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ASSESSMENT OF HIGH YIELDING MULBERRY VARIETIES AT NURSERY LEVEL UNDER THE TROPICAL AGRO CLIMATIC CONDITIONS OF ANANTAPUR, ANDHRA PRADESH

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ABSTRACT

Mulberry (*Morus alba* L.) a perennial plant in nature cultivated for its foliage to feed silkworm (*Bombyx mori* L.) as seasonal crop. Mulberry plants popularly propagated through vegetatively. Therefore, proficient method of propagation not only saves farmers economy but also plays pivotal role on the future of sericulture. Keeping the above aspects four high yielding mulberry varieties *viz*. Victory1 (V1), Genotype4 (G4), AGB8 and Berhampore (BER) varieties were planted during June-July, 2019 at Regional Sericultural Research Station, Central Silk Board, Anantapur, Andhra Pradesh. Each variety was planted @ 2500 cuttings and maintained properly for their survival. Considering V1 mulberry variety as a benchmark high yielding mulberry recommended for the South Indian geo-climatic conditions, the other varieties performance at nursery level was studied. Sprouting of G4 saplings was recorded 11.11% more compared to V1 (89.10%) followed by AGB8 (8.31%), however BER resulted in 22.78% less than the V1 variety. The survival behavior of G4 showed 32.83% more compared to V1 (73.40%) followed by AGB8 (22.89%) whereas 26.02% less survival was noticed in BER under Ananthapur conditions of Andhra Pradesh. Sapling height was recorded 27.78% high in BER followed by G4 (14.49%) and AGB8 (2.94%) compared to V1 (183.6cm/plant). The sapling biomass and shoot weight was recorded higher percent in AGB8 (60.0 & 91.2%) followed by G4 (49.0 & 73.7%), whereas the same were recorded least in BER (30.0 & 35.1%) compared to V1 variety (100.0 & 57.0 g/sapling). In case of root weight of the saplings it was recorded 23.26% more in BER variety followed by AGB8 (18.60%) and G4 (16.28%) compared to V1 variety (43.0g/sapling). Number of leaves per sapling was recorded 7.56% more in G4 followed by BER (4.20%) whereas the same was less on AGB8 (-6.72%) compared to V1 variety (23.8 leaves/sapling). Leaf area was significantly higher in BER (106.49%) followed by AGB8 (62.47%) and G4 (15.42%) over V1 saplings (201.7cm^2**).** Moisture content of leaves was noticed comparatively low in the decreasing order of G4 (-0.66%), AGB8 (-3.03%) and BER (-4.49%) compared with V1 where it was recorded higher moisture content (75.80%) among all the varieties. All the high yielding mulberry varieties *viz.* V1, G4, AGB8 & BER have shown morphologically significant growth variations during their establishment period of 45, 60 and 90 days after plantation.

KEYWORDS: Mulberry, sericulture, leaf yield, sprouting, survival, genotypes.

INTRODUCTION

Raising nurseries of any farming crops either agricultural, horticultural or sericultural is consequently the basic need (Ercisli and Read, 2001; Radwan *et al*., 1989, Pijut and Moore, 2002). Nurseries were raised with a great care in a limited area by providing all necessary inputs like manures, fertilizers and timely watering in a protective manner for quick, healthy with established shoot and root system thereby leading to successful establishment of a standing crop. The success of sprouting and vigor of the sapling are greatly influenced by competing with weeds, soil moisture and soil temperature. Mulberry (*Morus alba* L.) being a perennial plant cultivated for its foliage training as seasonal crop to feed silkworm (*Bombyx mori* L.). Being perennial in habit once mulberry plantation taken up in the main gardens after establishment it consistently yields quality mulberry leaf for a period of more than 15-20 years. For propagation of mulberry several methods are followed such as seedling propagation (sexual) as well as vegetative propagation (asexual) like bud grafting, stem grafting and through the planting of cuttings in soil (Mogili *et al.*, 2011; Sudhakar *et al.*, 2018). Mulberry is predominantly propagated through stem cuttings since time immemorial (Anonymous, 1987; Dandin *et al.*, 2003). Stem cuttings used for the propagation material

depending upon the nature of wood have been termed as hard wood, semi-hardwood and soft wood. Besides, the edaphic and climatic conditions, factors such as type of wood, stage of stock plant growth and time of plantation plays an important role in rooting and subsequent survival of cuttings (Fred T. Davies, Jr., *et al.,* 2018; Sudhakar *et al.,* 2018). In general most popularly and traditionally hard wood cuttings of 6-8 months old shoots after pruning are recommended for planting (Fig.1) (Krishnaswami, 1986, Dandin *et al*., 2003).

