Effect of planting method and spacing on growth, yield and fruit characteristics of papaya fruit (*Carica papaya* L.)

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ABSTRACT

Field experiments were conducted at the experimental farm of the Faculty of Agricultural Sciences, University of Gezira, Wad Medani, Sudan, during 2007-2009. The objective was to study the effects of plant spacing and planting method on vegetative growth, number of days to flowering, number of days from flowering to harvesting, yield and fruit characteristics of two papaya cultivars. Papaya cultivars used were "Baladi" and "Solo". Spacings used were 1.5X2 m, 2X2 m and 2 X 2.5m and the methods of planting were beds and flats. Treatments were arranged in a randomized complete block design with three replicates. Results showed that cultivars, plant spacing and method of planting had significant effects on papaya vegetative growth, flowering, yield and fruit characteristics. "Solo" cultivar showed more vigorous vegetative growth, more number of days to first flowering, less number of days from flowering to harvesting and produced more fruits per tree. However, the "Baladi" cultivar produced large fruits and high yield per ha. Plant spacing of 2X2.5 m and the bed planting method resulted in the best vegetative growth and yield as compared to the other treatments in both seasons.

INTRODUCTION

Papaya (*Carica papaya* L) is one of the most important tropical fruit crops. World papaya production in 2005 was approximately 6.6 million tons (FAO, 2007). It is mainly consumed as fresh fruit, but is also used in processing of soft drinks, jams, ice-cream flavoring. It is prepared as dried fruit and canned syrup (Purseglove, 1974). Papaya is a good source of carbohydrates, minerals, vitamin A and vitamin C (Unnithan, 2008). Among the cultivated fruits, it gives the highest production and income per hectare, next to banana. Papaya has greater importance for its short growing period, high yield, and production of bulky food (Azad and Rabbani, 2004). Trees begin to bear within the first year of planting. Commercial production cycle is usually 3 years, but maybe more or less in some areas (Singh, 1990; Watson, 1997).

Density of planting depends upon the papaya variety and the region where cultivated; typical practice establishes 1160 to 1930 plants per ha (Watson, 1997), with trees spaced from 1.8 m to 2.7 m apart in the rows and 2.7 m to 3 m between rows. Sometimes double rows are planted in the spacing of 3.25 ×1.75×2 m (PROSEA, 1991). The most frequently used spacing of 2.5 m, gives a density of 1600–2000 plants ha^{-1} (Nakasone and Paull, 1998).

In Sudan, papaya is considered as a minor fruit crop and grown in a small scale in the Blue Nile and Sennar States. Although papaya can be grown successfully in all parts of Sudan, production is low and statistical data is limited. Little research work has been done to explore the potentiality of papaya production in Sudan. Production depends on local unisexual cultivars. Bisexual or hermaphroditic plants are now available in different countries and are successfully used for papaya production. Future prospects for papaya production in Sudan are extremely good and more efforts are needed to promote commercial production. Therefore, the objective of this research was to evaluate planting method and spacing on growth, yield and fruit quality of 'Solo' and 'Baladi' papaya fruits.

MATERIALS AND METHODS

Field experiments were conducted at the experimental farm, Faculty of Agricultural Sciences, University of Gezira, Wad Medani, Sudan (latitude 14.5^0N, longitude 33.5^0E and altitude 405m above sea level), during the period from September 2007 to April 2009. The land was deep plowed, disc harrowed and leveled to improve aeration and water infiltration.

Seeds of two papaya cultivars, Solo and Baladi were sown on 20th of September 2007 in polyethylene bags 15 ×30 cm, filled with alluvial soil, and perforated at the bottom and sides to allow drainage of excess water. After 8 weeks from sowing, seedlings were transplanted in the field using two methods of planting, 120 cm beds or flats. Three plant spacings were used in the experiment, 1.5×2 m, 2×2 m and 2×2.5 m. Plot sizes were 3.5 × 4 m, 4×4 m and 4×4.5m depending on spacing. The nematicide "Furidan" was applied at the rate of 30g per pit at planting. The seedlings were watered at planting and then once a week.

There were 3 plant spacings, 2 methods of planting and 2 cultivars giving a total of 12 treatments. Treatments were arranged in a randomized complete block design with three replicates. There were four plants in each plot. All cultural practices were carried out as recommended (Morton, 1987).

