.58	25.44	9420	12.77	1.55	0.33	21.30	90	870
SK 6	529	94.44	25.13	9560	13.46	1.50	0.31	20.34	93	780
SK 7	521	95.55	26.19	9400	13.42	1.51	0.31	20.21	92	750
B.Con-1	397	92.72	25.13	9360	12.56	1.53	0.28	18.28	92	770
B.Con-4	399	88.71	25.00	9440	12.55	1.52	0.26	17.37	93	750
DUN 6	461	94.74	25.13	9500	12.72	1.53	0.29	19.06	93	825
DUN 22	437	93.79	25.13	9240	11.72	1.46	0.27	18.24	91	810
APS 4	520	94.67	24.75	9360	13.47	1.52	0.30	19.43	92	790
APS 5	505	94.55	25.07	9440	13.63	1.50	0.30	19.64	92	775
Mean	496	94.04	25.18	9370.53	12.97	1.55	0.31	20.07	91	824.58
SD	67.64	1.68	0.46	207.24	0.70	0.07	0.03	1.29	2.58	60.13

Table 5: Evaluation Index Values of Selected Traits during spring 2018

Genotypes	Fecundity	Hatching	Larval Duration	Yield/10,000 Larvae by Number	Yield/10,000 Larvae by Weight	Single Cocoon Weight	Single Shell Weight	Shell Ratio	Pupation Rate	Filament Length	Average Evaluation Index	Rank
Chaung Naung	45.62	45.71	47.62	38.64	43.75	46.67	46.67	49.22	44.91	47.42	45.40	XIV
Sanish 18 (M)	46.63	52.86	47.62	64.80	53.44	48.33	46.67	48.04	58.67	41.47	51.21	VII
Pam 114	35.17	56.01	45.71	59.90	66.25	63.33	56.67	53.04	58.67	59.00	56.45	III
Pam 117	47.14	52.30	39.52	61.53	69.84	66.67	60.00	57.45	63.26	62.31	60.06	II
CSR 2	45.62	40.56	39.52	59.90	62.19	58.33	63.33	67.84	26.56	65.62	54.44	V
CSR 6	40.01	14.87	37.62	25.55	54.69	63.33	60.00	60.00	35.73	51.56	45.08	XVI
CSR 26	53.00	47.72	51.43	51.72	60.00	60.00	56.67	58.92	49.50	64.79	55.81	IV
CSR 27	72.37	60.40	51.43	48.45	56.56	56.67	63.33	68.63	58.67	67.27	61.37	I
CSR 47	46.12	44.07	68.10	28.82	40.69	46.67	50.00	55.29	31.15	49.90	43.64	XVII
S 8	59.12	59.71	68.10	50.09	53.34	53.33	50.00	50.39	44.91	52.39	52.59	VI
N 5	62.18	56.38	68.10	53.36	43.81	41.67	43.33	43.82	54.08	44.94	49.29	IX
SK 6	35.42	51.38	47.62	51.72	39.55	36.67	40.00	40.59	49.50	40.97	42.87	XVIII
SK 7	57.34	54.87	51.43	51.72	38.05	35.00	40.00	45.00	44.91	39.98	45.21	XV
B.Con-1	47.40	54.66	34.76	50.09	36.80	35.00	36.67	36.18	54.08	30.71	42.40	XIX
B.Con-4	60.39	48.52	51.43	48.45	54.31	55.00	40.00	28.82	49.50	40.47	47.27	XII
DUN 6	44.85	46.72	47.62	48.45	47.56	46.67	46.67	48.63	58.67	49.08	48.59	X
DUN 22	60.65	52.35	51.43	56.63	46.34	43.33	46.67	48.92	54.08	51.56	51.17	VIII
APS 4	38.23	56.06	39.52	48.45	46.81	46.67	46.67	46.27	54.08	44.78	47.56	XI
APS 5	52.75	54.97	59.52	51.72	37.30	35.00	40.00	42.45	58.67	45.77	46.51	XIII

