Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

Journal of Entomology and Zoology Studies

E-ISSN: 2320-7078
P-ISSN: 2349-6800
www.entomoljournal.com
JEZS 2020; 8(4): 1253-1256

Received: 18-05-2020
Accepted: 20-06-2020

Ahalya BN
Department of Sericulture, UAS, GKVK, Bengaluru, Karnataka, India

Chikkalingaiah
Department of Sericulture, UAS, GKVK, Bengaluru, Karnataka, India

Mudalagiriyappa
Department of Sericulture, UAS, GKVK, Bengaluru, Karnataka, India

Murali K
Department of Sericulture, UAS, GKVK, Bengaluru, Karnataka, India

Corresponding Author:
Ahalya BN
Department of Sericulture, UAS, GKVK, Bengaluru, Karnataka, India

Evaluation of elite mulberry genotypes for growth and yield parameters in different seasons

Ahalya BN, Chikkalingaiah, Mudalagiriyappa and Murali K

Abstract
Studies on evaluation of elite mulberry genotypes for growth and yield parameters was carried out during the rainy and winter seasons of 2017-2018 in the Department of Sericulture, University of Agricultural Sciences, GKVK, Bengaluru-65. The experimental material for the present study comprised of fifteen elite mulberry genotypes and two check varieties M5 and S13. Among fifteen genotypes evaluated the leaf yield of different genotypes differed significantly among different seasons. Among the elite mulberry genotypes, no single genotype was superior in respect of all the traits in different seasons. However, The genotype ME-224 recorded highest leaf yield per plant (2689.3 g), plant height (247.50 cm) and number of branches per plant (62.75) whereas, maximum single leaf area (273.49 cm^2) was recorded in MI-143, ME-06 recorded lowest internodal distance (3.50 cm) in both rainy and winter season.

Keywords: Evaluation, Genotypes, Growth parameters

Introduction
The fabulous sericulture industry originated in China during 3000 B. C. It is an important and highly remunerative agro-based occupation of resource poor farmers of the world playing a major role in poverty alleviation by providing employment. It is characterized with high employment potential, low capital investment and highly remunerative (Sharma *et al*., 2000) [13]. The productivity and profitability in sericulture solely depends on the quality and yield of mulberry leaves. In recent years, much emphasis has been given to produce superior quality of raw silk to compete in the international market. To achieve this goal, efforts are being made to increase the production of good quality mulberry leaves which directly influence on the quality and quantity of raw silk produced. Developing a variety, that performs equally well under different environmental conditions is a great challenge to plant breeders. In commercial sericulture, mulberry requires more than 60 per cent of the total cost of cocoon production.

Silk is known as the "Queen of Textiles" the world over. On the other hand, it stands for livelihood opportunity for millions owing to high employment oriented, low capital intensive and remunerative nature of its production (Sastry *et al*., 1980) [14]. The vary nature of this industry with its rural based on-farm and off-farm activities and enormous employment generation potential has attracted the attention of the planners and policy makers to recognize the industry among one of the most appropriate avenues for socio-economic development of a largely agrarian economy like India.

Sericulture is an important and highly remunerative agro-based industry. More than 50 countries in the world are practicing sericulture, of which 14 are situated in Asia. They are producing about 90 per cent of the total silk produced in the world. India is the second largest producer of raw silk (Anonymous, 1970b) [1].

Mulberry is a perennial crop grows throughout the year. Mulberry (Morus spp.) (Family: Moraceae) is believed to have originated at the foothills of the Himalayas and has been distributed in the warm and moist climatic zones between 50° N Lat. and 10° S Lat. (Koidzumi, 1917) [7]. Mulberry is a fast growing deciduous woody perennial plant, normally cultivated as bush or dwarf tree by repeated pruning. It has a tap root system with minimum superficial roots, good coppicing power and is tolerant to lopping and pruning (Koul *et al*., 1980) [8]. The silkworm rearing is carried throughout the year. Mulberry leaf yield is a complex character jointly contributed by a good number of component characters and is highly influenced by different genotypes. The yield as such may not be the best criterion for selection and it is therefore, important to study the genetics of yield components and the degree of their

association with yield. In order to develop a season insensitive variety with uniform pattern of growth and leaf yield throughout the year, attempts have been made to identify mulberry genotypes with less response to seasonal variations, from the germplasm and used them in rearing (Pillai and Jolly, 1985) [10]. Mulberry leaf foliage is the only food for the silkworm (*Bombyx mori* L.) and is grown under varied climatic conditions, ranging from temperate to tropical.

