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RESPONSE OF SPRING SUGAR-CANE TO SOME ROW SPACING AND INTERCROPPING WITH SORGHUM AND SOYBEAN

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Abstract

Yield, yield components, juice quality as well as competitive relationships and economic evaluation of sugar-cane in response to intercropping with sorghum and soybean under different row spacings were investigated during 1995/1996 and 1996/97 seasons.

Intercropping soybean or sorghum with spring sugar-cane reasonably improved number of internodes/stalk, stalk weight, Brix%, sucrose %, fiber % and land equivalent ratio (L.E.R), while reduced number of millable cane, cane yield, top yield, purity%, sugar yield and monetary returns. Sugar recovery did not alter with intercropping compared with pure stand of sugar-cane. Agressivity value of sugar-cane was positive for soybean and for sorghum was negative under intercropping systems.

Increasing row spacings of sugar-cane was followed by an increase in stalk weight and a reduction in the number of millable cane, cane yield, top yield, sugar yield, monetary returns. The other studied characters did not change.

It is clear that intercropping sorghum with sugar-cane was more profitable than soybean in respect to the monetary returns.

INTRODUCTION

Because of the rapid increase of the population under condition of the limited cultivated area and water resources, self satisfaction with agricultural food products has been always considered a problem. Sugar is considered one of the cheapest sources of energy for the Egyptians. In spite of the continuous increase in sugar production and manufacture which succeeded to raise Egypt self satisfaction from sugar to 75%, the gap of sugar is still high (650000 tons).

Increasing the productivity per the unit area under sugar cane vertically becomes the only choice to attain the self-satisfaction from sugar. Also, the suitable agriculture intensification of some field crops with sugarcane will be a good choice to face the shortage in food materials.

It is well known that at first part of growth cycle (formative phase), sugar-cane does not utilize available growth resources fully. From germination to canopy closure, neither space, light nor water is fully utilized. Therefore, growing additional crop in the inter-rows of sugar-cane during this period is a means of achieving better resouce use and intensifying time and space dimensions. However, the choice of the intercrop is question of finding crops that complete each other rather than compete with each other. Sorghum and soybean are characterized with their fast growth and maturity which mean that they are harvested before the boom stage of sugar-cane during which cane stalks grow up quickly and their elongation rate is in its maximum.

Previous work show that varying row spacings of sugarcane substantially influenced both yield and its components. (Gascho and Shih, 1981; Dominf and Plana, 1989; Usman, 1989; Patel et al., 1990 and El-Gergawy et al., 1995).

The idea for intercropping sugarcane especially with legumes ascertained many agronomists. Their studies focused on the relation between intercropping and the yield and its components of the main crop. (Abd El-Gawad et al., 1985; Sathyaveln et al., 1991; Kanwar et al., 1992; El-Gergawy et al., 1995; Harlapur et al., 1995 and Singh and Chaudhary, 1996.

Sugarcane yield and its components in relation to the intercropping and row spacing was studied by many authors (Ahmed et al., 1990; Jayabal et al., 1990; Jayabal et al., 1991; Kumar and Srivastava 1994 and El-Gergawy et al., 1995). Abd El-Gawad et al. (1985) revealed that (LER) of single sugar-beet was greater than on by intercropping sugarcane with sugar beet at different densities. They added increasing sugarcane with sugar beet at different densities. They added increasing plant density of the intercrop. Govinden and Arnaon (1990), Kanwar et al. (1992), Govinden and Ramasamy (1995) and Singh and Chaudhary (1996) reported that intercropping sugar cane with maize caused reduction in cane and sugar yield. El-Gergawy et al. (1995) showed that yield of cane or soybean attained a significant increase in pure stand over those under the intercropping treatment. They obtained more profitable from intercropping soybean with cane. They added that sugarcane with soybean intercropping raised (L.E.R.) Gascho and Shih (1981) and Prasad et al. (1983) explained that narrow row spacing could result in higher yields. Jayabal et al. (1991) found that the highest sugar yield was obtained by planting three row of soybean between cane rows.

Thus, this work designed to study the effect of sugar-cane row spacing and intercropping of some summer crops on yield and yield components, juice quality as well as competitive competition and economic values under Souhag Governorate conditions.

MATERIALS AND METHODS

Two field experiments were conducted at Shandaweel Reearch Station (Souhag governorate) in two succesive seasons of 1995/96 & 1996/97 to study the relative advantage of intercropping soybean and sorghum with spring ugar-cane in respect to yield and quality of sugarcane.

Each trial included nine treatments which were the combination between three row spacings and three intercropping patterns of soybean and sorghum plants with sugar-cane as shown in Table (1) and the illustrated diagram.

Table 1. Intercropping systems of soybean and sorghum with the Spring planted sugar-cane.

