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Management of yellow leaf disease in sugarcane through micro propagation

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Abstract
Sugarcane seedlings derived through micro-propagation 2003V46 (TC) were studied compared to conventional set propagation (2003V46) for cane and sugar yields, yield components, juice quality parameters and tolerance to post harvest deterioration on YLD. The results indicated that cane and sugar yield, yield components at harvest, and juice quality parameters at 10th and 11th months were found to be high in 2003V46 (TC) compared to 2003V46. In addition 2003V46 (TC) is also moderately tolerant to YLD while 2003V46 is susceptible. Both 2003V46 (TC) and 2003V46 were relatively tolerant to post-harvest deterioration.

Keywords: Sugarcane, Micro-propagation, YLD, Post-harvest deterioration

Introduction
Sugarcane is the major source of sweetening agent and nearly 65-70 per cent of sugar is produced from sugarcane at the global level. It produces 25-30 per cent of sucrose on its fresh weight basis. Sugarcane is propagated through vegetative means (setts) either three/two/single eye budded setts or bud chip derived seedlings. As Sugarcane is a long duration, sucrose rich crop propagated through vegetative means, the chances of accumulation of cryptic diseases are high because of which the proven clones with high cane and sugar yield potential looses their vigour within a short period and ultimately runs out of commercial cultivation. The use of hygienic planting material free from diseases derived by micro propagation helps to prolong the shelf life and retain their full yield potential of the adaptable sugarcane clones. Meristem tip based tissue culture management for healthy seed production was advocated by Viswanathan *et al*. (2006) [8] and Singh and Singh (2015) [6] to manage the disease effectively and contain the disease spread and losses to the farmers by supplying healthy seed material.
Yellow leaf disease (YLD) of sugarcane was first reported in India during 1999 (Vishwanathan *et al*. 1999) [10]. The disease seriously affects growth, yield and juice quality parameters (Vishwanathan *et al*. 2014) [9]. Sugarcane yellow leaf virus (ScYLV), has been identified as the causative agent of the disease YLD, which spreads through planting materials and vectors. Sugarcane yellow leaf virus, a phloem-limiting virus belonging to family *Luteoviridae* and genus *Polerovirus*. The virus has been known to be transmitted by the sugarcane aphid *Melanaphis sacchari*. The sugarcane aphid acquires the virus during feeding on an infected plant. The aphid retains the virus for life and can transmit ScYLV during feeding to healthy plants within the same field or in other fields. The most characteristic symptom of YLD is a distinct yellowing of the lower surface of the leaf midrib on young leaves at the apex of the mature plants, which can extend laterally to the leaf lamina. The yellowing of the midrib may turn pink or have a reddish tinge. Older leaves show a red coloration of the midrib on the adaxial surface. The leaf blade becomes bleached, proceeding from the tip toward the base of the leaf, and tissue necrosis can eventually take place. The yellowing can spread into the leaf blade and mid-veins can turn pink in severely infected plants. Occurrence of different pathotypes of ScYLV was also studied extensively by several researchers. Variation in pathogenicity among genotypes of ScYLV *viz*., BRA (Brazil), CHN1 and CHN3 (China), CUB (Cuba), HAW (Hawaii), IND (India), PER (Peru), and REU (Re´union Island) was studied by several researchers (Viswanathan *et al*. 2008) [7].
An early maturing clone, 2003V46 (Bharani) developed from a bi-parental cross 86A146 x 83V15 is the widely cultivated early maturing high yielding and sucrose rich in different farming situations in Andhra Pradesh.

However, it is highly susceptible to the emerging disease YLD. Through the present study, micro propagation derived seedlings (2003V46 TC) were tested in comparison with the parental clone (2003V46) during 2022-23 in farmers' fields of M/S S. N. J sugars and products, Nelavoy, Chittoor, A. P for cane and sugar yields, juice quality parameters and tolerance to post harvest deterioration and YLD.

Materials and Methods

A study was conducted at Agricultural Research Station, Perumallapalle, Andhra Pradesh involving 2003V46 (TC) and its parental clone 2003V46 under light soils with bore well irrigation in I plant crop during 2022-23 to assess the advantage on the use of hygienic planting material derived through micro propagation for cane and sugar yields, juice quality, tolerance to delayed harvest and post-harvest deterioration at different hours of staling. Seedlings derived from micro-propagation (2003V46 TC) and setts in 2003V46 were planted in four rows of five meters length adopting 80x20 cm spacing. All the recommended package of practices for Southern zone was followed in raising a healthy crop. Matured canes of uniform size were harvested in each clone for recording cane yield, yield components and juice quality parameters. Per cent brix, sucrose and CCS were estimated at 24 hours intervals (0, 24, 48 and 72 hrs) at each harvest and at 10^{th} and 11^{th} months of crop age following standard procedures (Meade and Chen, 1977) [4]. Yield components *viz*., length of millable canes (m), girth of cane (cm), single cane weight (kg) at harvest were recorded on randomly selected canes while cane yield was recorded on plot basis. CCS yield was estimated based on cane yield and per cent CCS at harvest. Reaction to YLD was carried out following 0-5 scale as per the methodology suggested by Chinnarajappa and Vishwanathan (2015) [2].

