Cassman, 1994). Interaction effect between the varieties and P application was found to be significant.

The study conclusively proved that selection of phosphorus efficient rice varieties like ADT 39 coupled with best method of P application i.e., recommended dose of phosphorus as enriched farm yard manure increases the yields of rice. The superiority of ADT 39 over other varieties and P application as enriched farm yard manure was maintained throughout the crop growth period in all aspects. The combined use of organic manures with P fertiliser instigates the release of available P by reducing fixation. This increases the P uptake resulting in higher yields. In addition to this the application of phosphorus to both nursery and main field produces higher yields due to increased nitrogen and phosphorus availability in nursery and main field which in turn resulted in higher uptake of N and P. All methods of P application performed better than control. On the other hand the variety IR 20 recorded least in all growth parameters, yield attributes and yield.

References

Cassman, K.G. (ed.) (1994). Breaking the yield barrier: Proceedings of a workshop on rice yield potential in favorable environments, IRRI, 29 November - 4 December 1993. International Rice Research Institute, Manila, Philippines.

Kolambe, B.N. and Patel, M.N. (1994). Efficient utilization of P by transplanted rice in vertisols. *Fert. News.* 39 : 39-45.

Laskar, B.K. and De, G.K. (1990). Effect of phosphatic fertilisers and organic matter on grain yield of rice in acid sulphate soil. *Oryza.* 27 : 251-253.

Premkumar, T., Arunachalam, G. and Chandrasekharan, S. (1986). Use of rock phosphate with organic matter on rice yield. (In) Rock phosphate in Agriculture. (ed.), G.V.Kothandaraman, T.S. Manickam and K.Natarajan,TNAU and Pyrites, Phosphates and Chemicals Ltd. India : 204-208.

Rajendran, R. (1991). Effect of nursery manuring and phosphrous nutrition on grain yield of transplanted rice. *The Andhra Agric. J.* 37 : 372-373.

Rana, K.S. and Sharma, S.K. (1993). Effect of *rabi* legumes on nitrogen economy and productivity of direct seeded upland rice. *Crop Res.* 6 : 165-167.

Reddy, M.D. and Mittra, B.N. (1985). Response of rice to different forms of urea and phosphorus fertilisation under intermediate deep water condition (15-50 cm). *Plant and Soil.* 84 : 431-435.

Tandon, H.L.S. and Kanwar, J.S. (1984). A review of fertiliser use research on sorghum in India.*Research Bull.No.8, ICRISAT* : 57.

Tripathi, D. and Minhas, R.S. (1991). Influence of fertiliser phosphorus and farm yard manure on transformation of inorganic phosphate. *J. Indian Soc. Soil Sci.* 39 : 472-476.

Yoshida, S., Forno, D.A., Cock, J.H.and Gomez, K.A. (1976). Laboratory manual for physiological studies of rice crop science. P.67. Int. Rice Res. Inst., Los Banos, Philipines.

(Received : March 2000 ; Revised : March 2001)

Madras Agric. J. 88 (1-3) : 111-114 January - March 2001

https://doi.org/10.29321/MAJ.10.A00316

Mulberry leaf maturity as a stress factor in rearing of CSR hybrid silk worms and its impact on cocoon characters and incidence of diseases

K.M. VIJAYA KUMARI, M. BALAVENKATASUBBAIAH, R.K. RAJAN, M.T. HIMANTHARAJ, B. NATARAJU AND M. REKHA

Central Sericultural Research and Training Institute, Mysore-570 008, Karnataka.

