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Genotype × Environmental Interaction for Growth and Yield Parameters of Elite Mulberry Hybrids in Different Seasons

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Abstract

The investigation was carried out to study genotype × environmental interaction for growth and yield parameters of mulberry hybrids in different seasons during 2022-23 at the Department of Sericulture, UAS, GKVK, Bengaluru-65. The study comprised of eight mulberry hybrids and two check varieties. Analysis of variance for growth and yield parameters of mulberry hybrids in different seasons indicated highly significant mean sum of squares due to season for shoot height (cm), number of branches per plant, number of leaves per plant, single leaf area (cm^2), leaf moisture content (%) at harvest, leaf moisture retention capacity at 6, 9 and 12 hrs after harvest and leaf yield per plant (g). The mean squares due to seasons was significant for shoot length, number of branches per plant, number of leaves per plant, leaf moisture content, leaf moisture retention capacity at 6 and 9 hours after harvest of leaf and leaf yield per plant and non-significant for internodal distance (cm). The selection indices of mulberry hybrids revealed that rainy season (S-4) of 2023 was found more favourable for mulberry hybrids for good expression of shoot length, number of branches per plant, number of leaves per plant, single leaf area, leaf moisture content, leaf moisture retention capacity at 6 and 9 hours after harvest of leaf and leaf yield per plant. On the other hand S2-Summer season 2023 was found more favourable for mulberry hybrids for good expression of internodal distance (cm). Among the genotypes studied, no single genotype was stable across the season for all the traits. The mean performance of different mulberry hybrids in each season overall and the mean values of each genotype were computed and rankings were assigned. Among the different mulberry hybrids, ME-65 × V1 ranked first and found stable over the seasons for most of the traits *viz.*, shoot length(cm), number of branches per plant, internodal distance, single leaf area (cm^2), leaf moisture content (%), moisture retention capacity at 6, 9 hrs after leaf harvest and leaf yield per plant (g), followed by MI-79 ×MI-66.

Keywords : Mulberry hybrids, Regression coefficient, Deviation from Regression, Different seasons

The productivity of a genotype is the function of its adaptability to a particular environment. Stability of a genotype depends on the ability to retain certain morphological and physiological characters along with its production efficiency steadily allowing others to vary, resulting in predictable G×E interactions for yield. An improved population can adjust its genotypic and phenotypic states in response to environmental fluctuations in such a way that it can give high and stable yield. The study of yield or individual yield components under certain conditions can lead to simplification in genetic explanation and determination of environmental effects.

Mulberry (*Morus* spp.) is the sole host plant for silkworm (*Bombyx mori* L.). The leaf of this plant is fed to the silkworm during its larval stage. It is a perennial plant and is cultivated by the farmers in a particular field at least for 10-12 years for the production of quality leaves (Susheelamma *et al*., 2006).This plant is cultivated under various environmental conditions like tropical dry, tropical humid and sub-tropical regions. The yield stability in mulberry over a wide range of environments is one of the most desirable parameters to be considered for selecting mulberry for large scale cultivation. Sarkar *et al*. (1986) and Bari *et al*. (1990) have emphasized that a knowledge of the nature and relative magnitude of the genotype-environment interaction has great importance for selecting superior genotypes to be used commercially in diverse environmental conditions. Stable materials are therefore required to obtain least variability in leaf production per unit area over different locations.

G×E interaction is a phenomenon that phenotypes respond to genotypes differently according to different environmental factors. It is an important parameter for plant breeding programme to identify the stable genotypes/hybrids that are widely adapted to unique environment and also affects the gains, recommendation & selection of cultivars with wider adaptability (Lal *et al*., 2019). Leaf yield of mulberry fluctuates with the seasons due to sensitivity of the genotypes in different growing conditions. A G×E interaction exists where relative performance of the cultivar's changes from one environment to other environment. So, exploitation of Genotype× Environmental interaction may prove useful in identifying stable genotypes for various environmental conditions.

The present study has been undertaken to know the impact of genotype x season interaction for growth and yield parameters of mulberry hybrids in different seasons.

Material and Methods

The experiment was carried out during the year 2022-23 in Department of Sericulture, University of Agricultural Sciences, Gandhi Krishi Vignana Kendra, Bengaluru. The experimental material for the present study comprised of eight mulberry hybrids and two check varieties (Table 1). The hybrids were developed by Line × Tester mating design during 2019. Among them eight elite mulberry hybrids were selected for the study based on their per se performance. These hybrids were planted in three rows with four plants in each row, with a spacing of 3 ft × 3 ft in the field in RCBD design with three replications. These mulberry hybrids maintained as bush with a crown height of two and half feet from the ground level. The experimental plot was maintained as per the recommended package of practices for rain-fed mulberry (Dandin and Giridhar, 2014). Five competitive plants are selected per replication to take observations were selected randomly from each replication for recording growth and yield parameters. The elite mulberry hybrids were evaluated on 60th day after pruning for different growth and yield parameters during rainy, winter and summer seasons of 2022-2023. The mean data of each hybrid for each season were subjected to analysis of variance in order to study the genotype×environment interaction and hybrids stability following the Eberhart and Russell model (1966) by using linear regression model.

Table 1

List of mulberry hybrids used in study

Mulberry hybrids	
MI-47	(*M. indica*) × MI-66 (*M. indica*)
MI-79	(*M. laevigata*) × MI-66 (*M. indica*)
ME-03	(*M. cathyana*) × MI-66 (*M. indica*)
ME-146	(*M. indica*) × MI-66 (*M. indica*)
ME-65	(*M. alba*) × V1(*M. indica*)
ME-67	(*M. alba*) × V1(*M. indica*)
ME-02	(*M. cathyana*) × MI-66 (*M. indica*)
ME-95	(*M. rotandifolia*) x V1(*M. indica*)
V1	(Check variety)
S36	(Check variety)

Results and Discussion

Analysis of variance indicated high significance of mean sum of squares due to season for shoot length, number of branches per plant, internodal distance, number of leaves per branch, single leaf area, leaf moisture content, leaf yield per plant and moisture retention capacity at 6 and 9 hrs after harvest. Analysis of variance for mean sum of squares due to genotype × season was non-significant for all the characters. Further, it could be observed that variance due to seasons (linear) were highly significant for shoot length, number of branches per plant, number of leaves per branch, single leaf area, leaf moisture content, leaf yield per plant and moisture retention capacity at 6 and 9 hrs after harvest. Whereas non-significant for internodal distance. Variance due to G x S (linear) were significant for single leaf area, leaf yield per plant and moisture retention capacity at 6 and 9 hrs after harvest of leaf. Whereas variance due to G x S (linear) was non-significant for shoot length, number of branches, internodal distance, number of leaves per plant, moisture content (Table 2). Similarly, the present results are in concurrence with the findings of earlier reports. Chakraborty *et al.*, 2012, opined that varieties significantly interacted with additive environment for all the growth characters and leaf yield which was also reported by Ahalya and Chikkalingaiah, 2022.

