Journal of Crop and Weed, 5(1):44-47 (2009)

Effect of planting geometry on leaf yield and quality of mulberry *chawki* garden

A. GHOSH, T. DUTTA (BISWAS), A. K. SAHA, SHIVNATH, N.B. KAR, K.MANDAL AND A. K. BAJPAI

Central Sericultureal Research and Training Institute
Central Silk Board, Berhampore-742101, Murshidabad, West Bengal

ABSTRACT

Silk is the most prized natural fibres and known as "Queen of Textiles" for its gorgeous fall, grace and texture, produced by mulberry silkworm Bombyx mori L. It is a monophagous insect feeds solely on mulberry (Morus sp.) leaves which play most important role (38.2%) among the various factors that influence the production of quality cocoon crop.The garden of mulberry meant for young age silkworm rearing is known as " Chawki garden". Soft, succulent leaves rich in protein and carbohydrate are required for chawki worms. Keeping this in mind, an attempt was made to instigate the effect of planting geometry in the form of paired row plantation [(150 cm+90 cm) x 60 cm] and spaced plantation (90 cm x 90 cm) in Chawki mulberry garden against the present farmers practice of 60 cm x 60 cm plantation. Pooled data of five crops revealed that plant height, no of branches/plant, no of leaves/plant and leaf yield/plant were significantly superior in the chawki leaves of paired row plantation in comparison to others. Important biochemical parameters were also found superior in paired row plantation. While feeding the Chawki worms with mulberry leaves harvested from the above three types of planting geometry, it was found that cocoon yield/100 dfls, Shell %, Filament length and Reelability % were also significantly superior in paired row plantation.

Key words: chawki garden, Mulberry, planting geometry, paired row and spaced plantation, chawki worms, quality cocoon crop

The Mulberry garden specially meant for. young age silkworm rearing is known as "Chawki garden". Chawki rearing is a vital aspect of sericulture industry aiming to raise robust, healthy and vigorously growing stock of worms with an ultimate aim to produce qualitatively and quantitatively superior cocoon crop. . Tazima (1978) reported that in sericulturally developed countries like Japan, China and Korea about 90% of the farmers receive Chawki reared worms. The concept of Chawki garden of mulberry is introduced recently in India for production of quality leaves for Chawki worms

For *Chawk*i rearing, the leaf should be soft, succulent and rich in protein and sugar contents whereas for late age, mature and less succulent leaves are ideal (Krishnaswami, 1978 a). But from a general mulberry garden, such specific quality of leaves are not produced which affect adversely on quality cocoon production. Thus, a separate mulberry garden for quality leaf production for young age silkworm rearing is imperative (Dandin *et al*., 2002).

High yield associated with high quality, is always desirable both for mulberry leaf yield and cocoon production. Quality of mulberry leaves is one of the major factors influencing the healthy growth of silkworms and subsequently successful cocoon harvest. The quality of mulberry leaves also depends on number of factors such as genotype, package of practices, control of pest and diseases etc. (Patil 1998). It has been observed that silkworm is a highly sensitive insect and responds sharply to change in the feed quality. Parpiev (1968) reported the effects of high leaf water content (LWC) on the palatability and assimilability of nutrients . LWC also affects the growth and development of silkworms (Paul *et al*.,1992). Higher LWC is known to increase the amount of leaf ingestion and digestion capacity of silkworm through its olfactory and gustatory stimulant effect (Ito,1963).At the same time protein is also one of the important constituents of cell for monitoring the metabolic activities of silkworm body, silk & egg production (Zuhua,1994). Among the leaf biochemical constituents , the total nitrogen, total soluble sugar and total soluble proteins are considered to be the important parameters favoring larval growth and cocoon yield (Horie,1980). Further, higher level of leaf chlorophyll is indicative of photosynthetic efficiency of the plant system (Patil,1998)

Keeping this in mind, an attempt was made to instigate the effect of planting geometry in the form of paired row plantation [(150 + 90 cm) x 60 cm] and wider plantation (90 x 90 cm) in Chawki mulberry garden against the present farmers practice of 60 x 60 cm plantation with a goal of production of quality Chawki mulberry leaves and ultimately superior cocoon crop.

MATERIALS AND METHODS

The experiment was carried out under assured irrigated condition at Central Sericultural Research & Training Institute, Berhampore, Murshidabad, West Bengal during 2006 -2007. The high yielding mulberry variety, S1635 was selected for the experiment as it was found best for Chawki rearing .

E mail : csrtiber@rediffmail.com

Well rooted mulberry saplings of four months old were planted in 60cm x 60cm spacing (**T0),** (150cm +90cm) x 60cm spacing (**T1**) and 90cm x 90cm spacing (**T2**). The experiment was laid out in a randomized block design (RBD) having five replications for each treatment. Well decomposed organic manure was applied in the form of FYM @ 40 mt/ha/year along with NPK 236: 180: 112 kg/ha/year. Irrigation was provided at 4-5 days interval (as and when required). The pruning was given at 15 cm height above the ground level. Crop protection measures against fungal diseases and pest attack were followed as per recommendation evolved by the Institute. Cultural package of practices for cultivation under irrigated condition were applied (Ray *et al*., 1973). Data on growth, leaf yield, leaf quality parameters *viz*. moisture %, total chlorophyll, total soluble protein and total soluble sugar contents in leaves were recorded for five different crop seasons (April, July, September, November and February) following the 5 commercial crop schedule of West Bengal after 30-35 days of pruning.

