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RESEARCH ARTICLE

COMPARATIVE STUDIES OF V_1 AND G_4 HIGH YIELDING MULBERRY VARIETIES AT NURSERY LEVEL

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ABSTRACT

Propagation of a plant in efficient way is the prime act of any farming and plays vital role in its existence, survival and continuity in future course of action. Mulberry (*Morus alba* L.) being perennial in nature cultivated as seasonal crop for its foliage to feed silkworm (*Bombyx mori* L.) is mainly propagated through vegetatively and plays major role on the upliftment and socio economic conditions of the sericulturists. Therefore, proficient method of propagation not only saves farmers economy but also plays pivotal role on the future of sericulture. Keeping the above aspects two popular mulberry varieties such as V1 and G4 mulberry varieties were planted in winter *i.e.* during December, 2018 considering as one of the favourable season to raise mulberry nurseries at Regional Sericultural Research Station, Central Silk Board, Ananthapuram, Andhra Pradesh. Each variety was planted @ 2500 cuttings and maintained properly for their survival. It was noticed that after 30 to 45 days of plantation G4 mulberry variety has recorded increased levels of sprouting (6.36%), survival (10.90%) compared to V1 mulberry var. Similarly 60 and 90 day after plantation the saplings growth of G4 was luxuriant and healthy recording an increased plant height (66.67%), sapling biomass (66.67%), sapling shoot weight (46.51%) and root biomass (128.57%) compared to V1. Further, G4 saplings have also exhibited their superiority in resisting various pest incidences such as millibug, thrips and leaf hoffers compared to V1 mulberry saplings indicating its susceptibility in resisting the seasonal pests incidents by recording 64.50%. The above results not only encourages the farming community for opting G4 mulberry variety as the best plantation of choice to raise nurseries but also opens avenues to adopt as standing crop as alternate to V1 mulberry as because G4 is not only a high yielding variety but also suitable for late age rearing as because the farmers are rearing chawki worm only. Hence, G4 can be considered as strong in nurseries, healthy against pests and most suitable for bivoltine silkworm rearing thereby encouraging the farming community for adoption and silkworm rearing for enhanced quality cocoon production.

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INTRODUCTION

Nursery is a place where plants are propagated with a great care and grown to usable size for transplantation to main crops. Raising nurseries of any farming crops either agricultural, or sericultural is consequently the basic need (Ercisli and Read, 2001; Radwan *et al*., 1989, Pijut and Moore, 2002). Nurseries 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 and 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 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 after establishment it consistently yields quality mulberry leaf for a period of more than 15-20yrs. 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, 2000; 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 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

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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 60-70MT/ha/yr has been achieved and contributed significantly for the benefit of sericultural farming community and economy of India. In the recent past the high yielding mulberry varieties such as V1 and G4 were recommended and popularized to the southern part of India due to their superior habit of profuse growth, enhanced quality leaf and resistance to various pest and diseases as depicted in the Table 1 & Fig. 2. The performance of both the varieties (V1 & G4) in yielding increased levels of leaf production (> 60kg/ha/yr) is appreciating by the farming community thereby witnessing the increased quality cocoon production.

Ideal 6-7 months old mature mulberry shoots

Mulberry cuttings of 10-15cm planted

Healthy mulberry saplings

Established mulberry garden transplanted with saplings

Fig. 1. Suitable mulberry cuttings for raising healthy saplings for transplantation to main garden

MATERIALS AND METHODS

As a part of Research and Development programme (R & D) of Regional Sericultural Research Station, Central Silk Board, Ananthapuramu, Andhra Pradesh mulberry saplings of high yielding mulberry varieties such as V1 and G4 were raised and supplied to the needy farmers for not only supporting the sericulturists of the region but also for horizontal expansion of sericulture and to generate targeted revenue of the station as a mandatory assignment. Accordingly, during December, 2018 being the most favourable season to raise nurseries (after monsoon) both V1 and G4 mulberry varieties @ of 2500 each cuttings were planted using suitable planting material following the standard procedures (Dandin *et al.,* 2003). The saplings were maintained appropriately taking all the suitable measures for better establishment and healthy growth. Saplings establishment parameters such as sprouting, survival after 30 to 45 days of planting, growth of aerial and root zone as well as seasonal pest incidence after 60 and 90 days of interval were recorded and the mean values of the same were presented in the tables and discussed in Table 2 & Fig. 3.

