Evaluation of Seed Cane Treatments on Sugarcane Germination and Cane Yield in Two Planting Methods

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Abstract

The experiments were conducted in the glasshouse and field of Sugarcane Research and Development Farm, Pyinmana to evaluate the effect of seed cane treatments on sugarcane germination and cane yield of K-95/84 variety in two planting methods from 2015-2016. At first, the glasshouse experiment was conducted in 2×4 factorial arrangement in Randomized Complete Block Design (RCB) with three replications. It evaluated two different planting methods (single budded setts and three budded setts) with pre-planting treatments by using different levels of lime (7.5, 15, 22.5 g l^{-1}), different levels of topsin fungicide (0.5, 1, 1.5 g l^{-1}) and different degree of hot water (50, 52, 54˚C). In this experiment, the lowest levels of different treatments gave the maximum germination percentages in both single budded and three budded setts. Based on the results from this experiment, the field experiment was carried out in split-plot design with three replications. Two different planting methods, single budded setts (S) and three budded setts (T) were assigned in main plots and four different pre-planting treatments: lime 7.5 g l^{-1} (T_1), topsin fungicide 0.5 g l^{-1} (T_2), hot water 50˚C (T_3) and control (water, T_4) were assigned in sub-plots. Single budded setts gave the earliest and higher percentage of germination than three budded setts. Among the pre-planting treatments, the earliest and higher percentage of germination was obtained from the lime (7.5 g l^{-1}) treatment. As a combined effect of two factors, ST_1 gave maximum germination whereas TT_1 gave numerically the highest cane yield without any significant difference in other yield component characters with ST_1. Thus, this study highlighted that lime (7.5 g l^{-1}) treatment should be used for the uniformity of germination in both planting methods.

Key words: sugarcane, planting method, pre-planting treatment, germination, cane yield

Introduction

Sugarcane (*Saccharum* spp.) is an important commercial crop in developing and developed countries. It is also a first priority crop for many regions of the world including Myanmar. It is known as an important crop not only for domestic but also for ASEAN regions like rice, maize and pulses. Its domestic production, local consumption and international trade were gradually studied in Myanmar (MOAI 2005).

Sugarcane is vegetatively propagated consequently large amounts of seed cane are necessary for a new planting. The whole stalks or shorter stalk cutting called setts are used as planting material. It is usually propagated by cane sett cuttings consisting of 2 to 3 buds. In traditional system, about 6-8 tons seed cane is used as planting material (Jain et al. 2010). Seed is one of the costlier input and accounts for nearly 25 % of the total production cost in sugarcane cultivation. The planting material by changing type of seed material (sett size) and seed rate without any harmful effect on plant stand may help in receiving higher cane yield with lower cost of production (Patel and Rinku 2014).

Most sugarcane farmers do not treat the sett before planting and, so germination is generally only around 40% in India. It may be achieved about 60% by sett treatment before planting which is quite simple and cheap (Sundara 1998). When the quality

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of the cuttings or the external germinating conditions are inadequate, some planting treatments are required such as soaking in water, soaking inaqueous solutions of chemical compounds, treatment with fungicides and insecticides, and plant growth regulating substances (Dillewijn 1952).

In Myanmar, most of the sugarcane farmers used to grow three budded setts as planting materials without pre-planting treatments. Three budded setts generally cannot give the uniform germination of an individual bud and damage to the setts can cause large gaps along the cane rows. To overcome the poor germination and poor crop stand, the suitable cane treatments, cane sett size and planting methods are essential for commercial sugarcane planting.

Based on the above information, it seems that the evaluation of germination is still the critical component in sugarcane cultivation as well as varietal assessment before releasing a new variety (Sanda Kyaw Win and San Thein 2006). Therefore, this study was undertaken with the following objectives: (1) to find out the suitable seed cane treatment for uniform germination and crop stand, and (2) to compare cane yield and growth performance of sugarcane affected by seed cane treatments and planting methods.

Material and Methods

Two experiments were conducted from August 2015 to December 2016 of Sugarcane research and Development Farm, Pyinmana. At first, the glasshouse experiment was conducted in 2×4 factorial arrangement in Randomized Complete Block Design (RCB) with three replications. The glasshouse experiment consisted of three sets of experiments (lime, topsin fungicide and hot water). It evaluated two different planting methods (single budded setts and three budded setts) with three pre-planting treatments which include different levels of lime (7.5, 15, 22.5 g l^{-1}), different levels of topsin fungicide (0.5, 1, 1.5 g l^{-1}) and different degree of hot water (50, 52, 54˚C). The cane setts used in all treatments were cut into single budded setts and three budded setts before planting. These two sets of cane setts cuttings were soaked in each solution of different pre-planting treatments for 30 minutes. From these experiments, the lowest levels of different treatments gave the maximum germination percentages.

