Uttar Pradesh J. Zool. 25(1) : 29-33, 2005 ISSN 0256-971X

SAHA READY RECKONER - A NEW PRACTICAL APPROACH FOR DIRECT ASSESSMENT OF COCOON YIELD

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Quality silkworm seed play a vital role for production of better cocoon yield. Irrespective of fecundity, uniform number of eggs should be fixed for 100 dfls while assessing performance of silkworm breed or hybrid. Though the yield is directly proportional to fecundity, hatching percent, ERR percent and single cocoon weight, standard norms should be fixed for determination of cocoon yield/100dfls. The Saha Ready Reckoner described here may be helpful in direct assessment of cocoon yield at laboratory and field level easily.

The quality of yarn is the ultimate objective of silk industry and cocoon yield continues to be of prime importance from rearing point of view. Present trend is to express the rearing performance in terms of kilogram of cocoon per hundred numbers of Disease Free Layings (Dfls). As such it means kilogram of cocoons produced by the larvae from the laying of hundred of female moths, which in turn depends on factors like type of breed (univoltine, bivoltine, multivoltine or cross breed), breed concerned (because fecundity varies from race to race even within same type of voltinism), hatching ability, survival percent and quality of rearing along with other factors. To a particular rearer the variation in cocoon yield is mainly due to the variations other than the quality of rearing, which remains same for farmer. When it is said that productivity is 30 kg/100 dfls (say), it fails to explain the factors responsible for such type of cocoon yield compared to others. The following table (Table I) will reflect that though all the three types of race/combination are having same yield per hundred dfls but these differ in all other parameters *viz.* fecundity, ERR% (Effective Rate of Rearing) and single cocoon weight.

Table I : Rearing performance of the breed/hybrid.

Type of breed/Hybrid	Fecundity	ERR%	Single cocoon weight (g)	Yield/100 dfls (kg)
Multivoltine	350	85.71	1.00	30
Multi x Bi	450	44.40	1.50	30
Bivoltine	550	30.20	1.80	30

Among these three factors, fecundity and single cocoon weight are controlled genetically whereas ERR% is a derivative character which depends upon hatching percent followed by survival. Hatching percentage is mostly governed by the quality of seed supplied to farmers, whereas survival is greatly influenced by the rearing condition. So, the ERR% is the indication of rearing management which ultimately reflects through the average cocoon yield.

Generally the farmers are getting dfls in the form of egg card/sheet. Experience indicates that there is wide variation in number of eggs and also the number of fertile eggs per dfls. Thus, the quantity of fertile eggs being provided to the farmers is not in commensuration with the actual dfls supplied. This is bound to be reflected on ERR%. Thus, the technique of reflecting rearing performance in terms of yield per hundred dfls is required to be modified suitably.

Till date, however, because there are no standard norms, cocoon yield (kg)/100 dfls cannot be assessed properly. The system in vogue for calculating cocoon yield/100 dfls has some lacunae, as breeds/hybrids lost its original performance; yield gap is maximum between laboratory and field performance. No system is adopted till today to calculate directly survival percent of a particular breed or hybrid.

Authors are suggesting for consideration of yield per 40,000 larvae (1st Instar) in lieu of yield per 100 dfls and accordingly price of eggs should be fixed, not for 100 dfls as such. The procedure will be :

Assumption : Weight of single fertile/viable egg of particular race is known.

Methodology

- Standardize the weight of 40,000 fertile/viable eggs as unit e.g. it may be 18 gm/18.5 gm/20 gm/22 gm etc., depending upon the race/combination and breed concerned.
- Fix the price for each unit of eggs.

Hatching percent also depends upon the quality of seeds used. In view of shortage in supply of quality seed during the peak season of rearing the farmers are forced to purchase seed whatever is available to them and thereby increasing the possibility of yield variation or poor performance of crop in the form of varied hatching percent.

Thus, quantity of cocoon yield depends on mainly three factors, (i) type of silkworm breed/hybrid used, (ii) type of technology adopted and (iii) quality of seeds used. Adequate research and efficient transfer of technology can take care of the first two items while the last one could be solved through the adoption of efficient seed supply system. At present Government Organizations are supplying far below the required amount of seeds, only 19% and 26% of seed were supplied by the Government of West Bengal and Karnataka respectively during 1994-95 (Annoymous, 1997) thereby dependence on private grainage has become inevitable, and it is quite evident that any private enterpreuner is mostly interested in maximizing profit. Often farmers complain against quality of seeds which remains point of dispute between farmers and the seed suppliers. Above all, for the efficient extension and betterment of silk industry it is of utmost importance that Government Organization should have adequate monitoring over the functioning of private grainage so far as the quality and price of the seed are concerned.

At this juncture it is felt imperative that (i) whatever may be the production of seeds by the private grainage it should be inspected and thoroughly examined by the Government Organization before reaching the farmers at Government prefixed price, (ii) feasibility of loose eggs preparation may be explored and (iii) weight of 40,000 viable/fertile eggs should be considered as one unit and price may be fixed accordingly as explained.