The present scenario of sericulture industry demands new varieties suitable for various agro climatic conditions. Suitable parent material needs to be identified from large number of germplasm accessions for the purpose (Terefe *et al.,* 2018) [17]. Once the genotypes with probable contribution of maximum desirable traits are found or developed, testing the same in comparisons with the existing varieties form the second important step in improvement programmes which is termed as evaluation. Evaluation of any crop is a continuous process to evolve new varieties suitable for specific zones for commercial utilization.

Three tier system of evaluation as suggested by Dandin (1986) [4] could be used with required modification to suit the local or specific situation. With this background the present study was undertaken to evaluate elite the mulberry genotypes with an objective to study the growth and yield parameters of elite mulberry genotypes.

In commercial sericulture, more than 60% of the total cost of cocoon production goes towards mulberry production alone. Hence, in recent years maximum attention has been given for the improvement of mulberry both in terms of quality and quantity. Evaluation is essential to know the genetic potentiality of the materials or the varieties. Evaluation is the most important aspects of germplasm conservation in order to identify parents for the development of improved varieties (Dandin and Giridar, 2010) [5]. Appropriate selection of the tropical cultivars based on the plant quality parameters and their effect on growth and cocoon yield parameters of *Bombyx mori* races in different agro-climatic conditions is essential to select and exploit promising cultivars for better sericulture practice.

The main objective of evaluation of mulberry genetic resources is to promote utilization directly utilization by the breeders for the improvement of programme. In order to achieve such objectives, it is very essential to evaluate mulberry genetic resources for growth and yield traits. Hence the present studies were undertaken to evaluation of elite mulberry genotypes in different seasons.

Materials and methods

Studies on evaluation of elite mulberry genotypes for growth and yield parameters was carried out under rainfed condition in the Department of Sericulture, University of Agricultural Sciences, GKVK, Bengaluru-65. The experimental material for the present study comprised of fifteen elite mulberry genotypes *viz.*, ME-06, ME-27, ME-67, ME-18, ME-03, ME-052, ME-95, MI-66, MI-012, MI-79, MI-143, ME-224 and MI-517 and two check varieties (M5 and S13) were used. Each genotype was planted in one row with four plants with spacing of 2.4 x 2.5 m. The evaluation for growth and yield parameters was conducted during two seasons *viz.*, rainy and winter seasons of the 2017-18. The experimental plot was maintained as per the recommended package of practices for rain-fed mulberry (Dandin and Giridar, 2010) [5]. The genotypes were evaluated after 60th day after pruning for growth and yield parameters during different seasons. The mean data of each genotype for each season were subjected to statistical analysis (ANOVA)

Results and discussion

The leaf yield and growth parameters of different elite mulberry genotypes differed significantly among different seasons. During rainy season, no single genotype was superior in respect of all the traits studied. The genotype ME-224 was superior in respect of different traits like total shoot length (10603.00 cm), plant height (247.50 cm), number of branches per plant (62.75) and leaf yield per plant (2689.3 g). However, MI-143 was superior for single leaf area (292.07cm^2), fresh leaf weight (27.88 g). Number of leaves per plant in genotype ME-95 (911.50). Whereas, ME-052 was recorded maximum moisture percentage (83.03 %) (Table 1 and 2). The genotypic differences were more in rainy season compared to winter season. Tikader and Roy (2006) [16] observed variation for different growth attributes with number of branches ranged from 25 to 97, intermodal distance (2.54 to 5.29 cm), leaf area (64.03 to 242.00 cm^2), leaf yield (1.25 to 23.00 kg) per plant. Similar results were also reported by Tikader *et al*. (2004) [15]. These results are also agreement with Terefe *et al.,* 2018 [17], they are opined maximum leaf production per plant (371.3 and 373.1 kg/ha), fresh leaf weight (26,503 and 26,333 kg/ha) were recorded from S-13 and K-2, respectively during winter season. This may infer that considerable improvement in mulberry could be achieved through selection based on these parameters.