Determination of Genotype × Environmental Interaction for Growth and Yield Parameters of elite Mulberry Hybrids in Different Seasons

Shoot Length (cm)

Shoot length per plant in different hybrids differed from season to season as indicated by varying environmental indices (-42.88 to 35.00). The highest environment index and mean was recorded in S4 (35.00 and 174.00) and the same was minimum in S2 (-42.88 and 96.81) respectively. When considered overall mean ME-65 × V1 had recorded highest shoot height per plant (152.86 cm) followed by V1 (151.87cm) and MI-47 × MI-66 (146.48 cm).

Table 2

Analysis of variance for leaf yield and its contributing traits of elite mulberry hybrids in different seasons

Source of variations	d.f	Mean sum of squares due to								
		Shoot length (cm)	No. of branches /Plant	Internodal distance (cm)	No. of leaves/ branch	Single leaf area (cm^2)	Leaf moisture content (%)	LMRC at 6 hours (%)	LMRC at 9 hours (%)	Leaf yield / plant (g)
Replication with in season	11	49.587	0.905	0.106	3.205	72.652	2.103	8.541 **	4.277	7375.5Z *
Genotypes (G)	9	473.758 **	2.244 *	0.851 **	66.831 **	2320.785 **	28.728 **	11.074 **	28.875 **	224659.00 **
Seasons+ (G × S)	30	129.077 **	6.030 **	0.160	20.246 *	740.101 **	14.390 **	31.950 **	26.807 **	55041.720 **
Seasons	3	10366.080 **	54.829 **	0.636 **	119.055 **	5767.770 **	110.766 **	282.368 **	204.280 **	500608.00 **
G × S	27	102.743	0.608	0.107	9.267	181.471 *	3.682	4.125	7.087	5534.350
Seasons (Lin)	1	1098.250 **	164.487 **	1.907	357.165 **	17303.310 **	332.297 **	847.103 **	612.840 **	1501824.000 **
G × S (Lin)	9	119.835	0.289	0.097	10.242	351.367 **	7.500	8.361 **	11.744 *	10116.780 **
Pooled deviation	20	84.778 **	0.690 **	0.104 **	7.901 **	86.870 **	1.595	1.807	4.283 **	2918.821
Pooled Error	72	17.652	0.250	0.027	2.627	21.55	1.385	1.207	1.160	3274.553

*Significant@ 5%, ** Significant@1%, LMRC: Leaf Moisture Retention

The mean performance of shoot length in different mulberry hybrids was more than the grand mean in ME-65 × V1, V1, MI-47 × MI-66, ME-05 × MI-66, S36 and ME-03 × MI-66 and non-significant regression co-efficient indicated below average stability. Hence, these genotypes are specially adapted to favourable environments. The deviation from regression was highly significant which indicated unpredictable performance over the environments. The mean performance of ME-65 × V1 was more than the grand mean and significant regression co-efficient found average stability, hence it is well adapted to all the environmental conditions. On the other hand, the deviation from regression was highly significant by indicating unpredictable performance across the environment. However, the mean performance of ME-95 × V1, ME-146 × MI-66 and ME-67 × V1 was less than the grand mean with non-significant regression co-efficient and were grouped under above average stability. Hence, these genotypes were specially adapted to unfavourable environments. The genotype ME-67 × V1 recorded lowest mean performance than the grand mean with non-significant regression co-efficient indicating average stability and the deviation from regression was highly significant by indicating unpredictable performance across the environment (Table 3).

The present results are corroborated with the findings of earlier workers, Masilamani, 2005, who studied plant height in different environments like spring, summer and rainy seasons. The plant height in spring season and mean values of plant height in all the genotypes were on par with each other. Chakraborty *et al*., 2012, studied mean performance of different mulberry varieties for plant height in different environments. The mean performance of plant height was varied with different environment and highest plant height (181.68 cm) was recorded in E2 (rainy season). Doss *et al.*, 2012, who reported that, plant height of the hybrids CT-9, CT-15 and CT-159, had bi (regression co-efficient) around unity but CT-9 and CT-159 showed minimum S^2di (deviation from linear regression) owing to their above average stability for the parameters and its ability to perform well in unfavorable environment also. In CT-44 the bi was less than unity (0.59) with less S^2di (deviation from linear regression). Raksha, 2015, also reported plant height in different genotypes and reported that none of the genotypes were stable across the seasons. The plant height of two mulberry genotypes *viz*., MI-79 (286.04) and C-763 (292.35) has more than the grand mean and regression co-efficient indicating below average stability; hence these genotypes are better adapted to favourable environments.

Number of Branches Per Plant

The number of branches per plant in ten mulberry hybrids vary from season to season as indicated by varying environmental indices (-2.391 to 3.09). The environment means and index was maximum at S4 (10.52 and 3.09) respectively and was minimum in S2 (-2.39 and 8.66) respectively. When considered overall mean ME-65 × V1 recorded more number of branches per plant (8.15) followed by V1 (8.14) and MI-79 × MI-66 (7.98) (Table 4).

The present results are corroborated with the findings of Raksha, 2015, who reported that, the environmental mean and index was more in rainy season indicating rainy season was an ideal environment for expression of number of branches per plant. The minimum environmental mean and index observed in winter season indicated the unsuitability for the expression of number of branches per plant. Ahalya *et al.* (2020) recorded the environment means and index was maximum at S6 (14.90 and 3.47) respectively and was minimum in S2 7.97 and -3.44) respectively. When considered overall mean V1 recorded more number of branches per plant (13.40) followed by M5 (12.53) and MI-79 (11.76). The mean performance of number of branches per plant of ME-65 × V1 was more than the grand mean with non-significant regression co-efficient and its value is equal to one indicating average stability; hence these hybrids are specially adapted to all environments. Whereas the deviation from regression was non-significant by indicating predictable performance over environment. The mean performance of ME-146 × MI-66, ME-95 × V1 and MI-79 × MI-66 was lesser than the grand mean having non-significant regression co-efficient and it is equal

TABLE 3

Mean performance of ten elite mulberry hybrids in four seasons and their stability parameters for shoot length (cm)

Mulberry Hybrids	S1	Rank	S2	Rank	S3	Rank	S4	Rank	Mean	Overall Rank	b*i*		S^2di	
MI-47 × MI-66	142.33	5	115.21	1	146.36	5	182.03	4	146.48	3	0.82		56.51	*
MI-79 × MI-66	137.19	6	88.38	8	133.38	7	177.27	5	134.06	7	1.12		1.22	
ME-03× MI-66	157.64	3	100.67	4	142.61	6	173.28	6	143.55	6	0.95		20.55	
ME-146 × MI-66	134.63	8	90.61	5	118.85	9	153.59	10	124.42	9	0.81		13.57	
ME-65 × V1	177.66	1	87.23	9	155.16	3	191.42	1	152.86	1	1.39	**	170.14	**
ME-67 × V1	132.76	7	86.38	10	118.13	10	157.40	9	123.63	10	0.91		9.46	**
ME-05 x MI-66	148.18	4	110.70	2	155.53	2	170.92	8	146.33	4	0.77		24.20	
ME-95x V1	129.13	10	90.17	6	128.59	9	171.30	7	129.80	8	0.01		34.82	
V1	170.82	2	93.32	7	158.18	1	185.15	2	151.87	2	1.22		113.62	**
S36	132.63	9	105.59	3	153.05	4	184.70	3	143.99	5	0.96		195.19	***
Mean	146.29		96.81		140.98		174.70		139.70					
Environmental index	6.59		-42.88		1.28		35.00							
C.V.	5.966		5.83		4.45		4.59							
S.Em±	7.12		4.61		5.12		6.55							
CD @ P=0.05	14.97		9.68		10.76		13.76							
CD @ P=0.01	20.51		13.27		14.74		18.86							