Based on the result from the glasshouse experiment, the field experiment was conducted in split-plot design with three replications. Two different planting methods: single budded setts and three budded setts were used as main plots factors and four different pre-planting treatments: lime 7.5 g l^{-1}, topsin fungicide 0.5 g l^{-1}, hot water 50˚C and control (water) were used as sub-plots factors. The same procedure was used for the preparation of pre-planting treatments as in the glasshouse experiment.

The numbers of shoots germinated were counted at 3 days interval from 4 to 45 days aftre planting (DAP). The weighted germination percentage (WGP) was calculated by giving maximum weight to the seeds that germinated first and progressively less weight to that germinated setts subsequently. The WGP was calculated by the following formula (Al-Mudaris 1998).

$$WGP = \frac{[15 \times n1 + 14 \times n2 + \cdots + 1 \times n15]}{15 \times N} \times 100$$

WGP = Weighted Germination Percentage

Where $n_1, n_2, \ldots, n_{15}$ are the number of cane setts germinated on the 1st , 2nd and consequent days until 45 DAP (up to 15th count, starting from (10.12.2015 to 20.1.2016). N is the total number of eye buds placed for germination.

Germination percentage - Germination count is only based on the number of eye-buds per row, regardless of the cane sett length. The germination percentage was calculated by the following formula.

$$FGP = \frac{\text{Final number of shoots germinated}}{\text{total number of eye buds seeds}} \times 100$$

FGP = Final Germination Percentage

(Al-Mudaris 1998)

At harvest, all yield components such as number of harvested stalks, single cane weight, plant height, number of internodes, length of internode, internode girth and cane yield (t ha^{-1}) were recorded. Ten sample plants from each treatment were taken randomly and recorded for plant height, number of internode, length of internode and internode girth.

The data were subjected to analysis of variance by using Statistix (version-8) software and mean

comparisons were done by Least Significant Different (LSD) at 5% level.

Results and Discussion

Weighted germination percentage (WGP) and final germination percentage (FGP)

At the field experiment, the results of WGP and FGP are presented in Table 1 and Figure 1.a and 1.b. Single budded setts gave the highest value of WGP (442.64%) than the three budded setts (171.92%). Among the pre-planting treatments, maximum WGP (366.55%) was observed in lime (7.5 g l^{-1}) treatment (Table 1). Likewise, single budded setts gave the highest value of FGP (77.39 %) while three budded setts obtained 45.31% of FGP. In the pre-planting treatments, lime (7.5 g l^{-1}) treatment gave maximum FGP than the other treatments (Table 1). According to Singh and Gurpreet (2015), a small volume of tissue and a single root primordial adhering to the bud are adequate to ensure germination of the bud.

The combination effect of different planting methods and pre-planting treatments was significantly different at 5% level in WGP but it was not different in FGP (Figure 1.a and 1.b). The highest WGP (538.35%) was observed from single budded setts with lime 7.5 g l^{-1} treatment which was followed by single budded setts with hot water (50˚C) treatment (441.21%) (Figure1.a). The minimum WGP (157.15 %) was resulted from three budded setts with hot water (50˚C) treatment which was not statistically different with other three budded setts under different pre-planting treatments (Figure 1.a). This result was agreement with the study of Chen et al. (1986) in which soaking cane setts in 2% lime solution for 24 hours reduced the time to emergence of the first bud by 40% and increased the relative speed of shoot emergence by 55%. According to the mean effect of different planting methods and pre-planting treatments, both planting methods were more suitable with 7.5 g l^{-1} of lime treatment.

Yield and yield components

The mean effect of different planting methods and pre-planting treatments on plant height, number of internodes, internode girth, internode length, harvested stalk, cane yield and single cane weight of K -95/84 are shown in Table 2 and Figure 2 (a) to (g). Three budded setts gave the highest value of cane yield (86.68 t ha^{-1}) than the single budded setts (79.96 t ha^{-1}). Among the pre-planting treatments,

Table 1. Effect of different planting methods and pre-planting treatments on sugarcane germination of field experiment

Treatment	Weighted Germination Percentage (WGP)		Final Germination Percentage (FGP)	
Planting Method				
S Single budded sett	442.64	a	77.39	a
T Three budded sett	171.92	b	45.31	b
$LSD_{0.05}$	79.14		20.22	
Pre-planting Treatment				
T_1 (7.5g l^{-1} lime)	366.55	a	70.02	a
T_2 (0.5 g l^{-1} topsin fungicide)	284.08	b	58.22	b
T_3 (50˚C hot water)	299.18	b	61.33	ab
T_4 (water)	279.31	b	55.82	b
$LSD_{0.05}$	46.06		10.32	
Pr > F				
Planting Method (PM)	0.0046		0.0208	
Pre-planting Treatment (PT)	0.0048		0.0523	
PM × PT	0.0459		0.3554	
CV% (a)	14.66		18.76	
CV% (b)	11.92		13.38	

