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Evaluation of mulberry *(Morus sp)* accessions for morphological, growth and yield traits

Mohammad Rafiq Bhat[1*], S. Manimegalai[1], V. Ulaganathan[1], P. Mangammal[1], P. Priyadharshini[1]and P. Radha[2]

[1]Department of Sericulture, Forest College and Research Institute, Tamil Nadu Agricultural University, Mettupalayam-641 301, India
[2]Department of Forest Biology and Tree Improvement, FC & RI, Mettupalayam – 641 301, India

ABSTRACT

Evaluation of forty mulberry accessions for morphological, growth and yield parameters was carried out during the year 2021-2022 at the Department of Sericulture, Forest College and Research Institute, Mettupalayam.Qualitative traits such as growth nature, leaf surface, leaf lobation, leaf color and leaf wrinkles showed distinct variations in the present study. Among the forty accessions, the highest number of shoots/ plant was recorded in MI-0845 (27.40) and the highest shoot length was recorded in ME-0247 (230.70cm).The highest Internodal length was recorded in MI-0715 (8.39cm), the maximum number of leaves per plant was recorded in MI-0145 (584.00) and the maximum leaf area was recorded in MI-0477 (321.51cm^2). Specific leaf area was maximum in MI-0615 (282.50 cm^2/g) and a maximum number of leaves per branch were recorded in MI-0817 (55.80). The maximum 100 leaf weight was recorded in MI-0828 (673.40g) and leaf dry weight was significantly high in MI-0477 (88.71 g/plant). Phenotypic correlation between a number of shoots per plant showed a significantly positive correlation with specific leaf area and number of leaves per plant. Shoot length exhibited a significantly positive correlation with internodal length, number of leaves per plant had significantly positive correlation with specific leaf area. A significant and positive correlation between growth and yield traits can be utilized for mulberry leaf yield improvement. Based on the cluster analysis, 40 mulberry accessions were grouped into seven clusters. Among the clusters, cluster I and V exhibited maximum variability. The variability existing in the forty mulberry accessions provides opportunities for breeders to select specific donors for genetic improvement.

Keywords: *Mulberry, accessions, yield parameters, qualitative traits, variability, genetic improvement, breeders,*

INTRODUCTION

Mulberry is a deep-rooted perennial deciduous herb and high biomass-producing foliage plant belonging to the family *Moraceae*. Mulberry being highly heterozygous, dioecious and perennial produces a number of natural hybrids with many intermediate forms. This variation in each and every character of the species and varieties needs a systematic study for the selection of desirable characters. Morphological studies in mulberry are essential for taxonomists to classify different species and varieties and for breeders to develop high-leaf-yielding, pest and disease-resistant and drought-tolerant genotypes of mulberry. Mulberry Silkworm *Bombyx mori.* L is monophagous insect feeding solely on mulberry leaves (*Morus sp*). Leaf quality is an important parameter used for the evaluation of mulberry plants aimed at selecting superior varieties for rearing performance. Around 60 percent of the total cost of cocoon production goes towards mulberry production alone [4]. Hence, in recent years maximum attention has been given for the improvement of mulberry both in terms parameter of quality and quantity. The growth and development of *B.mori* and cocoon crop are mainly influenced by the yield and nutritional quality of mulberry leaf used as feed [16]. The quality of mulberry leaf was highly influenced by varieties, cultivation practices, preservation techniques, age and position of leaf. In this context, the present study was undertaken to evaluate 40 mulberry accessions for morphological, growth and yield traits.

