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PLANTING RATE EFFECTS ON SUGARCANE YIELD TRIALS

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ABSTRACT

Temperate sugarcane (*Saccharum* spp. hybrids) growing regions, such as Louisiana, often use higher planting rates than tropical and subtropical sugarcane growing regions. The common production practice in Louisiana is to use three to four whole-stalks (lines) placed along side each other when planting sugarcane. The LSU AgCenter's sugarcane breeding program uses a two whole-stalk planting rate in all stages of the program. The objective of this study was to assess the effect of planting rate on sugar yield and its components in sugarcane yield trials. A second objective was to determine characteristics affecting bud germination of different sugarcane genotypes. Two experiments were conducted during 2000 through 2004 at two locations at the Sugar Research Station in St. Gabriel, Louisiana. Eight sugarcane genotypes were planted at planting rates of two, three, and four whole stalks. Data were collected in the plant-cane through third ratoon crops. The lack of a sugarcane planting rate by genotype interaction indicated that sugarcane genotypes performed similarly in yield trials whether a two-stalk, three-stalk, or four-stalk planting rate was used. Only differences in magnitude were observed for the planting rates, which is of only minor consequence in breeding programs. Another experiment was conducted in 2002 with the same set of genotypes and germination traits were assessed. Correlation coefficients indicated no negative relationships for percent germination. The current use of a two-stalk planting rate in sugarcane selection and yield trials within the breeding program appears valid.

INTRODUCTION

Establishing an optimum plant population in any crop is vital for achieving maximum production. Sugarcane (*Saccharum* spp. hybrids) is no exception. The planting of sugarcane in Louisiana was first described by Debow (1846) as three sugarcane stalks (lines) laid in a row at a distance of four inches apart. Currently in Louisiana's temperate climate, sugarcane for commercial production is planted at rates of three to four whole stalks placed along side each other. The higher planting rates used in Louisiana compared to subtropical and tropical growing areas can be attributed to several factors. These factors include a greater incidence of stalk rot diseases, which proliferate in Louisiana's cool wet winter, increased stalk damage when the sugarcane is mechanically planted, loss of viable buds and/or plant population due to winter freezes and/or early spring frosts, and the use of whole stalks for planting instead of the use of setts or billets (two to four bud seed pieces).

Stalk rot diseases, such as red rot (*Colletotrichum falcatum* [*Glomerella tucumanensis*]) and pineapple disease [*Ceratocystis paradoxa* (Dade) Moreau], can reduce the number of viable shoots of newly planted sugarcane (Abbot, 1938; Croft et al., 2000). In temperate climates, newly planted sugarcane remains dormant under cool and often wet conditions during the winter months, which exacerbates the effects of these two stalk rotting diseases. *Sugarcane mosaic* disease is another factor contributing to the need in Louisiana for higher planting rates (Steib and Chilton, 1974), although mosaic resistant cultivars are now mainly planted.

The variable planting rates achieved by mechanical planters, commonly used in Louisiana, also causes farmers to plant sugarcane at higher rates than are recommended (Richard et al., 1999). Planting gaps caused by mechanical planters can be overcome by higher planting rates. Improvements in mechanical planters has helped to achieve a more uniform planting rate, and subsequently reduced the need for excessive planting rates. Another factor cited for higher planting rates when sugarcane is mechanically planted is the damage to sugarcane stalks caused by moving mechanical parts (Richard et al., 1999). Damaged stalks have increased bud damage resulting in reduced germination, and the wounds along the stalk serve as entry points to stalk rotting diseases.

In extreme weather conditions, newly planted and ratooning sugarcane can suffer stand losses due to severe freezes. In December, 1989, Louisiana experienced temperatures as low as -17 C. The subsequent plant-cane and ratoon crops experienced stand reductions up to 50% (Richard, 1990). Although sugarcane is grown primarily in the tropics and subtropics, temperate growing regions that also include Argentina, Morocco, and Iran, to name a few, experience near freezing or sub-freezing temperatures (James, 2004). An increased seeding rate is helpful in overcoming the effects of freezing temperatures.

Setts are commonly used for planting sugarcane because this procedure typically reduces apical dominance observed in whole-stalk planting. Apical dominance can reduce the germination of buds along the stalk. When the top bud of a stalk grows, hormone-like compounds or auxins retard the development of the lower buds to an increasing degree from top to bottom of the stalk (James, 2004). In whole-stalk plantings, large gaps can occur due to apical dominance. Therefore, higher planting rates are needed to overcome the effect of apical dominance.