Table 6: Evaluation Index Values of Selected Traits during summer 2018

Genotypes	Fecundity	Hatching	Larval Duration	Yield/10,000 Larvae by Number	Yield/10,000 Larvae by Weight	Single Cocoon Weight	Single Shell Weight	Shell Ratio	Pupation Rate	Filament Length	Average Evaluation Index	Rank
Chaung Naung	65.47	45.73	52.86	58.12	46.15	45.56	45.00	45.00	56.03	36.95	49.33	XIII
Sanish 18 (M)	51.27	27.15	44.29	53.89	42.31	44.44	35.00	38.02	51.06	40.90	42.67	XVIII
Pam 114	51.27	54.27	44.29	59.81	53.21	51.11	50.00	47.83	60.99	56.19	53.85	VII
Pam 117	51.48	55.08	44.29	60.65	52.95	51.11	60.00	59.53	59.34	58.53	56.52	III
CSR 2	50.19	58.58	44.29	48.82	58.33	61.11	70.00	59.43	54.37	60.33	57.91	II
CSR 6	30.39	58.46	44.29	29.39	30.13	44.44	55.00	58.30	27.88	51.33	42.81	XVII
CSR 26	37.28	49.31	44.29	53.89	67.18	66.67	75.00	56.51	56.03	61.23	58.12	I
CSR 27	55.57	58.05	44.29	49.67	47.05	50.00	55.00	54.53	51.06	71.12	54.67	IV
CSR 47	26.30	38.37	74.29	26.85	31.79	46.67	55.00	55.28	31.19	56.73	40.91	XIX
S 8	58.80	40.24	44.29	36.15	47.44	57.78	60.00	52.64	34.50	58.53	49.56	XII
N 5	40.72	44.39	44.29	44.60	41.79	47.78	55.00	54.06	36.16	51.33	46.20	XV
SK 6	60.09	63.62	74.29	56.00	51.41	37.78	40.00	47.92	56.03	43.24	50.68	IX
SK 7	54.50	57.80	42.86	57.27	62.31	35.56	40.00	49.72	59.34	40.54	50.78	VIII
B.Con-1	51.48	35.08	60.00	53.05	56.92	57.78	35.00	22.45	51.06	35.15	44.22	XVI
B.Con-4	48.90	41.42	44.29	46.29	67.18	71.11	55.00	32.55	49.40	34.25	49.57	XI
DUN 6	60.74	53.37	44.29	58.96	50.26	48.89	55.00	52.92	57.68	52.23	54.45	VI
DUN 22	51.48	49.59	60.00	58.96	50.90	50.00	65.00	63.58	54.37	47.74	54.63	V
APS 4	52.77	59.63	44.29	44.60	43.72	37.78	40.00	50.94	49.40	45.94	47.20	XIV
APS 5	51.27	60.16	44.29	53.05	48.46	41.11	45.00	49.62	54.37	47.74	50.09	X