**Corresponding Author: Mohammad Rafiq bhat*
Email Address: bmohammadrafiq@gmail.com

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MATERIAL AND METHODS

The experiment was conducted at the Department of Sericulture, Forest College and Research Institute, Mettupalayam, during 2021-2022 (Latitude 11.20^{0}N, Longitude 76.56^o N and Altitude 320 M). The mulberry accessions were planted in a randomized block design (RBD) with five replications per accession. Regular package of practices *viz.,* irrigation, weeding, fertilizers applications were done as per recommendation. Forty mulberry accessions were selected and subjected for further assessment of morphological and leaf yield parameters from a germplasm bank maintained at the Department of Sericulture, Forest College and Research Institute, Mettupalayam (Table.1) Various growth and yield parameters*viz.,* number of shoots per plant, shoot length, internodal length, number of leaves per plant, leaf area, specific leaf area (SLA), specific leaf weight (SLW), leaf area index (LAI),

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growth nature, leaf surface, leaf lobation, leaf colour and leaf wrinkles were recorded. Yield attributes such asnumber of branches per plant, number of leaves per branch, 100 leaf weight (g), leaf dry weight and leaf yield (g/ plants) were recorded 60 to 70 days after pruning. The data collected on various parameters were subjected to statistical analysis by adopting the "Method of Analysis of Variance" appropriate to the design of the experiment [9]. The growth and yield parameters were also subjected to correlation and hierarchical cluster analysis using SPSS 16.0 [7] statistical package to determine the relatedness of the mulberry accessions with respect to the different parameters.

Table 1. List of mulberry accessions selected for evaluation.

S. No	Accession number	Species	S. No	Name of the accession	Species
1.	MI-0012	*M. indica*	21.	MI-0034	*M. alba*
2.	MI-0029	*M. indica*	22.	MI-0615	*M. indica*
3.	MI-0489	*M. indica*	23.	MI- 0024	*M. indica*
4.	MI-0675	*M. indica*	24.	MI- 0065	*M. indica*
5.	MI- 0715	*M. indica*	25.	MI-0310	*M. indica*
6.	MI- 0835	*M. indica*	26.	MI- 0355	*M. indica*
7.	ME- 0058	*M. alba*	27.	MI- 0477	*M. indica*
8.	MI-0145	*M. alba*	28.	MI- 0497	*M. indica*
9.	ME-0247	*M. alba*	29.	MI- 0573	*M. indica*
10.	MI- 0637	*M. alba*	30.	MI- 0669	*M. indica*
11.	MI- 0828	*M. alba*	31.	MI- 0790	*M. indica*
12.	MI- 0252	*M. laevigata*	32.	MI-0827	*M. indica*
13.	ME- 0071	*M. latifolia*	33.	ME-0179	*M. latifolia*
14.	ME- 0109	*M. bombycis*	34.	MI- 0632	*M. latifolia*
15.	ME- 0220	*M. macroura*	35.	MI- 0665	*M. latifolia*
16.	ME- 0006	*M. latifolia*	36.	MI- 0783	*M. latifolia*
17.	MI-0845	*M. latifolia*	37.	MI- 0817	*M. latifolia*
18.	R. local	*M. alba*	38.	ME- 0174	*M. alba*
19.	ME- 0025	*M. alba*	39.	MI- 0300	*M. alba*
20.	MI-0013	*M. indica*	40	MI-0812	*M. alba*

RESULTS

Qualitative morphological characters

The morphological variation among the mulberry accessionsare presented in Table 2. High variation was observed between accessions for different morphological and yield-related traits. The results obtained in the present study indicate that all the mulberry accessions were different in all the major morphological traits.

Qualitative traits such as growth nature, leaf surface, leaf lobation, leaf colour, leaf wrinkles exhibited distinct variations (Table 2). Growth nature was found to be either spreading or erect. However, the frequency of spreading was more in 24mulberry accessions while erect nature was found in 16 mulberry accessions. Mulberry accessions varied in their leaf surface where the 25 accessions weresmooth, 13 mulberry accessions were slightly smooth and 02 accessions were rough. Leaf lobation of different mulberry accessions also varied where 31 mulberry accessions were unlobed and 09 accessions were lobed. Leaf colour in mulberry accessions also showed variations where 37 were green colour, 02 were light green and 01 was dark green. Leaf wrinkles in different mulberry accessions also varied, where 33 mulberry accessions were smooth and 07 accessions were slightly wrinkled.

Table 2. Morphological traits of mulberry accessions.

