EFFECT OF MULBERRY VARIETIES ON THE DEVELOPMENT AND COCOON SHELL OF JAPANESE VARIETY OF *BOMBYX MORI* L.

INAYAT AHMAD HAFIZ SENIOR RESEARCH OFFICER, SERICULTURE DIVISION, PAKISTAN FOREST INSTITUTE, PESHAWAR

ABSTRACT

The leaves of four mulberry varieties PFI-1, PFI-2 Karyansuban (Korean) and a Japanese hybrid were biochemically analyzed and fed to a Japanese silkworm variety to study their effect on its development at different stages especially on economic cocoon characters. The results show that mortality of larvae and pupae was low and the effect of PFI-1 and PFI-2 was significant on economic cocoon characters of the variety. The chemical analysis of these varieties showed that protein contents of PFI-1 and PFI-2 were higher than that in Japanese hybrid and Karyansuban

varieties and hence gave better cocoon shell ratio. The cocoon quality did not show much difference and the percentage of good quality cocoons was 89.5.

INTRODUCTION

Silkworms feed only on mulberry leaves for all their nutrition. Therefore, the selection and cultivation of good mulberry varieties is essential for raising healthy silkworms and obtaining raw silk. Feeding on quality leaves results in better silk and it provides necessary vigour for resistance against diseases. Better food also shortens developmental stages and thus economises labour. The quality of raw silk is improved with quality feed. Advanced research is being done on mulberry varieties in different countries e.g China, Korea and Japan which are known for large scale cocoon production from pure lines of silkworm of their own. This activity is being extended to other Asian countries like India, Bangladesh, Burma and Pakistan (Hyde, 1984; Khan, 1990; Naseer; 1990, Guo, 1985; Tajima, 1932 and George, 1979).

It has been reported by Kobayashi (1982) that varietal improvement of mulberry through breeding not only gives superior leaf yield for feeding the silkworm but also better raw silk and adaptability of silkworm to climatic conditions, and resistance against disease. According to this author, cocoon crop is closely related to the nutrition of the silkworm. Horie, and Watanabe, (1983) have also noted that larvae and pupae, reared on young and tender leaves, were markedly larger, than those reared on normal leaves and the cocoon quality was also good in the former case. Studies were made by Machii and Kalagiri (1990) on varietal difference in food value of mulberry leaves with special reference to production efficiency of cocoon shell. They found out that Hikojre variety gave excellent results in digestibility cocoon shell weight, and production efficiency of cocoon shell and "Shimanouchi" gave highest yield in terms of cocoon shell. Their studies on imported varieties showed that "Kashmir 7", "Kashmir 11", "Pakistan 4", "Pakistan 11" and "Turkey 3" gave very good cocoon shell in spring and "Kashmir 7", "Kashmir 11" and "Pakistan 4" gave best cocoon production in late autumn. They concluded that there was a high co-relation between nitrogen contents of mulberry leaves and the silkworm cocoon production efficiency. Similarly, production efficiency of cocoon shell had high co-relation with amino acid contents of mulberry leaves including methionine and histidine, and theonine. Theorines is needed for silk protein.

Karimullah *et al* (1989) studied the effect of mulberry varieties on the development of *Bombyx mori* L. and its cocoon quality. They noticed significant effect of these varieties on larval weight, number of cocoons per litre, weight of cocoon per litre, single cocoon weight and percent layer. They found that in spring rearing, the larval weight was higher but the cocoon weight and percent silk layer was lower than the autumn rearing. The larval mortality and production of defective cocoons was higher in spring than in autumn, while larval duration was more in autumn than in spring. They attributed these factors to the food value of mulberry varieties used in rearings.

The performance of bivoltine breeds of silkworms *Bombyx mori* as influenced by mulberry varieties on high altitudes was studied by Raju *et al* (1990). They observed that two breeds performed better than the other two and furthermore the nutritive value of one set of mulberry varieties was better than the other. In an another study Kumar and Benchamin (1990) evaluated mulberry leaf quality under two systems of prunning for young and late age silkworm rearing. They found that survival rate, cocoon

yield and absolute silk content of bivoltine hybrid were significantly increased in treatment batch feeding of young (I-III instars) and late age (IV-V instars) silkworms on high and basal pruned plants as compared to control batch (continuous feeding on basal pruned plants throughout life).