*Significant@ 0.05 level ** Significant@ 0.01 level, bi=regression co-efficient, S^2di=Deviation from regressionS1=2022 Rainy season (June-August), S2=2022 Winter season (Nov-Jan), S3=2023 Summer season (March-May),S4=2023 Rainy season (July- Sept)

TABLE 4

Mean performance of ten elite mulberry hybrids in four seasons and their stability parameters for number of branches per plant

Mulberry Hybrids	S1	Rank	S2	Rank	S3	Rank	S4	Rank	Mean	Overall Rank	b*i*	S^2di
MI-47 × MI-66	8.30	4	4.22	9	6.60	5	9.00	10	6.96	7	0.82	0.53
MI-79 × MI-66	8.16	5	5.13	4	7.16	3	11.46	1	5.92	9	1.12	-0.23
ME-03× MI-66	7.13	7	4.76	5	6.06	6	10.33	6	7.00	6	0.95	-0.29
ME-146 × MI-66	6.56	9	5.00	6	5.56	8	11.00	5	7.03	5	1.12	0.41
ME-65 × V1	8.56	3	5.83	2	6.83	4	11.40	2	8.15	1	1.03	-0.26
ME-67 × V1	5.36	10	4.73	7	4.36	9	9.40	9	5.96	8	0.91	0.94 *
ME-05 x MI-66	9.63	1	5.13	4	6.06	6	10.20	8	7.75	4	0.98	1.35 **
ME-95x V1	6.50	9	4.40	8	5.93	7	11.30	3	7.03	5	1.24	0.27
V1	8.13	6	5.96	1	7.26	2	11.20	4	8.14	2	0.94	-0.25
S36	9.4	2	5.16	3	8.30	1	10.26	7	7.98	3	0.48	1.24 **
Grand Mean	7.75		5.03		6.41		10.52		7.43			
Environmental index	0.32		-2.39		-1.01		3.09					
C.V.	12.52		8.66		15.14		9.13					
S.Em±	0.79		0.35		0.79		0.78					
CD @ P=0.05	1.66		0.74		1.66		1.64					
CD @ P=0.01	2.28		1.02		2.28		2.26					

*Significant@ 0.05 level ** Significant@ 0.01 level, bi=regression co-efficient, S^2di=Deviation from regression

S1=2022 Rainy season (June-August), S2=2022 Winter season (Nov-Jan), S3=2023 Summer season (March-May), S4=2023 Rainy season(July- Sep)

to one with average stability indicating these hybrids are poorly adapted to all environments. The mean performance of ME-03 × MI-66, MI-47 × MI-66 and ME-67 × V1 was lesser than the grand mean having non-significant regression co-efficient and it is less than one with above average stability indicating these hybrids are specifically adapted to unfavourable environments and the deviation from regression was highly significant for ME-67 × V1, ME-05 × MI-66 and S36 indicating unpredictable performance across the environment (Table 4).

Similar findings were obtained by Raksha, 2015, who reported that number of branches per plant and reported different genotypes *viz.*, MI-142 (25.24), MI-79 (37.87), C-763 (29.73), SB-21 (27.64), S-36 (26.77) and S-13 (28.77) possessed mean performance was more than the grand mean and significant regression co-efficient having below average stability. Hence these genotypes are specifically adapted to favorable environmental conditions.

Internodal Distance (cm)

Internodal distance in different mulberry hybrids vary from season to season, as indicated by varying environmental indices (-0.27 to 0.26). The environment mean and index was maximum at S2 (6.20 and 0.26) and the same was minimum in S1 (5.66 & -0.27) respectively. When considered overall mean ME-67 × V1 had highest internodal distance (6.89cm) followed by ME-03 × MI-66 (6.51 cm) and ME-05 × MI-66 (6.11 cm). Whereas lowest internodal distance (5.32 cm) was recorded in ME-65 × V1 followed by ME-146 × MI-66 (5.67 cm) (Table 5).

The mean performance of internodal distance of ME-67 × V1 and ME-03 × MI-66 was more than the grand mean with non-significant regression co-efficient and its value was equal to one indicating average stability hence these hybrids are specially adapted to all environments. Whereas the deviation from regression was non-significant by indicating predictable performance over environment. The mean performance of ME-146 × MI-66, ME-65 × V1 and MI-95 × V1 and V1 was lesser than the grand mean having non-significant regression co-efficient and it is equal to one with average stability indicating these hybrids are poorly adapted to all environments. The mean performance of MI-47 × MI-66 and S-36 was lesser than the grand mean having non-significant regression co-efficient and it is less than one with above average stability indicating these hybrids are specifically adapted to unfavourable environments. On other hand, the deviation from regression was highly significant for ME-146 × MI-66, ME-65 × V1, ME-05 × MI-66 and V1 indicating unpredictable performance across the environment (Table 5).

Similar findings were obtained by Raksha, 2015, who reported that the genotypes *viz*., MI-142 (5.34cm) and MI-139 (6.54 cm) possessed above average stability and specifically adapted to unfavourable environment since their mean performance was lesser than the grand mean and regression coefficient less than unity. Ahalya *et al*. (2020) studied internodal distance in different genotypes. The environment mean and index were maximum at S2 (5.64 and 0.36). V1 had higher mean than the grand mean indicated average stability and well adapted to all favourable environments and possessing significant deviation from regression indicating performance across the environment.

Number of Leaves Per Plant

The number of leaves per plant in ten mulberry hybrids differed from season to season as indicated by varying environmental indices (-2.68 to 4.96). The environment mean and index was maximum at S4 (39.61 and 4.96) and the same was minimum in S2 (31.97 and -2.68 respectively. When considered overall mean ME-146 × MI-66 had recorded highest number of leaves per plant (39.12) followed by MI-47 × MI-66 (39.10.2) and ME-65 × V1 (37.13) (Table 6).