However, evolution and contribution of superior mulberry varieties is the most satisfying and inexpensive of all the efforts to improve stable productivity and quality of mulberry. In the recent years, due to the development and evaluation of superior mulberry varieties under improved cultivation technologies, the leaf productivity of 60-70 mt/ha/yr has been achieved and contributed significantly for the benefit of sericultural farming community and economy of India. Moreover, in the recent past the high yielding mulberry varieties such as V1, G4 & AGB8 for South Indian Farming conditions and Berhampore (BER) [GANGA (C-1360)] for the Eastern Indian climatic zone were popularized among the sericulturists due to their superior habit of profuse growth, enhanced quality leaf and resistance to various pest and diseases as depicted in the Table 2. The performance of all the high yielding mulberry varieties such as V1, G4, AGB8 & BER leaf production standardized to a tune of >60kg/ha/yr is appreciated by the farming community thereby witnessing the increased quality cocoon production. Therefore, evaluation of the above high yielding mulberry varieties for their survival and performance in varied geo-climatic conditions of India has become priority of the study. Hence the present study was carried out.

MATERIALS AND METHODS

As a part of Research and Development programme (R & D) of Regional Sericultural Research Station (RSRS), Central Silk Board, Anantapuramu, Andhra Pradesh, mulberry saplings of high yielding mulberry varieties such as V1, G4, AGB8 and BER were raised for the transplantation in the AICEM experimental plots/sites in the varied locations for undertaking long term studies for their performance under the tropical conditions of the RSRS, Anantapuramu. Accordingly, during the onset of monsoon season June, 2019 all the 4 high yielding varieties (HYVs) were planted @ of 2500 each variety cuttings following the standard procedures (Dandin et al., 2003; Sudhakar et al., 2019). The saplings were maintained appropriately taking all the suitable measures for better establishment and healthy growth. Saplings standard establishment parameters such as sprouting, survival after 30, 45 & 60 days after plantation followed by the recording of growth, morphological and physiological parameters were studied. The observations recorded were presented in the Table 1, 2 & Fig. 3.

RESULTS AND DISCUSSION

The phenotypic behavior such as plant growth, yield and leaf quality parameters of V1, G4, AGB8 and Berhampore (BER) mulberry high yielding varieties were detailed in Table 1,2 and Fig. 1,2,3. V1 mulberry variety was evolved with S30xC776 parental combination, G4 with *Morus multicaulis* x S13, AGB8 (Sujanpur-5 x Philippines) & (K-2 x Black cherry) and Berhapore (BER) with Philippines x Vietnam-2 parental combinations evolved as the high yielding varieties for the South and North Indian conditions. All the 4 varieties are potential enough of generating the yield potency level ranging from 40-60mt/ha/yr around the year provided with sufficient manure (FYM @ 25mt/ha/yr) and fertilizer combinations of Ammonium Sulphate (AS), Single Super Phosphate (SSP) and Muriate of Potash (MOP) for supplementing NPK @ 350:140:140kg/ha/yr along with sufficient irrigation as because they have been evolved for irrigated Geo-climatic conditions of tropical zones. Further, from the reference data (Table 1) indicates that the varietal behavior of the varieties indicates that G4 var with increased leaf yield followed by V1, AGB8 and the least was in BER variety. Internodal distance was less in G4, followed by AGB8, V1 and BER variety. Leaf size was noticed wider leaves in BER followed by AGB8, G4, whereas V1 is showing small leaves compared to all the above varieties. Leaf thickness was noticed higher in G4 followed by AGB8, V1 and BER, respectively. Sprouting & survival percentage was recorded high in G4 among all the other varieties followed by V1, AGB8 and BER varieties. However, BER variety shown lower sprouting and survival percentage compared among all the other varieties. In case of nutrient stratus like chlorophylls, proteins and sugar all most all the varieties are showing more or less similar ranges. However in case of leaf moisture and moisture retention capacity (MRC) were comparatively more in V1 followed by G4, AGB8 and BER varieties, respectively. The photo pictures of V1, G4, AGB8 and BER in Fig 1 & 2 further confirms the leaf size, shape, vigor with lush growth showing appropriate thickness indicating rich in desired levels of essential nutrients, chlorophylls and sufficient fiber confirming all the HYVs are most suitable for healthy, successful silkworm rearing with enhanced cocoon production.