Abstract : The rearing of newly evolved productive bivoltine hybrid (CSR 2 x CSR 5) was conducted with different leaf maturity (50, 65, 80, 90 days after pruning) during fifth instar. The rearing performance and the incidence of diseases were studied under optimum rearing conditions as well as in the presence of 1% infextious source of flacherie and grasserie. The results revealed that the cocoon characters were significantly improved, diseases incidence and spread of diseases were minimised in leaf fed wtih 65 days matured leaf. (*Key words : Cocoon characters, Disease incidence,Disease spread, Flacherie, Grasserie, Leaf maturity.*)

The mulberry leaf is the exclusive food of silkworm, *Bombyx mori* L. Suitable quality of mulberry leaves decide the success of silkworm crops (Datta *et al.* 1996). There is an established relationship between growth of mulberry plant and rearing of silkworms. Immature mulberry leaves cannot provide proper nutrition to silkworm larvae and they suffer from diseases. Larval growth and cocoon quality are poor when silkworm larvae are fed with over matured leaves (Narasimhanna, 1988). The tender leaves are not suitable for feeding of silkworms particularly in the later ages as they lead to crop losses (Krishnaswami *et al.* 1970). Utilization of leaf at correct maturity is an important factor to obtain the best cocoon crop and good quality cocoons.(Anonymous, 1987). So it is imaportant to select the right type of leaf at appropriate maturity to feed the silkworms of different instars according to their need. The mulberry leaves for grown up silkworms have a great effect not only on the nutrition of the silkworm but also on the raw silk percentage and the quality of the cocoon (Jolly, 1987).The information on the effect of feeding different leaf maturity in fifth stage silkworms and on the economic characters is scanty. Hence, it was felt necessary to study the effect of feeding different maturity mulberry leaf to newly evolved productive bivoltine hybrid, (CSR2 x CSR5) and its effect on their growth, cocoon characters and disease incidence under normal (control) and in the presence of 1% infectious source of flacherie and grasserie diseases.

Materials and Methods

The CSR2 x CSR5 larva were brushed and reared upto 3rd moult by feeding normal quality of leaves following the standard rearing practice (Krishnaswami, 1978). Immediately after 3rd moult, few larvae were inoculated with BmNPV ($1x10^7$ it's a occluded virus /ml/100 larvae) and reared separately till the 4th moult. Another set of larvae were inoculated with BmIFV, a non occluded virus (1 ml of 10% BmIFV diseased larval homogenate) was smeared uniformly on the mulberry leaf surface and fed to a population of 100 larvae on the first day and *Streptococcus* bacteria (1×10^7 bacterial cells/ml/100 larvae) on second day and reared as above. The remaining larvae were reared upto fourth moult. On resumption of fourth moult, they were replicated thrice with 200 larvae/replication/ treatment. In first set, larvae were grouped into 4 treatments and fed with mulberry leaves of different maturity level after pruning *viz.*, 50, 65, 80 and 95 days in normal control condition. In the second set, the larvae were replicated as above and each treatment had inoculation of either 1% infection with flacherie or grasserie at the beginning of the 5th instar. Both the sets of larvae were reared under optimum rearing conditions except for the different level of matured leaves. During the rearing and also on the mountages the disease incidence was recorded. The larvae were weighed prior to spinning to find out the maximum larval growth. After completion of spinning, cocoons were harvested on sixth day and assessed for the effective rate of rearing, cocoon characters *viz.*, single cocoon weight, single shell weight and shell ratio and disease incidence. The experiment was repeated thrice and the data were subjected to suitable statistical analysis.

Results and Discussion

Incidence of Flacherie and Grasserie

In control batch, the larvae fed with 65 days old leaf during 5th instar showed improvement in the cocoon characters with minimum incidence of flacherie. The highest incidence of flacherie and cocoon melting was observed in larvae fed with 95 days old leaves. Feeding with 50 days old leaves also enhanced disease incidence. This observation is in agreement with the earlier findings of Krishnaswami (1990). The poor performance in the batch fed with 95 days old leaves may be due to less nutrients and inferior quality mulberry leaves. Similar observations were also recorded by Sarkar *et al.* (1992). Hence, feeding the worms with premature or over matured mulberry leaves enhanced the incidence of flacherie. There was no effect on the incidence of grasserie by feeding leaf of different levels of maturity in normal control conditions, whereas in infectious source there was significant difference between the treatments. (Fig 1and 2).