Two plants were randomly selected from each plot for measuring the different parameters. Plant height was measured 5 cm above the ground level and up to the apical meristem. Stem girth was measured 5 cm above the ground. Number of leaves per plant was counted in each month till flowering time. Number of days from planting to flowering and from flowering to harvesting were recorded. The fruits were harvested at the ripe stage. At each harvest, first fruit height, number, weight and dimensions of fruit, fruit yield per tree and total yield were determined. Fruit cavity and total soluble solids (TSS) were determined using a vernier and a hand refractometer (model HRN-32), respectively.

RESULTS AND DISCUSSION

Vegetative growth

The main effects of cultivar, plant spacing and method of planting on vegetative growth at the first and second flowering seasons are shown in Table 1. Cultivars showed significant differences in plant height at the first flowering and number of leaves, stem girth and plant height at the second flowering. Solo cultivar showed higher values in all parameters at the first and second flowering seasons.

The main effects of plant spacing on stem girth were significant at the first flowering. The largest stem girth was obtained at the spacing of 2×2.5 m. At the second flowering, there were significant differences in plant height. The tallest plants were obtained with the spacing of 1.5×2 m. This was due to the competition between plants for sunlight at the closer spacing. These results are in agreement with those reported by Bose *et al.* (1992) and Aisha (2003).

There were also significant differences between methods of planting in plant height at the first flowering. The highest values were obtained with the bed planting method. In the second flowering, there were significant differences between planting methods in the number of leaves and plant height. The highest values were obtained with the bed planting method. This was most probably because the flat planting method caused water logging conditions which resulted in somewhat stunted growth as compared to the bed method where water was available to plants through capillarity.

The interaction effects of papaya cultivar and plant spacing on vegetative growth at both flowering times are shown in Table 2. There were significant differences in stem girth at the first flowering. Within each cultivar, stem girth increased with an increase in plant spacing. This was mostly due to the low competition between plants encountered at the wider spacing. Also, there were significant differences between all vegetative growth parameters at the second flowering. The highest vegetative growth parameters were obtained with Solo cultivar at 2x2.5 m. Generally, as plant spacing increased, vegetative growth parameters increased except plant height which was higher at the closer spacing due to the competition between plants for sunlight. These findings are in agreement with those reported by Singh *et al.* (2007), who worked on papaya grown at five

spacings and found that the tallest plants were obtained with the closer spacing.

The interaction effects of papaya cultivar and method of planting at both flowering times are shown in Table 3. There were significant differences in stem girth and plant height at the first flowering and in plant height at the second flowering. The highest values of these parameters were obtained with Solo cultivar at the bed planting method. This was most probably because the bed method did not result in water logging problems which reduced vegetative growth.

Flowering

The papaya plant started to flower in July and the second flowering appeared in November. The number of days ranged from 238 to 248 to the first flowering and from 345 to 357 to the second flowering.

The main effects of cultivar, plant spacing and method of planting on number of days to flowering and number of days from flowering to harvesting are shown in Table 4. There were significant differences between cultivars in the number of days to the first flowering, with Solo resulting in the highest values. Plant spacing had significant effects on number of days required to both flowering times. The wider spacing resulted in the longest period to both flowering times. Also, the flat planting method took a longer time to flowering at both times.

Cultivars differed significantly in number of days from the first flowering to harvesting. Solo cultivar required less time from the first flowering to fruit harvesting as compared to the Baladi cultivar. This was because Solo had more vigorous vegetative growth than the Baladi cultivar (Table 1) which produced higher amounts of assimilates which resulted in faster fruit growth and maturation.

Plant spacing had significant effects on the number of days from both flowering times to harvesting. The closer spacing resulted in a longer duration of time from flowering to fruit harvesting at both times. This was because the closer spacing resulted in weaker vegetative growth (Tables 1 and 2) due to the competition between plant for water and nutrients and hence took a longer time for fruit development and maturation.

Method of planting had significant effects on the number of days from the first flowering to harvesting. The bed planting method took a shorter duration of time from flowering to both harvesting times. As shown in Tables 1 and 3, the most vigorous plants were produced using the bed planting method.

Yield and fruit quality

The main effects of papaya cultivar, plant spacing and method of planting on number of fruits/tree, fruit yield per tree, fruit weight and total yield are significant (Table 5). Solo cultivar produced the highest number of fruits per tree, but it had lower yield per tree, lower fruit weight and lower yield per ha in both harvesting seasons as compared to the Baladi cultivar. Although Solo cultivar produced a higher number of fruits per tree, yet it resulted in lower total yield per ha, which was due to its small- sized fruits. On the other hand, Baladi cultivar produced a fewer number of fruits per tree, yet it resulted in higher total yield per ha due to its large-sized fruits. Subhadrabandha *et al.* (1989) reported that large sized fruits are undesirable in papaya fruit production. Our results are in line with those reported by Drew *et al.* (1998) who found that dioecious varieties had higher fruit yields.

