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Research Paper

EVALUATION AND CHARACTERIZATION OF IMPROVED MULBERRY GENOTYPES

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Abstract

Mulberry silkworm is a monophagous insect, which feeds only on mulberry leaves. Mulberry includes a number of species and varieties. They differ in their suitability for silkworm rearing because of their varying nutritious value and palatability for the worm. The nutritive value and palatability of each variety vary with the age of the leaf, the type of cultivation, the season, fertilizer and irrigation schedules, the harvesting method adopted and by pests and diseases. Mulberry is the sole food plant of silkworm *Bombyx mori* grown in throughout the country. The nature and magnitude of genetic variability of different mulberry varieties and their interrelationship were studied for leaf and yield traits in 6 mulberry genotypes and to see their impact of feeding on the ruling silkworm hybrid of Jammu; SH6 X NB4D2. Analysis of variance of leaf yield, total number of shoots per plant, longest shoot length, total shoot length, intermodal distance, number of leaves in 100g, weight of 100 fresh leaves, moisture content %, moisture retention capacity %, lenticels density per sq cm, and shoot diameter showed significant variation. Leaf yield was recorded highest when the silkworm was given S1635 leaves (0.83kg) during spring season. The cocoon yield was also highest when the silkworm were fed with S1635 leaves followed by S146, Thus from the results obtained it is evident that the top two mulberry varieties were S-1635 and S-146 based on all parameters.

Key words: Mulberry varieties, Leaf yield parameters, Cocoon yield, bioassay and Genotypes.

INTRODUCTION

Mulberry is perennial, deciduous, deep rooted fast growing and high biomass producing plant. Mulberry silk is known to be the most luxurious, elegant, tender, and soft yarn in nature. The quality of mulberry leaves is influenced by several factors such as variety, agronomic practices, biotic and abiotic components (Krishnaswami et al, 1970) thereby, positively affecting the overall cocoon production. The quality of mulberry leaves play an important role in the nutrition of silkworm and in turn cocoon/silk production for the success of sericulture industry (Choudhury et al., 1991). Leaf quality is also an important parameter used for evaluation of

genotypes aimed at selection of superior variety for rearing performance (Bongale et al., 1997). Therefore variety wise quality and nutrient value of the leaf has to be determined for successful rearing and production of good cocoons. In the event of some minor changes in climate and rearing practices, the quality of leaf acts as a buffer and helps in getting a good cocoon crop. The first important step is to select the excellent variety of mulberry. In this connection, the selection of variety for cultivation should be made by carefully considering the suitability of the plant for the existing weather conditions, climate, and the aim of cultivation. Some varieties of mulberry appeared to be superior to others varieties in respect of feed conversion efficiencies (Raman et al., 1995)

The three important features considered for the selection of mulberry varieties are high yield, excellent quality of leaves and healthy condition of the plants. The varieties which are resistant to pests and diseases and are nutritionally efficient will be used for rearing resulting into successful cocoon crop as nutrition and quality of leaf acts as major contributing factor for successful rearing. Miyashita (1986) clearly indicated that the percentages of different factors responsible for successful rearing are mulberry leaf which include 38.1%, Climate 37.5%, Rearing Technique 9.1%, Silkworm race 4.1% and other factors 11.2 %.

Therefore, major contributing factor for seasonal silkworm rearing depends on the quality of leaves, however, while cultivating mulberry, either the yield or the quality of leaves is given the main importance. Alternatively, the healthy condition of the plants is considered as the important feature. Hence, it is necessary to select the varieties, which will fulfill the objective of cultivation.

This region can boast of attaining the top position so far the production of quality bivoltine commercial and seed cocoons are concerned. The environmental and geographical conditions are suitable for bivoltine sericulture (Dhar et al, 2005). However, sericulture has yet to take the real shape which may help farmers to strengthen their economy. Since it is a established fact that the quality mulberry foliage plays the most important role for the better crop yield, it becomes absolutely necessary to improve by replacing the old and local varieties with new improved ones. This makes it necessary to study the varieties available in germplasm to screen out genotypes at least on leaf yield and quality parameters and their test through bioassay. Thus with this aim the present study was under taken to characterize the 6 improved mulberry genotypes.