Row spacing (cm)	Intercropping		
	I	II	III
100	Cane alone	Cane + one row of soybean	Cane + one row of sorghum
120	Cane alone	Cane + two rows of soybean	Cane + two rows of sorghum
140	Cane alone	Cane + three rows of soybean	Cane + three rows of sorghum

In addition to the above mentioned intercropping treatments, both soybean and sorghum were singly sown in four replications as a check treatment to follow up their performance under intercropping with their growing in pure stand. All the agronomic processes for both crops were done as usual in pure stand. All the agronomic processes for both crops were done as usual in pure stand condition.

Because of the studied factors are in the same level of importance and to attain a random distribution for the studied treatments, a complete randomized complete block design was used. It is worth mentioning that row spacing of sugar-cane were manually prepared. The experimental unit area was 42m2, 6m in length and 7m-width. Sugar-cane was planted during the first week of April in both growing seasons.

The companion crops i.e., soybean and sorghum (in pure stand and/or intercropping with sugar-cane) were sown after 15 and 30 days after planting sugarcane, respectively. Moreover the rows of the companion crops i.e., soybean and sorghum were allocated between sugarcane row spacing. A commercial sugar-cane variety viz G.T. 54-9 was used in both seasons. Also, short stem sorghum variety viz Drado and Crowford soybean variety were used.

Nitrogen fertilizer was added as Urea (46% N) at rates of 180,130 and 100 kg N/fed. for sugar-cane, soybean and sorghum, respectively according to the recommended doses for the three crops. Nitrogen dose given to sugar-cane was splitted into two equal doses, the first dose was added after 70 days from planting, while the second one was applied after the removal of the companion crops (soybean or sorghum). In respect to the companion crops, nitrogen was applied to soybean once after 21 days from sowing and after 21 and 50 days from sowing for sorghum. Phosphorus at rate of 30 kg P_2O_5 was added during land preparation as Calcium Superphosphate (15% P_2O_5) Meanwhile, potassium fertilizer at rate of 48 kg K_2O was applied as potassium sulphate (48% K_2O) with the second dose of nitrogen fertilizer. Normal agricultural practices were applied as usual.

Data recorded:

1. At harvest, a sample of 10 labeled stalks was chosen at random in the field for each treatment to determine the following attributes:

a. Number of internodes/stalk. b. Stalk weight "gm"

2. Number of millable cane per fed. was counted.

3. Cane yield (tons/fed.): plants of 4-guarded row of each treatment were harvested, topped, cleaned and cane yield/fed. was calculated.

4. Top yield (ton/fed).

A sample of 30 stalks from each treatment was taken at random and the following data were recorded:

1. Brix /100 cm3 of juice was determined in the laboratory using brix hydrometer.

2. Sucrose/100 cm3 of juice (S%) was determined according to A.O.A.C. (1995).

3. Purity percentage (P%) was calculated according to the following equation:

[Purity % = (Sucrose % /Brix %) 100]. Purity % (Sucrose % /Brix)

4. Fiber percentage (F%): at harvest, samples of three stalks were taken, cut, oven dried, ground to determine fiber % according to Pleskhow (1976).
5. Sugar recovery percentage (SR%) was calculated as follows:

[SR% = Richness % x Purity %] where:

Richness = (Sucrose in 100 grams x Factor)/100

Factor = 100 - [Fiber % + physical impurities + water free from sugar %].

6. Sugar yield/fed. was estimated according to the following equation:

Raw sugar production (ton/fed.) = cane yield (tons/fed.) x SR%

Comptitive relatioship and yield advantages:

1. Land Equivalent Ratio (LER): was determined according to Willey and Osiru (1972):
2. Relative crowding coefficient (K): was computed for sugar-cane (K_s), soybean or sorghum (K_i) according to Hall (1974):

3- Agressivity (A): was recorded according to Hall (1974).

Economic evaluation:

Gross return were estimated in Egyptian pounds (LE) per fed. for pure stand of sugar-cane, soybean and sorghum or the intercropping systems.

Price of the yield was cosseted according to Department of Agricultural Economic and Statistics, Ministry of Agriculture, Giza, Egypt.

The collected data were subjected to the proper statistical analysis of variance of complete randomized block design according to the procedures outlined by Snedecor and Cochran (1981). A combined analysis of the data of the two growing seasons was calculated. For comparison among means, the new multiple range test method of mean separation was used (Duncan, 1962).

RESULTS AND DISCUSSION

The effect of intercropping patterns of soybean and sorghum under different sugar-cane row spacing is presented in Table (2). Results indicated that the average

of internode number/plant tended to be equal under the studied row distances. This observation was true throughout the two growing seasons and their combined analysis. Concerning the influence of intercropping patterns the companion crops with sugar-cane. The collected data in Table (2) pointed out that all intercropping ystem of the two companion crops recorded superiority in the number of internodes/plant over those in pure stand. This result is in accordance with that concluded by Fergany et al., (1997).