The observations were made by Giridhar *et al* (1990) on local and imported varieties with reference to leaf and cocoon yield at farmer's level. They found that imported mulberry had better leaf yield and the cocoon yield varied in different regions.

Raju et al (1990) evaluated four mulberry varieties through silkworm rearing which were grown under irrigated conditions. He found out that chemical composition of the mulberry varieties showed maximum moisture percentage, carbohydrates, proteins, amino acids and minerals in S-41 and percentage of viable eggs was more in NB-18 than NB-7.

The present study was undertaken to compare the effect of various mulberry varieties grown at the Pakistan Forest Institute Peshawar, on different stages of silkworm especially cocoon formation and determine relationship between chemical constituents of mulberry leaves and cocoon yield.

MATERIALS AND METHODS

Japanese silkworm variety (J3) was used as test variety in the experiment and four different mulberry varieties PFI-1, PFI-2, a Japanese hybrid and Karyansuban (Korean) were used as food. There were four replications with 100 larvae in each treatment. The rearing environment was thoroughly dis-infected with 3% formalin before the rearing was started. First to third instar larvae were fed on top leaves while 4th and 5th instar larvae were provided leaves from middle of the branches. The feeding was done 5 times a day at 0600, 1000, 1400, 1800 and 2200 hours.

The average temperature and relative humidity during the experiment was as below:

Table-I Temperature and relative humidity during rearing Instars

Av.Temp & R.Humidity	I	II	III	IV	V	Pupal stage
Temp.(°C)	25.65	25.26	25.85	25.90	25.38	26.26
Relative humidity (%)	64.05	58.66	67.55	63.06	58.64	63.89

The rearing was done without any cover and the data was recorded on biology, economic cocoon characters and cocoon quality, mortality of different stages, disease susceptibility, and emergence percent of adults.

The biochemical analysis of leaves of different varieties was carried out. Their fresh weight and moisture percentage after air and oven drying were determined.

RESULTS AND DISCUSSION

Biological Studies

The data were recorded on duration of 1 to 5th instar larvae, pupation, moulting time, feeding time and percentage of emergence which are given in Table-2.

Table 2. Biological data of the test silkworm variety

Stage	Duration (days)
Ist Instar	3.2
2nd Instar	3.1
3rd Instar	4.2
4th Instar	5.1
5th Instar	7.8
Pupation	9.0
Moulting time	5.1
Feeding time	19.1
Percent emergence	98.5

The biological data of various instars, pupation time, moulting and feeding time are according to accepted standards.

Mortality of different stages

Observations were also recorded on the larval and pupal mortality. The data are presented in Table-3.

Table-3 Percent mortality of larvae and pupae

Hosts	Larvae		Pupae	
	No.	%	No.	%
PFI-1	-	-	5	1.2
PFI-2	-	-	7	1.7
Karyansuban	2	0.5	19	4.7
Japanese hybrid	-	-	5	1.2

The data show that no larval mortality occurred in PFI-1 and PFI-2 and Japanese hybrid but the pupal mortality was 1.2, 1.7 and 1.2% respectively for these variations. In Karyansuban, 0.5% larvae and 4.7% pupae died of a viral disease. It appears that food quality of all varieties was good for inducing vigour and resistance against diseases.