Plant descriptor	Range in expression	Number of accessions	Accession
Growth nature	Spreading	24	MI-0012, MI-0029, MI-0489, MI-0715, MI-0145, MI- 0637, MI-0828, ME-0220 , MI-0845, R. local, ME-0025, MI-0013, MI-0034, MI-0615, MI-0065, MI-0310, MI-0355, MI-0497, MI-0669, MI-0790, MI-0827, MI-0632, MI-0783 and MI-0812.

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	Erect	16	MI-0675, MI-0835, ME-0058, ME-0247, MI-0252, ME-0071, ME-0109, ME-0006, MI-0024, MI-0477, ME-0179, MI-0665, MI-0817, MI-0818, ME-0174 and MI-0300
Leaf surface	Smooth	25	MI-0012, MI-0489, MI-0675, MI-0835, ME- 0058, MI-0145, ME-0247, ME-0071, ME- 0220, MI-0845, ME-0025, MI-0013, MI-0024, MI-0065, MI-0310, MI-0477, MI-0497, MI-0669, MI-0790, MI-0827, ME-0179, MI-0665, MI-0783, MI-0817, and ME-0174
	Slightly smooth	13	MI-0029, MI-0715, MI-0637, MI-0828, ME- 0109, ME- 0006, MI-0034, MI-0615, MI-0355, MI-0632, MI-0818 and MI-0812
	Rough	02	MI- 0252 and R. local
Leaf lobation	Unlobed	31	MI-0012, MI-0489, MI-0675, MI-0715, MI- 0835, ME- 0058, ME-0247, MI-0637, MI-0828, ME-0071, ME-0220, ME-0006, MI-0845, MI-0013, MI-0034, MI-0615, MI-0024, MI-0065, MI-0310, MI-0477, MI-0497, MI-0573, MI-0669, MI-0827, ME-0179, MI-0632, MI-0665, MI-0783, MI-0817, ME- 0174 and MI-0300
	Lobed	09	MI-0029, MI-0145, MI-0252, ME-0109, R-Local, ME-0025, MI-0355, MI-0790 and MI-0812
Leaf colour	Green	37	MI-0012, MI-0489, MI-0675, MI-0715, MI-0835, ME-0058, ME-0247, MI-0637, MI-0828, ME-0071, ME-0220, , MI-0845, MI-0013, MI-0034, MI-0615, MI-0024, MI-0310, MI-0477, MI-0497, MI-0573, MI-0669, MI-0827, ME-0179, MI-0632, MI-0665, MI-0783, MI-0817, ME-0174, MI-0300, MI-0029, MI-0145, MI-0252, ME-0109, ME-0025, MI-0790 and MI-0812
	Light green	02	MI-0355 and ME-0006
	Dark green	01	R-Local
Leaf wrinkleness	Smooth	33	MI-0012, MI-0489, MI-0675, MI-0715, MI- 0835, ME- 0058, ME-0247, MI-0637, MI-0828, ME-0071, ME-0220, MI-0845, MI-0013, MI-0034, MI-0615, MI-0024, MI-0310, MI-0477, MI-0497, MI-0573, MI-0669, ME-0179, MI-0632, MI-0665, MI-0783, MI-0817, ME-0174, MI-0300, MI-0029, MI-0145, ME-0025, MI-0790 and MI-0812
	Slightly wrinkled	07	MI-0145, MI-0252, ME-0109, ME-0006, MI-0355, MI-0827 andMI-0812

