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Yield and yield attributes of sugarcane as affected by some crop management treatments

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Abstract

This study was carried out at Shandaweel Agricultural Research Station, Sohag, Egypt in two ratoon crops to evaluate the effects of three row spacing (100, 120, 140 cm) on yield and yield attributes of three sugarcane varieties (F 153, G. 85-37 and G.T. 54-9). Results revealed that commercial variety G.T. 54-9 gave the highest values of stalk height, stalk thickness and stalk weight. Whereas, F 153 gave the highest values of number of valid stalks per ha and cane yield per ha. The narrow row spacing (100 cm) gave the highest values of stalk height, number of valid stalks per ha and cane yield per ha. On the other hand, the wide row spacing (140 cm) gave the highest values of stalk height, stalk thickness and stalk weight.

Key words: Varieties, row spacing, valid stalk, cane yield

Introduction:

Sugarcane (*Saccharum officinarum* L.) is an important economic crop in the tropics and sub-tropics due to its high sucrose content and bioenergy potential (FAO, 2010). Sugarcane is the major source for sugar production in Egypt. Cane plantations are concentrated in the area of Middle and Upper Egypt specifically in Menia, Sohag, Qena, Luxor and Aswan. In Egypt, the total cultivated area of sugar cane is about 126 hectares and the average of productivity is 120 tones/ha which is the highest globally about 85% of sugar cane production is sent to sugar

factories for sugar production, 4% is used for honey industry, about 2% is used for seeds and 9% is used for fresh juice.

Commercial sugarcane varieties are inter-specific hybrids and consequently differ in their performance due to the great variation in their genetic make up. Sugarcane varieties differed in yield and yield attributes (Yadav and Sharma, 1980, Gowda, et al., 2001, Shafshak et al., 2001, Mohamed and Ahmed 2002, Sundara, 2003 Azzazy et al., 2005, El-Shafai and Ismail, 2006, Ismail et al., 2008 and Taha, et al., 2008).

Planting density plays an important role in the amount of solar radiation intercepted and water transpired by crop canopy which intern affects the photosynthesis processes and ultimately the dry matter produced and sugar extracted by sugarcane plant. Moreover, planting density broadly affect cane diameter, length and weight as individual plants which contribute to cane yield. According to Collins (2002), plant density is a function of inter and intra-row spacing. Sugarcane has a high compensating ability to maintain potential yield under different cases of spacing and population density (Netsanet et al., 2014).

Inappropriate planting density is the most serious factors reducing sugarcane yield (Bashir et al., 2000). Sub-optimal planting density result in low plant population density and hence less number of millable canes per unit area which is the key component of cane yields (Mahmood et al., 2005). Planting density directly affects the number of stalks, stalk length and stalk diameter which are positively associated with cane yield per unit area (Nazir et al., 1999)

An experiment conducted on plant cane and ratoon cane with pre-seasonal planting indicated that cane girth, number of millable canes per clump and average cane weight were significantly higher at the intra-row spacing of 90 cm rather than at the intra-row spacing off 30 cm and 60 cm (Raskar and Bhoi,2003). Other researchers also reported higher yields from narrow spacing (90 and 60 cm) compared with wide spacing (130, 140 and 180 cm) (Sharma 1982; Irvine et al., 1984, Singh and Singh 1984, Gonzalaz et al., 1989 and Arvind Misra et al., 1990).

The main goal of the present work is to study the relative potentiality of crop ratoon yields for some sugarcane varieties under the various rows spacing to attain the highest yield.

Materials and methods

The present investigation was carried out at Shandaweel Agricultural Research Station, Sohag Governorate (26°34'N, 31°42'E, and 61m above mean sea level). The soil of the experimental area was clay loam (28.6% sand, 11.0% silt and 60.4% clay) and contained 35.0, 12.7 and 214 ppm available N, P, K, respectively, with pH of 7.3.

Treatments were laid out in split plot in RCB where 3 row spacing and 3 sugarcane varieties on

main plot and sub plot, respectively. The three pacing were 100 cm, 120 cm and 140 cm. The three sugarcane varieties were F 153, G. 85-37 and G.T. 54-9 (commercial variety).

Sugarcane was planting by seed-cutting in the 2nd week of March. Plot area was 42 m^2 (6 X 7 m). Fertilizers were applied at the rate of 500 kg N, 70 kg P_2O_5 and 100 kg K_2O per ha. The other agronomic practices were kept normal and uniform for all the treatments.