The increase in plant spacing resulted in a significant increase in all yield components at both harvesting seasons. This was because plants grown at close spacing were weak and slender due to competition between them for water and nutrients and hence resulted in lower yield components as compared to the wider spacing. These results are in agreement with those reported by Bose *et al.* (1992) who found that papayas grown at a wider spacing produced higher fruit weight and fruit yield per tree. Along the same lines, Aisha (2003), who worked on African and American Solo with three spacings of 0.5 x 2 m, 2 x 2 m and 3 x 3 m, found that an increase in plant spacing resulted in an increase in fruit weight, number of fruits and fruit yield per tree.

The bed planting method resulted in significantly higher yield components in both harvesting seasons, except fruit yield per tree in the first harvesting season. This was most probably due to the more vigorous vegetative growth obtained at the bed planting method.

The interaction effects of papaya cultivar and plant spacing are significant (Table 6). Regardless of cultivar, yield components generally increased as plant spacing increased in both harvesting seasons. The largest number of fruits per tree were produced by Solo cultivar planted at 2x2.5 m in both seasons. However, the highest fruit yield per tree, the highest fruit weight and the highest total yield per ha were produced by the Baladi cultivar grown at 2x2.5m in both seasons.

The interaction effects of papaya cultivar and method of planting on number of fruits/tree, fruit yield per tree, fruit weight and total yield per ha are shown in Table 7. There were significant differences in yield and yield components in both seasons. Within each cultivar, the bed planting method resulted in significantly higher yield components as compared to the flat method. The highest number of fruits per tree in the two harvesting seasons were obtained with Solo cultivar planted in beds. The highest fruit yield per tree and the highest fruit weight were obtained with the Baladi cultivar planted in beds in both seasons. The highest total yield was obtained with the Baladi cultivar in the bed method in both seasons. In all treatments, the total yield in the first harvesting season was higher than that of the second harvesting season. These findings are in agreement with those reported by Morton (1987) who showed that average papaya yield in Hawaii was 38ton/ha and 11ton/ha for the first and second year, respectively.

The main effects of papaya cultivar, plant spacing and method of planting on first fruit height, fruit length, fruit width, cavity diameter and TSS are shown in Table 8. There were significant differences between papaya cultivars in first fruit height, fruit length and cavity diameter in the first and second harvesting seasons. Solo cultivar obtained the highest first fruit in the two harvesting seasons. The first bearing height is an important character in papaya as it facilitates harvest and extends the economic life of the plantation (Muthulakshmi *et al*., 2007). The Baladi cultivar had the highest fruit length, and the largest fruit cavity diameter. The large fruit size and fruit cavity are undesirable characters as reported by Subhadrabandha *et al*. (1989).

The main effects of plant spacing on fruit length were significant at the first harvesting season and on fruit width and cavity in the second season. The largest fruits were obtained at the spacing of 2x2.5 m. Planting methods had no significant effects on fruit characteristics except fruit cavity in the first season.

The interaction effects of papaya cultivar and plant spacing on first fruit height, fruit length, fruit width, cavity diameter and TSS are shown in Table 9. There were significant differences in fruit length and TSS at the first harvesting season and fruit cavity at the second season. The treatments did not show any consistent trend regarding these parameters.

The interaction effects of papaya cultivar and method of planting on first fruit height, fruit length, fruit width, cavity diameter and TSS are shown in Table 10. There were significant differences in both seasons except TSS. Regardless of planting method, Solo cultivar resulted in the highest first fruit in both seasons. This was due to the more vigorous vegetative growth of Solo as compared to the Baladi cultivar. However, the Baladi cultivar had longer fruits and larger fruit cavity in both seasons. Within each cultivar, the bed planting method resulted in higher values in most of the parameters.

In conclusion, it is recommended to grow the Baladi cultivar at a spacing 2X2.5 m in beds 120 cm wide.

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Table 1. The main effects of cultivar, plant spacing and method of planting on papaya vegetative growth at flowering.