MATERIALS AND METHORDS

The present study was carried out to study the growth parameters of six mulberry varieties (S-146, Tr-10, S-1635, Sujanpur-Local, Chinese White and V-1) growing in the Regional Sericultural Research Station, Miran Sahib, Jammu and to see their impact of feeding on the ruling silkworm hybrid of Jammu; SH6 X NB4D2 during the spring season (March-April) of 2014-15. This was taken up to find out the yield of mulberry leaf and suitability of these varieties to silkworm feeding for cocoon production. The work details & methodology adopted for study are described here under:

TOPOGRAPHY OF EXPERIMENTAL PLACE

The experiment was carried at Regional Sericultural Research Station (RSRS) Miran sahib Jammu. It is the winter capital of the J&K State of India. The Jammu city is a hilly area & is surrounded by Snow capped mountains. The Jammu city is located at an altitude of 327 meter Above Mean Sea Level (AMSL) & has a latitude & longitude of 32.73 North & 74.87 East. Jammu city is a hilly area & is also surrounded by Shivalik range, Trikuta range. It is 600km from New Delhi; the capital of India. Most of the annual rainfall in the district is observed between the months of June to September. Jammu the Northern most part of India experiences a sub tropical climate that features two major seasons, a very hot summer & a Chilly Winter. During the summer months temperature in Jammu climbs to 45^0C, although the season gets a great level of rainfall. It hardily helps to reduce the heat .On the other hand winter remains chilly. Temperature often drops down to 4^0C and it fluctuates between 14-18^{o}C. The soils of Jammu province is slightly acidic to alkaline having pH of 6.8- 7.4.The soil samples of Jammu,

Udhampur, Rajouri & Poonch show low nitrogen contents, medium Phosphorus contents & low Potassium contents.

PARAMETERS STUDIED: For growth parameters data on three randomly selected plants from each replication of bush was recorded. The important growth parameters studied include:

- **Leaf yield/plant/crop(kg)**
- **Total number of shoots/plant**
- **Longest shoot length(cm)**
- **Total shoot length/plant(cm)**
- **Internodal distance(cm)**
- **Number of leaves in 100 g**
- **Weight of 100 fresh leaves(kg)**
- **Moisture content %**

Leaves from the three replications were plucked randomly at 10am & weighed immediately by using electronic balance. Thereafter the leaves were dried perfectly at 80 ^{0}c for 48hrs into hot air oven to determine the total moisture content. Moisture % was calculated by the following formula:

Moisture% = (Weight of fresh leaves–Weight of dry leaves) ×100/Weight of fresh leaves.

- **Moisture retention capacity % after 6hrs of harvest**

The leaves harvested from the mulberry garden were stored inside the rearing house in open at room temperature. Every hrs they were turned up & down. After 6hrs of leaf harvest, weight of 100 leaves were taken by using electronic balance. The moisture retention after 6hrs of harvest in % was calculated by the following formula:

Moisture Retention Capacity = (Weight of leaves after 6 hrs- dry weight of leaves) ×100/ weight of leaves after 6 hrs.

- **Lenticels density/sq cm**
- **Shoot diameter**

BIOASSAY

To observe the effect of the different six varieties of mulberry on the different characters of silkworm, such as cocoon yield/10000worms, single cocoon weight, single shell weight, shell ratio %, rearing was done during spring season in 2014. The three replications were taken (R1, R2 and R3) and out of these three replications their average was taken as the result. The larvae retained after 3rd moult in each replication was 300.

STATISTICAL ANALYSIS

Two way analysis of variance was done with the package available in windows 07 version of excel.