At harvest time, ten plants were randomly taken from each sub plot to determine the following traits: stalk height (cm), stalk diameter (cm) and stalk weight (kg). Plants of the four guarded rows were harvested, cleaned, topped and the following parameters were recorded: number of valid stalks per ha and cane yield (ton/ha). The data were recorded on first and second ratoons.

The data were analyzed by analysis of variance (ANOVA) using MSTAT-C statistical software. Treatment means were compared using Duncan's multiple tests (Steel and Torrie, 1980). Probability levels lower than 0.05 or 0.01 were held to be significant.

Results and discussions

Stalk height

The data in Figure 1 show that planting at 100 cm between rows gave the highest value of stalk height in the first and second ratoons (305 and 320 cm) followed by planting at 120 cm (300 and 313 cm). Different authors also reported taller plants under high population than under low population conditions (Irvine and Benda, 1980).

Results presented in Figure 2 clear that commercial variety G.T. 54-9 gave the largest stalk height of 312 and 322 cm in the first and second ratoons, respectively. The means of F 153 (291 and 307 cm) were significantly lower than the means of the other two varieties in both ratoons. Differences in stalk height existed among these varieties could be attributed to the differences in their genetic ability of joints formation that determine stalk length. The differences in stalk cane height was widely indicated that EL-Taib (1999) and Taha et al., (2003) who reported genetic variability in millabe cane height among sugarcane genotypes.

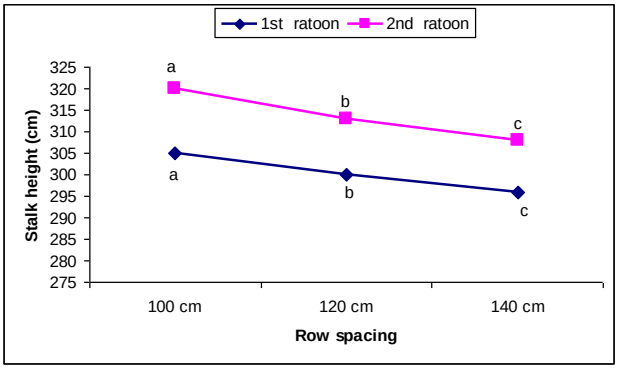

Figure 1: Effect of row spacing on stalk height of sugarcane ratoons.

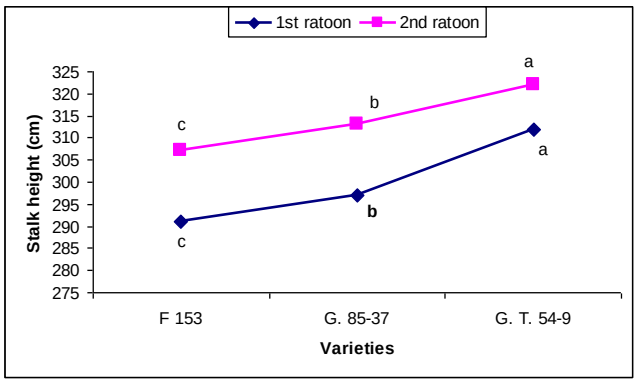

Figure 2: Effect of varieties on stalk height of sugarcane ratoons.

Stalk diameter

Results in Figure 3 showed that stalk diameter was significantly affected by the inter-row spacing in the both ratoons. However, it was observed that planting sugarcane in the widest inter-row spacing (140 cm) resulted in the thicker stalk compared with the narrower ones (100 or 120 cm). This result may be attributed to the great competition among plants in dense planting in case of narrow spacing on growth factors, i.e. nutrients and solar radiation, in addition to the negative influence of mutual shading.

In both ratoons, the thickest diameter was obtained by G.T. 54-9 followed by G.85-37 while the thinner stalk was recorded by F 153. Bora et al. (1997) and El Taib (1999) reported great difference in stalk diameter among sugarcane varieties (Figure 3).

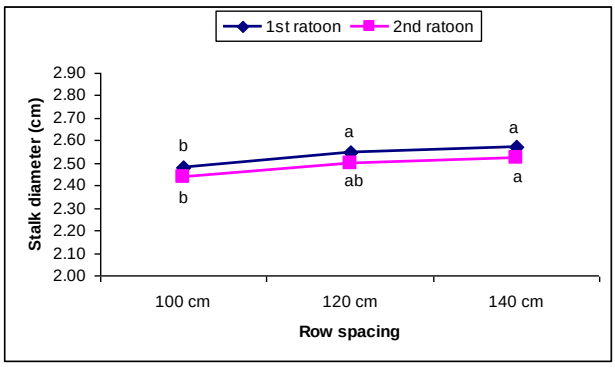

Figure 3: Effect of row spacing on stalk diameter of sugarcane ratoons.