Growth and yield parameters of mulberry accessions

The agronomic variations among the accessions are presented in (Table 3). The results obtained in this study indicate that all the mulberry accessions were significantly different in all the major agronomic traits. Among the forty accessions, the number of shoots ranged from 27.40 in MI-0845to 5.00 in MI-0252. Significantly highest number of shoots/plants was recorded in MI-0845 (27.40cm) followed by MI-0145 (22.60), MI-0715 (22.20) and MI-0790 (20.40). The shoot length ranged from 230.70 cm in ME-0247 to 81.39 cm inMI- 0665 and the highest shoot length was recorded in ME-0247 (230.70cm) followed by MI-0675 (222.70cm), ME-0058 (204.40cm) and MI-0715 (197.30cm). Internodal length ranged from 8.39cm in MI-0715 to 5.16cm in MI-0665, Highest Internodal length was recorded in MI-0715(8.39cm) followed by, MI-0835(8.29cm), MI-0675 (7.93cm) and ME- 0058 (7.67cm). Number of leaves per plant ranged from 584.00 in MI-0145 to 126.00 in MI-0665. Significantly maximum number of leaves per plant was recorded in MI-0145 (584.00) followed by MI-0012 (580.20), MI-0675 (571.20) and MI-0845 (559.60). Leaf area ranged from 321.51cm^2 in MI-0477 to 85.28cm^2 in MI-0355. Significant maximum leaf area was recorded in MI-0477 (321.51cm^2) followed by MI-0665 (268.90cm^2), MI-0300 (245.83 cm^2) and MI-0310 (244.00 cm^2). Specific leaf area ranged from 282.50cm^2/g in MI-0615 to 59.78 cm^2/g ME-0174. Specific leaf area was maximum in MI-0615 (282.50 cm^2/g) followed by ME-0058 (253.31 cm^2/g), MI-0828 (195.97 cm^2/g) and MI-0675 (186.04 cm^2/g).

A number of leaves per branch ranged from 55.80 in MI-0817 to 20.60 in MI-0845. Maximum number of leaves per branch was recorded in MI-0817 (55.80) followed by MI-0477 (54.20), ME-0247 (47.60) and MI-0029 (44.80). 100 leaf weight (g) ranged from 673.40g in MI-0828 to 132.69g in MI-0835. The maximum 100 leaf weight was recorded in MI-0828 (673.40g) followed by MI-0300 (620.00g), MI-0665 (535.33g) and MI-0632 (490.08g). Leaf dry weight ranged from 88.71g/plant in MI-0477 to 12.24g/plant in MI-0615. Leaf dry weight was significantly high in MI-0477 (88.71 g/plant) followed by MI-0300 (80.46 g/plant), MI-0632 (72.07g/plant), MI 0024 (70.28g/plant) and MI-0818 (66.80g/plant).

Correlation studies

The correlation coefficient measures the mutual relationship between various plant characters and determines the component characters on which selection can be relied upon for the genetic improvement of crops. The association of all growth and yield parameters were estimated by correlation analysis as given in table 4. Number of shoots per plant

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showedasignificantly positive correlation with specific leaf area (0.316*), number of leaves per plant (0.682**) and a significantly negative correlation with leaf area (-0.396*), leaf dry weight (-0.457**) and number of leaves per branch (-0.485**). Shoot length exhibited significantly positive correlation with internodal length (0.471**) and significantly negative correlation with 100 leaf weight (-0.431**). Correlation of number of leaves per plant was significantly positive to specific leaf area (0.349*) and significantly negative with leaf area (-0.362*), 100 leaf weight (-0.402*) and leaf dry weight (-0.421**). Leaf area hada significantly positive correlation with number of leaves per branch (0.313*), 100 leaf weight (0.345*) and leaf dry weight (0.718**). Specific leaf area showed significantly negative correlation with leaf dry weight (-0.669**). Correlation of 100 leaf weight was significantly positive to leaf dry weight (0.424**).

Cluster analysis

Based on Euclidean distance, 40mulberry accessions were grouped into seven distinct clusters (Table.5 & Fig.1). It was revealed that cluster IVcomprised the maximum number (14) ofgenotypes followed by cluster II and cluster III comprising 7 and 6 genotypes, respectively. Cluster VI had 5 accessions and Cluster VII had 4 accessions. Cluster I and V exhibited 2 accessions each.