Results and Discussion

Data recorded on morphological, agronomical and economic characters, cane yield and yield components were presented in Table 1 and 2, respectively. The micro propagated 2003V46 (TC) recorded higher mean values for yield components *viz*; girth of cane (2.9 cm), length of millable canes (2.97 m), single cane weight (1.66 kg) and number of millable canes (127'000/ha) at harvest when compared to the sett propagated s ndard 2003V46 (2.78 cm, 2.88 m, 1.61 kg and 124'000/ha), respectively (Table 1).

Mean cane and sugar yields of 2003V46 (TC) at harvest were 142.69 and 21.29 t/ha while the standard 2003V46 recorded 138.93 and 19.63 t/ha. The per cent increase in 2003V46 (TC) for cane and sugar yields was 2.71 and 8.46 over the standard 2003V46. The mean sucrose in 2003V46 (TC) was 20.74 and 21.77 whereas the standard 2003V46 registered 19.96 and 20.64 per cent at 10^{th} and 11^{th} months, respectively. The per cent increase in 2003V46 (TC) was 3.91 and 5.47 over 2003V46 for sucrose. The mean CCS per cent in 2003V46 (TC) at 10^{th} and 11^{th} months was 14.92 and 15.33 whereas the standard 2003V46 registered 14.13 and 14.59 per cent, respectively. The per cent increase in 2003V46 (TC) was 5.59 and 5.07 over 2003V46 for sucrose (Table 2). The results of the present study clearly revealed the superiority of micro-propagation planting material over conventional sett propagation.

Juice quality parameters studied at different time lag intervals (0, 24, 48 and 72 hrs after harvest) showed that per cent sucrose and CCS decreased progressively from 0 to 72 hrs after harvest and were high at 11^{th} month as compared to 10^{th} month of crop age. The per cent reduction in 2003V46 (TC) for sucrose at 10^{th} and 11^{th} months of crop age was 4.44 and 9.14 while it was 3.16 and 4.31 in the standard 2003V46 at 72 hours after harvest over crushing at 0 hrs after harvest, respectively. The per cent reduction in 2003V46 (TC) for CCS at 10^{th} and 11^{th} months of crop age was 7.77 and 12.39 while it was 6.65 and 8.36 in the standard 2003V46 at 72 hours after crushing, respectively. The reduction in per cent sucrose and CCS in staled cane in 2003V46 (TC) and the standard 2003V46 could be due to higher sucrose content and formation of dextrans as reported by Bhatia *et al*. 2009 [1] and Saxena *et al*. 2010 [5]. Naidu (2022) [4] also reported both 2003V46 (TC) and 2003V46 were relatively tolerant to post harvest deterioration out of 15 clones studied.

Incidence of YLD recorded following 0-5 scale as suggested by Chinarappa and Viswanathan (2015) revealed that 2003V46 (TC) is moderately tolerant (1-2 score) while 2003V46 (4-5 score), the standard which is susceptible for YLD.

Table 1: Morphological, agronomical and economic characters of 2003V46 (TC) and 2003V46(S)

S. No.	Character (s)	2003V46 (TC)	2003V46(S)
1	Stem colour (Exposed)	Purple	Purple
2	Stem colour (unexposed)	Greenish cane	Greenish cane
3	Lamina colour	Green	Green
4	Leaf sheath colour	Purple with white transverse bands	Purple Purple with white transverse bands
5	Girth of cane (cm)	2.90	2.78
6	Single cane weight (kg)	1.66	1.61
7	Length of millable cane (cm)	2.97	2.88
8	Number of millable canes ('000/ha)	127	124

Table 2: Performance of 2003V 46 (TC) for cane and sugar yield, juice quality and tolerance to post harvest deterioration and YLD

S. No	Character (s)	2003V46(TC)	2003V46(S)
1	Planting material for propagation	Micro propagation derived seedlings	Three budded setts
2	Cane yield (t/ha) at harvest	142.69	138.93
3	Sucrose per cent in juice at 10th month at 0 hrs after crushing	20.74	19.96
	At 24 hrs after crushing	20.57	19.82
	At 48 after crushing	20.03	19.47
	At 72 hrs after crushing	19.82	19.33
4	Sucrose per cent (in juice at 11th month at 0 hrs after crushing	21.77	20.64
	At 24 hrs after crushing	20.96	20.25
	At 48 after crushing	20.49	19.89
	At 72 hrs after crushing	19.78	19.75
5	CCS Per cent in juice at 10th month at 0 hrs after crushing	14.92	14.13
	At 24 hrs after crushing	14.67	13.89
	At 48 after crushing	14.02	13.44
	At 72 hrs after crushing	13.76	13.19
6	CCS Per cent in juice at 11h month at 0 hrs after crushing	15.33	14.59
	At 24 hrs after crushing	14.80	14.07
	At 48 after crushing	14.19	13.65
	At 72 hrs after crushing	13.43	13.37
7	CCS yield (t/ha) at harvest	21.29	19.63
8	Reaction to YLD (0-5 scale)	Moderately tolerant (1-2 score)	Susceptible (4-5 score)

Conclusion

The study clearly indicated the advantage of use of hygienic and healthy planting material derived through micro-propagation (2003V46 TC) over conventional sett propagation (2003V46) for cane and sugar yield, yield components at harvest and juice quality parameters. The crop raised from micro-propagation (2003V46 TC) showed moderate tolerance to YLD as compared to conventional sett propagated 2003V46 which is susceptible. Both 2003V46 (TC) and 2003V46 were relatively tolerant to delayed and delayed crushing.

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