Table 1: Physiological, morphological growth and yield characters of high yielding mulberry varieties (HYVs).

Varietal specification	V1 mulberry variety	G4 mulberry variety	AGB8 mulberry variety	BER mulberry variety
Parentage of the variety	S30 x C776	*Morus multicaulis* x S13	(Sujanpur-5 x Philippines) & (K-2 x Black cherry)	PhillipinesxVietnam-2
Leaf yield (mt/ha/yr)	>60 in irrigated conditions	>65 in irrigated condition.	>47 in irrigated conditions	57 mt/ha/yr
Number of shoots /plant	10 -12/ plant	10 -12 plant	9-12 plant	8-11
Total shoot length (cm/plant)	1280 cm	1200 cm	716 cm	755 cm
Inter-nodal distance (IND)	5.2 cm	3.9 cm	4.2 cm	3.7 cm
Leaf size (area) & shape	201.7 cm^2	232.8 cm^2	327.7 cm^2	416.5 cm^2
Leaf shape & surface	Smooth & Glossy Large, entire, ovate, smooth and glossy dark in green.	Smooth, glossy, wavy surface Large, entire, cordate	Smooth and dark green Large, entire & cordate	Smooth and dark green Large, entire & cordate
Leaf thickness (µm)	135-140 µm	155-160 µm	144-158 µm	130-145 µm
Weight of 100 leaves (g)	530 - 560 g	416 - 425 g	535-540 g	530-545 g
Resistance to diseases	Moderately tolerant to leaf blight	Moderately resistant to leaf spot, resistant to leaf rust & root rot.	Moderately resistant to foliar diseases.	Moderately resistant to foliar diseases.
Regeneration capacity	12-14 days in winter & 10-11 days in other seasons	11-13 days in winter & 9-10 days	8-10 days after pruning	10-12 days after pruning
Sprouting (30^{th} day)	>90%	96%	90%	98%
Rooting (at 90 days)	>94%	92%	91%	80-83%
Nitrogen (%)	3.98%	3.94%	4.01%	--
Phosphorous (%)	0.333%	0.375%	0.390%	--
Potassium (%)	1.79%	1.64%	1.76%	--
Total chlorophylls (mg/g)	2.74 mg/g	2.98 mg/g	2.84 mg/g	--
Crude Protein (%)	24.88%	24.63%	22.60%	--
Total Sugars (%)	16.48%	16.34%	17.02%	--
Moisture content (%)	75.8%	75.3%	72.5%	73.5%
% of MRC [6 hrs after harvest]	80.2%	78.6%	74.4%	70.1%

MRC= Moisture Retention Capacity; BER= Berhampore variety; *Courtesy to CSRTI, Central Silk Board, Mysore, Karnataka

Considering V1 mulberry variety as a benchmark high yielding mulberry recommended for the South Indian climatic conditions, the other varieties performance at nursery level was studied. Sprouting of G4 saplings was recorded 11.11% more compared to V1 (89.10%) followed by AGB8 (8.31%), however BER resulted in 22.78% less than the V1 variety. The survival behavior of G4 showed 32.83% more compared to V1 (73.40%) followed by AGB8 (22.89%) whereas 26.02% less survival was noticed in BER under Ananthapur conditions of Andhra Pradesh. Sapling height was recorded 27.78% high in BER variety followed by G4 (14.49%) and AGB8 (2.94%) compared to V1 (183.6cm/plant). The sapling biomass and shoot weight was recorded higher percent in AGB8 (60.0 & 91.2%) followed by G4 (49.0 & 73.7%) whereas the same were recorded least in BER (30.0 & 35.1%) compared to V1 variety (100.0 & 57.0 g/sapling). In case of root weight of the saplings it was recorded 23.26% more in BER variety followed by AGB8 (18.60%) and G4 (16.28%) compared to V1 variety (43.0g/sapling). Number of leaves per sapling was recorded 7.56% more in G4 followed by BER (4.20%) whereas the same was less on AGB8 (-6.72%) compared to V1 variety (23.8 leaves/sapling). Leaf area was significantly higher in BER (106.49%) followed by AGB8 (62.47%) and G4 (15.42%) over V1 saplings (201.7cm^2**).** Moisture content of leaves was noticed comparatively low in the decreasing order of G4 (-0.66%), AGB8 (-3.03%) and BER (-4.49%) compared with V1 where it was recorded higher moisture content (75.80%) among all the varieties (table 1). All the high yielding mulberry varieties *viz.* V1, G4, AGB8 & BER have shown significant visual morphological variations during their establishment period of 45, 60 and 90 days after plantation (Fig. 3 & 4).