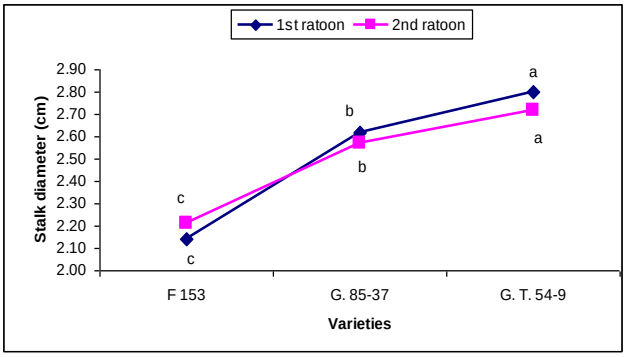

Figure 4: Effect of varieties on stalk diameter of sugarcane ratoons.

Stalk weight

Results illustrated in Figure 5 revealed that row spacing had a significant influence on stalk weight in the first and second ratoons crops. Planting sugar cane using 140 cm row spacing significantly recorded the highest mean value of stalk weight compared with 100 and 120 cm

row spacings. Similar to the current results obtained, Orgeron et al. (2007) also observed lower weight per stalk under narrow spacings than under wider spacings.

The obtained results in Figure 6 revealed that the tested varieties significantly differed in stalk weight in the first and second ratoons crops. Sugar cane G.T. 54-9 variety recorded the highest means value of stalk weight. The lowest value of stalk weight was recorded from F 153 variety. These differences could be attributed to the genetic structure of the evaluated sugarcane varieties.

Similarly, Muhammad et al. (2002) found significant difference among different sugarcane genotypes in weight per stalk.

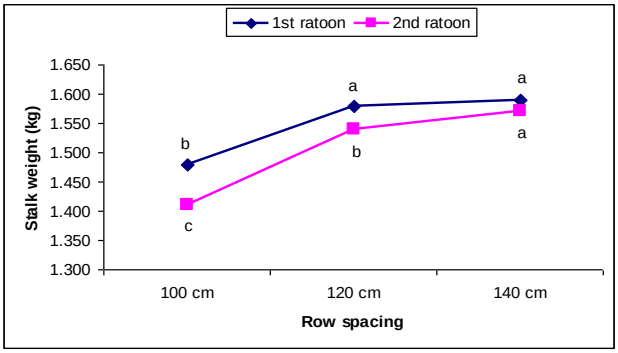

Figure 5: Effect of row spacing on stalk weight of sugarcane ratoons.

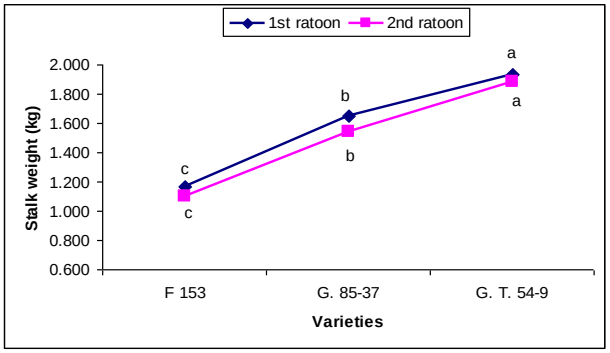

Figure 6: Effect of varieties on stalk weight of sugarcane ratoons.

Number of valid stalk

A significantly higher number of valid stalks per ha was recorded by planting at 100 cm between rows however, the planting at 140 cm gave a significantly lower mean number of valid stalks per ha than planting at 120 cm row spacing (Figure 9). This observation is in agreement with the findings of Netsanet et al. (2014) that high density planting rates result in higher number of millable canes than the low density plantings. Besides, Preecha (2006) also found that numbers of millable canes per unit area were influenced by plant spacing.

The results indicated that the three varieties were significantly different in number of valid stalk. The variety F 153 had significantly higher number of valid stalk than the other varieties. The variety G. 85-37 gave the minimum number of valid stalks per ha (Figure 10). Similar to this result, Feyissa et al. (2008) also observed variation among varieties on number of millable canes.