During winter season, the genotype ME-224 was superior in respect of different traits like plant height (253.7 cm), number of branches per plant (61.25), number of leaves per plant (969.50), leaf yield per plant (2642.7 g) and moisture percentage (74.52%). In contrast to this, MI-143 was recorded highest single leaf area. More fresh leaf weight was recorded in ME-95 (25.68 g), less intermodal distance was noticed in ME-06 (3.60 cm), moisture retention capacity at 6 and 9 hr. was recorded in ME-052 (70.43 % and 66.44 %) respectively (Table 3 and 4). These results of the present study is in conformity with the findings of Bari *et al.* (1988) [3], Tikader *et al*. (2004) [15], Ram Rao *et al.* (2006) [11] and Banerjee *et al*. (2007) [2] obtained maximum leaf yield during winter season in ME-27 (1658.0g) and S-13 (1399.7g) recorded maximum leaf yield per plant. These results are also in line with the findings of Saratchandra *et al.*, 1992 [12] they recorded high leaf yield in S-36 (33.24 t/ha/yr) followed by RFS-135(32.93 t/ya/yr). Similar results were also reported by Masilamani *et al*., 2000 [9].

In both the seasons of rainy and winter, the genotype ME-224 was found to be superior with respect to leaf yield per plant among the fifteen genotypes. Kasiviswanathan and Iyengar (1969) [6] reported that, there is a difference in leaf yield during different seasons in a particular year is due to wide behavioural variation met with its growth. Waktole sori *et al.*, 2016 [18] opined that Kumbi and M4 genotypes were found to adapt and perform better than the remaining nine genotypes under Jimma environmental conditions.

Table 1: Performance of elite mulberry genotypes for different growth and yield parameters during rainy season

Sl. No	Genotypes	Plant height (cm)	Total shoot length (cm)	Number of branches/plant	Internodal distance (cm)	Single leaf area (cm^2)
1	ME-06	125.50	2,214.50	21.00	3.50	88.52
2	ME-27	178.75	8,862.50	54.75	4.62	138.15
3	ME-67	197.50	4,276.00	30.75	5.00	151.45
4	ME-18	229.50	10,096.00	62.25	5.12	115.40
5	ME-03	199.75	5,208.00	28.75	5.87	205.05
6	ME-052	212.50	8,773.00	44.00	5.50	166.55
7	ME-95	181.00	4,990.50	30.50	4.55	184.00
8	MI-66	198.25	5,111.50	27.50	3.87	84.72
9	MI-012	236.00	7,760.75	34.50	4.55	94.37
10	MI-79	188.75	8,497.25	51.75	4.15	83.67
11	MI-143	182.00	5,446.50	32.00	5.50	292.07
12	ME-224	247.50	10,603.00	62.75	5.40	108.12
13	MI-517	168.75	7,542.50	47.75	4.07	96.15
14	M5(Check)	203.75	6,868.50	34.75	3.82	100.77
15	S13(Check)	195.25	4,651.75	26.75	4.62	101.40
	F-Test	*	*	*	*	*
	C.D. 5%	9.842	710.295	3.38	0.61	4.87
	SE m ±	3.43	248.005	1.18	0.21	1.70

Table 2: Performance of elite mulberry genotypes for different growth and yield parameters during rainy season

Sl. No	Genotypes	Number of leaves/plant	Leaf yield/plant(g)	Fresh leaf weight (g/10 leaves)	Moisture Content (%)	Moisture retention Capacity (%)	
						At 6 hr	At 9 hr
1	ME-06	159.50	1,239.57	11.00	73.66	63.12	53.57
2	ME-27	575.50	1,526.97	17.16	81.36	66.40	59.84
3	ME-67	703.00	1,613.10	18.66	72.60	69.07	52.29
4	ME-18	799.00	1,699.15	18.47	76.26	62.66	53.25
5	ME-03	386.25	2,282.52	18.86	77.09	60.90	54.79
6	ME-052	236.50	2,213.60	9.23	83.03	71.28	67.85
7	ME-95	911.50	2,387.65	25.17	81.80	70.73	61.70
8	MI-66	214.75	1,918.77	18.42	80.22	67.93	62.82
9	MI-012	637.00	2,558.42	23.70	79.66	69.82	65.44
10	MI-79	188.75	1,994.22	9.98	71.85	66.92	62.58
11	MI-143	284.75	2,304.65	27.88	82.56	63.73	60.95
12	ME-224	614.75	2,689.37	17.37	74.97	71.18	67.06
13	MI-517	505.75	1,867.95	22.02	71.82	66.86	63.13
14	M5(Check)	524.2	1,894.40	22.52	80.74	74.15	68.70
15	S13(Check)	467.50	2,046.42	19.90	77.85	66.42	51.59
	F-Test	*	*	*	*	*	*
	C.D. 5%	10.60	154.59	1.56	1.84	1.64	2.24
	SE m ±	3.70	53.98	0.547	0.64	0.57	0.78