RESULTS AND DISCUSSION

The phenotypic, growth, yield and leaf quality parameters of V1 and G4 mulberry high yielding varieties were in detailed in Table 1 and Fig. 2. V1 mulberry variety was evolved with the parental combination of S30xC776 where one of the parents S30 tolerant to leaf blight disease where as C776 induces yield potentiality. Whereas, G4 parental combination was *Morus multicaulis* xS13 not only promotes growth and yield but also S13 induces drought tolerance and Multi caulis induces resistant to foliar pests and root rot diseases too. Both the varieties are potential enough of generating the yield level of more than 60mt/ha/yr around the year provided with sufficient manure (FYM @20mt/ha/yr) and fertilizers (NPK @ 350:140:140kg/ha/yr) along with sufficient irrigation as because they have been evolved for irrigated tropical southern regions only. Further, it was noticed that increased levels of total shoot length, leaf area, leaf yield, regeneration of plant growth, rooting and nutrient parameters such as nitrogen, phosphorous, potassium, crude protein and total sugars and leaf moisture and moisture restoration capacity mentioned in the table shows V1 mulberry variety exhibiting its superiority over G4 mulberry (Table 1). The pictures of V1 & G4 in Fig 2 further confirms the leaf size, shape, vigor, lush green colour with appropriate thickness indicating rich in desired levels of essential nutrients, chlorophylls and sufficient fibre confirming the both varieties (V1 & G4) are most suitable for silkworm rearing.

Table 1. V1 and G4 mulberry varieties in regard to plant growth, yield and leaf quality*

Sl No	Plant growth, yield and leaf quality parameters	V1 Mulberry var	G4 Mulberry var
1	Parentage of the variety	S30 x C776	*Morus multicaulis* x S13
2	Leaf Yield (mt/ha/yr)	>60 under irrigated conditions	>65 under irrigated condition.
3	Number of shoots /plant	10 -12	10 -12
4	Total shoot length	1280cm	1200cm
5	Inter-nodal distance	5.2 cm	3.9 cm
6	Leaf size (area) and shape	290cm^2 large, entire, ovate, smooth and glossy dark in green. L x B = 20.15 x 14.85cm	280 cm^2, entire, cordate L x B = 19.12 x 15.17cm
7	Leaf surface	Smooth & Glossy	Smooth, glossy, wavy surface
8	Leaf thickness	135-140 µm	155-160 µm
9	Weight of 100 leaves (g)	530 - 560 g	416 - 425 g
10	Resistance to diseases	Moderately tolerant to leaf blight	Moderately resistant to leaf spot, resistant to leaf rust & root rot.
11	Regeneration	12-14 days in winter & 10-11 days in other seasons	11-13 days in winter & 9-10 days
12	Sprouting (30th day)	>90%	96%
13	Rooting (at 90 days)	>94%	92%
14	Nitrogen (%)	3.98	3.94
15	Phosphorous (%)	0.333	0.375
16	Potassium (%)	1.79	1.64
17	Crude Protein (%)	24.88	24.63
18	Total Sugars (%)	16.48	16.34
19	Moisture content (%)	75.8	75.3
20	Moisture Retention capacity (%) [After 6 hrs of harvest]	80.2	78.6

*Courtesy to CSRTI, Central Silk Board, Mysore, Karnataka

V1 mulberry variety **G4 mulberry variety**

Fig. 2. Physical appearance of V1 and G4 mulberry varieties

But, when the same varieties were compared with their sprouting, survival and establishment characteristics have resulted diverse way when the both varieties were planted to raise nurseries at this station. The perusal of the results presented in Table 2 and Fig 2 & 3 indicated that the mean values of the saplings sprouting, survival, establishment and pest incidence recorded 30 to 45 days after plantation were revealed that percent of saplings sprouted was higher in G4 mulberry variety (100.0%) compared to V1 saplings (94.3%) with a marginal percentage of increase (6.36%). Survival was significantly high in G4 (98.7%) compared to V1 variety (89.0%) with an increase of 10.90% over V1 saplings. In case of plant height and shoot, root biomass, significantly increased level of saplings height was observed in G4 (78.0%) compared to V1 (46.8%) indicating a huge leap of percentage of increase in G4 sapling height (66.67%) over V1 saplings indicating the profuse growth and dominant vigor of G4 saplings.

Further, G4 saplings exhibited increased levels of total biomass (66.67%), shoot biomass (46.51%) and root biomass (128.57%) compared to V1 mulberry saplings indicating the dominance growth behavior of growth G4 saplings (Table 2 & Fig. 3,4). Both the varieties (V1 & G4) have shown significant visual morphological variations during their establishment period such as 45, 60 and 90 days after plantation (Fig. 5. 6 & 7). Further, V1 mulberry saplings have exhibited very poor resistance towards the occurrence of various pests *viz.* thrips (*Pseudodendrothrips mori*), millibug (*Maconellicoccus hirsutus*) and leaf hoppers (*Wolbachia coexisting*) when compared with G4 (7.1%) resulting in 64.50% reduction of pest incidence in G4 mulberry saplings indicating that V1 saplings are crossing economic thresh hold level (ETL) in case of pest occurrence posing economic loss to the sericulturists Table 2 & Fig. 3.