The mean performance of number of leaves per plant of ME-65 × V1 and ME-95 × V1 was more than the grand mean with non-significant regression co-efficient and its value is equal to one indicating average stability hence these hybrids are specially adapted to all environments. The mean performance of ME-05 × MI-66 and S36 was lesser than the grand

TABLE 5

Mean performance of ten elite mulberry hybrids in four seasons and their stability parameters for internodal distance (cm)

Mulberry Hybrids	S1	Rank	S2	Rank	S3	Rank	S4	Rank	Mean	Overall Rank	b*i*	S²d*i*
MI-47 × MI-66	5.43	3	5.70	3	5.40	3	6.15	7	5.67	2	0.97	0.05
MI-79 × MI-66	5.90	5	6.20	5	5.70	6	6.06	6	5.96	5	0.70	-0.01
ME-03× MI-66	6.06	7	6.70	9	6.43	7	6.85	9	6.51	7	1.23	-0.00
ME-146 × MI-66	5.33	2	6.36	6	5.53	4	5.46	1	5.67	2	1.39	0.10 *
ME-65 × V1	4.66	1	5.33	1	4.43	1	5.88	4	5.32	1	1.31	0.17 **
ME-67 × V1	6.33	9	7.60	8	6.73	9	6.90	10	6.89	8	1.92	0.03
ME-05 x MI-66	6.03	6	6.46	7	6.30	8	5.66	2	6.11	6	0.10	0.14 **
ME-95x V1	5.43	4	6.20	5	5.23	2	5.96	5	5.70	3	1.65	0.00
V1	5.33	2	5.60	2	5.53	4	6.28	8	5.67	2	1.02	0.13 *
S36	6.16	8	5.90	4	5.63	5	5.68	3	5.84	4	-0.35	
Grand Mean	5.66		6.20		5.79		6.09		5.94			
Environmental index	-0.27		0.26		-0.14		0.15					
C.V.	3.96		6.05		5.18		3.50					
S.Em±	0.18		0.30		0.24		0.17					
CD @ P=0.05	0.38		0.64		0.51		0.36					
CD @ P=0.01	0.52		0.88		0.70		0.50					

*Significant@ 0.05 level ** Significant@ 0.01 level, bi=regression co-efficient, S²di=Deviation from regression

S1=2022 Rainy season (June-August), S2=2022 Winter season (Nov-Jan), S3=2023 Summer season (March-May), S4=2023 Rainy season (July-Sept)

TABLE 6

Mean performance of ten elite mulberry hybrids in four seasons and their stability parameters for number of leaves per plant

Mulberry Hybrids	S1	Rank	S2	Rank	S3	Rank	S4	Rank	Mean	Overall Rank	b*i*	S^2di
MI-47 × MI-66	39.13	2	38.17	1	38.73	1	40.36	3	39.10	2	0.24	-2.47
MI-79 × MI-66	36.50	4	29.84	8	36.33	4	38.62	4	35.32	6	0.79	7.64 *
ME-03× MI-66	41.43	1	31.30	7	36.16	5	37.67	8	36.64	4	0.28	22.20 ***
ME-146 × MI-66	38.43	2	35.70	2	38.63	2	43.73	1	39.12	1	0.94	-1.61
ME-65 × V1	33.60	6	34.51	3	37.16	3	43.27	2	37.13	3	1.24	-1.71
ME-67 × V1	26.00	7	24.82	10	26.70	9	31.48	9	27.25	10	0.84	-2.55
ME-05 x MI-66	21.50	10	26.98	9	26.53	10	38.09	7	28.27	9	1.84	9.89 *
ME-95x V1	29.26	8	31.74	6	35.26	7	43.73	1	35.00	7	1.76	1.39
V1	35.30	5	32.17	5	36.06	6	39.64	5	35.79	5	0.83	-0.89
S36	25.90	9	34.47	4	31.33	8	39.56	6	32.89	8	1.20	20.27
Grand Mean	32.70		31.97		34.32		39.61		34.60			
Environmental index	-1.94		-2.68		-0.33		4.96					
C.V.	5.60		6.89		9.38		9.07					
S.Em±	1.49		1.80		2.63		2.93					
CD @ P=0.05	3.14		3.78		5.52		6.16					
CD @ P=0.01	4.31		5.18		7.57		8.44					

*Significant@ 0.05 level ** Significant@ 0.01 level, bi=regression co-efficient, S^2di=Deviation from regression

S1=2022 Rainy season (June-August), S2=2022 Winter season (Nov-Jan), S3=2023 Summer season (March-May), S4=2023 Rainy season (July- Sept)

mean having non-significant regression co-efficient and is equal to one with average stability indicating these hybrids are poorly adapted to all environments. The mean performance of ME-67 × V1 was lesser than the grand mean having non-significant regression co-efficient and it is less than one with above average stability indicating these hybrids are specifically adapted to unfavourable environments. Whereas the deviation from regression was highly significant for MI-79 × MI-66, ME-03 × MI-66 and ME-05 × MI-66 indicating unpredictable performance across the environment. The deviation from regression was non-significant for MI-47 × MI-66, ME-146 × MI-66, ME-65 × V1, ME-67 × V1, V1 and S36 indicating predictable performance across the environment (Table 6). Similar findings were obtained by Raksha, 2015, who reported that, environmental index for number of leaves per plant was maximum in rainy season indicated that, rainy season was favourable environment for expression number of leaves per tree. Whereas winter season was unfavourable as it is evident by the least environmental index (-15.19). The genotypes C-20 (274.32), ME-52 (415.52), ME-012 (489.78) and SB-21 (490.04) had mean performance lesser than the grand mean with the average stability hence these genotypes are poorly adapted to all the environments.

Single Leaf Area (cm^2)

Single leaf area in different mulberry hybrids vary from season to season as indicated by varying environmental indices (-24.47 to 26.39). The environment mean and index was maximum at S4 (174.73 and 26.39) and minimum at S2 (123.87 and -24.76 respectively). When considered overall mean, ME-146 × MI-66 had highest single leaf area (192.21 cm^2) followed by V1 (171.19 cm^2) and ME-05 × MI-66 (170.62 cm^2) whereas, it is lowest (132.49 cm^2) in MI-139 (Table 7).

The mean performance of number of leaves per plant in hybrid ME-146 × MI-66 and ME-67 × V1 was more than grand mean with non-significant regression co-efficient and its value is equal to one indicating average stability, hence these hybrids are specially adapted to all environments with average stability indicating these hybrids are poorly adapted to all environments. The mean performance of hybrid ME-47 × MI-66, ME-03 × MI-66 and ME-95 × V1 was lesser than the grand mean having non-significant regression co-efficient and it is less than one with above average stability indicating these hybrids are specifically adapted to unfavourable environments. Whereas the deviation from regression was highly significant for MI-79 × MI-66, ME-03 × MI-66, ME-146 × MI-66, ME-65 × V1 and ME-67 × V1 these genotypes indicating unpredictable performance across the environment. The deviation from regression was significant for MI-47 × MI-66, ME-05 × MI-66, ME-95 × V1, V1 and S36 indicating predictable performance across the environment (Table 7).