Means followed by the same letter in each column are not significantly different at 5% level

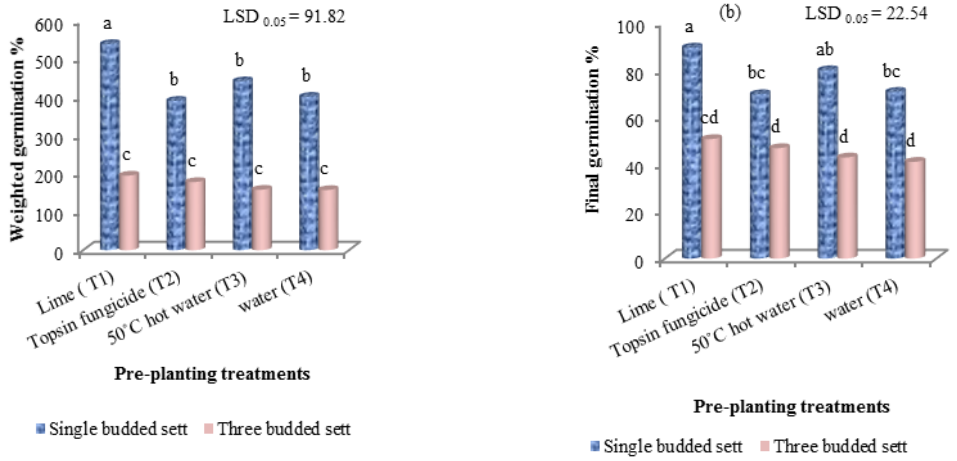

Figure 1. Mean comparisons of (a) weighted germination and (b) final germination percentage (FGP) as affected by different planting methods and pre-planting treatments (field experiment)

Table 2. Yield and yield components of sugarcane as affected by different planting methods and pre-planting treatments (2015-2016)

Treatment	Plant Height (cm)	No. of In-ternodes (no.)	Internode girth (mm)	Internode length (cm)	No. of harvested (stalk ha^{-1})	Unit cane weight (g)	Cane Yield (t ha^{-1})
Planting Method							
S Single budded sett	255.07 a	22.92 a	31.22 a	10.39 a	38794 a	2.06 a	79.96 a
T Three budded sett	262.94 a	24.80 a	31.81 a	10.03 a	38346 a	2.27 a	86.68 a
LSD $_{0.05}$	27.29	3.08	1.09	1.52	556.76	0.34	8.78
Pre-planting Treatment							
T_1 (7.5g l^{-1} lime)	261.97 a	24.60 a	32.20 a	10.34 a	42158 a	2.30 a	92.29 a
T_2 (0.5 g l^{-1} topsin fungicide)	256.15 a	23.30 a	30.92 b	10.15 a	37673 a	2.10 a	79.43 a
T_3 (50˚C hot water)	258.30 a	23.85 a	31.52 a b	10.22 a	36477 a	2.21 a	80.91 a
T_4 (water)	259.60 a	23.71 a	31.42 a	10.14 a	37972 a	2.05 a	80.66 a
LSD $_{0.05}$	10.43	2.24	1.04	0.43	9323.6	0.28	18.52
Pr > F							
Planting Method (PM)	0.3403	0.1194	0.1443	0.4253	0.0741	0.1235	0.1235
Pre-planting Treatment (PT)	0.6789	0.6541	0.1197	0.7320	0.5863	0.2713	0.2713
PM× PT	0.5483	0.4582	0.3714	0.8291	0.5960	0.4533	0.4533
CV% (a)	6.00	7.36	1.99	8.49	0.82	9.10	9.10
CV% (b)	3.20	7.46	2.64	3.42	19.22	10.60	10.60