RESULTS

Mulberry silkworm (*Bombyx mori L.) sus*tains its nutrition from its food plants of different species of *Morus.* The quality of different cultivars of mulberry influences the larval growth of silkworm, which ultimately influences the economic traits – such as yield, cocoon, shell weight and silk percentage of silkworm. The results of growth parameters of six improved mulberry varieties i.e. S146, TR10, S1635, Sujanpur-Local, Chinese white and V1 growing in the farm of Regional Sericultural Research Station Miran Sahib Jammu (RSRS) are given below :-

Growth Parameters:

Leaf Yield /Plant: The leaf yield was significantly different among varieties and highest was in S1635 (0.83 kg). The varieties were distributed in 4 different groups based on leaf yield per plant (LYPP), there was non- significant difference in varieties V-1 (0.54kg) and S146 (0.53kg). The difference between Tr10 (0.47kg) and Sujanpur-local (0.43kg) was also non-significant. Minimum leaf yield per plant was recorded in case of Chinese white (0.36kg). (Table-1)

Total Number of shoots/plant: The total number of shoots per plant was significantly different and S1635(29) showed highest number of shoots in a single plant followed by V1 (28), S146 (24), Sujanpur-local(23), Chinese white(23) and Tr10(20). The varieties were distributed in 2 different groups, in the first group there was non- significant difference in varieties S1635, V1 and S146 and in the second group Sujanpur-local, Chinese white and Tr10 was non-significant. (Table-1)

Longest shoot length: The varieties were distributed in 2 different groups based on longest shoot length(LSL). S1635(107cm) showed highest longest shoot length and there was non-significant difference in varieties S1635(107cm), S146(106.3cm), Sujanpur-local(105.6cm), Chinese white(104cm) and Tr10(101.6cm). V1(93.6cm) was placed in second group with minimum shoot length. (Table-1)

Total shoot length: The total shoot length was significantly different among varieties and highest was in S1635 (1743.3cm). The varieties were distributed in 3 different groups based on total shoot length (TSL), there was non-significant difference in varieties S146(1463.3cm), Sujanpur local(1460cm), Tr10(1423.3cm), Chinese white(1366.6cm). Minimum shoot length was recorded in V1(1271.6cm). (Table-1)

Internodal Distance: The varieties were distributed in 2 different groups based on Internodal distance(ID). It was highest in Chinese white (7cm) and Sujanpur Local (7cm), followed by Tr-10(6.9 cm), S-146(6.9cm), S1635 (6.3 cm) and V1(5.1cm). The difference between Chinese white, S1635, Tr-10, S-146 and Sujanpur local was non-significant. (Table-1)

Number of leaves in 100g: The number of leaves in 100g was significantly different among varieties and V1(55 leaves) was recorded with the highest number of leaves per 100gm. varieties were distributed in 4 different groups based on number of leaves in 100g, there was non- significant difference in varieties S146(38), S1635(38) and Chinese white(36). The minimum number of leaves in 100g was recorded in case of TR10(32).(Table-1)

Weight of 100 fresh leaves: The weight of 100 fresh leaves was significantly different among varieties and highest was recorded in S1635(0.37 kg). The varieties were distributed in 5 different groups and there was non-significant difference in varieties S146(0.36kg) and Tr10(0.34kg), weight of 100 fresh leaves was measured lowest in Sujanpur local(0.21kg).(Table-1)

Moisture content %: The varieties were distributed in 2 different groups based on moisture content % and the varieties shows significance difference. It was observed highest in Tr10 (78.1%). There was non-significant difference in varieties Tr10 (78.1%), S146(78%), Sujanpur local(77.8%), Chinese white(77.1%) and V1(76.5%). Minimum moisture content % was recorded in variety S1635(74.7%).(Table-1)

Moisture retention capacity %: The varieties were distributed in 1 group based on moisture retention capacity %. There was non- significant difference in varieties S146 (91.4), Chinese white (91.3), S1635 (90.7), V1 (89.7), Tr10(89.6) and Sujanpur local(88). The result are almost at par in all the varieties.(Table-1)

Lenticels density/sq cm: Lenticels density/sq cm shows significant difference among different varieties. The varieties were distributed in 3 different groups on the basis of Lenticels density/sq cm and it was recorded highest in TR10 (16) followed by Chinese white(12), S1635(11), sujanpur local(10), S146(7) and V1(6)respectively. There was a non-significant difference between Chinese white, S1635 and Sujanpur local. The difference between S146 and V1 was also non-significant. (Table-1)