Rearing of silkworm was done with mulberry leaf obtained from above three spaced of plantation up to 2nd stage (*Chawk*i). At 3rd stage, 2500 worms in 5 replications were kept per treatment for the study. Worms were reared as per recommended package of practices (Krishnaswamy, 1978 b) with S1635 mulberry leaf. Rearing and Reeling parameters were also recorded. Average of two years pooled data of five crop seasons were statisticallyanalyzed.

Treatment details:

T0 = 60 x 60cm spacing + 40 mt FYM /ha/yr + NPK 236: 180: 112 kg/ha/year

T1 = (150 +90cm) x 60cm spacing (paired row) + 40 mt FYM /ha/yr + NPK 236: 180: 112 kg/ha/year

T2 = 90 x 90cm spacing + 40 mt FYM /ha/yr + NPK 236: 180: 112 kg/ha/year

RESULTS AND DISCUSSION

Growth attributes

Pooled data of five crops of two years i.e. April, July, September, November and February revealed that plant height was significantly higher (85.1 cm) in Paired Row plantation in comparison to 90 x 90 cm and 60 x 60 cm plantation. Number of branches/plant (7.6) and no of leaves/ plant (135.9) in Paired Row plantation was at par with 90 cm x 90 cm plantation (7.9 and 133.9) which was however, significantly higher than 60 cm x 60 cm plantation (Table 1).

Leaf yield

Leaf yield/plant (279.7 g) was found significantly higher in paired row plantation than 60 cm x 60 cm plantation (146.1g). Similarly leaf yield / ha / crop with paired row plantation (3985.2 kg) was recorded at par with 60 cm x 60 cm plantation (4066.9 kg), although the number of plants/ha was almost double in 60 cm x 60 cm spacing (27777) against 13888 in paired row system. However, leaf yield / ha/crop was found significantly higher in both the cases in comparison with 90 cm x 90 cm plantation i.e.3621.3 kg (Table 1).

L*eaf quality of mulberry*

Total soluble protein and moisture % were found significantly higher in paired row plantation in comparison to other two treatments. Paul *et al*. (1992) and Perpiev (1968) also reported effect of high leaf moisture contents on the palatability of nutrients and considered that leaf moisture contents may serve as one of the criteria in estimating leaf quality. Horie (1980) and Zuhua (1994) stressed upon the importance of total soluble protein in larval growth and cocoon yield. Total soluble sugar was however recorded significantly lower (Table 2) in paired row plantation (38.11 mg/g fr. wt) which was supported by earlier works of Li and Sano (1984) who reported that high contents of carbohydrates and low contents of water and protein in the leaf resulted in slow larval growth, less body weight and cocoon weight.

L*eaf quality as assessed through chawki silkworm rearing*

Bioassay was also conducted for assessing the quality of mulberry leaves in all the five commercial crop seasons; superiority was observed in most of the economic parameters by feeding leaves from paired row plantation (Table 3). Cocoon yield/100 disease free layings (dfls) (64.2 kg), filament length (675.6m) and reelability % (85.6) were found significantly higher in paired row plantation in comparison with 90cm x 90cm plantation (61.4 kg, 647.7 m and 82.8% respectively) and 60 x 60cm plantation (59.5kg, 641.5 m and 81% respectively).

The above technology ensures the yield of *chawki* leaves 22 mt /ha/yr as against 7 mt /ha/yr (Dandin *et al*., 2002) obtained from common mulberry garden through selected harvesting. The uniqueness of this technology is the 100% utilization of the produced leaves as "*Chawki* leaves", suitable for *chawki* rearing. Qualitatively the leaves produced by this technology are superior to the leaves obtained from the common mulberry garden. Bioassay study also confirmed the superiority of chawki leaf obtained from paired row system of plantation. Dandin *et al.*

(2002) also reported the superiority of chawki leaf harvested from *chawki* garden with paired row system of plantation and the leaves were found suitable to conduct chawki rearing for production of qualitatively superior cocoons.

The quality of leaf used for young age silkworm is of greater relevance in view of its influence on chawki rearing and ultimately supports a successful cocoon crop. Hence, production of suitable quality leaves is of great significance, though the leaf consumption is very less (0.33%) during this stage (Anon., 1975).

The aim of raising exclusive chawki*i* garden is to maximize chawki*i* leaf productivity as well as improvement of leaf quality for chawki*i* rearing which helps for robust silkworm growth and ultimately enhances the cocoon productivity. However, for production of quality chawki leaf, farmers can demarcate a small portion of the existing garden ($1/10^{th}$) as "chawki*i* garden" following the application of higher quantity of organic manures, reduction of chemical fertilizers (NPK 236: 180: 112 kg/ha/year) compared to general garden and desired pruning height as per the recommendation mentioned earlier.