Larval duration

Among the treatments, larval duration was significantly reduced in 65 days old leaf treatment. But there was significant difference between normal rearing and rearing with infectious source. In infectious source of rearing, the larval duration was prolonged, when compared with normal rearing. With increase leaf maturity, the larval duration was prolonged (Tables 1 and 2)

Effective Rate of Rearing (ERR)

The survival of larvae both in number and weight improved when larvae were fed with 65 days old leaf during 5th instar both in normal and inoculated batch. The ERR significantly decreased in 95 days old leaf. The over matured leaves are generally less in moisture, protein, carbohydrate contents. This resulted in prolonged larval period with poor cocoon weight. This indicates that leaf maturity has significant

Table 1. Comparative rearing performance with infectious source of grasserie and control batch

Treatment	larval weight (g)		V Instar larval duration (h)		ERR No.		ERR.Wt (kg)		Cocoon. Wt. (g)		Shell. Wt (g)		S.R.%	
	IFS	Control	IFS	Control	IFS	Control	IFS	Control	IFS	Control	IFS	Control	IFS	Control
50 days	43.92	44.49	177	155	4616	9508	7.142	17.065	1.546	1.887	0.341	0.440	22.11	23.27
65 days	48.03	47.98	173	155	5116	9775	8.699	18.288	1.705	1.991	0.385	0.481	22.52	24.13
80 days	42.05	46.06	181	163	4700	9525	7.327	17.335	1.576	1.939	0.348	0.454	21.08	23.36
95 days	40.20	45.46	189	165	3183	9375	4.916	16.650	1.545	1.889	0.333	0.433	21.55	22.91
CD at 5%	1.498 **		1.097 **		261 **		0.969 **		0.082 **		0.029 **		0.894 **	

IFS : Infectious source

Table 2. Comparative rearing performance between flacherie and healthy batch

Treatment	larval. weight (g)		V Instar larval duration (h)		ERR No.		ERR.Wt (kg)		Cocoon. Wt. (g)		Shell. Wt (g)		S.R.%	
	IFS	Control	IFS	Control	IFS	Control	IFS	Control	IFS	Control	IFS	Control	IFS	Control
50 days	41.35	44.49	178	155	5416	9508	8.430	17.065	1.556	1.888	0.343	0.440	22.05	23.27
65 days	47.68	47.98	169	155	5800	9775	9.781	18.288	1.688	1.991	0.376	0.481	22.25	24.13
80 days	43.38	46.06	188	163	5250	9525	8.285	17.335	1.581	1.939	0.343	0.454	21.69	23.36
95 days	41.83	45.46	189	165	4016	9375	6.161	16.650	1.535	1.889	0.328	0.433	21.35	22.91
CD at 5%	1.884 **		1.097 **		300 **		0.923 **		0.080 **		0.029 **		0.873 **	

IFS : Infectious source

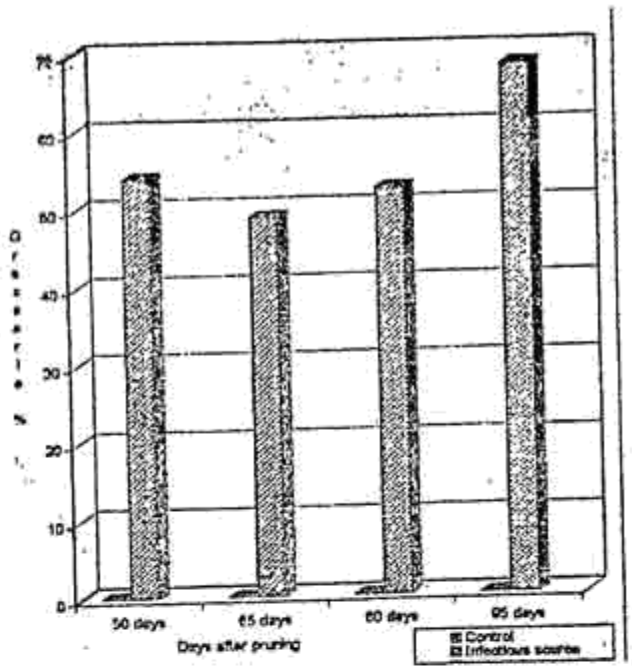

Fig.1 Effect of leaf maturity on Grasserie disease percentage in control and in infectious source