Table 7: Evaluation Index Values of Selected Traits during autumn 2018

Genotypes	Fecundity	Hatching	Larval Duration	Yield/10,000 Larvae by Number	Yield/10,000 Larvae by Weight	Single Cocoon Weight	Single Shell Weight	Shell Ratio	Pupation Rate	Filament Length	Average Evaluation Index	Rank
Chaung Naung	66.59	61.90	48.04	60.11	48.43	47.14	50.00	53.26	55.00	37.60	53.34	VIII
Sanish 18 (M)	57.69	56.49	66.52	55.28	43.86	44.29	46.67	45.58	58.88	41.75	50.05	XI
Pam 114	53.84	50.95	31.30	63.00	52.43	50.00	50.00	50.70	62.75	54.23	54.21	VI
Pam 117	56.65	57.80	34.78	61.07	55.57	54.29	53.33	53.02	64.69	59.22	57.29	I
CSR 2	54.13	48.10	48.91	41.77	54.14	62.86	63.33	57.98	47.25	63.37	54.77	III
CSR 6	53.10	51.79	48.91	21.51	21.29	35.71	50.00	60.62	22.05	47.91	40.44	XVIII
CSR 26	55.47	55.48	52.17	38.88	56.00	65.71	56.67	50.00	43.37	63.37	53.88	VII
CSR 27	53.99	50.48	46.09	49.49	56.29	61.43	56.67	53.95	53.06	65.87	55.69	II
CSR 47	62.29	58.04	48.91	36.95	61.14	72.86	63.33	54.34	31.74	50.90	54.62	IV
S 8	28.93	36.61	66.52	53.35	56.71	58.57	70.00	72.64	47.25	65.87	54.44	V
N 5	36.94	41.31	55.65	52.39	47.14	50.00	56.67	59.53	45.31	57.55	49.65	XII
SK 6	54.88	52.38	48.91	59.14	57.00	42.86	50.00	52.09	55.00	42.59	51.77	IX
SK 7	53.69	58.99	71.96	51.42	56.43	44.29	50.00	51.09	51.12	37.60	50.51	X
B.Con-1	35.31	42.14	48.91	49.49	44.14	47.14	40.00	36.12	51.12	40.92	42.93	XVI
B.Con-4	35.60	18.27	46.09	53.35	44.00	45.71	33.33	29.07	55.00	37.60	39.11	XIX
DUN 6	44.80	54.17	48.91	56.25	46.43	47.14	43.33	42.17	56.94	50.07	49.03	XV
DUN 22	41.24	48.51	48.91	43.70	32.14	37.14	36.67	35.81	47.25	47.58	41.12	XVII
APS 4	53.54	53.75	40.65	49.49	57.14	45.71	46.67	45.04	51.12	44.25	49.64	XIII
APS 5	51.32	53.04	47.61	53.35	59.43	42.86	46.67	46.67	51.12	41.75	49.58	XIV

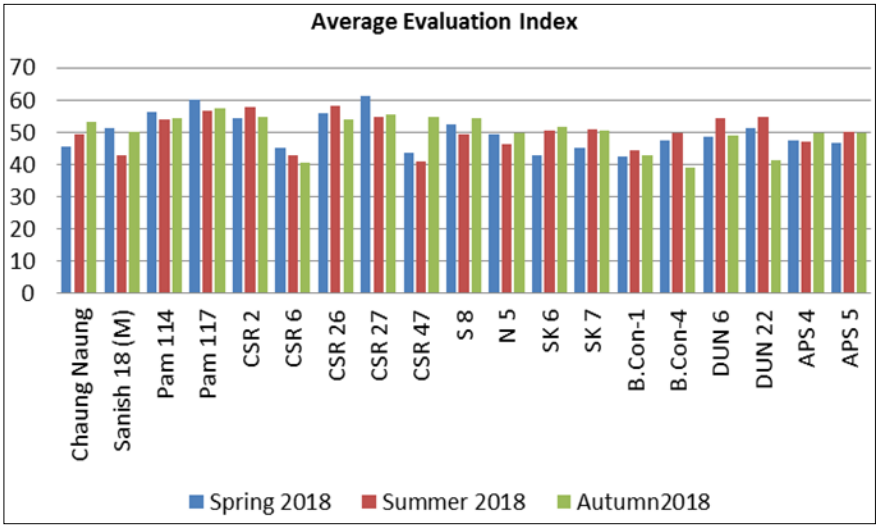

Fig 1: Graphical representation of the performance of the studied genotypes during different rearing seasons based on average evaluation index values

4. Conclusion

The results have revealed that the genotypes CSR 27, Pam 117 and CSR 2 have performed better during all the three seasons. Pam 114 have figured in the top ranking genotypes in spring and autumn while as CSR 26 performed better during spring & summer seasons and S 8 during spring and autumn season. The genotypes DUN 22 and DUN 6 have showed their better performance during summer season only. These genotypes have recorded evaluation index > 50 for positive traits and < 50 for negative traits like larval duration. The genotypes having scored above the limit are considered to possess greater economic value. The identified genotypes can be utilised in future breeding programmes for development of season specific hybrids for temperate climatic conditions of Kashmir.

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