Table 3. Growth and yield parameters of mulberry accessions

S No	Name of the Accession	Number of shoots / plant	Shoot length (cm)	Internodal length (cm)	Number of leaves/ plant	Leaf area(cm^2)	Specific leaf area (cm^2/ g)	Number of leaves/branch	100 leaf weight (g)	Leaf dry weight (g/plant)
1.	MI-0012	15.20	170.72	6.42	580.20	158.49	136.62	37.80	227.65	25.33
2.	MI-0029	12.00	158.08	5.41	540.00	137.10	175.76	44.80	42.76	19.92
3.	MI-0489	15.20	147.01	6.20	482.00	93.33	145.85	31.40	262.06	17.16
4.	MI-0675	13.40	222.70	7.93	571.20	113.49	186.04	41.40	424.09	15.21
5.	MI- 0715	22.20	197.30	8.39	246.00	178.89	156.72	11.00	336.06	28.07
6.	MI- 0835	9.60	196.45	8.39	246.00	162.51	171.06	32.60	132.69	23.29
7.	ME- 0058	11.60	204.40	7.67	401.00	215.32	253.31	37.60	170.79	21.33
8.	MI-0145	22.60	172.34	7.67	584.00	112.20	162.60	26.40	246.21	17.71
9.	ME-0247	5.60	230.70	6.66	244.00	207.90	165.00	47.60	136.62	31.66
10.	MI- 0637	18.60	164.30	5.91	365.00	147.62	158.73	18.60	256.70	23.38
11.	MI- 0828	5.60	88.61	5.38	184.00	184.22	195.97	33.80	673.40	23.45
12.	MI- 0252	5.00	118.75	7.13	180.20	205.05	122.14	36.40	172.83	42.23
13.	ME- 0071	9.80	179.60	5.49	249.00	151.88	108.48	27.40	348.24	35.13
14.	ME- 0109	7.00	135.55	5.44	170.60	139.97	133.30	25.40	247.50	26.35
15.	ME- 0220	15.40	124.95	6.53	305.00	191.59	177.31	22.40	340.14	16.78
16.	ME- 0006	8.40	159.20	5.73	195.40	100.32	164.45	23.20	340.14	15.25
17.	MI-0845	27.40	108.40	7.39	559.60	236.31	106.92	20.60	262.16	55.34
18.	R. local	16.00	103.18	6.38	385.20	100.96	158.10	23.80	154.72	16.07
19.	ME- 0025	10.80	182.90	7.26	249.60	192.99	170.78	24.40	280.12	28.43
20.	MI-0013	13.00	150.25	5.16	379.00	131.45	68.460	29.20	183.69	48.17
21.	MI-0034	8.60	106.95	6.32	256.00	174.49	95.870	30.00	186.52	14.73
22.	MI-0615	17.60	88.60	5.26	431.00	172.36	282.55	24.80	418.28	12.24
23.	MI- 0024	7.81	95.50	7.66	280.00	227.80	80.727	36.00	448.50	70.28
24.	MI- 0065	9.80	88.55	5.79	337.60	125.90	117.66	35.60	330.96	26.95
25.	MI-0310	6.80	92.50	6.44	134.00	244.30	116.88	23.20	437.29	52.40
26.	MI- 0355	16.40	102.30	5.90	322.00	85.28	167.21	21.600	308.08	12.36
27.	MI- 0477	5.12	174.99	6.23	256.00	321.51	81.60	54.200	240.920	88.713
28.	MI- 0497	9.40	128.50	7.40	241.00	197.58	108.56	30.400	490.080	45.690
29.	MI- 0669	10.60	88.46	5.68	235.00	155.35	91.380	23.40	370.05	42.60
30.	MI- 0790	20.40	102.39	5.36	375.00	92.97	125.50	18.60	162.12	18.67
31.	ME-0179	7.10	89.99	6.07	152.00	201.49	100.24	22.20	441.34	50.48
32.	MI- 0632	7.80	108.66	6.66	196.60	175.72	147.66	26.40	490.08	72.07
33.	MI- 0665	6.00	81.39	5.67	126.00	268.90	95.34	20.80	535.33	63.87
34.	MI- 0783	20.00	122.19	6.05	336.20	145.10	122.26	16.60	240.92	29.76
35.	MI- 0817	7.30	124.66	6.86	400.60	203.88	126.63	55.80	308.32	40.35
36.	MI-0818	7.40	163.19	6.05	278.00	201.60	75.50	37.60	441.04	66.80
37.	ME- 0174	7.00	134.59	6.49	198.60	103.42	59.78	27.40	235.36	43.33
38.	MI- 0300	5.20	99.50	5.46	178.60	245.83	76.58	34.80	620.00	80.46
39.	MI-0812	7.20	103.99	5.46	256.00	210.03	91.31	34.00	391.66	57.60
40.	MI-0827	8.00	120.10	6.55	210.40	164.30	111.20	18.30	280.00	46.10
	S.Ed	**1.857**	**11.453**	**0.416**	**49.333**	**16.427**	**1.874**	**5.09**	**6.06**	**1.497**
	CD (=0.05)	**3.672**	**22.650**	**0.823**	**97.566**	**32.487**	**3.738**	**10.08**	**12.095**	**2.988**