Table 2. Effect of row spacing and intercropping patterns on stalk characters of sugar-cane (1995/96, 1996/97) and its combined) snalysis.

Row spacing	Intercropping Patterns	No.of internods / stalk			Stalk weight (g)		
		95/96	96 /97	combined	95/96	96/97	combined
100 cm	Cane alone	19.9^{d}	21.3^{ab}	20.6^{bcd}	1276^{e}	1350^{e}	1312^{e}
	Cane + one row soybean	22.0^{abc}	22.4^{a}	22.2^{abc}	1363^{de}	1530^{cd}	1446^{de}
	Cane + one row sorghum	22.9^{ab}	21.9^{a}	22.4^{ab}	1314^{de}	1477^{d}	1395^{e}
120 cm	Cane alone	20.9^{cd}	20.0^{b}	20.4^{cd}	1488^{bc}	1560^{bc}	1523^{bcd}
	Cane + 2- row soybean	21.1^{bcd}	23.3^{a}	22.2^{abc}	1589^{ab}	1653^{ab}	1621^{ab}
	Cane + 2- row sorghum	23.7^{a}	22.1^{a}	22.9^{a}	1406^{cd}	1560^{bc}	1483^{cde}
140 cm	Cane alone	20.4^{cd}	20.0^{b}	20.2^{d}	1554^{ab}	1613^{bc}	1583^{bc}
	Cane+ 3- row soybean	21.9^{abc}	23.3^{a}	22.6^{a}	1657^{a}	1743^{a}	1700^{a}
	Cane + 3- row sorghum	23.2^{a}	22.1^{a}	22.6^{a}	1526^{bc}	1587^{bc}	1556^{bcd}

In the same table, the obtained results revealed that the average of stalk weight was distinctly increased with increasing sugarcane row spacing. Growing sugar-cane under wider row spacing produced heavier stalk weight. This is true in both seasons and their combined analysis. The results are mainly due to the increase in interpecific as well as intraspecific by intercropping. Also, these results indicate that combining both crops in wide distance (140cm) encouraged unfavorable influence of intercropping on stalk weight. Table (2) obviously show that cane stalk weight was statistically affected by the used intercropping system. It could be noticed that intercropping soybean with sugar-cane attained the best results in respect to sugar-cane stalk weight/plant compared with sorghum with cane. Intercropping 3-row of soybean with sugar-can under 140-cm. row spacing attained the highest

values of sugar-cane stalk weight. The relative advantage of intercropping soybean with cane in respect to stalk weight may be due to the fewer number of sugar-cane plant grown with soybean which gave a good chance to sugar-cane to grow and become thicker than those growing with sorghum. This result is in accordance with that found by Fergany et al., (1997).

The presented result in Table 3 showed that there was an inverse relationship between row distance and number of millable cane/fed. The closer row spacing (100cm.) produced the higher number of millable cane whereas, increasing row spacing up to 14cm., reduced the number of millable cane/fed. As for, the influence of intercropping patterns on the number of millable cane, it could be noticed that the companion crops caused a negative effect on the number of millable cane/fed. compared with pure stand. Intercropping soybean with cane under the various sugarcane row spacing was better than intercropping sorghum with cane in respect to the number of millable cane/fed. Also, it is clear that the differences between all treatments were significant in both season and their combined. These results are in line with those reported by El-Gergawy et al., 1997. Data in Table (3) cleared that net cane yield was broadly and negatively affected by spacing. Collected results clearly showed that the closer the row distances (100cm) the highest the net canes yield. It is well cleared that plant grown under 100cm attained cane increase amounted to be 6% and 12% in the I^{st} season and 7.7% and 18% in the 2 nd season and 7% and 18.9% for the combined analysis of the two seasons compared with 120 and 140cm. respectively. The results obtained in Table (3) obviously show that the cane yield of sugar-cane attained the greatest values by growing sugar- cane in pure stand. This was valid in both seasons and their combined. Sugar-cane grown in pur stand out-yieled those grown with soybean when sugarcane and soybean or sorghum was associated in wide distance (140cm.). Thus, increased cane yield/fed. (cane alone with 100cm.), since the can yield/ unit area is the product of plant weight and number of plant/ m^2. It is worth mentioning that intercropping sorghum with suger-cane was more profitable than soybean with sugarcane in respect to net yield of sugar-cane stalk. This result may be due to the increment in the number of millable cane under this treatment. These results were fairly true not only under the two growing seasons and their combined but also under the various sugar-cane row pacing. These results are in good agreement with those reported by Jayabal et al.,1991.