Economics

It has been calculated that a farmer can earn a net income of Rs.450.00 per crop from rearing of 100 nos. of disease free layings (dfls) by adopting this technology (Table 4).

It could be concluded from the above observations that among the three different plant geometry studied for production of quality mulberry leaf with respect to the young age silkworm rearing, paired row planting system [(150cm + 90cm) x 60cm spacing] is the best and may be utilized for the vertical growth of the silk industry of the country.

REFERENCES

Anonymous 1975. *Text book of tropical Sericulture*. Japan overseas Co-operative volunteers, Japan.

Dandin , S. B., Rajan,R.K., Mishra, R. K. Singh, G. D. and Das, P. K.2002. In : *A Model for commercial* chawki *Rearing.* Bull. No.3. Central Sericultural Research & Training Institute, Mysore, India. pp.1-23.

Horie,Y. 1980 . Recent advances in sericulture. *Ann. Rev. Entomol*. **25**, 9-71.

Kriswnaswami S. 1978 a. *Mulberry Cultivation in South India*. Bulletin No. 1, CSRTI, Mysore, India.

Kriswnaswami S. 1978 b. *New Technology of Silkworm Rearing*, Bulletin No. 2, CSRTI, Mysore, India.

Li, R.and Seno,Q 1984. The relationship between quality of mulberry leaves and some economic characters during the latter larval stage. *Sci. Seric.* **10,** 197-201

Parpiev, B.A.1968. Water metabolism in silkworm fed with a different mulberry strain changing diet. *Shelk.* **39**:15-17

Patil, S. V. 1998. A correlative analysis of the components of leaf yield and quality in improved genotypes of mulberry.*Ph. D. Thesis* , Bangalore University, Bangalore, India. pp.180.

Paul, D.C., Subba Rao, G. and Deb, D. C.1992. Impact on dietary Moisture on nutritional indices and growth of Bombyx mori and concomitant larval duration. *J.Insect. Physiol*.**38,** 229-231.

Ray,D.,Mondal,L.N., Pain,A.K. and Mandal,S.K. 1973. Effect of NPKand Farm Yard Manure on the yield and nutritive value of mulberry leaf. *Indian J. Seric*. **12**, 7-12

Tazima,Y. 1978. *The Silkworm - an Important laboratory Tool*. Kodansha Ltd. Japan.

Zuhua, S. 1994. Silkworm nutrition and Physiology. In :*Silkworm Physiology*. Editorial Department Bulletin of Sericulture pp. 73-80. Hangzhou China.

Table 1: Effect of planting geometry on growth attributes and leaf yield of mulberry

Treatment	Plant height (cm)	No. of branches /plant	No of leaves /plant	Leaf yield /plant (g)	Leaf yield (kg/ ha/crop)
T0	72.0	6.5	83.2	146.1	4066.9
T1	85.1	7.6	135.9	279.7	3985.2
T2	80.6	7.9	133.9	293.3	3621.3
LSD (P=0.05)	**2.215**	**0.259**	**2.865**	**7.004**	**102.635**

Table 2: Effect of planting geometry on leaf quality of mulberry

Treatment	Total chlorophyll (mg/g fr wt)	Total sol. protein (mg/g fr wt)	Total sol. sugar (mg/g fr wt)	Leaf moisture (%)
T0	1.686	29.84	46.44	75.57
T1	1.853	33.11	38.11	79.75
T2	1.851	29.86	43.03	77.22
LSD (P=0.05)	**NS**	**3.05**	**3.66**	**2.7199**

Table 3. Effect of planting geometry on leaf quality of mulberry as assessed through chawki silkworm rearing and reeling

Treatment	Yield/100 dfls (kg)	FL (m)	Reelability (%)	SCW (g)	Shell (%)	Renditta
T0	59.5	1.419	15.60	8.83	641.5	81.0
T1	64.2	1.437	15.88	8.57	675.6	85.6
T2	61.4	1.415	15.77	8.78	647.0	82.8
LSD (P=0.05)	**1.352**	**NS**	**0.163**	**NS**	**28.346**	**1.300**

Table 4. Economics of chawki mulberry garden

Sl.no.	Item	Economics
1.	Land required to produce 20kg chawki leaf to rear 100 dfls chawki rearing	0.75 katha (545 sq ft.)
2.	Additional expenditure for FYM other than general practice	100 kg @ Rs.0.28/kg = Rs. 28.00
3.	Savings from application of 100 kg less Nitrogen other than recommended practice	1 kg @Rs.7.60 = Rs. 7.60 (required for an area of 545 sq ft.)
4.	Additional expenditure/ 100 dfls (Sl. No. 2 - 3)	Rs. 28.00 – Rs. 7.60 = Rs. 20.40
5.	Additional cocoon yield / 100 dfls (Without following chawki garden. cocoon yield 59.50 kg/100 dfls)	4.7 kg.
6.	Gain from selling extra cocoon @ Rs.100/kg	4.7 x Rs.100 = Rs. 470 .00
7.	Net Gain from 100 Dfls / crop	Rs. 470 - Rs. 20.40 = Rs 450.00