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Table 4. Phenotypic correlation coefficients for 9 quantitative traits in 40 mulberry accessions

Traits	NSPP	SL	IL	NLPT	LA	SLA	NLPB	HLW	LDW
NSPP	1.00	0.107^{NS}	0.197^{NS}	0.682**	-0.396*	0.316*	-0.485**	-0.309^{NS}	-0.457**
SL		1.00	0.471**	0.304^{NS}	-0.090^{NS}	0.290^{NS}	0.309^{NS}	-0.431**	-0.242^{NS}
IL			1.00	0.175^{NS}	0.141^{NS}	0.177^{NS}	0.065^{NS}	-0.149^{NS}	-0.044^{NS}
NLPT				1.00	-0.362*	0.349*	0.198^{NS}	-0.402*	-0.421**
LA					1.00	-0.229^{NS}	0.313*	0.345*	0.718**
SLA						1.00	-0.027^{NS}	-0.122^{NS}	-0.669**
NLPB							1.00	-0.110^{NS}	0.221^{NS}
HLW								1.00	0.424**
LDW									1.00

* Significant at P =0.05 and ** Significant at P =0.01

NSPP	Number of shoots / plant	**SLA**	Specific leaf area (cm^2/ g)
SL	Shoot length (cm)	**NLPB**	Number of leaves/branch
IL	Internodal length (cm)	**HLW**	100 leaf weight (g)
NLPT	Number of leaves/ plant	**LDW**	Leaf dry weight (g/plant)
LA	Leaf area (cm^2)		

Table 5. Distribution of 40 mulberry germplasm accessions in different clusters

Clusters	Number of accessions	Constituent accessions
I	2	MI-0715 , MI-0845
II	7	MI- 0817 , MI- 0024 , MI- 0497, MI-0675, MI-0012, MI-0145 MI-0489
III	6	MI-0034, MI- 0665, MI-0310, ME-0179, ME- 0220, ME- 0025
IV	14	MI- 0790, MI- 078, MI- 0065, R. Local, MI- 0355, MI- 0817, MI-0300, ME- 0109, ME- 0006, MI- 0637, ME- 0071, MI-0013, MI-0669, MI-0812
V	2	MI- 0828, MI-0615
VI	5	MI- 0632, MI- 0835, MI- 0252, ME- 0174, MI-0827
VII	4	ME-0247, MI- 0477, MI-0029, ME- 0058