Table 2: Growth and physiological behavior of HYVs (V1, G4, AGB8 & BER) at nursery levels.

Parameters	*Mulberry saplings of HYVs*						
	V1	*G4*	*% increase over V1*	*AGB8*	*% increase over V1*	*BER*	*% increase over V1*
Sprouting (%)	89.10	99.00	11.11	96.50	8.31	68.80	- 22.78
Survival (%)	73.40	97.50	32.83	90.20	22.89	54.30	- 26.02
Sapling height (cm)	183.6	210.2	14.49	189.0	2.94	234.6	27.78
Sapling Biomass (g)	100.0	149.0	49.00	160.0	60.00	130.0	30.00
Sapling Shoot weight (g)	57.0	99.00	73.68	109.0	91.23	77.00	35.09
Sapling Root weight (g)	43.00	50.00	16.28	51.00	18.60	53.00	23.26
No. of leaves/ plant	23.80	25.60	7.56	22.20	- 6.72	24.80	4.20
Leaf area (cm^2)	201.7	232.8	15.42	327.7	62.47	416.5	106.49
Leaf moisture (%)	75.80	75.30	- 0.66	73.50	- 3.03	72.40	- 4.49

G4 variety of mulberry saplings have exhibited their superiority in recording higher leaf yield, intermodal distance, leaf thickness, sprouting percentage compared to the other mulberry varieties. However, V1 variety has expressed its dominance in recording higher rooting, leaf moisture and moisture retention capacity (MRC) compared to all the other varieties which are very important parameters to be considered for choosing suitable for Geo-climatic conditions of the Southern Indian. Though AGB8 & BER varieties have shown their superiority in recording higher leaf size, plant height and root, shoot biomass but failed to record their superiority in recording increased levels of leaf moisture, MRC, profuse rooting, sprouting and survival of the saplings which are considered as the prime factors for recommending any variety for the adoption at farmers level.