The present results are corroborated with the findings of earlier workers, Doss *et al*., 2012, revealed that Leaf area was stable across seasons in CT-159. CT-15 had above average stability for leaf area with the ability to perform equally well during unfavourable season CT-44 had high bi (2.10) and moderate S^2di (45.10). The bi of LAI was around unity in CT-11, CT-44, CT-210 & S-1635 and their respective S^2 di were also very low, suggested the uniform development of canopy in these hybrids irrespective of seasonal influence on them. Chakraborty *et al*. (2012) studied the genotype × environment interaction and phenotypic stability of 13 mulberry varieties for plant growth and leaf yield characters. The study indicated that none of varieties showed average and above average stability for growth and leaf yield characters. TR-10 for leaf area exhibited above average linear stability. In addition, S54 was stable for leaf area were found to be promising and stable variety and also Raksha, 2015, reported single area in different genotypes and reported, among the evaluated genotypes, MI-506 (119.08 cm^2), MI-79 (149.35 cm^2), C-20 (186.12 cm^2) and ME-144 (121.29 cm^2) indicated average stability and poorly adapted to all the environmental conditions. Whereas, ME-52 (234.84 cm^2), MI-32 (202.74 cm^2), SB-21 (354.23 cm^2), ME-012 (261.23 cm^2), MI-142 (220.53 cm^2), S-36 (229.12 cm^2) and S-13 (272.51 cm^2) had below average stability with and mean performance was more than the grand mean.

TABLE 7

Mean performance of ten elite mulberry hybrids in four seasons and their stability parameters for Single leaf area (cm²)

Mulberry Hybrids	S1	Rank	S2	Rank	S3	Rank	S4	Rank	Mean	Overall Rank	b*i*	S²d*i*
MI-47 × MI-66	135.80	9	103.79	8	107.58	8	153.12	9	125.07	9	0.97	-14.65
MI-79 × MI-66	166.70	6	128.10	5	117.75	7	175.85	6	147.10	7	1.12	87.35 *
ME-03× MI-66	108.69	10	104.99	7	106.25	10	131.93	10	112.96	10	0.42	57.53 *
ME-146 × MI-66	199.87	1	157.03	1	200.04	1	211.89	1	192.21	1	1.78	309.04 **
ME-65 × V1	168.34	5	94.42	10	129.70	4	182.79	5	143.81	5	1.61	94.05 *
ME-67 × V1	186.91	2	113.70	6	119.22	5	191.52	2	152.84	4	1.71	76.62 *
ME-05 x MI-66	175.28	4	153.97	2	162.58	2	190.68	3	170.62	3	0.65	-10.72
ME-95x V1	142.24	8	128.43	4	123.04	6	154.11	8	136.95	6	0.55	5.59
V1	182.48	3	153.17	3	158.76	3	190.37	4	171.19	2	0.75	-25.71
S36	154.63	7	101.08	9	101.74	9	165.07	7	130.63	8	1.39	22.92
Grand Mean	162.09		123.87		132.67		174.73		148.3			
Environment index	13.75		-24.47		-15.67		26.39					
C.V.	3.24		10.83		3.92		2.79					
S.Em±	4.28		10.95		4.25		3.98					
CD @ P=0.05	9.00		23.02		8.93		8.36					
CD @ P=0.01	12.34		31.54		12.24		11.46					

*Significant@ 0.05 level ** Significant@ 0.01 level, bi=regression co-efficient, S²di=Deviation from regression

S1=2022 Rainy season (June-August), S2=2022 Winter season (Nov-Jan), S3=2023 Summer season (March-May), S4=2023 Rainy season (July- Sept)

TABLE 8

Mean performance of ten elite mulberry hybrids in four seasons and their stability parameters for leaf moisture content (%)

Mulberry Hybrids	S1	Rank	S2	Rank	S3	Rank	S4	Rank	Mean	Overall Rank	b*i*	S^2di
MI-47 × MI-66	70.61	7	62.46	6	67.86	6	72.09	3	68.25	5	1.21	1.13
MI-79 × MI-66	71.00	5	66.19	3	70.83	4	71.00	4	69.78	4	0.68	-0.57
ME-03× MI-66	69.38	8	58.79	9	66.23	7	68.93	8	65.83	8	0.21	1.58
ME-146 × MI-66	72.12	4	65.07	4	71.26	2	71.05	6	69.87	3	0.93	-0.21
ME-65 × V1	74.56	3	72.18	1	70.70	3	72.22	2	72.41	1	1.45	-0.79
ME-67 × V1	68.56	10	61.46	8	62.30	9	64.60	10	64.23	10	0.79	3.23 *
ME-05 x MI-66	70.72	6	56.15	10	67.35	8	68.84	9	65.76	9	1.94	0.25
ME-95x V1	69.78	9	64.42	5	68.67	5	69.20	7	68.02	6	0.72	-1.15
V1	74.81	2	67.97	2	71.76	1	73.26	1	71.95	2	0.87	-1.39
S36	71.84	1	62.45	7	60.93	10	68.90	5	67.53	7	1.16	-0.70
Grand Mean	71.35		63.71		68.39		70.01		68.36			
Environment index	2.98		-4.65		0.02		1.64					
C.V.	1.60		5.06		2.61		1.86					
S. Em±	0.93		2.63		1.46		1.06					
CD @ P=0.05	1.96		5.53		3.06		2.24					
CD @ P=0.01	2.68		7.58		4.2		3.07					

*Significant@ 0.05 level ** Significant@ 0.01 level, bi=regression co-efficient, S^2di=Deviation from regression

S1=2022 Rainy season (June-August), S2=2022 Winter season (Nov-Jan), S3=2023 Summer season (March-May), S4=2023 Rainy season (July- Sept)

Hence these genotypes are specifically adapted to favourable environment.

Leaf Moisture Content (%)

Leaf moisture content of different mulberry hybrids differed from season to season as indicated by varying environmental indices (-4.65 to 2.98). The environment mean and index was maximum at S1 (71.35 and 2.98 respectively) and these were lowest in S2 (63.71 and -4.65 respectively). When considered overall mean ME-65 × V1has recorded highest moisture content of leaf (72.41%) followed by V1 (71.95%) and ME-146 × MI-66 (69.87%) whereas it is lowest (64.23%) in ME-67 × V1 (Table 8).

The mean performance of number of leaves per plant of ME-65 × V1 was more than the grand mean with non-significant regression co-efficient and its value is equal to one indicating average stability. Hence this hybrid is specially adapted to all environments. The mean performance of MI-47 × MI-66, ME-05 × MI-66 and S36 lesser than the grand mean having non-significant regression co-efficient and it equal to one with average stability indicating these hybrids are poorly adapted to all environments. The mean performance of ME-03 × MI-66, ME-67 × V1 and ME-95 × V1 was lesser than the grand mean having non-significant regression co-efficient and it is less than one with above average stability indicating these hybrids are specifically adapted to unfavourable environments. Whereas the deviation from regression was highly significant for ME-67 × V1 indicating unpredictable performance across the environment. The deviation from regression was non-significant for MI-47 × MI-66, ME-65 × V1, ME-05 × MI-66, ME-95 × V1, V1 and S36 indicating predictable performance across the environment (Table 8).