Rice (1981) conducted two sugarcane planting rate experiments with six Florida sugarcane cultivars planted at rates of one, two, and three stalks. It was concluded that the one-stalk planting rate achieved cane yields equal to that of the two- and three-stalk planting rates. In addition, the cultivar by planting rate interaction was nonsignificant. Accordingly for Florida's subtropical climate, a planting rate of one stalk is the recommended practice.

In Australia, Bell and Garside (2005) investigated the impact of crop rotation, plant population, tillage and trash management on sugarcane shoot and stalk dynamics and yield. They reported that nitrogen (N) status had limited effect on the initiation of secondary tillers. However, the survival of secondary tillers until final harvest was influenced by the population density of established primary shoots and the growing conditions during the latter part of the growing season. Reduced water stress and application of N fertilizer near the time of maximum tiller numbers increased tiller survival.

The sugarcane planting rate for all stages in the Louisiana State University AgCenter's sugarcane variety development program is two whole-stalks planted alongside each other; which is the minimum commercial planting rate recommended for planting in Louisiana's temperate climate. A two-stalk planting rate is used because there is a lack of available seed-cane and labor required to handle greater volumes of sugarcane. Another reason for using a two-stalk planting rate in the sugarcane breeding program, is that less damage occurs to the seedcane during hand-harvesting and hand planting. A detailed description of the LSU AgCenter's sugarcane breeding program is provided by Bischoff and Gravois (2004). It is unknown how planting rate affects sugar yield and its components in yield trials within a sugarcane breeding program.

The main objective of this study was to determine the effect of planting rate on genotype performance for sugar yield, cane yield, sugar content, stalk weight, and stalk population in sugarcane yield trials. A second objective was to determine characteristics affecting germination of buds of different sugarcane genotypes.

MATERIALS AND METHODS

Planting Rate Experiment

Two experiments were conducted during 2000 through 2004 at the Sugar Research Station in St. Gabriel, Louisiana. The experiments were planted in a Commerce silt loam (*Fine-silty, mixed, nonacid, thermic Aeric Fluvaquent*) soil. A randomized complete block design was used for each experiment (three replications per experiment). Two commercial cultivars, LCP 85-384 (Milligan et al., 1994) and HoCP 91-555 (Legendre et al., 2000), and six experimental clones L 97-105, L 97-126, L 97-128, L 97-129, L 97-137, and L 97-147 (Bischoff et. al, 1998) were hand-harvested and hand-planted on August 29, 2000 (Site 1) and replanted in a second experiment on August 22, 2001 (Site 2). The three whole-stalk planting rates were two-, three-, and four-stalks. Sugarcane genotype and planting rate were planted to achieve a factorial treatment arrangement.

Plot size consisted of two adjacent 1.8 m wide rows that were 6.1 m long with a 1.5 m alley between each plot. At planting, stalks of each planting rate were placed alongside each other until the plot was filled. Each experiment was covered with approximately 8 cm of field soil and culti-packed to insure good seed to soil contact. A pre-emerge herbicide (metribuzin) was applied immediately after planting (3.4 kg/ha). In the spring of each growing season, fertilizer was applied at the rate of 134-0-90 (kg/ha, N-P_2O_5-K_2O). Metribuzin was again applied in the spring. At lay-by (last cultivation), pendimethalin (3.4 kg/ha) and atrazine (3.4 kg/ha) were applied for weed control. The experiments were scouted for the sugarcane borer [*Diatraea saccharalis* (Fabricius)] each summer, and insecticides were applied when infestation levels reached the five percent threshold level.

Each year, millable stalk counts of the entire plot were made in early August. Stalk population was calculated as the number of millable stalks per hectare. At harvest (Table 1), a random 10-stalk hand-harvested sample was taken from each plot, stripped of the immature top and leaves, and weighed for an estimate of stalk weight (kg). Afterwards, a sucrose analysis was done on each sample at the Sugar Research Station sucrose laboratory. Brix and pol readings were used to determine sugar content (g sucrose/kg cane) (Gravois and Milligan, 1992). After the

10-stalk samples were collected, plots were harvested with a sugarcane combine/weigh-wagon system. Each plot was weighed in a modified self-dumping wagon fitted with load cells. No burning was done prior to harvest. Cane yield (Mg/ha) for each plot was estimated from the plot weight, less 14% to adjust for leaf-trash weight. Sugar yield (Mg/ha) was estimated as the product of cane yield and sugar content and then divided by 100.