Cocoon yield (Y) is directly proportional to four important contributory factors *viz.* fecundity (α), hatching percent (β), survival percent (r) and single cocoon weight (δ). The actual mathematical relation can be derived as : $\mathbf{Y = K \times \alpha \times \beta \times r \times \delta}$ **kg per 100dfls** where, K is the proportionality constant and estimated as 10^{-1}.

Thus, any factor can be worked out if the others are known. Saha Ready Reckoner (Table II) has been prepared for comparison of yield *vis-à-vis* rearing perfomances, taking 40,000 larvae (1st Instar) for the purpose, which may be popularized among the farmers.

Table II : Saha Ready Reckoner for direct assessment of cocoon yield.

SCW (g)	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5
	COCOON YIELD (kg)																	
ERR (%)																		
100	32.00	36.00	40.00	44.00	48.00	52.00	56.00	60.00	64.00	68.00	72.00	76.00	80.00	84.00	88.00	92.00	96.00	100.0
98	31.36	35.28	39.20	43.10	47.04	50.96	54.88	58.80	62.72	66.64	70.56	74.48	78.40	82.32	86.24	90.16	94.08	98.00
96	30.72	34.56	38.40	42.24	46.08	49.92	53.76	57.60	61.44	65.28	69.12	72.96	76.80	80.64	84.48	88.32	92.16	96.00
94	30.08	33.84	37.60	41.36	45.12	48.88	52.64	56.40	60.16	63.92	67.68	71.44	75.20	78.96	82.72	86.48	90.24	94.00
92	29.44	33.12	36.80	40.38	44.16	47.84	51.52	55.20	58.88	62.56	66.24	69.92	73.60	77.28	80.96	84.64	88.32	92.00
90	28.80	32.40	36.00	39.60	43.20	46.80	50.40	54.00	57.60	61.20	64.80	68.40	72.00	75.60	79.20	82.80	86.40	90.00
88	28.16	31.68	35.20	38.72	42.24	45.76	49.28	52.80	56.32	59.84	63.36	66.88	70.40	73.92	77.44	80.96	84.48	88.00
86	27.52	30.96	34.40	37.84	41.28	44.72	48.16	51.60	55.04	58.48	61.92	65.36	68.80	72.24	75.68	79.12	82.56	86.00
84	26.88	30.24	33.60	36.96	40.32	43.68	47.04	50.40	53.74	57.12	60.48	63.84	67.20	70.56	73.92	77.28	80.64	84.00
82	26.24	29.52	32.80	36.08	39.36	42.64	45.92	49.20	52.48	55.76	59.04	62.32	65.60	68.88	72.16	75.44	78.72	82.00
80	25.60	28.80	32.00	35.20	38.40	41.60	44.80	48.00	51.20	54.40	57.60	60.80	64.00	67.20	70.40	73.60	76.80	80.00
78	24.96	28.08	31.20	34.32	37.44	40.56	43.68	46.80	49.92	53.04	56.16	59.28	62.00	65.52	68.64	71.76	74.88	78.00
76	24.32	27.36	30.40	33.44	36.48	39.52	42.56	45.60	48.64	51.68	54.72	57.76	60.80	63.84	66.88	69.92	72.96	76.00
74	23.68	26.64	29.60	32.56	35.52	38.48	41.44	44.40	47.36	50.32	53.28	56.24	59.20	62.16	65.12	68.08	71.04	74.00
72	23.04	25.92	28.80	31.68	34.56	37.44	40.32	43.20	46.08	48.96	51.84	54.72	57.60	60.48	63.36	66.24	69.12	72.00
70	22.40	25.20	28.00	30.80	33.60	36.40	39.20	42.00	44.80	47.60	50.40	53.20	56.00	58.80	61.60	64.40	67.20	70.00
68	21.76	24.48	27.20	29.92	32.64	35.36	38.08	40.80	43.52	46.24	48.96	51.68	54.40	57.12	59.84	62.56	65.28	68.00
66	21.12	23.76	26.40	29.04	31.68	34.32	36.96	39.60	42.24	44.88	47.52	50.16	52.80	55.44	58.08	60.72	63.36	66.00
64	20.48	23.04	25.60	28.16	30.72	33.28	35.84	38.40	40.96	43.52	46.08	48.64	51.20	53.76	56.32	58.88	61.44	64.00
62	19.84	22.32	24.80	27.28	29.76	32.24	34.72	37.20	39.68	42.16	44.64	47.12	49.60	52.08	54.56	57.04	59.52	62.00
60	19.20	21.60	24.00	26.40	28.80	31.20	33.60	36.00	38.40	40.80	43.20	45.60	48.00	50.40	52.80	55.20	57.60	60.00
58	18.56	20.88	23.20	25.52	27.84	30.16	32.48	34.80	37.12	39.44	41.76	44.08	46.40	48.72	51.04	53.36	55.68	58.00
56	17.92	20.16	22.40	24.64	26.88	29.12	31.36	33.60	35.84	38.04	40.32	42.56	44.80	47.04	49.28	51.52	53.76	56.00
54	17.28	19.44	21.60	23.76	25.92	28.08	30.24	32.40	34.56	36.72	38.88	41.04	43.20	45.36	47.52	49.68	51.84	54.00
52	16.64	18.72	20.80	22.88	24.96	27.04	29.12	31.20	33.28	35.36	37.44	39.52	41.60	43.68	45.76	47.84	49.92	52.00
50	16.00	18.00	20.00	22.00	24.00	26.00	28.00	30.00	32.00	34.00	36.00	38.00	40.00	42.00	44.00	46.00	48.00	50.00
48	15.36	17.28	19.20	21.12	23.04	24.96	26.88	28.80	30.72	32.64	34.56	36.48	38.40	40.32	42.24	44.16	46.08	48.00
46	14.72	16.56	18.40	20.24	22.08	23.92	25.76	27.60	29.44	31.28	33.12	34.96	36.80	38.64	40.48	42.32	44.16	46.00
44	14.08	15.84	17.60	19.36	21.12	22.88	24.64	26.40	28.16	29.92	31.68	33.44	35.20	36.96	38.72	40.48	42.24	44.00
42	13.44	15.12	16.80	18.48	20.16	21.84	23.52	25.20	26.88	28.56	30.24	31.92	33.60	35.28	36.96	38.64	40.32	42.00
40	12.80	14.40	16.00	17.60	19.20	20.80	22.40	24.00	25.60	27.20	28.80	30.40	32.00	33.60	35.20	36.80	38.40	40.00