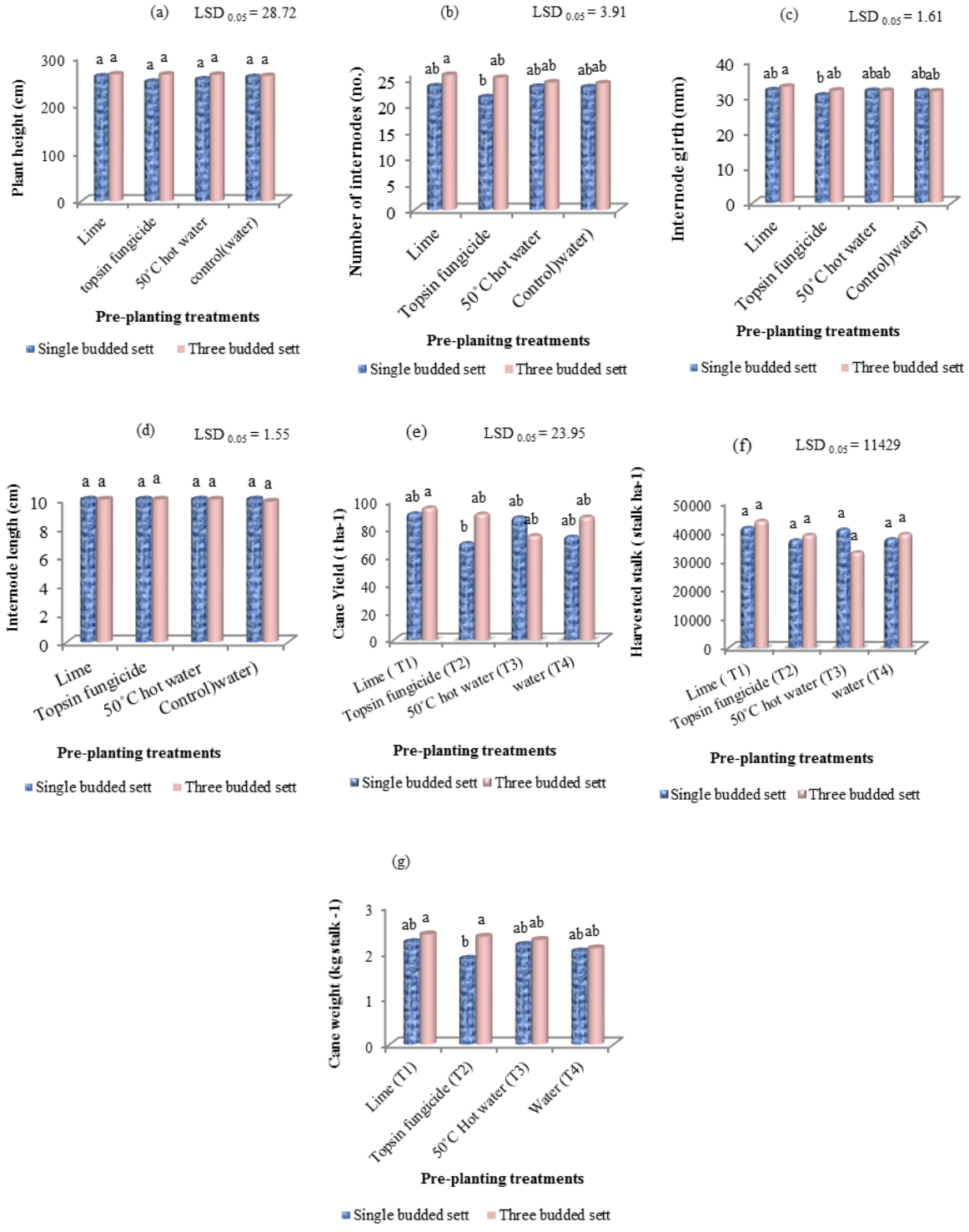

Figure 2. Mean comparisons of (a) plant height (b) number of internodes (c) internode length (d) internode girth (e) cane yield (f) harvested stalk (g) cane weight as affected by pre-planting treatments in two planting methods (field experiment)

maximum cane yield (92.29 t ha^{-1}) was observed in lime (7.5 g l^{-1}) treatment (Table 2). In Figure 2 (e), the maximum cane yield (94.42 t ha^{-1}) of K-95/84 was found in the combined treatment of TT_1 (Three budded setts and lime 7.5 g l^{-1}). However, there was no statistically difference of yields in the combined treatments of different planting methods and pre-planting treatments. Devi et al. (2011) stated that three budded sett can be used as planting material for getting higher cane and sugar yields rather than single budded sett. Kathiresan 2000 also reported that the tested cultivar with lime soaking significantly improved the percentage of germination, number of tillers, number of millable cane, cane and sugar yields. According to the results, plant height, number of internodes, intrnode girth, internode length, harvested stalk, single cane weight and cane yield characters were not influenced by different planting methods with pre-planting treatments.

Conclusion

Based on the result of this study, planting of single budded setts and three budded setts were not significantly different on the final cane yield. If the single budded setts is used in the cultivation, it can reduce the seed rate and ensures the germination. This study highlighted that single budded setts could reduce the seed rate, since the cane yields were not different between the two planting methods. Lime (7.5 g l^{-1}) treatment gave higher percentage of germination than topsin fungicide, hot water and water treatments. In sugarcane cultivation, lime (7.5 g l^{-1}) treatment should be used for the uniformity of germination in both planting methods. In concerning with the combined effects, single budded setts with lime treatment is suggested for K-95/84 variety to increase germination and cane yield.

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