Shoot diameter (cm): Shoot diameter shows significant difference, shoot diameter was more in TR10 (1.07), followed by S146 (1.03), Chinese white(1.01), S1635(0.95), sujanpur local(0.88) and V1(0.75) respectively. The varieties were distributed in 2 group based on Shoot diameter. Varieties TR10, S146, Chinese white and S1635 shows non-significant difference in one group whereas, Sujanpur local and V1 were also non-significant in other group. (Table-1)

BIOASSAY RESULTS

Mulberry silkworm (*Bombyx mori L.) sus*tains its nutrition from its food plants of different species of *Morus.* The quality of different cultivars of mulberry influences the larval growth of silkworm, which ultimately influence the economic traits – such as yield, cocoon, and shell weight of silkworm.

Actual yield/300 worms (In numbers)

The actual yield/300 worms was significantly different among varieties and was recorded highest when the silkworm were given S1635(251) leaves. The varieties were distributed in 5 different groups based on actual yield/300 worms. Variety V1(184) and TR10(174) shows non-significant difference. Minimum yield was recorded in case of Sujanpur local(148). (Table: 2)

Actual yield/300 worms (In weight)

The actual yield/300 worms in terms of weight was also significantly different among varieties and was recorded highest when the silkworm were given S1635(0.45kg) leaves. The varieties were distributed in 6 different groups based on actual yield/300 worms (In weight) and was recorded minimum in Sujanpur local(0.27kg). (Table: 2)

Cocoon Yield/10000 worms (Computed value)

The values recorded in respect of cocoon yield during spring season are presented in Table: the silkworm fed with S1635 (15.03kg) leaves showed highest yield followed by S146 (14.03kg), Chinese white (13.6kg), V1(12.0kg), Tr10(11.06kg) and Sujanpur local(9.03kg) respectively. (Table: 2)

Single Cocoon Weight

The varieties were divided into 1 group based on Single cocoon weight and were recorded maximum in Tr-10 (1.97g). There was a non-significant difference between Tr-10 (1.97g), S-146 (1.94g), S-1635 (1.88g), V-1 (1.87g), Sujanpur local (1.86g) and Chinese white (1.83g). (Table: 2)

Single Shell Weight

When the silkworm was fed with different mulberry varieties, single shell weight shows significant difference. S-146 (0.42g) showed the highest single shell weight followed by varieties: Tr-10 (0.38g), V-1 (0.37g), S-1635 (0.36g), Chinese white (0.36g) and Sujanpur local (0.35g) respectively. The varieties were divided into 2 groups and there was a non-significant difference between varieties S-146 and Tr-10. The difference between V-1 (0.37g), Chinese white (0.36g), S-1635 (0.36g), and Sujanpur local (0.35g) was also non-significant. (Table: 2)

Shell Ratio Percentage

It denotes the percentage of silk in the cocoon for commercial exploitation. It shows significant difference, as S146 (21.83) shows highest shell ratio, the minimum shell ratio was recorded when the silkworm was fed with Sujanpur local (19.30). The varieties were divided into 3 groups, there was a non-significant difference between varieties Chinese white (20.32), V1 (20.26), Tr10(19.88) and S1635(19.68). (Table: 2)

DISCUSSION:

The work done by various workers makes it amply clear that evaluation of mulberry genotypes is essential to get success in plantation and production of qualitative and quantitative leaves for production of quality silkworm cocoons. This is illustrated by the works of Sinha *et al*., (2001) who evaluated four elite mulberry varieties viz. S1, K2, C763 and C776 on the basis of growth parameters like extension growth, branching, no. of leaves, leaf area, 100 leaf weight, weight of 100 sq cm laminar area, total photosynthetic area, fresh leaf yield and moisture content of leaf. Santosha Gowda V. Patil (2002) noticed that, mulberry genotype S1635 grown under different conditions revealed good rooting (87%) compared to M5 (81%). Adolkar *et al*., (2007)

evaluated six mulberry varieties K2,Thailand, Thika, S1, S2 and S36 for growth and yield parameters and reported that, all the varieties differ significantly in different conditions. Gnanaraj *et al*., (2011) reported that, among the four saline tolerant mulberry genotypes S1635, S36, S13 and MR2 studied, S1635 gives good results in growth and yield parameters compared to other 3 genotypes.