For 40,000 larvae (Ist Instar); SCW = Single Cocoon Weight (avg.); g = Gram; ERR = Effective Rate of Rearing.

Mode of application : Saha Ready Reckoner helps in determination or calculation of different rearing parameters more accurately than that of the existing method provided number of larvae should be 40,000/100 dfls as unit of calculation. The following rearing parameters can be read from Saha Ready Reckoner without any arithmetical calculation.

- *Direct assessment of cocoon yield* : Take the ERR% and average single cocoon weight (g) of any particular lot/breed/hybrid from rearing and see the Saha Ready Reckoner. Cocoon yield (kg/100 dfls) can be obtained readily. The cocoon yield calculated in this method is more accurate than any other method of yield calculation. If ERR% is 90% and average single cocoon weight is 1.3 g, the cocoon yield/100dfls is 46.80 kg.
- *Instant determination of survival percentage* : Take the cocoon yield/100dfls and average single cocoon weight, either from farmers' level data or laboratory data of rearing and apply in the Saha Ready Reckoner. The survival percentage will be obtained easily. If cocoon yield/100dfls is 48 kg and average single cocoon weight is 1.5 g, the survival percentage is 80% as seen in Table II.
- *Reasons for yield gap between lab and land and minimization of error in data collection of rearing performance* : The cocoon yield and ERR% calculation are currently based on a fixed number of larvae counted out during the 3rd and 4th instars at the laboratory level. The average single cocoon weight as well SR% is also determined based on a selected minimum number (~10 or 20) of cocoons. Fecundity is also not fixed for the breed or hybrid. The yield and survival thus calculated leads to magnified values, since the method does not account for larval mortality upto 3rd and 4th Instar. Thus when the same breed/ hybrid is evaluated at farmers' level, there is lot of difference in cocoon yield which is more accurate result than the laboratory because one takes into consideration the missing percent and larval mortality right from hatching. Yield gap studies in sericulture are quite important in different regions, eco-climatic conditions as it may throw more light on bridging the gap between the lab and land performance also to know the potentiality of the breeds in the laboratory and in the field (Ramanuja *et al.*, 1996). In order to minimize this error of the yield gap between lab and land, the Saha Ready Reckoner has kept the unit of 40,000 viable eggs/larvae as a base for calculating yield, survival as well as average single cocoon weight.
- *Actual evaluation of performance of a particular breed or hybrid* : The Saha Ready Reckoner can directly help to evaluate the actual performance of a particular breed or hybrid (Table III).

Table III : Evaluation of performance of a particular breed or hybrid.

Race	Fecundity (No.)	ERR%	SCW (g)	Yield/100 dfls (kg)
R1	400	90	1.11	40
R2	600	60	1.25	45

Table IV : Evaluation of the actual performance of a particular breed or hybrid.

Race	Cocoon yield/100 dfls (kgs)	ERR%	Single cocoon weight (g)
R1	40	90	1.11
R2	30	60	1.25

Based on above, one will automatically prefer race R2 compared to the race R1 because of higher cocoon yield per 100 dfls (Table III), instead, if we consider yield per 40,000 larvae then the race R1 express much better yield than the race R2 (Table IV).

Moreover, as the ERR% is also very high for R1, wastage of mulberry leaf will also be less and adaptability of the race R1 is also more than the R2. By this way the original performance of the breed or hybrid will be evaluated. And it is expected that this method will replace almost all anomalies for assessing rearing parameters and will give a new direction for improvement of the silk industry.

ACKNOWLEDGEMENTS

The authors are grateful to Dr. S.K. Das, Dr. T. Datta (Biswas), Mr. B.C. Roy and Mr. D. Bhattacharya for helping in preparation of manuscript and to Mr. R.K. Das for typing the manuscript.

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