In the same Table, top yield of sugar-cane responded negatively to the increase in row distance. The wider row distance gave the lowest top yield. It is distinctly shown that the companion crop with cane led to a significant reduction in the

Table 3. Effect of row spacing and intercropping patterns on cane yield (ton/fed.), No. of millable cane (tons/fed) ant Top yield (ton/fed.) (1995/96 & 1996/97) and its combined) analysis.

Row Spacing	Intercropping patterns	No.of millable cane			Cane yield			Top yield		
		95/96	96/97	combined	95/96	96/97	combined	95/96	96/97	combined
100 cm	Cane alone	77.1^{a}	68.1^{a}	72.7^{a}	85.3^{a}	83.4^{a}	84.3^{a}	21.1^{a}	20.5^{a}	20.8^{a}
	Cane + one row soybean	53.3^{c}	45.8^{de}	49.6^{c}	70.3^{c}	69.6^{de}	69.9^{de}	16.7^{c}	15.9^{e}	16.3^{c}
	Cane + one row sorghum	60.7^{b}	51.9^{c}	56.4^{b}	76.7^{b}	71.5^{cd}	74.1^{cd}	19.1^{b}	18.3^{bc}	18.7^{b}
120 cm	Cane alone	65.5^{b}	57.6^{b}	61.6^{b}	80.8^{ab}	78.7^{ab}	79.8^{ab}	19.3^{b}	18.8^{b}	19.1^{b}
	Cane + 2- row soybean	43.0^{d}	37.5^{e}	40.8^{d}	66.6^{c}	63.9^{e}	65.2^{e}	14.2^{d}	13.9^{eg}	14.0^{d}
	Cane + 2- row sorghum	52.6^{c}	41.0^{e}	46.8^{c}	70.8^{c}	65.6^{e}	68.2^{e}	16.9^{c}	16.1^{de}	16.5^{c}
140 cm	Cane alone	53.6^{c}	46.9^{d}	50.7^{c}	79.3^{b}	75.9^{bc}	77.6^{bc}	18.4^{b}	17.3^{cd}	17.8^{b}
	Cane + 3- row soybean	34.7^{e}	32.1^{g}	33.4^{e}	55.2^{d}	55.9^{g}	55.5^{e}	13.3^{c}	12.9^{g}	13.1^{d}
	Cane + 3- row sorghum	42.0^{d}	36.8^{eg}	39.4^{d}	49.4^{d}	58.6^{g}	59.0^{e}	16.2^{d}	15.2^{e}	15.7^{c}

top yield of cane compared with the yield of the pure stand. The highest values were obtained from sole sugar-cane under 100cm. in both seasons and their combined. This may be attributed to decreasing sugar-area under intercropping.

Date presented in Table (4) showed that the used row distance seemed to be equal in its effect on B%, the values of this trait were 21%, 20.7 and 20.8% when sugar-cane was grown under100.120 and 140cm. respectively.The date pointed out that B% was statistically affected by the used intercopping patterns. The highest values of B% were recorded when sugar-cane plants were intercopping with sorghum with a row distance of 140-cm. This rsult is in line with those found by Irvime *et al.*, 1984; Kanwar *et al.*, 1992 and Fergany *et al.*, 1997.

The obtained date in Table (40 indicated that intercopping sorghum with sugar-cane increased the values of sucrose%.This increment was significant in the 1st. season and combined sorghum with can mostly attained better values of sucrose % under the various row distance compared with intercopping soybean with cane. On the contrary, Sathyaveln *et al.*, (1991) mentioned that sucrose % was unaffected by intercopping treatments.

Date in Table (4) showed that purity% was significantly affected by intercopping in the 1st season only. In general the results obtained in Table (4) showed that intercropping sorghum (3 rows) with cane almost attained the highest values of purity% compared with the pure stand (140cm.). This finding partially coincide with that reported by Jayabal *et al,* 1991.

Suger-cane grown under the closer row spcing (100cm.)m produced higher fiber % (Table 5) On the contrary, Fergany *et al* (1997) elucidated that of fiber % were distance the lower fiber% and vice versa. The values of fiber % were attained when cane was grown in the pure stand. Moreover, it could be noted that intercropping sorghum with cane mostly increased the values of fiber % compared with intercropping soybean with sugar-cane.

The highest SR % values were recorded under the wider space (140cm.) followed by 100cm. then 120 cm. (Table 5).Opposite results were found by Fergany *et al.* (1997) who showed that the highest sugr recovry % was recorded under the closer row spacing (100cm.). The collected date revealed that intercropping soybean with cane almost produced the highest values of SR%. This finding was mostly true under the various sugar-cane row distances. These results are in harmony with Jayabal *et al.*, 1991.