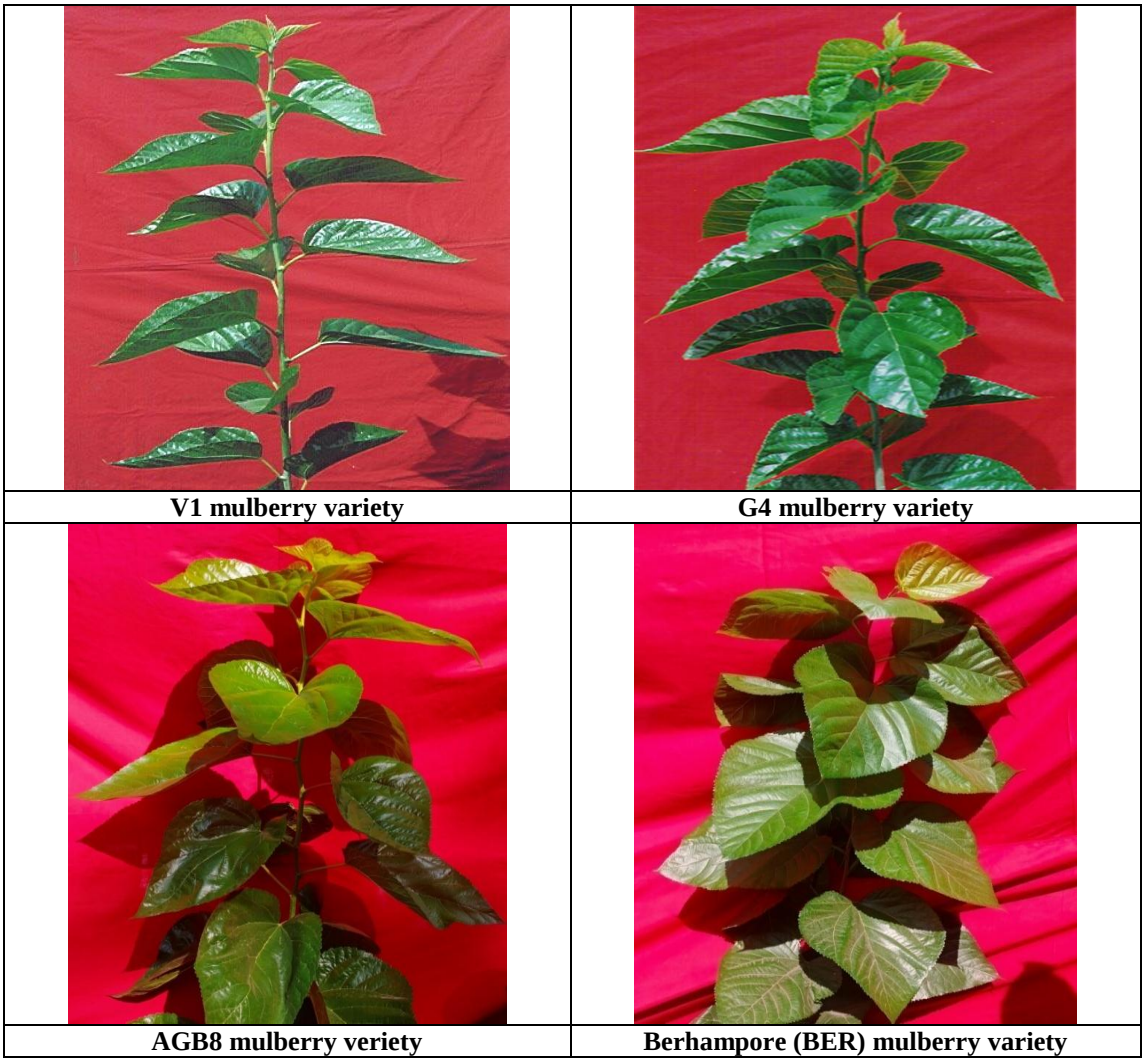


Fig. 1: Morphological appearance of V1, G4, AGB8 and Berhampore (BER) mulberry varieties.