Table 1. Harvest dates for each planting rate experiment conducted during 2001 through 2004 at the Sugar Research Station in St. Gabriel, Louisiana.

	Locations	
	Site 1	Site 2
Plant-cane	15 Nov 2001	13 Dec 2002
First ratoon	13 Dec 2002	5 Nov 2003
Second ratoon	5 Nov 2003	13 Dec 2004
Third ratoon	11 Nov 2004	

To analyze the data the following linear model was used:

$$Y_{ijklm} = \mu + L_i + R_{j(i)} + G_k + PR_l + GL_{ik} + GPR_{kl} + PRL_{il} + GPRL_{ikl} + GPRR_{klj(i)} + C_m + CL_{im} + CG_{km} + CPR_{lm} + CGL_{ikm} + CGPR_{klm} + CGPRL_{iklm} + E_{ijklm}$$

L, G, PR, C, and E refer to location, genotype, planting rate, crop, and residual error, respectively. Location, replication, their interactions, and the residual error were considered random effects. All other terms in the model were considered fixed effects.

The Proc Mixed procedure was used to analyze the linear model (SAS v9.0). The analyses used crop as a repeated measures. Based on procedures described by Tao et al. (2002), for analyses with crops cycles as repeated measures, compound symmetry (CS) was the covariance structure selected to describe repeated measures covariance for each of the dependent variables (traits). Least square means were separated using the PDIFF option (P=0.05).

Coefficient of variation CV (%) was estimated as the (square root of residual / mean)*100. Pearson correlation coefficients were obtained with the Proc Corr procedure (SAS v9.0).

Germination experiment

A germination experiment was conducted in the fall of 2002 at the Sugar Research Station in St. Gabriel, Louisiana. A randomized complete block design was used in this experiment. The treatments for each experiment were replicated three times. The genotypes included the same set of cultivars and experimental clones used in the first experiment. The experiment was planted at two different locations on the Sugar Research Station. Each location had a different soil type. The experimental field located on the west side of the research station had a Commerce silt loam (*Fine-silty, mixed, nonacid, thermic Aeric Fluvaquent*) soil, and the experimental field located on the east side had a Sharky clay (*Very fine, montmorillontic, nonacid, thermic, Vertic Halauept)* soil. Plot size consisted of a single 1.8 m row, 6.1 m long, with a 1.5 m alley between plots. Prior to planting, leaves were removed by hand from each stalk. The number of viable buds was then recorded for each stalk. Viable buds were determined by visual inspection followed by pressing on the bud to determine firmness. Other measurements taken were stalk height (cm), stalk diameter (mm), and bundle weight (kg). Bundle weight was divided by stalk number to obtain stalk weight (kg). The experiments were planted on August 19, 2002, and each plot was planted at a rate of two whole stalks with an overlap of two mature internodes. Cultural practices were similar to those used for the planting rate experiment.

Shoot counts were made from September 9, 2002 through September 20, 2002 and expressed as number of shoots per plot. Plots were counted as plants in each plot reached the five-leaf stage. Shoots per plot were divided by viable buds per plot to obtain germination percentage. Buds per meter of stalk were calculated by dividing (buds per stalk by stalk height) * 100.

The germination data were analyzed using the following linear model:

$$Y_{ijk} = \mu + L_i + R_{j(i)} + G_k + GL_{ik} + E_{ijk}$$

Replication (R) and the residual error (E) were considered random effects. Genotype (G), location (L), and their interaction were considered fixed effects. The analysis was similar to the one conducted for the planting rate study.

RESULTS AND DISCUSSION

Planting Rate Study

The analysis of variance indicated that all traits were significantly (P=0.05) different among genotypes (Table 2). Planting rate significantly affected sugar yield, cane yield, and stalk population but not sugar content and stalk weight. The genotype by planting rate interaction was nonsignificant for all traits, indicating that genotype performance did not differ among the planting rates used in this study. The three-way interaction, among crop, planting rate, and genotype was also nonsignificant. Thus, genotypes responded similarly to changes in planting rates regardless of crop (plant-cane through third ratoon). In a similar study done only with commercial cultivars, Landry (1974) reported the absence of a planting rate by variety interaction. In another study, Irvine and Benda (1980) reported on sugarcane stalk population changes due to varying row spacing. They reported increased sugar and cane yields on closer row spacing. A significant correlation (r = 0.71) was reported between varietal rankings in cane yield on closer and wider row spacing, indicating that sugarcane selections made on wide rows should perform adequately on closer rows.