The present results are corroborated with the findings of earlier reports of Bhavyashree *et. al.* (2014) reported that the moisture content of genotype SB-21 performed uniformly well over all the seasons (Mean= 67.20, C. V= 2.56 %), on the other hand, Surat local recorded greater variation for moisture content over all the seasons (Mean = 67.20, C. V = 11.97%). Among the different seasons, *kharif* 2011 recorded uniform moisture content over all the seasons. Raksha, 2015, reported moisture content of leaf and reported that, the mulberry genotypes *viz*., ME-52 (70.45%), MI-79 (73.30%), SB-21 (70.4 0%) and S-36 (72.21%) having average stability hence these genotypes are well adapted to all the environments since, these possessed the mean performance was more than the grand mean. Ahalya *et al*. (2020) revealed that based on the stability parameters *viz*., mean, regression (bi) and deviation from regression (S^2di) of eight tree mulberry genotypes indicated, V1 yielded stable performance across the seasons for moisture content.

Moisture Retention Capacity at 6 Hours of Leaf Harvest (%)

Leaf moisture retention capacity at 6 hours of different mulberry hybrids vary from season to season as indicated by varying environmental indices (-6.95 to 5.02). The environment mean and index was maximum at S4 (67.75 and 5.02 respectively) and these were lowest at S2 (55.78 and -6.95 respectively). When considered overall mean ME-65 × V1 had highest leaf moisture retention capacity at 6 hours (65.97%) followed by V1 (64.69%) and MI-47 × MI-66 (63.34%) whereas, it is lowest (60.07%) in ME-95 × V1 (Table 9).

The mean performance of leaf moisture retention capacity at 6 hours of ME-65 × V1 and ME-67 × V1 was more than the grand mean with non-significant regression co-efficient and its value is equal to one indicating average stability. Hence these hybrids are specially adapted to all environments. The mean performance of ME-03 × MI-66, ME-05 × MI-66 and S36 lesser than the grand mean having non-significant regression co-efficient and it equal to one with average stability indicating these hybrids are poorly adapted to all environments. The mean performance of MI-79 × MI-66, ME-146 × MI-66 and ME-95 × V1 was lesser than the grand mean having non-significant regression coefficient and it is less than one with above average stability indicating these hybrids are specifically adapted to unfavourable environments. Whereas the deviation from regression

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TABLE 9

Mean performance of ten elite mulberry hybrids in four seasons and their stability parameters for leaf moisture retention capacity at 6 hours of leaf harvest (%)

Mulberry Hybrids	S1	Rank	S2	Rank	S3	Rank	S4	Rank	Mean	Overall Rank	b*i*	S^2di
MI-47 × MI-66	65.92	6	61.12	8	57.06	3	69.26	2	63.34	3	0.99	-0.64
MI-79 × MI-66	66.18	4	62.44	2	52.27	8	68.18	4	62.27	6	0.65	1.08
ME-03× MI-66	66.20	3	61.86	4	52.77	7	68.20	3	62.26	7	1.28	-1.00
ME-146 × MI-66	65.60	8	61.73	7	55.73	4	67.26	6	62.58	5	0.96	-1.87
ME-65 × V1	68.14	1	63.15	1	62.47	2	70.14	1	65.97	1	1.31	0.21
ME-67 × V1	66.80	2	61.77	6	54.88	5	67.80	8	62.81	4	1.10	-1.56
ME-05 x MI-66	64.94	9	61.90	3	51.86	10	66.28	7	61.24	9	1.19	1.28
ME-95x V1	63.13	10	57.65	9	54.39	6	65.13	10	60.07	10	0.91	-0.70
V1	65.94	5	61.80	5	63.73	1	67.27	9	64.69	2	0.31	2.51
S36	65.64	7	61.90	3	52.60	9	67.98	5	62.03	8	1.26	-0.63
Grand Mean	65.85		61.53		55.78		67.75					
Environment index	3.12		-1.19		-6.95		5.02					
C.V.	2.89		3.09		3.33		2.86					
S.Em±	1.55		1.55		1.52		1.58					
CD @ P=0.05	-		3.26		3.19		3.33					
CD @ P=0.01	-		4.47		4.37		4.56					

**Significant@ 0.05 level ** Significant@ 0.01 level, bi=regression co-efficient, S^2di=Deviation from regression

S1=2022 Rainy season (June-August), S2=2022 Winter season (Nov-Jan), S3=2023 Summer season (March-May), S4=2023 Rainy season (July- Sept)

TABLE 10

Mean performance of ten elite mulberry hybrids in four seasons and their stability parameters for leaf moisture retention capacity at 9 hours of leaf harvest (%)

Mulberry Hybrids	S1	Rank	S2	Rank	S3	Rank	S4	Rank	Mean	Overall Rank	b*i*	S^2di
MI-47 × MI-66	57.89	7	55.60	5	51.01	4	59.89	7	56.10	4	0.84	-1.25
MI-79 × MI-66	59.35	3	54.94	6	46.41	8	61.35	3	55.51	5	0.50	-1.32
ME-03× MI-66	56.36	9	45.59	10	47.60	7	57.70	9	51.81	10	1.13	15.00 ***
ME-146 × MI-66	58.46	6	53.88	7	48.79	5	60.46	6	55.40	6	1.15	-1.45
ME-65 × V1	61.88	1	60.32	1	58.14	2	63.55	1	60.97	1	1.46	-0.43
ME-67 × V1	57.30	8	54.88	9	46.13	9	58.64	8	54.24	8	1.20	1.68
ME-05 x MI-66	58.63	5	55.84	4	44.59	10	60.63	5	54.92	7	1.52	3.85 *
ME-95x V1	55.52	10	51.15	8	50.16	3	57.52	10	53.59	9	0.73	0.35
V1	59.49	2	56.36	3	60.34	1	61.83	2	59.50	2	0.14	5.85 **
S36	59.15	4	57.88	2	46.97	6	60.82	4	56.20	3	1.30	5.82 **
Grand Mean	58.40		54.64		50.01		60.24		55.82			
Environmental index	2.5		-1.18		-5.81		4.41					
C.V.	2.15		4.12		4.76		2.14					
S.Em±	1.02		1.83		1.94		1.03					
CD @ P=0.05	2.16		3.85		4.08		2.17					
CD @ P=0.01	2.95		5.28		5.60		2.97					

*Significant@ 0.05 level ** Significant@ 0.01 level, bi=regression co-efficient, S^2di=Deviation from regression
S1=2022 Rainy season (June-August), S2=2022 Winter season (Nov-Jan), S3=2023 Summer season (March-May), S4=2023 Rainy season (July-Sept)

was non-significant for all mulberry hybrids indicating predictable performance across the environment (Table 9).

Leaf Moisture Retention Capacity at 9 Hours of Leaf Harvest (%)

Leaf moisture retention capacity at 9 hours of different mulberry hybrids vary from season as indicated by varying environmental indices (-5.81 to 4.41). The environment mean and index was maximum at S4 (60.24 and 4.41 respectively) and minimum S3 (50.01 and -5.81 respectively). When considered overall mean ME-65 × V1 had highest leaf moisture retention capacity at 9 hours (60.97%) followed by V1 (59.50%) and S36 (56.20%). Whereas it is lowest (51.81%) in ME-03 × MI-66 (Table 10).