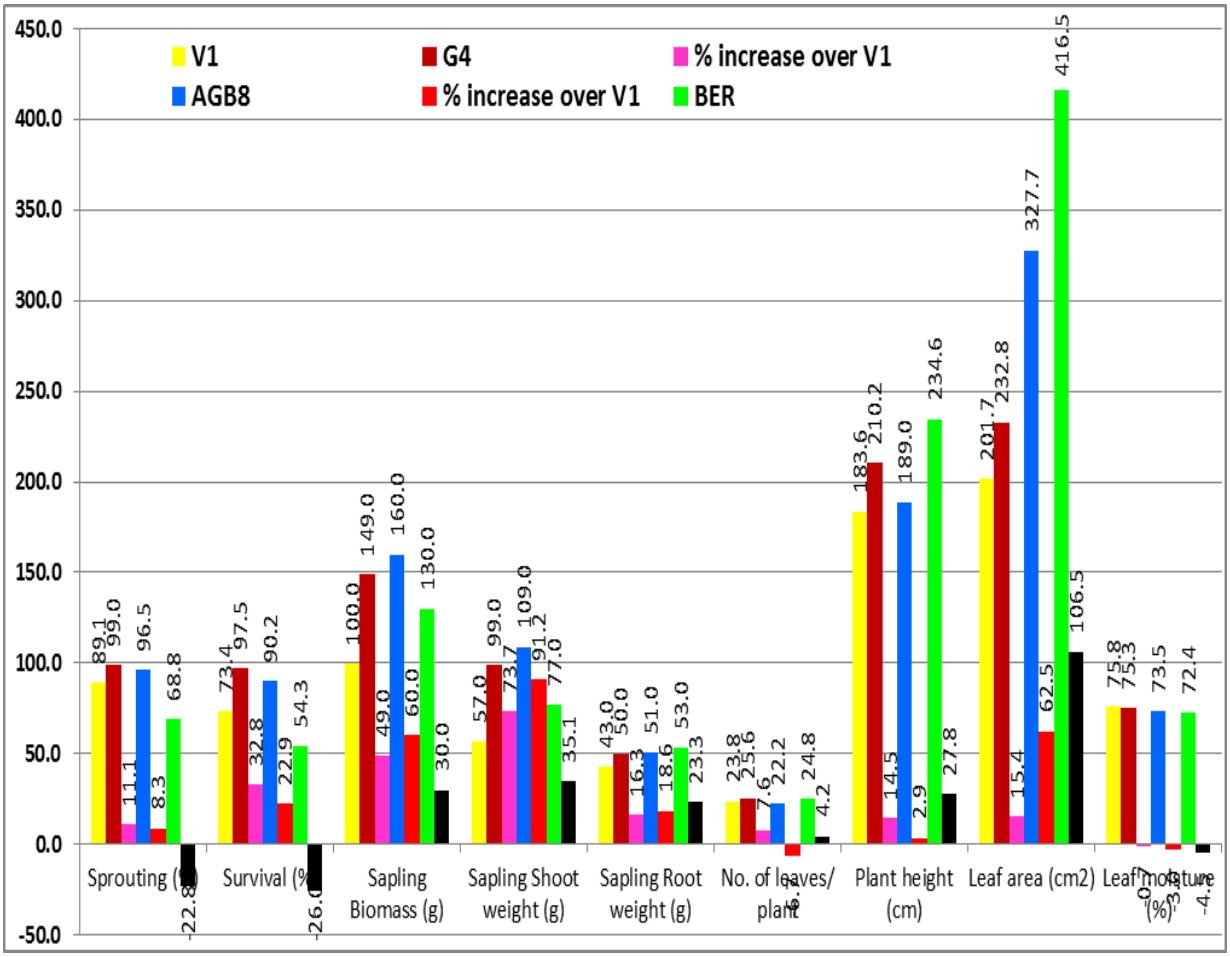
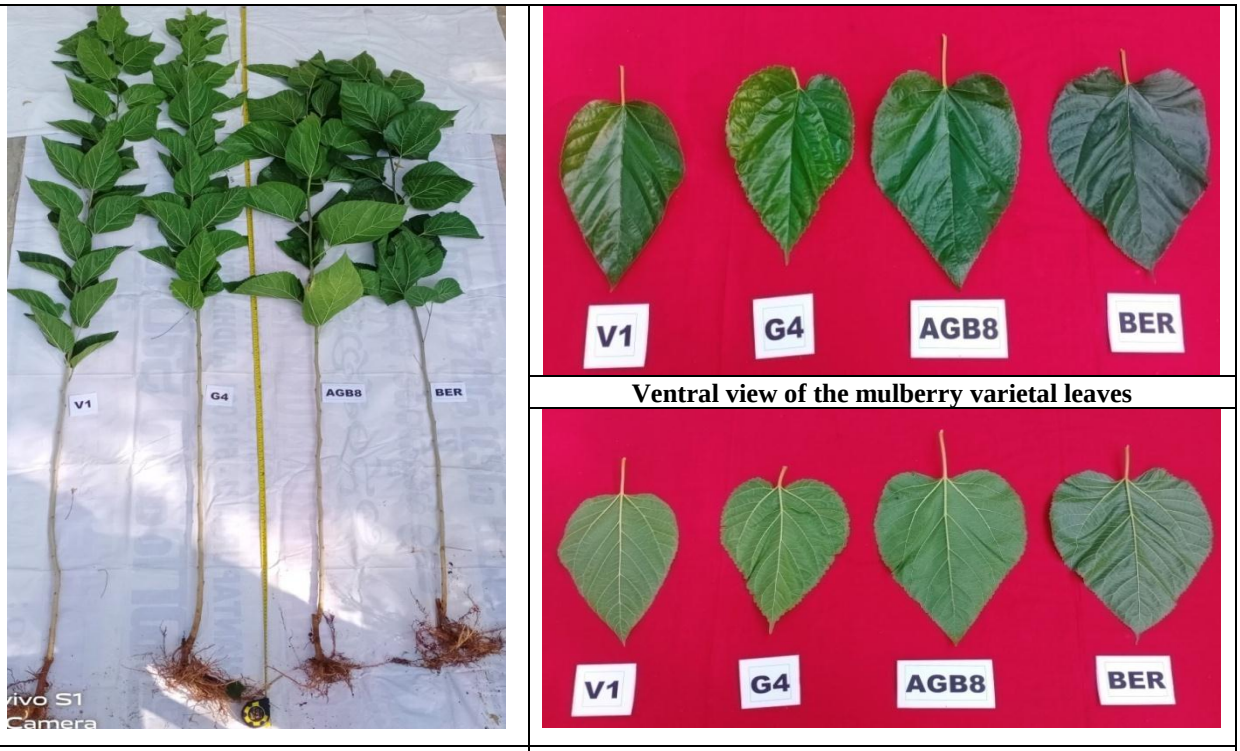