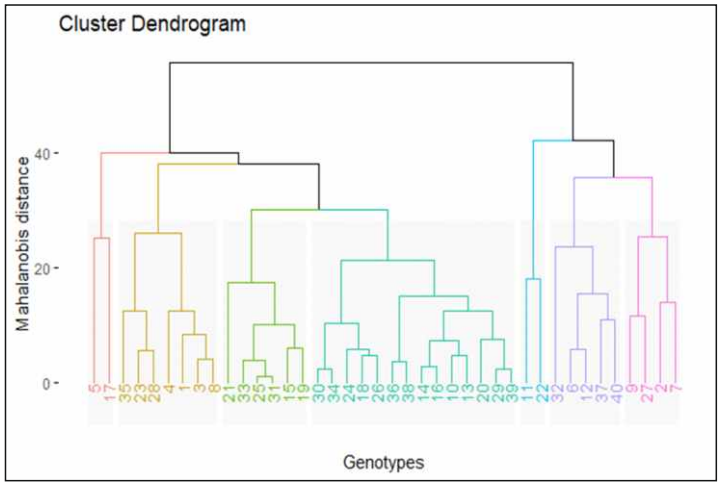

Fig 1. Cluster analysis for 40 mulberry germplasm accessions

Discussion

In the present study, the accession MI-0845 had the highest number of shoots per plant (27.40) which is in line with [1] who evaluated elite mulberry genotypes for growth and yield parameters in different seasons and reported that highest number of shoots per plant was recorded in ME-224 (62.75).[13] observed variation for different growth attributes with a 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). [1] Reported that during winter season, the genotype ME-224 was superior with respect to different *viz.,* 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%). [11] Opined that maximum leaf production per plant (371.3 and 373.1 kg/ha), fresh leaf weight (26,503 and 26,333 kg/ha) were recorded high in S-13 and K-2, respectively during

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the winter season. [3] studied the growth parameters of sixty-four mulberry accessions in four seasons and observed significant variation in terms of branch height from 65.04 to 110.36cm; number of branches from 11.11 to 37.05; number of leaves per branch from 23.87 to 34.02; leaf area from 55.44 to 190.18 cm^2; single leaf weight from 70 to 275g/plant; internodal distance from 2.61 to 3.70cm and leaf yield per plant from 101.44 to 402.11g. [16] selected thirty-three mulberry genotypes and evaluated for different biometric attributes *viz.,* number of branches per stump (119.33), length of longest shoot (152.33cm), internodal distance (2.65cm), leaf yield (33008.27kg/ha/year) among them fourteen mulberry genotypes showed significant difference in yield attributes characters. [5] recorded growth and yield parameters 14 mulberry varieties where the plant height ranged from 1.73 to 2.30cm, total shoot length from 9.49 to 8.19cm, number of leaves per meter of length from 18.22 to 27.00, weight of 100 fresh leaves from 170.50n to 511.75 g, leaf yield from 16.03 to 27.19 ton per ha and overall result indicated that S- 1635 variety performed better in all parameters followed by Kanva-2 and Tr-4. An experiment conducted with 18 mulberry genotypes at Central Sericulture Research and Institute Mysore revealed lot of variation for quantities traits *viz.,* plant height (120 to 258cm), number of branches (4.3 to 38), total length of branches (214 to 2900 cm), number of leaves per length of branch (12.3 to 24.5), weight of 100 leaves (189 to 464g), leaf area (74.5 to 201cm^2), leaf yield per plant (144 to 1054g), weight of shoot per plant (97 to 1044g) [8].

Correlations are important in understanding the relationships between growth and yield parameters of mulberry accessions. This helps breeders to formulate appropriate breeding strategies for selection of desired traits [8]. In the present study, number of shoots per plant showed significantly positive correlation with specific leaf area and number of leaves per plant. Shoot length had significantly positive correlation with internodal length, whereas, the number of leaves per plant exhibiteda significantly positive correlation with specific leaf area. Leaf area had significantly positive correlation with number of leaves per branch, 100 leaf weight and leaf dry weight. 100 leaf weight showeda significantly positive correlation with leaf dry weight. Internodal length and shoot length were found to have a positive effect on yield parameters [12]. However, a positive correlation of leaf yield is mainly contributed toa number of branches and internodal length [2] [14]

Based on the hierarchical cluster analysis, seven groups were evident from the dendrogram. Cluster I had two genotypes namely MI-0715 and MI-0785 which were characterized by a maximum number of shoots per plant, shoot length and internodal length respectively. Cluster V had two genotypes namely MI-0828 and MI-0615 which were characterized by maximum 100 leaf weight, leaf area and specific leaf area. Similarobservations were reported earlier [12] [10].

Conclusion

A study of growth and yield parameters of 40 different mulberry accessions revealed that MI-0845 recorded the highest number of shoots per plant, ME-0247 and MI-0715 recorded shoot length and internodal length respectively, MI-0145 maximum number of leaves, MI-0477 and MI-0615 for leaf area and specific leaf area. Among the forty mulberry accessions MI-0817 recorded maximum number of leaves per branch, MI-0828 recorded highest 100 leaf weight and MI-0477 for leaf dry weight. The highly correlated parameters *viz.,* number of shoots per plant, shoot length, number of leaves per plant and 100 leaf weight can be considered during selection of mulberry accession for high yield.Cluster I and V exhibited maximum variability consisting genotypes with good yield parameters.Consequently, these traits can be utilized in selection of mulberry accessions for future mulberry crop improvement and breeding of high yielding varieties.