Table 2: V1 & G4 mulberry sapling exhibiting their growth, establishment and pest tolerance

Sl No	Observed Parameters	Mulberry Saplings of		% of increase over V1 saplings
		V1 var	G4 var	
1	Sprouting (%)	94.3	100.0	6.36
2	Survival (%)	89.0	98.7	10.90
3	Sapling height (cm)	46.8	78.0	66.67
4	Sapling Biomass (g)	57.0	95.0	66.67
5	Sapling Shoot weight (g)	43.0	63.0	46.51
6	Sapling Root weight (g)	14.0	32.0	128.57
7	Pest incidence (%)	20.0	7.1	64.50*

*Percentage of decrease of pest in G4 saplings.

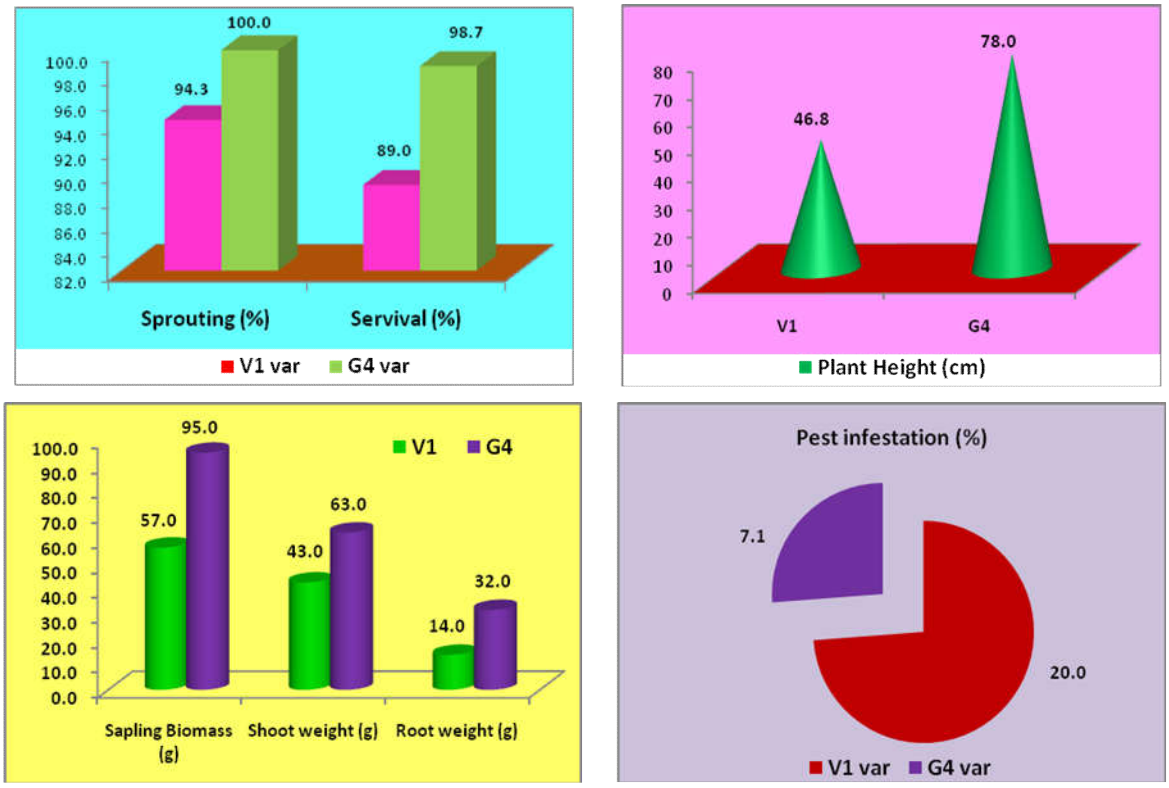

Fig. 3. V1 & G4 mulberry saplings growth, establishment and resistance behavior to pest occurrence

Fig. 4. V1 and G4 mulberry saplings root and shoot growth variation after 90 days of plantation

Though both the mulberry varieties of V1 and G4 were evolved as high yielding mulberry varieties for the tropical region of South India but shown significant variations and diversity at nursery level the reasons may be many. 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 perforce 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) are 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.

Fig. 5. Mulberry saplings of V1 and G4 growth and establishment after 45 days of plantation

In reality, the term subsumes 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.

Fig. 6. V1 & G4 mulberry saplings growth and establishment after 60 days of plantation

Fig. 7. Healthy foliage and well established G4 mulberry saplings after 90 days of plantation

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 are 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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