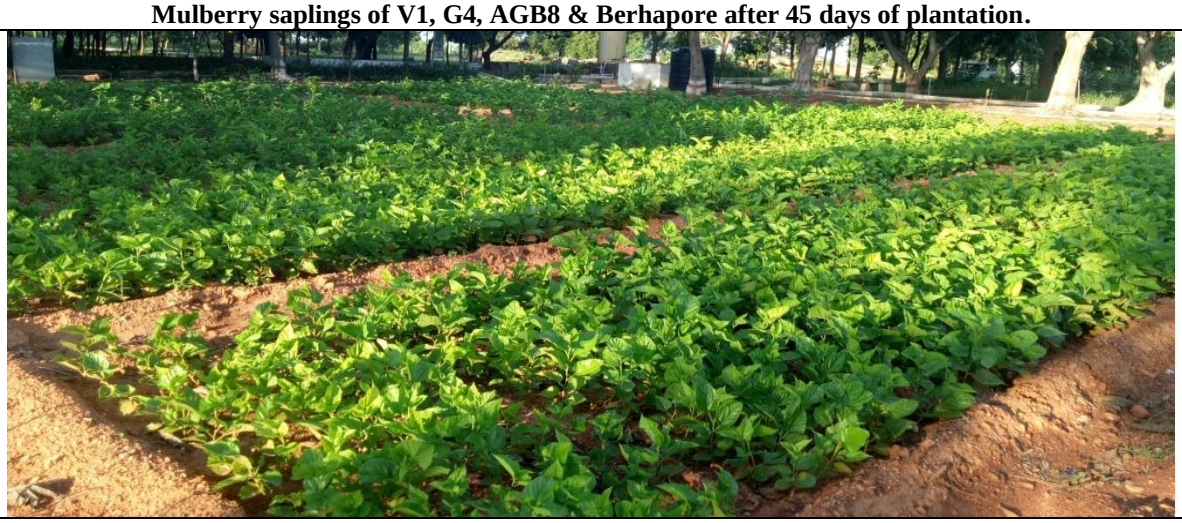
Fig. 2: Growth & physiological variations of V1, G4, AGB8 & BER mulberry saplings.



Physical growth of 4 mulberry varieties | **Ventral view of the mulberry varietal leaves** | **Dorsal view of the mulberry varietal leaves**

Fig. 3: Morphological features of V1, G4, AGB8 & BER mulberry saplings at nursery level.

Mulberry saplings of V1, G4, AGB8 & Berhapore after 45 days of plantation.



Mulberry saplings of V1, G4, AGB8 & Berhapore after 60 days of plantation.

Mulberry saplings of V1, G4, AGB8 & Berhapore after 180 days of plantation

Fig. 4: Mulberry saplings of V1, G4, AGB8 & BER varieties growth behaviour at nursery level.

Though all the mulberry varieties (V1, G4, AGB8 & BER) were evolved as high yielding mulberry varieties for the tropical regions of South as well as North Indian Geo-climatic conditions but shown significant variations and diversity at nursery level the reasons may be several (Sudhakar *et al*., 2019). Evaluation of mulberry gene pool for important agronomic traits is a pre-requisite for mulberry improvement. Breeders always concerned with the selection of superior genotypes which performance is dependent on the phenotypic expressions. Heritability and genetic advances are important selection parameters which help the breeder in selection of elite genotypes from diverse genetic population. Masilamani et al (2000) were in the opinion that often selection based on phenotypic performance does not lead to expected genetic advances mainly due to **[genotype (g) x environment (e)]** interactions. Plant **"adaptation"** sounds like plants are **"doing"** something. In reality, the

