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25% commercial bleach (Berekina) through step by step by washing the explants subsequently between each steps using sterilized distilled water. Finally, they were inoculated on MS [13] media supplemented with 0.5 mgl-1 each of BAP, Kin and NAA [14] with 1 mgl-1 methylene blue, 0.08 mgl⁻¹ ADS. In this experiment, the clump shoots were separated and used to test di erent levels of table sugar (20, 30, 40, 50 and 60 gl⁻¹) concentration e ects on multiplication considering other media components constant as shoot establishment. In addition, 30 gl-1 grade sucrose was used as a control for both genotypes because most researchers used 30 gl⁻¹ sucrose by default. Completely randomized design (CRD) in 2×6 (two genotypes and six levels of sucrose concentration) in factorial arrangement with three replications were used. Data on number of shoots, shoot length and number of leaves were recorded a er 30 days of culture. SAS so ware (SAS, 2008 version 9.2) was used for the analysis of variance, and Duncan multiple range test (DMRT) was used for mean separation at 5% probability.

Results and Discussion

Analysis of variance showed that the interaction e ects of genotypes and di erent table sugar concentration was very highly signi cant (P<0.001) for number of shoots/explant, shoot length and number of leaves/shoot. In B4906, MS medium with 30 gl-1 grade sucrose (control) was statistically di erent from 20, 30, 40, 50 and 60 gl⁻¹ table sugar for shoot number per explant, shoot length and number of leaves per shoot (Table 1). Except 20 gl⁻¹, all concentrations of table sugar gave more numbers of shoot than 30 gl⁻¹ pure sucrose. B4906 gave 6.22 ± 0.05 shoot number with 5.39 ± 0.10 cm shoot length and 5.33 ± 0.14 leaves/ shoot at 30 gl⁻¹ pure grade sucrose while 30 gl⁻¹ table sugar resulted in 7.17 \pm 0.14, 3.05 \pm 0.05 cm and 7.42 \pm 0.10 shoot number, shoot length, and leaf number per shoot respectively (Table 2). Whereas, 30 gl-1 pure sucrose was statistically di erent from all treatments for shoot number, shoot length and leaf number in Pr1013, however, only 50 gl⁻¹ and 60 gl⁻¹ table sugar gave better multiplication than 30 gl⁻¹ pure sucrose (Table 1). Pr1013 gave 4.00 \pm 0.14 shoot number with 2.67 \pm 0.06 cm shoot length and 6.89 ± 0.02 leaves/shoot on MS medium with 30 gl 1 table sugar, while 5.04 \pm 0.12, 3.23 \pm 0.15 cm and 7.75 \pm 0.25 for shoot number, shoot length and leaf number per shoot on grade sucrose respectively (Table 1).

is indicates that table sugar was better than grade sucrose to

Genotype	Sucrose (gl ⁻¹)		

get more multiple shoots and can be an alternative to reduce the cost of plant tissue culture media. It is reported that table sugar enhanced micropropagation and extensively reduced costs by 34% to 51% compared with pure sucrose [5]. According to the current exchange rate, table sugar is much cheaper (USD \$ 0.75-1.5 kg⁻¹) than sucrose (USD \$ 31.2 kg⁻¹) besides its ease of availability compared to sucrose which needs to be imported. In addition, the di erence in terms of shoot number may be due to the impurities of table sugar that contained other elements like iron, phosphorus, potassium and sodium, which are important to promote shoot development when compared with grade sucrose [5,6]. In addition, table sugar has impurities of glucose, which is easily and highly assimilated by plant tissue primarily than sucrose. Buah et al. and Ogero et al. [6,15] also con rmed this by using table sugar as carbon source for the *in i* ro culture of sweet potato and banana. e authors found table sugar to be superior to grade sucrose in terms of shoot number, but there is contradiction in terms of shoot length, which this may be due to plant species di erence of used in the experiment.