Table 4. Effect of row spacing and intercropping patterns on juice quality of sugar-cane (1995/97 & 1996/97 and its combined) analysis.

Row spacing	Intercropping patterns	Brix %			Sucrose %			Purity %		
		95/96	96/97	combined	95/96	96/97	combined	95/96	96/97	combined
100 cm	Cane alone	20.6^{ab}	21.6^{c}	21.1^{a}	19.5^{ab}	18.7^{a}	19.1^{ab}	89.9^{ab}	91.9^{a}	90.9^{a}
	Cane + one row soybean	21.1^{ab}	22.4^{abc}	21.7^{a}	19.5^{ab}	19.1^{a}	19.4^{ab}	88.1^{ab}	92.5^{a}	90.3^{a}
	Cane + one row sorghum	21.2^{a}	22.6^{abc}	21.8^{a}	19.6^{ab}	19.1^{a}	19.4^{ab}	87.1^{b}	91.4^{a}	89.2^{a}
120 cm	Cane alone	20.8^{ab}	21.9^{bc}	21.4^{a}	19.1^{b}	18.6^{a}	18.8^{b}	91.0^{a}	88.4^{a}	89.7^{a}
	Cane + 2- row soybean	20.7^{ab}	22.5^{abc}	21.6^{a}	19.6^{ab}	19.3^{a}	19.4^{ab}	88.7^{ab}	92.3^{a}	90.5^{a}
	Cane + 2- row sorghum	20.5^{b}	22.9^{ab}	21.7^{a}	18.9^{b}	19.3^{a}	19.1^{ab}	88.1^{ab}	89.5^{a}	88.8^{a}
140 cm	Cane alone	20.9^{ab}	22.6^{abc}	21.8^{a}	19.4^{b}	18.9^{a}	19.2^{ab}	89.1^{ab}	90.4^{a}	89.7^{a}
	Cane + 3- row soybean	20.7^{ab}	23.1^{a}	21.9^{a}	19.6^{ab}	19.1^{a}	19.4^{ab}	89.1^{ab}	89.8^{a}	89.5^{a}
	Cane + 3- row sorghum	20.7^{ab}	23.1^{a}	21.9^{a}	20.3^{a}	19.3^{a}	19.8^{a}	90.6^{ab}	91.8^{a}	91.2^{a}

Table 5. Effect of row spacing and intercropping patterns on fiber %, sugars recovery, % and sugar yield of sugarcane (1995/96 & 1996/97) and its combined) analysis.

Row Spacing	Intercropping patterns	Fiber %			Sugar recovery %			Sugar yield (ton/fed.)		
		95/96	96/97	combined	95/96	96/97	combined	95/96	96/97	combined
100 cm	Cane alone	12.5^{cd}	12.8^{cd}	12.6^{c}	13.6^{ab}	13.1^{ab}	13.3^{a}	11.1^{a}	11.1^{a}	11.1^{a}
	Cane + one row soybean	13.1^{b}	13.4^{ab}	13.2^{b}	12.9^{bc}	13.4^{ab}	13.2^{a}	9.3^{bc}	8.9^{bc}	9.2^{bcd}
	Cane + one row sorghum	13.4^{a}	13.7^{ab}	13.6^{a}	13^{abc}	13.2^{ab}	13.1^{a}	10.1^{ab}	9.8^{ab}	9.9^{bc}
120 cm	Cane alone	12.4^{d}	12.3^{e}	12.4^{d}	13.1^{abc}	12.4^{b}	12.8^{a}	10.4^{ab}	9.9^{ab}	10.2^{ab}
	Cane + 2- row soybean	12.7^{bc}	12.6^{de}	12.7^{c}	13.5^{abc}	13.5^{a}	13.5^{a}	8.9^{c}	8.4^{bc}	8.6^{d}
	Cane + 2- row sorghum	13.1^{b}	12.3^{e}	12.7^{c}	12.6^{c}	13.1^{ab}	12.9^{a}	8.8^{c}	8.9^{bc}	8.8^{cd}
140 cm	Cane alone	12.8^{bc}	12.9^{de}	12.6^{c}	12.9^{bc}	12.9^{ab}	12.9^{a}	10.1^{ab}	9.7^{ab}	9.9^{bc}
	Cane + 3-·row soybean	13.0^{b}	13.2^{bc}	13.1^{b}	13.4^{abc}	13.6^{a}	13.5^{a}	7.1^{d}	6.9^{c}	7.0^{c}
	Cane + 3- row sorghum	13.7^{a}	13.8^{a}	13.6^{a}	13.9^{a}	13.4^{ab}	13.6^{a}	8.2^{cd}	8.0^{bc}	8.0^{d}