Similar results were reported by Ahalya *et al*., 2020, who reported that leaf moisture retention capacity at 9 hours of different genotypes vary from season to season as indicated by varying environmental indices (-6.62 to 7.42). The environment mean and index was maximum at S5 (62.44 and 7.42 respectively) and minimum S3 (48.39 and -1.78 respectively). When considered overall mean M5 had highest leaf moisture retention capacity at 9 hours (59.42%) followed by V1 (58.57%) and MI-012 (56.18%) whereas it is lowest (51.83%) in MI-21.

The mean performance of leaf moisture retention capacity at 9 hours of ME-65 × V1 and S36 was more than the grand mean with non-significant regression co-efficient and its value is equal to one indicating average stability hence these hybrids is specially adapted to all environments. The mean performance of ME-03 × MI-66, ME-146 × MI-66, ME-67 × V1 and ME-05 × MI-66 lesser than the grand mean having non-significant regression co-efficient and it equal to one with average stability indicating these hybrids are poorly adapted to all environments. The mean performance of MI-79 × MI-66, ME-95 × V1 was lesser than the grand mean having non-significant regression coefficient and it is less than one with above average stability indicating these hybrids are specifically adapted to unfavourable environments. Whereas the deviation from regression was highly significant for ME-03 × MI-66, ME-05 × MI-66, V1 and S36 indicating unpredictable performance across the environment. The deviation from regression was non-significant for MI-47 × MI-66, MI-79 × MI-66, ME-146 × MI-66, ME-65 × V1, ME-65 × V1, ME-67 × V1 and ME-95 × V1 indicating predictable performance across the environment (Table 10).

Similar results were reported by Raksha, 2015, reported the leaf moisture retention capacity at 9 hours and reported that, ME-012 (52.94%), C-763 (52.35%), SB-21 (54.08%), C-20 (49.84%) and MI-506 (54.14%) had mean performance lesser than the grand mean and regression co-efficient with above average stability indicating these genotypes are specifically adapted to unfavourable environments.

To determine the leaf moisture at six and nine hours of harvest, a composite sample of ten leaves was collected and fresh weight was taken. The leaves were kept open under laboratory condition and the weight was recorded at 6 hr after harvest. The leaves were dried thoroughly at 80 ^{0}C in the oven. Dry weight was taken, the moisture retention capacity was calculated by using the formula below (Shivashankar, 2015).

$$\text{Moisture retention capacity (\%)} = \frac{\text{(Weight after 6 hr) - (Dry weight)}}{\text{(Fresh weight) - (Dry weight)}} \times 100$$

$$\text{Moisture retention capacity (\%)} = \frac{\text{(Weight after 9 hr) - (Dry weight)}}{\text{(Fresh weight) - (Dry weight)}} \times 100$$

'Single Leaf Area', which leaf was taken for analysis as each leaf varies with its area.

4th or 5th leaves are taken for observation, yes it varies.

Leaf area was estimated by measuring the length and breadth of individual leaf from different hybrids and multiplied with factor and expressed in cm^2.

$$SLA = L \times B \times 0.69$$

Where, SLA = Single Leaf Area

L = Length (cm^2)

B = Breadth (cm^2)

0.69 = Correction factor

Leaf Yield Per Plant (g)

The leaf yield per plant in different mulberry hybrids varied from season to season as indicated by varying environmental indices (-264.42 to 231.02). The environment mean and index was highest at S4 (1063.70 and 231.02) and lowest in S2 (568.25 and -264.42) respectively. When considered the overall mean ME-65 × V1 had highest leaf yield per plant (1089.99g) followed by ME-03 × MI-66 (1082.34g) and V1 (1018.57g). Whereas it is lowest (468.93g) in ME-67 × V1 (Table 11)

The leaf yield per plant in different mulberry hybrids *viz.*, MI-79 × MI-66, ME-03 × MI-66, ME-68 × V1 and V1 was more than the grand mean with non-significant regression co-efficient and its value is equal to one indicating average stability hence these hybrids is specially adapted to all environments. The mean performance of MI-47 × MI-66, ME-146 × MI-66 and ME-95 × V1 and lesser than the grand mean having non-significant regression co-efficient and it equal to one with average stability indicating these hybrids are poorly adapted to all environments. The mean performance of ME-67 × V1, ME-05 × MI-66 was lesser than the grand mean having non-significant regression co-efficient and the value is less than one with above average stability indicating these hybrids are specifically adapted to unfavourable environments. On other hand the deviation from regression was highly significant for ME-03 × MI-66, ME-05 × MI-66, V1 and S36 indicated unpredictable performance across the environment. The deviation from regression was significant for all mulberry hybrids for leaf yield per plant indicating predictable performance across the environment (Table 11).

The present results are in concurrence with the findings of Masilamani, 2005 revealed the leaf yield performance in different seasons of spring, summer and rainy season. Among the genotypes studied the leaf yield of mulberry was highest in TR-8 during spring, summer and rainy seasons of 2002. In contrary the genotype BC-259 yielded higher leaf yield in all the seasons of 2003. Doss *et al*., 2012 also reported that the stability analysis revealed that hybrids CT-44, CT-159, CT-11 are the most stable hybrids for leaf yield while CT-210, CT-9 and CT-210 are suitable for constrained areas while CT-94 and CT185 are good for optimal conditions. Ghosh *et al*., 2013, evaluated leaf yield performance of 10 mulberry varieties was tested through stability analysis for different crop seasons. Variance for deviation from regression (S_{di}^2) of varieties C_{2017}, RFS_{175} and Thalaghatapura did not differ significantly from zero. However, the b_i values of only RFS_{175} out of these three is not significantly different from unity and may be considered to be a stable variety with moderate leaf yield.

While C_{2017} having b_i value significantly higher than unity is suitable for places like Berhampore, Jorhat and Imphal having positive environmental indices Thalaghatapura having b_i value significantly lower than unity is suitable for Koraput, Muluk, Ranchi and Kalimpong with negative environmental indices. Ahalya *et al*. (2020) revealed that based on the selection indices, S6-rainy season 2019 was found more favourable for mulberry genotypes for good expression of leaf yield per tree. Based on the stability parameters *viz*., mean, regression (bi) and deviation from regression (S^2di) of eight tree mulberry genotypes indicated, V1 yielded stable performance across the seasons for leaf yield per tree. Sathyanarayana and Sangannavar (2021) determined the stability analysis and genotype x environment interaction of alkali tolerant mulberry genotypes *viz*., AR-12, AR-14, AR-10, AR-08, AR-29, V1 and S34 at different alkali soils on leaf yield. The large variation in mean leaf yield/microplot, regression co-efficient (bi) and deviation from regression (S^2di) indicated the different responses of genotypes to soil reclaimed with amendments. Genotypes AR-12 and AR-14 showed high leaf yield (AR-12: 18.240 kg, AR-14: 16.15 kg), the low deviation from regression (S^2di) (AR-12: -0.04, AR-14: 0.03) and their regression coefficient values (bi) were close to unity (AR-12: 1.41, AR-14: 1.34) and could be classified as stable genotypes.