The analysis of variance dictated that planting rate means could be averaged across genotypes and crops (Table 3). Sugar yield for the planting rates ranged from 8.2 Mg/ha (two-stalk rate) to 9.3 Mg/ha (four-stalk rate) in the planting rate studies. The three- and four-stalk planting rates had a significantly greater sugar yield than did the two-stalk rate. Sugar yield was not significantly different between the three- and four-stalk planting rates. Cane yield varied from 71.2 Mg/ha (two-stalk rate) to 79.5 Mg/ha (four-stalk rate). Cane yield for the two-stalk planting rate was significantly lower than the three-stalk and four-stalk planting rates. Landry (1974) reported that a two-stalk planting rate resulted in significantly lower sugar yield, cane yield, and stalk population than a three- and four-stalk planting rate. However, they reported that the yield increases at the higher rates were not justified due to higher seed usage for Louisiana conditions. However in contrast to his conclusion, Louisiana sugarcane growers have adopted three- to four-stalk planting rates to take advantage of the higher sugar yields. For the conservation of seed, two-stalk planting rates are used for the increase of newly released cultivars and for tissue culture generated seed cane that is used as disease-free seed sources.

Table 2. Analysis of variance of fixed effects across crops for the experiments involving eight sugarcane genotypes and three planting rates conducted at two locations and harvested in the plant-cane, first ratoon, second, and third ratoon crops at the Sugar Experiment Station in St. Gabriel, Louisiana during 2001 through 2004.

Source	Numerator df	Denominator df	Sugar yield	Cane yield	Sugar content	Stalk weight	Stalk population
			P Values				
Genotype (G)	7	116	0.001	0.001	0.001	0.001	0.001
Planting Rate (PR)	2	116	0.001	0.001	0.287	0.478	0.001
G*PR	14	116	0.894	0.779	0.535	0.996	0.798
Crop (C)	3	283	0.001	0.001	0.001	0.001	0.001
G*C	21	299	0.001	0.010	0.240	0.228	0.001
PR*C	6	299	0.699	0.967	0.563	0.122	0.527
G*PR*C	42	299	0.993	0.999	0.751	0.820	0.907
			%				
CV (%)			16.7	17.3	7.2	13.8	20.0

Sugar content and stalk weight were not significantly different among the planting rates (Table 3). Stalk weight did decrease numerically as planting rate increased. The four-stalk planting rate stalk population was significantly higher than the three-stalk planting rate, and the three-stalk planting rate was significantly higher than the two-stalk planting rate. Compensatory relationships between stalk weight and stalk population have been noted in other sugarcane research (Irvine and Benda, 1980; Milligan et al., 1990; Milligan et al., 1996; Bell and Garside, 2005). The recommended sugarcane planting rate in Louisiana is three to four stalks, and these data support these recommendations.

Table 3. Means averaged across the eight genotypes and the four crops for the experiments conducted at the Sugar Research Station in St. Gabriel, Louisiana during 2000 through 2004. †

Planting Rate	Sugar yield	Cane yield	Sugar content	Stalk weight	Stalk population
	Mg sugar/ha	Mg cane/ha	g sugar/kg cane	kg	stalks/ha
Two-stalks	8.2 B	64.3 B	115 A	0.89 A	79208 B
Three-stalks	9.0 A	70.0 A	117 A	0.87 A	86945 A
Four-stalks	9.3 A	72.2 A	117 A	0.87 A	90252 A

† Means in a column sharing the same letter are not significantly different at P=0.05.

Sugar yield, cane yield, and stalk population had significant genotype by crop interactions; and therefore, genotype means for these traits were reported by crop (Tables 4 and

5). Milligan et al. (1990) found genotype by crop interaction was important for sugar yield and its component traits. Their work stressed the importance of evaluating genotypes in second ratoon crops, which was exceeded in this study by including third ratoon data. However, their work was conducted with a two stalk planting rate and did not assess the impact of planting rate on their results.