The narrow row space (100 cm.) produced the highest numberof millable cane and consequently the highest sugar yields (Table 5). The relative advantage in sugar yield under the closer row distance mainly due to increase in the number of millable cane under this treatment (100 cm.) Growing cane plant in pure stand condition produced higher sugar yields than those grown with the companion crops and intercropping sorghum with sugar cane attained the highest sugar yield. This result may be due to the relative increase in the net cane yield when sorghum was intercropping with cane. This result is in accordance with that showed by Fergany *et al.*, 1997.

competitive relationships:

Compentitive relationship and yield advantages for intercropping soybean and sorghum with sugar-cane in three different pattern are presented in Table (6 and 7) the results obtained clearly showed that by intercropping soybean or orghum with sugar-cane under these various intercropping patterns with sugar-cane, the value of land equivalent ratio (LER) waas greater than one (Table 6). These results were similar for the three patterns of intercropping. However, it could be oberved that the values of LER in Table (6) cleared that there was a relative advantage of intercropping soybean with sugar cane rather that sorghum. These result were completely true under the different intercroppings treatments as well as in the growing seasons and their combined. Intercropping 2-row of soybean or sorghum with cane attained the best results of LER. an soybean.

Table 6. Land equivalent ratio and relative crowding coefficient of intercropping sugar-cane with soybean and sorghum (1995/96 & 1996/97) and its combined analysis.

Row spacing	Intercropping of sugar-cane	Land equivalent Ratio (LER)		Combined	Crowding coefficient (K)		Combined
		95/96	96/97		95/96	96/97	
100 cm.	Cane+soybean	1.44	1.32	1.38	9.23	5.08	7.15
	Cane+sorghum	1.32	1.23	1.27	8.58	3.95	6.26
120 cm.	Cane+soybean	1.67	1.56	1.62	31.95	15.32	23.63
	Cane+sorghum	1.55	1.47	1.51	19.50	11.26	15.38
140 cm.	Cane+soybean	1.61	1.58	1.59	40.32	22.64	31.48
	Cane+ sorghum	1.47	1.51	1.49	9.02	11.04	10.03

Once more, the high values of relatives crowding coefficient (K) in the two growing seasons and their combined showed clear advantage for intercropping soybean with cane compared with sorghum. The relative advantage of intercropping soybean with cane may be attributed to companion crop i.e. cane and soybean diffrences in their use of growth resources and development of the crop canopy. It is well known that suger-cane is a C_4 plant, while soybean is C_3 plant, this fact provides the possibility of combining crops, which have different inherent response to environmental factors.

Concerning the effect of intercropping systems, (Table 7), results showed that agressivity value (A) of sugar-cane were always positive and those of soybean and sorghum were negative under intercropping systems in both seasons and their combined. Such results indicated that sugar-cane was the dominant intercrop component in all association, while soybean or sorghum were dominant component.Also, in all intercropping systems, sugar cane yielded more than the expected yield.

It could concluded that under the conditions of the experiment, sugar- cane showed higher competitive abilities for the soybean and sorghum insicating that sugar- -cane could be considered a good components when intercropping with soybean or sorghum, in the other words sugar-cane crop was dominant in the three intercropping patterns.

Table 7. Agrressivity of intercropping soybean and sorghum with cane (1995/96 1996/97) and its combined analysis.

Row spacing (cm)	Intercropping patterns	1995/96	1996/97	Combined
100 cm.	Sugar-cane	0.2^+	0.65^+	0.42^+
	Soybean	0.2^-	0.65^-	0.42^-
	Sugar-cane	0.47^+	0.91^+	0.69^+
	Sorghum	0.47^-	0.91^-	0.69^-
120 cm.	Sugar-cane	1.17^+	1.16^+	1.17^+
	Soybean	1.17^-	1.16^-	1.17^-
	Sugar-cane	1.63^+	1.52^+	1.28^+
	Sorghum	1.63^-	1.52^-	1.28^-
140 cm.	Sugar-cane	1.58^+	1.81^+	1.68^+
	Soybean	1.58^-	1.81^-	1.68^-
	Sugar-cane	2.3^+	2.12^+	2.07^+
	Sorghum	2.3^-	2.12^-	2.07^-

Economic evaluation:

The effect of intercropping systems on monetary returns in Egyptian pounds (L.E.)/fed. during 1995/96 and 1996/97 seasons are presented in Table (8). the represent results showed that intercropping systems significantly affected monetary returns in both seasons.

Regarding row spacing, the results revealed that the monetary returns L.E./ fed. increased by bdecreaing row spacing, in other words, the closer distance (100cm.) attained a distinct increasiny in monetary returns in both season. With regard to the effect of companion crop with sugar cane. The results obtained in Table (8) obviously showed that the monetary returns of sugar cane attained the greatest value by growing sugar cane in pure stand.