term subsume a variety of adjustments, all rooted in evolution in the sense of having arrived in an **"adapted state"**, carrying adaptive traits. Some of these characteristics are genotypic (Scherrer and Korner, 2010), which means they are irreversible within the lifespan of a plant or several generations of plants (evolutionary adaptation). The second category of adjustments is the ability to modify plant structure during development, a response to the environment that is also not reversible within a plant's or organ's lifespan, which is often termed modification. Finally, some adjustments are reversible, and they are known as acclimation or physiological adjustments. Before we enter these various ways of being adapted, a brief account is needed on what is often termed **"cold"**. Lee Hannah (2006) expressed that environmental conditions play a key role in defining the function and growth behavior of plants, in combination with other factors. Climate change known to have had enormous impacts on current plant diversity patterns. However, with single trial of nursery plantation it is difficult to draw any conclusion and needs series of trials in varied seasons may give some conclusions to draw about these varieties establishment, survival and performance.

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REFERENCES

1. Anonymous, ***Manual on Sericulture***. Food and Agriculture Organization of the United Nations (FAO), Rome. 1976. Reprinted Central Silk Board, Bangalore. Published by Geethanjali Printers, No. 5. MSR Industrial Estate. Goka, Bangalore-4. Karnataka, 1987.
2. Dandin, S.B., Jayaswal, J. and Giridhar, K. ***Handbook of Sericulture Technologies*** (Recommended for South Indian States). Pp. 259. Published by Central Silk Board, CSB Complex, BTM Layout, Madivala, Bangalore, Karnataka, 2003
3. Ercisli, S. and Read, P.E. Propagation of hazelnut by softwood and semi-hardwood cuttings under Nebraska conditions. *Acta Horticulturae*, 2001; 556(556): 275-279.
4. Fred, T. Davies, Jr., Robert, L. Geneve., Sandra, E. Wilson., Hudson, T. Hartmann., and Dale E. Kester. Hartmann & Kester's Plant Propagation: Principles and Practices. 9th Edition. Published by Pearson Education Limited, 2018; 1024.
5. Krishnaswami, S. *Mulberry cultivation in South India*. Reprinted from Bulletin No. 1 of Central Sericultural Research and Training Institute, Mysore, 1986; 1-19.
6. Lee Hannah. *Climate Change and Biodiversity*. TERI Press. ISBN 978-81-7993-084-7, 2006.
7. Masilamani, S., Reddy, A.R., Sarkar, A., Sreenivas, B.T. and Kamble, C.K. Heritability and Genetic advantage of quantitative traits in mulberry (*Morus spp.*). *Indian J. Seric*., 2000; 39(1): 16-20.
8. Mogili, T. Mulberry Cultivation. Report submitted to Central Silk Board, Bangalore, 2000.
9. Mogili, T., Rajashekar, K., Balakrishna, R. and Kamble, C.K. Development of protocol for raising mulberry saplings from soft wood and semi-soft wood cuttings. *Av. Plant Sci*., 2011; 24(II): 443-446.
10. Pijut, P.M. and Moore, M. Early season softwood cuttings effective for vegetative propagation of *Juglans conerea*. *Hort. Science*, 2002; 37(4): 697-700.
11. Radwan, M.A., Max, T.A. and Johnson, D.W. Softwood cuttings for propagation of red aider. *New Forests*. 1989; 3(1): 21-30.
12. Scherrer D, Körner C. Topographically controlled thermal-habitat differentiation buffers alpine plant diversity against climate warming. *J Biogeogr*, 2011; 38(2): 406-16.
13. Sudhakar, P., Hanumantharayappa, S.K., Jalaja S Kumar, Sivaprasad, V. and Nagesh Prabhu, H. Rapid production of mulberry (*Morus alba* L.) saplings through the incorporation of clonal and root trainer methods. *Int. J. Infor. Res. Rev.*, 2018; 5(6): 5571-5578.
14. Sudhakar, P., Vijaya Naidu, B., Kiran Kumar, K.P. and Teotia, R.S., Comparative studies of V_1 and G_4 high yielding mulberry varieties at nursery level. Int. J. Cur. Res., 2019; 11(4): 2745-2750.
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