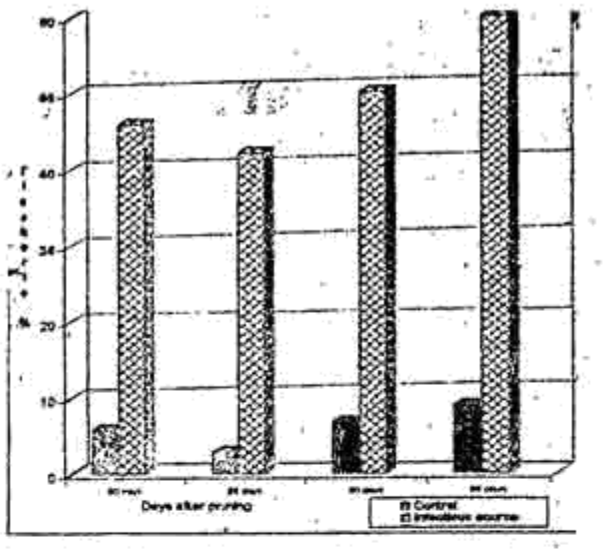

Fig.2 Effect of leaf maturity on Flacherie disease percentage in control and in infectious source

effect on the ERR. The batches fed with 65 days old leaves showed higher survival in healthy and inoculated infectious source of rearing. (Table 1 and 2).

Cocoon and Shell weight

The single cocoon and shell weight were significantly increased when larvae fed with 65 days old leaf. Larvae fed with 95 days old leaf showed low cocoon and shell weight both in healthy and inoculated batches. This is may be due to comparative high nutritional content of the leaves. Similar observation was made by Li and Sano (1984). Among the treatments, there was significant difference between normal and infectious source of rearings in respect of shell weight. (Tables 1 and 2).

This study highlighted the importance of feeding quality mulberry leaf during final instar rearing. Leaf maturity has significant effect on the rearing parameters and disease incidence. This study also clearly indicated that 65 days old leaf after pruning is ideal for 5th instar silkworms to harvest good cocoon crop and to minimise the disease incidence.

Acknowledgements

The authors wish to thank the Director, CSR &TI, Mysore for providing the basic facilities and encouragement. The help and co-operation of Miss B. Nirmala of Rearing Technology and Innovation Lab is acknowledged.

References

Anon. (1987). A Hand Book for Sericulture Extension workers *CSB Publication, Anon.* (1987). p.120

Datta, R.K., Basavaraja, H.K and Mano, Y.K. (1996). Manual on Bivoltine rearing maintenance and multiplication. :14.pp

Jolly, Manjeet. S. (1987). Appropriate Sericulture Techniques. pp 93-94.

Krishnaswami, S., Ahsan, M. and Sriharan, T.P. (1970). Studies on the quality of mulberry leaves and silkworm cocoon crop production. *Indian. J. Seric.* 9 : 11-25.

Krishnaswami, S. (1978). New Technology of Silkworm Rearing. *Bull. No.3,* C.S.R & T.I, Mysore. 10 pp.

Krishnaswami, S. (1990). Special features of tropical sericulture and five crucial steps to successful silkworm rearing. *Indian Silk* **31** : 27-34.

Li, R and Sano, Q. (1984).The relationship between quality of mulberry leaves and some economic characters during the later larval stage. *Science of Sericulture. (Canye kexue)* **10** : 197-201.

Narasimhanna, M.N. (1988). Manual on Silkworm Egg Production, Central Silk Board, Bangalore. p.63-64

Sarkar., A, Quadar, M.A., Rab, M.A and Ahmed, S.U (1992). Studies on the nutrient composition of some indigenous and exotic mulberry varieties. *Bull. Seri. Res.* 3 : 8-13.

(Received : December 2000 ; Revised : April 2001)