It is worth mentioning that intercropping soyrghum sugar-cane was more profitable than soybean with sugar-cane in respect tyo the monetary returns L.E/ fed. This result may be due to the high yield of sorghum comparing with soybean/ fed.

The date clearly indicated that intercropping soybean or sorghum with sugarcane caused a reduction in monetary rturns at all treatments compared with sugarcane alone. Such results could be explained according to the monetary returns calculated on the basis of the unit price of intercropping components and quantity of production. In this study, sugar-cane alone produced more yield than sugar-cane grown in intercropped, furthermore, the price of sugar-cane yield (ton) and the yield fed. were raised in last years.

Table 8. Monetary returns in L.E./fed. of intercropping sugarcane with soybean and-sorghum in 1995/96 and 1996/97) seasons analysis.

Row spacing	Intercropping of sugar-cane	1995/1996	1995/1997
100 cm.	Cane alone	6067.0 a	5896.0 a
	Cane+ one row soybean	4857.9 b	4828.3 b
	Cane+ one row sorghum	5992.1 ac	5374.8 c
120 cm.	Cane alone	5772.0 acd	5589.0 cd
	Cane+ one row soybean	4787.4 bc	4667.6 be
	Cane+ one row sorghum	6057.7 af	5583.4 cf
140 cm.	Cane alone	5737.0 dg	5431.0 cfg
	Cane+ one row soybean	3916.5 h	4133.6 h
	Cane+ one row sorghum	4296.4 i	5164.7 i

REFERENCES

1. Abd El-Gawad, A.A; Nemat; A.Nour El-Din; A.M. Abo-Shetaia and G.G. Saleh. 1995. Intercropping sugar-beet with sugarcane. 2-Effect on yield and some properties of sugar-cane. Annals Agric. Sci., Fac. Agric., Ain Sham Univ., Cairo, Egypt., 30 (2): 1145-1154.

2. Ahamed, M.S.; M.S. Cheena and G.Muhammad. 1990. Feasibi lity of intercropping rabi crops in autmn crop of sugarcane. Pakistan Sugar J., 5 (2): 10-14. Agric. Sta., Khanpure, Pakistan.

3. A.O.A.C. 1995. Official methods of analysis, puplished by the A.O.A.C., Box 540, Washington, D.C.

4. Dominf, M.E. and R Plana. 1989. Effect of planting density on growth and production of setts in sugar-cane. Cultivos Tropicales, 11 (3): 67-73. Instituto Nacional de Ciencias Agricolas, Havana, Cuba [C.F. Field Crop Abst., 1991, 44 (5): 3373].

5. Duncan, D.B. 1962. Multiple Range Test and Multiple F. Test. Biometric, 11: 1-124.

6. El-Gergawy, A.S.S.; Laila, M.S; T.S. El-Amari and I H. El-Geddawy. 1995. Intercropping some oil crops with spacing planted sugar-cane in middle Egypt. Egypt J. Appl. Sci., 10 (5): 225-234.

7. Fergany, M.E.; T.Y.Rizk and M.H. El-Agroudy and I.H. El-Geddaw. 1997. Studies on some factors affecting germination and tillering of sugar-cane. M.Sc., Thesis Fac. of Agric., Ain Shams Univ.

8. Gascho, G.J. and S.F. Shih. 1981. Row spacing effects on biomass and composition of sugarcane in Florida Proc. Amer. Soc. Sugar Cane Technol., N.S. 8: 72-76.

9. Govinden, N and J. T.Arnason. 1990. The relative importance of competition for water and for light in intercropping of sugarcane with maize. Agric. Water Mangement, 17 (1-3): 233. Manuritius Sugar Indust. Res. Inst., Reduit, Mauritius.

10. Govinden, N and S.Ramasamy. 1995. Intercropping of sugar-cane with maize: Results of industrial trials. In Ecophysiology of tropical intercropping. Proc. inter. meeting, Guadeloupp, 6-10 Dec., 1994. Eddited by Sinoquet, H.; Cruz, P. Paris France; Institut National de la Recherche Agronomique (INRA), Sugar Industry Res. Inst., Reduit, Mautitius. [C.F. Field Crop Abst., 1996, 49 (8): 5900].

11. Hall, R.L. 1974. Analysis of the nature interference between plants of different species Aust J. Agric. Res., 25: 749-756.

12. Harlapur, S.I.; C.S. Hunshal and T.D.K. Moorty. 1995. Effect of maize intercropping on yield and quality of sugar-cane. Cooperative Sugar, 26 (11): 87-859. Agric. Res. Sta., Sankeshwar 591314, Karnataka, India.

13. Irvine, J.E.; C.A. Richard; C.E. Carter and J.W. Dunckelman. 1984. The effect of row spacing and subsurface drainage on sugarcane yield. Sugar-Cane J. (2): 3-5.