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References

1. Ahalya BN, Chikkalingaiah, Mudalagiriyappa and Murali K (2020).Evaluation of elite mulberry genotypes for growth and yield parameters in different seasons.*Journal of Entomology and Zoology Studies***8**(4): 1253-1256.

2. Banerjee, R., Sukhen, R., Haradhan, S., Bimal, K. D., Pannalal, G., &Beera, S. (2007). Genetic diversity and interrelationship among mulberry genotypes. *Journal of genetics and genomics, 34*, 691-697.

3. Bari MA, Quiyyom MA, Islam M and Ahmed SV (1988). Comparative evaluation of morphological characters of some open-pollinated progenies and parental lines of mulberry. *Sericologia*.**28**(4):509-517

4. Doss SG, Vijayan K, Rahman MS, Das KK, Chakraborti SP, Roy BN (2000). Effect of plant density on growth, yield and leaf quality in triploid mulberry. *Sericologia***40**(1):175-180.

5. GargiSukla P, Kumar D, Kumar R and Pandey RK (1997). Intercropping for profitable in purvanchal. *Indian Silk* **35**(11) 31-32.

6. Herbert, D., Faure, S., &Oliveri, I. (1994). Genotypic, phenotypic and environmental correlation in black medic, *Medicagolupilina*L. grown in three different environments. *Theor. Appl. Genet, 88*, 604-613.

7. Levesque R (2007). SPSS. Statistical package for thesocial sciences, version 16.0. SPSSProgramming and data management. Aguide for SPSS and SAS users, fourthedition, *SPSS inc.,* Chicago III.

8. Masilamani S, Reddy AR, Sarkar A, Sreenivas BT andKamble CK (2000). Heritability and genetic advance of quantitative traits in mulberry (*Morus* spp.). *Indian Journal of Sericulture*. **13**(1):16-20.

9. Ramani S, David J, Catherine loader. Statistical analysis of modified complete randomized designs: applications to chemo-orientation studies. *Journal of Experimental Biology*, 2005, 208.

10. Shabir A. Wani, G. N. Malik, M. R. Mir, G. parveez, Naina Majid and M. Ashraf Bhat (2014). Evaluation of mulberry germplasm based on leaf and yield parameters. *The bioscan***9**(4): 1399-1404.

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11. Terefe M, Shifa K, Tilahun A, Ibrahim A, Biratu K and Bogale A (2018) Performance of different mulberry/ *Morus* sp/ genotypes and their effect on mulberry silkworm, *Bombyx Mori* (Lepidoptera: *Bombycidae*), Open Access *Journal Agricultural Research*. **3**(11):1-7

12. Tikadar, A. and Rao, A. A. 2002. Intra- and inter-specific hybridization studies in mulberry. *Bulletin of Indian* Academy of Sericulture. **6**:17-22.

13. Tikader A, Roy BN (2006). Evaluation of mulberry germplasm based on morphological and yield attribute for selection. *Indian Journal of Forestry*. **29**(1):99-103.

14. Tikader, A., &Kamble, C. K. (2019).Performance of exotic mulberry (*Morus* spp.) germplasm on growth and yield traits in Indian condition. *International Journal of Plant Breeding and Genetics,* ISSN 5756-2148 Vol. **6** (8), pp. 001-007.

15. Tikader, A., & Roy, B. N. (2001). Multivariate analysis in some mulberry (*Morus spp*.) germplasm accessions. *Indian Journal of Sericulture, 40*, 71-74.

16. Vijayan, Chakraborthy, S, Doss, S, Tikader, A and Roy, B. (1998). Evaluation of triploid mulberry genotypes morphological and anatomical studies. *Indian journal of Sericulture,***37**(1), 64-67.

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