Sugar yield, cane yield, and stalk population for the genotypes varied significantly between plant-cane, first ratoon, second ratoon, and third ratoon crops (Tables 4 and 5). L 97-128 sugar and cane yield was significantly higher than all genotypes tested and was subsequently released as a commercial cultivar in 2004. Averaged across crops and planting rates, L 97-128 and L 97-147 had significantly higher sugar content than all other genotypes, with L 97-137 having the lowest sugar content. Stalk weight ranged from 0.98 kg (L 97-128) to 0.76 kg (L 97-129) when averaged across crops and planting rates. LCP 85-384 in the first ratoon crop had the highest stalk population (119,668 stalks/ha), whereas L 97-126 in third ratoon had the lowest stalk population (29,119 stalks/ha). L 97-126 had the lowest stalk population of all genotypes. These data indicate that this set of genotypes exhibited yield and yield components typically found within sugarcane breeding programs.

Bud-germination Experiment

The maximum soil temperature on the day of planting (August 19, 2002) was 30.6 C, and the minimum soil temperature was 26.7 C. There was adequate moisture in the soil, so germination conditions were considered to be excellent. The analysis of variance for the 2002 bud-germination experiments indicated significant genotype effects for stalk weight, stalk height, buds per meter, buds per stalk, and percent emergence, but not percent germination (Table 6). Location (soil type) and the genotype by location interaction were nonsignificant for all traits. Therefore, means were averaged across the two locations.

Stalk weight for the genotypes varied significantly at planting and ranged from 0.71 kg (L 97-105, L 97-126, HoCP 91-555) to 0.97 kg (L 97-128) in 2002 (Table 7). L 97-128 (207 cm) and L 97-147 (205 cm) were significantly taller than all other genotypes. Bud number per meter of sugarcane stalk varied from 4.8 buds/m (L 97-126) to 6.4 buds/m (L 97-129). Buds per stalk is a function of stalk height and buds per meter of stalk. Buds per stalk ranged from 8.9 buds (L 97-105 and L 97-126) buds to 11.7 buds (L 97-128). Shoot emergence ranged from 14.0 shoots per plot (L 97-105) to 27.8 shoots per plot (LCP 85-384). Germination percentage was not significantly different among the genotypes. Germination percentage varied numerically from 26.2% (L 97-105) to 41.4% (LCP 85-384). The relatively high CV (23.7%) for germination percentage in this study indicated the need for increased replication for better assessment.

Stalk height was highly significant and positively correlated with buds per stalk and stalk weight, which were also significantly and highly correlated (Table 8). Percent germination was significantly correlated with total emergence (r=0.897). The correlations indicated no adverse relationships with other traits that would compromise the selection of better germinating genotypes.

Table 4. Sugarcane genotype sugar and cane yield means averaged across the three planting rates for the experiments conducted at the Sugar Research Station in St. Gabriel, Louisiana in 2000 through 2004.†

Genotype	Sugar yield				Cane yield			
	Plant cane	First Ratoon	Second ratoon	Third ratoon	Plant cane	First ratoon	Second ratoon	Third Ratoon
	Mg sugar /ha				Mg cane/ha			
LCP 85-384	11.2 B	10.7 B	10.0 BC	8.4 BC	91.1 BC	84.8 B	78.5 B	61.5 B
HoCP 91-555	11.3 B	11.0 B	9.6 C	7.4 C	92.3 ABC	85.9 B	73.1 B	54.4 B
L 97-105	8.1 C	8.0 D	7.6 DE	8.1 C	66.8 D	63.2 D	59.7 C	61.7 B
L 97-126	8.6 C	7.6 D	5.4 F	3.1 E	68.5 D	60.1 D	42.8 E	23.8 D
L 97-128	12.6 A	13.1 A	11.8 A	12.1 A	99.0 A	102.7 A	90.2 A	84.6 A
L 97-129	8.2 C	7.6 D	6.7 E	4.4 DE	65.9 D	60.8 D	52.2 D	33.9 CD
L 97-137	11.0 B	10.4 BC	10.7 B	9.9 B	93.5 AB	88.5 B	87.3 A	74.9 A
L 97-147	11.2 B	9.5 C	7.7 D	4.8 D	85.5 C	70.9 C	58.5 CD	35.7 C

† Means in a column sharing the same letter are not significantly different at P=0.05.