14. Jayabal, V; N. Sankaran and S. Chockalingan. 1990. Effect of intercrops and nitrogen levels on the quality of sugar-cane. Indian Sugar-Cane Res. Sta. Melalathur 635806, Tamil Nadu, India. [C.F. Field Crop Abst., 1993, 46: 3785].

15. Jayabal, V.; N. Tamilselvan and S.Chockalingam. 1991. Influnce of soybean intercropping on yield and quality of sugar-cane. Cooperat. Sugar, 22 (5): 313-315. Sugarcane Res. Sta. (TNAU), Melalthur 635806, Tamil Nadu, Indian Punjab, India. [C.F. Field Crop Abst., 1993, 46:380].

16. Kumar, S. and S.N.L. Srivastava. 1994. Effect of planting methods and intercrops on yield and quality of spring planted sugar-cane. Indian Sugar, 43 (12): 919-922. [C.F. Field Crop Abst., 1995. 48 (7): 5507].

17. Kumar, S. and S.N.L. Srivastava. 1994. Effect of planting methods and intercrops on yield and quality of spring planted of spring planted sugar-cane. Indian Sugar, 43 (12): 919-922. [C.F. Field Crop Abst., 1995. 48 (7): 5507].

18. Patel, H.S; N.J. Mehta; M. P. Patil and B.C. Naik. 1990. Effect of row spacing and nitrogen levels on yield and quality of early maturign sugar-cane cultivars. Indian ugar, 5 (8): 609-611.

19. Pleskhow, B.P. 1976. Analysis in Agriculture Biochemistry. 2nd Ed., Moscow, Kales.

20. Prasad, D; U. K. Prasad and P.K.Bose. 1983. Effect of pre-monsoon irrigation, nitrogen and spacing on the yield of sugarcane varieties. Indian. J. Agron., 28 (2): 131-133.

21. Sathyaveln, A.; K. Chinnasamy and S.Rajaekaram. 1991. Studies on intercropping in sugar-cane with pulses and oil seeds SISSTA Sugar J., 17 (2-3): 35-37. Sugar Cane Res. Sta., Cuddalore, Tamil Nadu, India. [C.F.Field Crops Abst., 1993, 46: 5326].

22. Singh, S.N. and D.C. Chaudhary. 1996. Effect of intercropping maize (*Zea mays*) varieties on autumn-planted sugar-cane. Indian J. Agron., 41 (1): 30-34.

23. Snedecor, G.W. and W.G. Cochran. 1981. Statistical Methods. Seventh Ed. Iowa State Univ. Press, Ames, Iowa, USA.

24. Usman, B. 1989. Influnce of AS dosage addition and amount of cane cuttings on plant growth, NPK leaf content and yield of several cane varieties. Majalah Perusahaan Gula, 25 (1): 1-12.

25. Willey, R.W. and S.O. 1972. Studies on mixtures of maize and beans (Phaseolus vulgaris) with particular reference to plant population. J. agric, Sci., Cambridge 79:519-529.

أستجابة قصب السكر الربيعي لبعض مسافات الزراعة والتحميل بالذرة الرفيعة وفول الصويا

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–تم دراسة أستجابة المحصول وخصائصة والعلاقات التنافسية والتقييم الأقتصادي لقصب السكر للتحميل بالذرة الرفيعة وفول الصويا تحت مسافات زراعة وذلك خلال موسمي ٩٥ / ١٩٩٦ & ١٩٩٦ / ١٩٩٧.

ولقد أوضحت النتائج المتحصل عليها الأتي:

– أن تحميل الذرة الرفيعة أو فول الصويا مع القصب يحسن بفاعلية عدد السلاميات في العود، وزن العود نسبة المواد الصلبة الذائبة الكلية، نسبة السكروز، نسبة الألياف، كفاءة أستغلال الأرض بينما أدي إلي نقص عدد السيقان القابلة للعصير، محصول السيقان، محصول الكالوح، نسبة النقاوة، محصول السكر، العائد النقدي ولم يؤثر التحميل علي محصول السكر النظري وذلك بالمقارنة بزراعة القصب بمفرده. وكانت المنافسة للقصب إيجابية عند تحميل فول الصويا وسلبية عند تحميل الذرة الرفيعة.

– صاحب الزيادة في مسافة الزراعة للقصب زيادة تدريجية في وزن العود ونقص تدريجي في عدد السيقان القابلة للعصير، محصول السيقان، محصول الكالوح، محصول السكر، العائد النقدي ولم تتأثر باقي الصفات تحت الدراسة.

– علي ضوء هذه النتائج فإنة يتضح أن تحميل الذرة الرفيعة علي قصب السكر يكون أكثر فائدة عن تحميل فول الصويا بخصوص العائد النقدي الناتج.