e concentrations of table sugar a ected the proliferation of shoot, also indicate that an optimum concentration was required for each genotype as evidenced in the results. B4906 gave the highest (13.42 ± 0.29) shoots/explant with 4.09 ± 0.08 cm shoot length and 8.92 ± 0.14 leaves/shoot on MS media with 50 gl⁻¹, followed by 8.78 ± 0.05 shoots/explant with 2.94 ± 0.04 cm shoot length, 8.25 ± 0.25 leaves/ shoot at 40 gl⁻¹. Pr1013 produced a maximum of 7.78 ± 0.19 shoots/explant with 4.61 ± 0.04 cm shoot length and 7.77 ± 0.03 leaves/shoot at 60 gl⁻¹ (Table 1 and Figure 1), followed by 6.06 ± 0.1 , 4.77 ± 0.11 cm, and 7.45 ± 0.03 shoot number, shoot length, and leaf number per shoot at 50 gl⁻¹ respectively (Table 1). MS media with 30 and 60 gl⁻¹ were not statistically di erent in terms of shoot number in B4906 (Table 1).

ese results indicate that the concentration of sugar in uenced the shoot multiplication besides the genotypic factor and PGRs for *in i ro* propagation as it facilitates metabolic rate and stress the genotypes to induce organogenesis. Khan et al. [7] obtained di erent shoot number/ explant from NIA-98, NIA-2004, BL4 and AEC82-223 genotypes tested using 40 and 60 gl⁻¹ table sugar.

By increasing the concentration from 40 to 50 gl⁻¹, shoot number, shoot length, and leaf number per shoot were increased from 8.78 \pm 0.05 to 13.42 \pm 0.29, 2.94 \pm 0.04 to 4.09 \pm 0.08 cm and 8.25 \pm 0.25 to 8.92 \pm 0.14 respectively in B4906, but further increase to 60 gl⁻¹ resulted in a decrease in shoot number, shoot length and leaf number per shoot (Picture 1). Pr1013 also showed increased number of shoots and leaves from 6.06 \pm 0.10 to 7.78 \pm 0.19 and 7.45 \pm 0.09 to 7.77 \pm 0.03 respectively when the concentration increased from 50 to 60 gl⁻¹, but decreased in shoot length from 4.77 \pm 0.11 to 4.61 \pm 0.04 (Picture 2).

is indicates that the concentration of sugar plays a vital role and it is critical besides plant growth regulators in sugarcane multiplication under *in i ro* conditions. Khan et al. [7] reported that the presence of sugar was necessary for shoot proliferation, but its concentration in the medium is critical. e present results for B4906 are in contrast to Khan et al. [7] who obtained 11.50 ± 0.57 shoots in AEC82-223 and 12.00 ± 0.81 shoots in NIA-2004 genotypes on MS media with 4% and

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6% table sugar respectively. Whereas the result of Pr1013 is in line with Khan et al. [7] who reported 12.00 \pm 0.81 shoots in NIA-2004 at 6% table sugar, on which 7.78 \pm 0.19 average shoots were produced in the current study. However, they did not use 50 gl⁻¹ rate in their experiment. Sorory and Hosien [16] also con rmed this that the use of 6% sucrose concentration enhanced shoot regeneration in sugarcane.

Cost analysis

e cost of analytical grade sucrose and table sugar used in the analysis were the current price in the Ethiopian local market. e cost of analytical grade sucrose and table sugar required for one litre MS medium worked out to be \$0.94 and \$0.048 respectively (Table 2). When using 4% (w/v) table sugar as a carbon source, a cost reduction of 94.89% was achieved (Table 2).

It was observed that on MS medium with 50 gl⁻¹ table sugar, B4906 gave the highest shoot multiplication and number of leaves per shoot whereas Pr1013 produced maximum shoots on MS plus 60 gl⁻¹. However, 40 gl⁻¹ table sugar supplemented medium was optimum to produce usable, morphologically good and separable shoots for successive subculture in both genotypes. Sucrose is the prime importance for cell growth but signi cant cost incurred by analytical sucrose brings economic obstacle in full exploitation of tissue culture for commercial propagation. e costs of media can be brought down by 94.89% using locally available and cheap table sugar without compromising the quality of plantlets.

Acknowledgements



Conclusion