Table 5. Sugarcane genotype sugar content, stalk weight and stalk population means averaged across the three planting rates for the experiments conducted at the Sugar Research Station in St. Gabriel, Louisiana in 2000 through 2004.†

Genotype	Sugar content	Stalk weight	Stalk population			
			Plant cane	First ratoon	Second ratoon	Third ratoon
	g/kg	kg	stalks/ha			
LCP 85-384	116 B	0.85 DE	103409 A	119668 A	105153 A	79650 BC
HoCP 91-555	117 B	0.82 E	104281 A	110661 A	101999 A	72707 C
L 97-105	115 B	0.88 CD	81243 CD	84274 BC	75938 B	84089 BC
L 97-126	115 B	0.85 DE	71579 E	78856 C	57013 C	29119 E
L 97-128	120 A	0.98 A	85203 C	108926 A	102170 A	103788 A
L 97-129	115 B	0.76 F	75539 DE	91924 B	76180 B	51957 D
L 97-137	111 C	0.92 BC	93397 B	115041 A	104798 A	93120 AB
L 97-147	120 A	0.95 AB	72750 E	86933 BC	72848 B	42140 DE

† Means in a column sharing the same letter are not significantly different at P=0.05.

Table 6. Analysis of variance of fixed effects for the two germination experiments involving eight sugarcane genotypes conducted at the Sugar Research Station in St. Gabriel, Louisiana in 2002.

Source	Stalk height	Buds per Meter	Buds per stalk	Total emergence	Germination percentage	Stalk weight
	------------	------------	------------	P-value	------------	------------
Location (L)	0.286	0.947	0.505	0.486	0.482	0.116
Genotype (G)	0.001	0.001	0.001	0.002	0.082	0.001
GL	0.313	0.743	0.930	0.808	0.949	0.489
	------------	------------	------------	%	------------	------------
CV (%)	3.1	5.7	6.3	22.4	23.7	9.5

Table 7. Sugarcane genotype means averaged across the two locations for the germination experiments conducted at the Sugar Research Station in St. Gabriel, Louisiana in 2002.†

Genotype	Stalk weight	Stalk height	Buds per meter	Buds per stalk	Total emergence	Germination percentage
	kg	cm	no./m	no.	no./plot	%
LCP 85-384	0.79 BC	188 B	5.9 ABC	11.2 AB	27.8 A	41.4 A
HoCP 91-555	0.71 C	185 B	5.3 D	9.7 C	23.5 ABC	40.4 A
L 97-105	0.71 C	184 B	4.8 E	8.9 D	14.0 D	26.2 A
L 97-126	0.71 C	149 D	6.0 BC	8.9 D	18.3 CD	34.8 A
L 97-128	0.97 A	207 A	5.6 CD	11.7 A	22.0 BC	31.4 A
L 97-129	0.75 C	182 B	6.4 A	11.6 A	24.5 AB	35.4 A
L 97-137	0.76 C	173 C	6.1 AB	10.5 B	21.2 BC	33.9 A
L 97-147	0.86 B	205 A	5.6 CD	11.5 A	23.5 ABC	34.2 A

† Means in a column sharing the same letter are not significantly different at P=0.05.

Table 8. Pearson correlation coefficients among sugarcane germination traits for the 2002 germination experiments conducted at the Sugar Research Station in St. Gabriel, Louisiana.†

	Buds per meter	Buds per stalk	Total emergence	Germination percent	Stalk weight
Stalk height	-0.234	0.641 **	0.229	-0.067	0.667 **
Buds per meter		0.595 **	0.316 *	0.087	0.124
Buds per stalk			0.446 **	0.022	0.645 **
Total emergence				0.897 **	0.199
Germination percent					-0.078

† n = 24.
*, ** Significance at P = 0.05 and 0.01, respectively.

Conclusions

The absence of a sugarcane planting rate by genotype interaction indicated that sugarcane genotypes performed similarly in yield trials whether a two-stalk, three-stalk, or four-stalk planting rate was used. Only differences in magnitude of the traits measured were observed for each of the three planting rates. Baker (1990) indicated that only cross-over interactions (changes in genotype rankings) rather than interactions due to magnitude are of consequence in a plant breeding program. The nonsignificant planting rate by crop interaction indicated that increased planting rates were not effective for improving ratooning ability. The current use of a two-stalk planting rate in sugarcane selection and yield trials within the breeding program is validated.

Correlation coefficients among percent germination and other traits indicated no negative relationship to overcome when selecting for increased germination percentage among experimental clones. The high CV for percent germination indicated that sufficient replication is needed to adequately assess the trait.

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