The other workers reported that Sprouts in spring season are observed in February and leaves become ready as fresh flush in March and are utilized fresh for spring rearing.(Dhar and Khan , 2005).The quality of leaves were evident through moisture, protein and sugar contents and showed that all the three were higher in S-1635 followed by S-146 , S-13, S-34 and TR-10 in comparison to other varieties.(Machii et al., 1997, Rahman, et al., 1994 and Chaluachari and Bongale, 1995).The bioassay results indicate that all the varieties are almost at par for feeding to silkworm but it is leaf yield that will make the difference as the cocoon productivity will be more with variety giving higher leaf yield. Thus from the results obtained it is evident that mulberry variety S-1635 was the top most variety followed by S-146 and TR-10 (Rajat Mohan et.al 2004, 2010, 2011, 2012 & 2013).The cocoon yield in general was affected due to the bad weather prevailing during the rearing season with intermittent rains in each week.The present work done is in conformity with various workers as mentioned in the references.**SUMMARY**

The present experimental work was carried to study the growth parameters of six mulberry varieties (S-146, Tr-10, S-1635, Sujanpur-Local, Chinese white and V-1) growing in the RSRS, Jammu farm and to see the impact of feeding on the ruling silkworm hybrid of Jammu; SH6 X NB4D2 during the spring season (March-April) of 2014-15. This was taken up to find out the yield of mulberry leaf and suitability of these varieties to silkworm feeding for cocoon production.

Thus from the results obtained it is evident that the top two mulberry varieties were S-1635 and S-146 based on all parameters. The cocoon yield in general was affected due to the bad weather prevailing during the rearing season with intermittent rains in each week.

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Table: 1 Growth parameters of six different Mulberry varieties

S No	Parameters	Varieties						LSD @ 0.01
		S146	Tr 10	S 1635	Sujanpur local	Chinese white	V1	
1.	Leaf yield/plant/crop[kg]	0.53	0.47	0.83	0.43	0.36	0.54	0.06
2.	Total no of shoots/plant	24.00	20.00	29.00	23.00	23.00	28.00	5.09
3.	Longest Shoot Length [cm]	106.30	101.60	107.00	105.60	104.00	93.60	6.57
4.	Total Shoot Length/Plant[cm]	1463.30	1423.30	1743.30	1460.00	1366.60	1271.60	181.36
5.	Internodal Distance(cm)	6.90	6.90	6.30	7.00	7.00	5.10	0.91
6.	Number of leaves in 100 g	38.00	32.00	38.00	43.00	36.00	55.00	2.91
7.	Weight of 100 fresh leaves[kg]	0.360	0.345	0.377	0.216	0.339	0.268	15.90
8.	Moisture content%	78.00	78.10	74.70	77.80	77.10	76.50	2.12
9.	Moisture Retention capacity (%)	91.40	89.60	90.70	88.00	91.30	89.70	3.66
10.	Lenticel density/sq cm	07	16	11	10	12	6	3.49
11.	Shoot diameter[cm]	1.03	1.07	0.95	0.88	1.01	0.75	0.17

Table: 2 Bioassay of six Mulberry varieties on rearing of SH6×NB4D2
Season: Spring 2014 Worms/replicate: 300

Varieties	Actual yield/300 worms		Yield /10000 worms (computed values)		Single Cocoon Wt (g)	Single Shell Wt. (g)	Shell Ratio %
	No	Wt (Kg)	No	Wt (kg)			
S146	225	0.421	7500	14.03	1.94	0.42	21.83
TR10	174	0.332	5800	11.06	1.97	0.38	19.88
S1635	251	0.451	8367	15.03	1.88	0.36	19.68
SUJANPUR LOCAL	148	0.271	4933	9.03	1.86	0.35	19.30
CHINESE WHITE	204	0.409	6800	13.6	1.83	0.36	20.32
V1	184	0.361	6133	12.0	1.87	0.37	20.26
LSD @ 0.01	11.70	0.0025	-	-	0.15	0.03	0.81

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