Table 3: Performance of elite mulberry genotypes for different growth and parameters during winter season

Sl. No	Genotypes	Plant height (cm)	Total shoot length (cm)	Number of branches	Internodal distance (cm)	Single leaf area (cm^2)
1	ME-06	91.50	1,322.00	16.25	3.60	77.50
2	ME-27	160.50	4,400.50	45.50	4.37	116.89
3	ME-67	179.25	2,386.25	27.0	5.62	135.30
4	ME-18	207.75	8,858.50	55.00	5.75	107.15
5	ME-03	179.25	3,876.00	21.00	5.57	188.94
6	ME-052	202.75	5,264.50	36.25	5.90	140.86
7	ME-95	164.00	4,481.75	43.50	5.00	175.23
8	MI-66	171.00	2,601.75	21.50	3.87	65.49
9	MI-012	210.00	4,473.00	36.00	4.07	95.65
10	MI-79	168.00	5,867.50	47.25	4.92	63.24
11	MI-143	169.25	2,571.25	23.25	5.25	273.49
12	ME-224	253.75	7,625.25	61.25	5.17	104.92
13	MI-517	142.00	4,218.00	47.00	5.05	91.80
14	M5(Check)	190.50	4,253.00	26.25	3.82	103.04
15	S13(Check)	182.75	3,181.00	19.00	4.45	105.07
	F-Test	*	*	*	*	*
	C.D. 5%	20.354	1,076.86	8.98	0.98	17.45
	SE m ±	7.107	375.99	3.13	0.34	6.09

Table 4: Performance of elite mulberry genotypes for different growth and yield parameters during winter season

Sl. No.	Genotypes	Number of leaves/plant	Leaf yield/plant (g)	Fresh leaf weight (g/10 leaf)	Moisture content %	Moisture retention Capacity (%)	
						At 6 hrs	At 9 hrs
1	ME-06	79.00	1,164.12	9.85	63.900	55.76	49.73
2	ME-27	556.25	1,484.60	15.83	72.993	63.59	61.53
3	ME-67	673.75	1,593.97	17.25	72.498	55.19	40.85
4	ME-18	755.75	1,706.95	16.07	67.733	56.24	53.31
5	ME-03	325.25	2,165.50	17.43	68.583	58.56	54.08
6	ME-052	189.75	2,098.40	8.53	73.510	70.43	66.44
7	ME-95	852.75	2,303.45	25.68	72.955	64.31	58.87
8	MI-66	188.50	1,712.77	16.04	70.903	65.91	62.97
9	MI-012	608.50	2,396.45	25.78	74.045	68.56	65.51
10	MI-79	736.00	1,710.35	7.410	71.640	65.01	46.54
11	MI-143	250.50	2,380.45	25.56	71.175	64.77	59.89
12	ME-224	969.50	2,642.27	16.32	74.525	68.72	64.42
13	MI-517	568.50	1,812.42	11.09	72.228	66.99	58.71
14	M5(Check)	464.75	1,858.72	24.16	73.913	55.00	48.46
15	S13(Check)	288.00	1,942.37	17.85	78.048	56.25	51.13
	F-Test	*	*	*	*	*	*
	C.D. 5%	33.63	144.05	2.48	1.678	1.95	2.09
	SE m ±	11.74	50.29	0.86	0.586	0.68	0.73

Conclusion

Study of growth and yield parameters of different elite mulberry genotypes revealed that, during rainy and winter seasons, ME-224 genotype was found to be superior with respect to leaf yield per plant, plant height and number of branches per plant followed by ME-18 compared to check varieties S13 and M5. Among the fifteen genotypes, ME-052 recorded maximum leaf moisture content and moisture retention capacity in both rainy and winter season. The study revealed that the genotype ME-224 was preferred better for growth and yield parameters in different seasons.

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