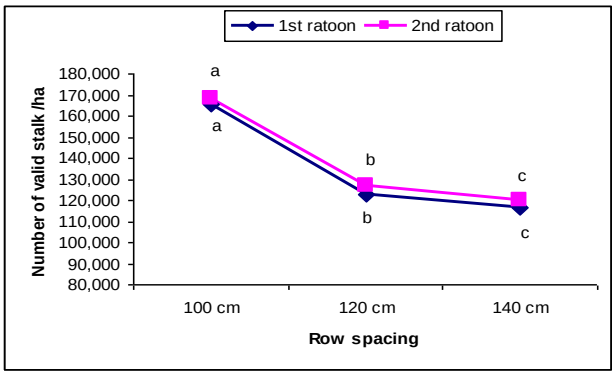

Figure 7: Effect of row spacing on number of valid stalk of sugarcane ratoons.

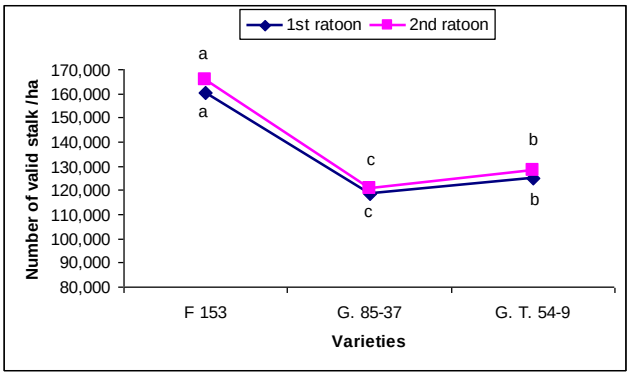

Figure 8: Effect of varieties on number of valid stalk of sugarcane ratoons.

Cane yield

The data in Figure 9 showed that the 100 cm spacing and the 120 and 140 cm spacings were significantly different in cane yield in both ratoons. The 140 cm spacing had the lowest cane yield (ton/ha); followed by 120 cm. Spacing of 100 cm out yielded all other spacings in the first and second ratoons. These results may be due to the fact that the narrower inter-row spacing gave higher the valid stalk and stalk height (Figures 1 and 7). Similar results were obtained by El-Shafai and Ismail (2006), who found that planting sugarcane in rows spaced at 80 cm apart attained significant increases in cane yields/fed compared with 100 and 120 cm.

Results showed a significant difference in cane yield between the three sugarcane varieties in the both ratoons. The F 153 variety surpassed other two varieties in the both ratoons. Also, G.T. 54-9 variety surpassed G. 85-37 in this respect. This result could be attributed to higher value of valid stalk for F 153 compared to other varieties (Figures 8). The presence of variation of cane yield among varieties indicated the difference in their inherent yielding ability (Soomro et al. 2006).

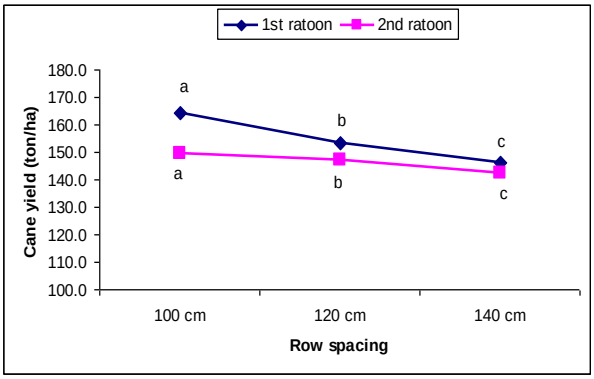

Figure 9: Effect of row spacing on cane yield per ha of sugarcane ratoons.

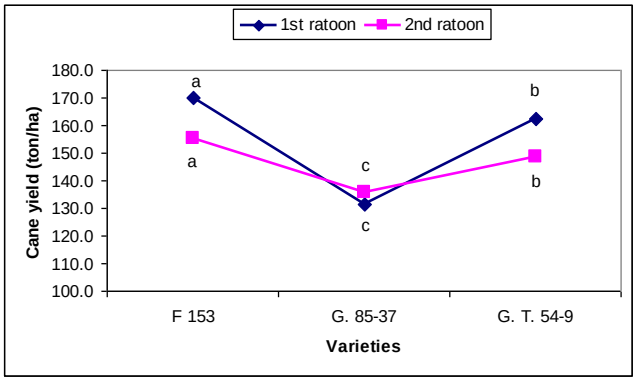

Figure 10: Effect of varieties on cane yield per ha of sugarcane ratoons.

Conclusion

The results of this study revealed that inter-row spacing influenced cane yield and its attributes. The narrow row spacing (100 cm) gave the highest values of stalk height, number of valid stalks per ha and stalk yield per ha comparing to other spacings (120 and 140 cm). F 153 plants recorded at harvest higher significant values of number of valid stalks per ha and cane yield per ha than two varieties (G.T. 54-9 and G. 85-37).

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