Cocoon Characters

Economic Cocoon Characters: The observations were made on economic cocoon characters, such as cocoon weight, shell weight and shell ratio in male and female silkworms fed on different mulberry varieties. The data have been given in Table-4

Table-4 Economic cocoon characters fed on different mulberry varieties

Host	Cocoon weight		Shell weight		Shell ratio (%)	
	Female	Male	Female	Male	Female	Male
PFI-1	1.351	1.101	0.289	0.277	21.429	25.585
PFI-2	1.301	1.102	0.290	0.302	22.337	27.400
Karyansuban	1.304	0.991	0.257	0.256	20.475	25.813
Japanese hybrid	1.287	1.079	0.269	0.276	20.942	25.632

The data show that the differences in cocoon weight of males were significant at 1% level in treatment PFI-1 and PFI-2. The value for females was higher for PFI-1 followed by Karyansuban and PFI-2 and least of all in Japanese hybrid. The shell weight in case of PFI-2 was significant at 5% level in case of males and was not significant in case of females showing overlapping tendency. The shell ratio was significant at 5% level in treatment PFI-2 in both sexes. Other hosts again showed overlapping tendency. The variety PFI-2 had thus comparatively better effect on shell weight and shell ratio of cocoons.

Biochemical analysis of leaves of mulberry varieties

The leaves from each variety were collected in the morning and weighed separately soon after. The leaves were air-dried in shade and then oven dried. Their water, total ash, crude oil, fiber, protein and carbohydrate contents were determined. The data are given in the following table.

Table-5 Chemical composition of mulberry varieties

Contents	PFI-1	PFI-2	Karyansuban	Japanese hybrid
Fresh wt.(gm)	285.50	234.00	237.00	232.50
Air dried wt.(gm)	118.00	92.30	82.20	88.30
Water air-dried(%)	41.33	33.44	35.00	37.97
Oven dry water(%)	63.30	62.40	69.02	67.17
Total ash (gm)(%)	14.09	15.37	14.14	15.07
Crude oil (%)	6.68	5.00	8.54	9.68
Fiber (%)	20.15	17.47	15.25	18.40
Protein (%)	22.51	25.96	20.71	20.56
Carbohydrate (%)	36.57	36.20	41.35	36.28

The data show that PFI-1, Karyansuban and Japanese hybrid contained more water than PFI-2. The total ash did not vary much but the crude oil was higher in Karyansuban and Japanese hybrid than that of other two varieties. The fibre content was more in PFI-1 than all others. The protein content was higher in PFI-2 and PFI-1 and less in Karyansuban and Japanese hybrid. Karyansuban contained more carbohydrate than the three other varieties.

Chemical content and cocoon shell ratio relationship.

The proteins are the building material to produce silk substance. Therefore the relationship was determined between economic cocoon characters and the chemical composition of different mulberry varieties to find out their effect, especially, their protein content on shell ratio. The data are given below:

Table-6 Relationship between economic cocoon characters and chemical composition of leaves of different mulberry varieties.

Host	Protein	Carbohydrate	Shell ratio	
	(%)	(%)	Female	Male
PFI-1	22.51	36.57	21.429	25.585
PFI-2	25.96	36.20	22.337	27.400
Karyansuban	20.71	41.35	20.475	25.813
Japanese hybrid	20.56	36.28	20.942	25.632

It is clear from the above data that a highest protein content in PFI-2 gave highest shell ratio which was followed by PFI-1 which also gave comparatively better cocoon shell ratio. It appears that the protein contents of leaves and shell ratio have a direct relationship and high protein contents will give high cocoon shell ratio. Other chemical contents of the leaves did not seem to have any pronounced effect on this parameter.

Cocoon quality:

During the experiments observations were also recorded on the quality of cocoons which were graded as good quality cocoons, double cocoons and defective cocoons. The results are reproduced in table-7.

Table-7. Percentage of different grades of cocoons

Host	Good Cocoon (%)	Double Cocoon (%)	Defective Cocoons (%)
PFI-1	82.75	4.5	8.25
PFI-2	82.50	5.25	7.00
Karyansuban	89.50	2.5	5.00
Japanese hybrid	86.25	3.5	6.75

The data show that various grades of cocoons were more or less similar in different feeds with no marked difference.

CONCLUSIONS

The present study has shown that food has positive effect on development of silkworms, some mulberry varieties give better economic cocoon characters, protein content in mulberry leaves has a direct bearing on cocoon and silk yield and mulberry nutrition promotes vigour and resistance in silkworms.

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