TABLE 11

Mean performance of ten elite mulberry hybrids in four seasons and their stability parameters for leaf yield per plant (g)

Mulberry Hybrids	S1	Rank	S2	Rank	S3	Rank	S4	Rank	Mean	Overall Rank	b*i*	S^2di
MI-47 × MI-66	939.56	6	513.61	6	521.66	7	1041.90	6	754.18	7	1.18	6265.52
MI-79 × MI-66	1182.36	3	713.60	5	796.00	5	1271.71	3	990.92	5	1.21	658.43
ME-03× MI-66	1254.36	2	745.23	1	995.53	2	1334.24	2	1082.34	2	1.88	-2600.99
ME-146 × MI-66	835.36	8	420.48	8	493.83	8	925.93	8	668.34	8	1.09	-284.62
ME-65 × V1	1252.60	1	740.23	2	996.63	1	1366.50	1	1089.99	1	1.11	-1771.63
ME-67 × V1	537.66	9	312.00	10	395.76	10	630.30	9	468.93	10	0.63	-3349.07
ME-05 x MI-66	511.98	10	321.38	9	496.77	9	615.42	10	486.39	9	0.50	-487.25
ME-95x V1	903.86	7	440.38	7	708.73	6	1013.73	7	766.68	6	1.24	-3002
V1	1142.56	4	731.96	4	954.03	4	1245.75	4	1018.57	3	1.00	-2844.12
S36	1080.93	5	743.61	3	987.43	3	1191.50	5	1000.87	4	0.82	-243.01
Grand Mean	964.12		568.25		734.64		1063.70		832.68			
Environmental index	131.44		-264.42		-98.04		231.02					
C.V.	14.21		4.19		0.69		13.27					
S.Em±	111.89		19.44		4.07		115.24					
CD @ P=0.05	235.07		40.85		8.55		242.12					
CD @ P=0.01	322.06		55.98		11.72		331.73					

*Significant@ 0.05 level ** Significant@ 0.01 level, bi=regression co-efficient, S^2di=Deviation from regression
S1=2022 Rainy season (June-August), S2=2022 Winter season (Nov-Jan), S3=2023 Summer season (March-May), S4=2023 Rainy season (July- Sept)

Genotype × environment interaction has great importance for selecting superior cultivars to be used commercially in diverse environmental conditions. The selection indices of mulberry hybrids revealed that rainy season (S-4) of 2023 was found more favourable for the expression of shoot length (cm), number of branches per plant, number of leaves per branch, single leaf area (cm^2), leaf yield per plant (g) at harvest and leaf moisture retention capacity at 6 and 9 hrs after harvest, respectively). Based on the stability parameters *viz*., mean (x) and regression (bi), ME-65 × V1 yielded stable performance across the seasons for the maximum number of parameters *viz*., shoot length (cm), number of branches, internodal distance (cm), leaf moisture retention capacity (%) and leaf yield per plant (g) and for single leaf area and leaf moisture content, ME-146 × MI-66 is stable.

References

Ahalya, B. N. and Chikkalingaiah, 2022, Genotype × Environmental interaction for growth and yield parameters of tree mulberry genotypes in different seasons and bioassay studies of silk worm *Bombyx mori* L. *Mysore J. Agric. Sci.,* **56** (1) : 458.

Ahalya, B. N., Chikkalingaiah, Jayaramu, H. D. and Chandrashekar, S., 2020, Genotype × Environmental interaction for growth and yield parameters of tree mulberry genotypes in different seasons. *Int. J. Environ. Clim*., **10** (12) : 6 - 12.

Bari, M. A., Qaiyyum, M. A. and Ahmed, S. U., 1990, Stability of leaf yield in some selected genotype of mulberry (*Morus alba* L.). *Indian J. Seric*., **29** : 88 - 92.

Bhavyashree, S. K., Krishnamurthy, N. and Chikkalingaiah, 2014, Statistical analysis for yield and yield attributing characters on elite mulberry genotype. *M.Sc. (Agri.) Thesis,* UAS, Bangalore, India, pp. : 41 - 50.

Chakraborthy, R., Neog, K. and Talukdar, P., 2012, Studies on phenotypic stability and Genotype × Environment interaction of thirteen mulberry varieties under the agro-climaic conditions of Assam. *Annual Report, CMR& TI, CSB Lahdoigarh Jorhat*, 105 - 108.

Dandin, S. B. and Giridhar, K., 2014, Handbook of sericulture technologies, CSB Publications, pp. : 13.

Doss, S., Chakraborti, S. P., Roychowdhuri, S., Das, N. K., Vijayan, K. and Ghosh, P. D., 2012, Development of mulberry varieties for sustainable growth and leaf yield in temperate and subtropical regions of India. *Euphytica*, **185** : 215 - 225.

Eberhart, S. F. and Russel, 1966, Stability parameters for comparing varieties. *Crop Sci*., **6** : 36 - 40.

Ghosh, M. K., Bindroo, B. B., Das, N. K. and Singh, M. K., 2013, Yield stability in mulberry over different regions of Eastern and North-Eastern India. *J. Crop & Weed,* **9** (1) : 103 - 105.

Lal Chuni, Ajay, B. C., Chikani, B. M. and Gor, H. K., 2019, AMMI and GGE biplot analysis to evaluate the phenotypic stability of recombinant inbred lines (RILs) of peanut under midseason water stress conditions. *Indian J. Genet. Plant Breed*., **79** (2) : 420 - 426.

Masilamani, S., Reddy, A. R., Sarkar, A., Sreenivas, B. T. and Kamble, C. K., 2005, Heritability and genetic advance of quantitative traits in mulberry (*Morus* spp.). *Indian J. Seric*., **13** (1) : 16 - 20.

Raksha, 2015, Studies on performance of elite mulberry genotypes (*Morus* spp) under rainfed during different seasons, *MSc. Thesis*. UAS, GKVK, Bengaluru, pp. : 45 - 70.

Sarkar, A., Das, B. C. and Chakraborty, S. P., 1986, Yield stability in mulberry. *Ind. J. Agri. Sci*., pp. : 56 - 30.

Sathyanarayana, K. and Sangannavar, P. A., 2021, Genotype × Environmental interaction and stability analysis for leaf yield of mulberry (*Morus alba* L.) under alkali affected soils. *Electron. J. Plant Breed*., **12** (2) : 435 - 443.

Susheelamma, B. N., Kamble, C. K., Dayananda, D., Shankar, M. A. and Gururaj, R., 2006, Studies on the identification of suitable mulberry genotypes for block plantation under dry farming. *Mysore. J. Agric. Sci*., **34** (4) : 330 - 334.