Cultivar	First flowering(July 2008)			Second flowering(Nov. 2008)		
	Number o leaves	Stem girth(cm)	Plant height(cm)	Number of Leaves	Stem girth(cm)	Plant height(cm)
Baladi	24	20.2	86.4	21.2	34.0	172.9

Solo	26	21.4	99.9	23.0	41.1	229.7
Sig.	NS	NS	*	***	***	***
Plant spacing (m)						
1.5x2	24	18.67c	94.42	22.42	37.25	207.91a
2x2	27	20.75b	101.25	21.75	37.33	191.08c
2x2.5	24	22.92a	83.75	22.17	38.08	204.91b
Sig.	NS	*	NS	NS	NS	***
Method of planting						
Flat	25	21.5	81.8	21.7	37.5	189.6
Bed	26	20.1	104.5	22.6	37.6	213.1
Sig.	NS	NS	***	**	NS	***
CV (%)	16.49	16.47	18.81	14.36	15.25	14.75

Means within columns followed by the same letter(s) are not significantly different at P≤0.05 level according to Duncan's Multiple Range Test. *, **, *** and NS indicate significance at P≤0.05, 0.01, 0.001 and not significant, respectively.

Table 2. Interaction effects of papaya cultivar and plant spacing on papaya vegetative growth at flowering.

Treatment		First flowering(July 2008)			Second flowering(Nov. 2008)		
Cultivar	Spacing(m)	Number of Leaves	Stem girth (cm)	Plant height	Number of leaves	Stem girth	Plant height

				(cm)		(cm)	(cm)
Baladi	1.5x2	21.0	18.8c	93.7	21cd	31.7f	171.0d
	2x2	28.5	19.7bc	93.7	20 d	33.3e	168.3d
	2x2.5	22.0	22.0ab	71.8	22bc	37.0d	179.3c
Solo	1.5x2	26.5	18.5c	95.2	22bc	39.5c	238.8a
	2x2	25.8	21.8b	108.8	23b	41.4b	213.8b
	2x2.5	25.3	23.8a	95.7	24 a	42.3a	236.5a
Sig.		N.S	*	N.S	***	***	***
CV (%)		16.49	16.47	18.81	14.36	15.25	14.75

Means within columns followed by the same letter(s) are not significantly different at P≤0.05 level according to Duncan's Multiple Range Test.

*, *** and NS indicate significance at P≤0.05, 0.001 and not significant, respectively.

Table 3. Interaction effects of papaya cultivar and method of planting on papaya vegetative growth at flowering.

Treatment		First flowering(July 2008)			Second flowering(Nov. 2008)		
Cultivar	Method of planting	Number of Leaves	Stem girth(cm)	Plant height(cm)	Number of Leaves	Stem girth (cm)	Plant height(cm)
Baladi	Flat	24	19c	84.1c	22	33.3	166.3d
	Bed	24	21b	88.7b	21	34.7	179.4c
Solo	Flat	25	19c	79.4d	23	41.7	212.7b
	Bed	27	24a	120.3a	23	40.6	246.7a
Sig.		NS	**	**	NS	NS	*
CV (%)		16.49	16.47	18.81	14.36	15.25	14.75

Means within columns followed by the same letter(s) are not significantly different at P<0.05 level according to Duncan's Multiple Range Test.

*, ** and NS indicate significance at P≤0.05, 0.01 and not significant, respectively

Table 4. The main effects of papaya cultivar, plant spacing and method of planting on number of days to flowering and number of days from flowering to harvesting .

Cultivar	No of days to flowering	No. of daysfrom1st flowering to harvesting	No of days to flowering	No. of days from 2nd flowering to harvesting
Baladi	241	167	348	138
Solo	245	155	350	139
Sig	*	*	NS	NS

1.5 x 2	238c	163a	345b	143a
2 x 2	243b	161b	345b	138b
2x2.5	248a	157c	357a	134c
Sig.	*	*	*	*
Flat	244	165	351	138
Bed	242	156	347	130
Sig.	NS	*	*	*
CV (%)	3.77	9.24	7.03	10.57

Means within columns followed by the same letter(s) are not significantly different at P≤0.05 level according to Duncan's Multiple Range Test.

* and NS indicate significance at P≤0.05 and not significant, respectively.

Table 5. The main effects of papaya cultivar, plant spacing and planting method on number of fruits/tree, fruit yield per tree, fruit weight and total yield.

	First season (July 2008)				Second season(Nov. 2008)			
Cultivar	Number of fruits/ tree	Fruit yield/ tree (kg)	Fruit weight(g)	Yield (ton/ha)	Number of fruits/ tree	Fruit yield/ tree (kg)	Fruit weight(g)	Yield (ton/ha)
Baladi	18	19.5	1019.8	44.6	10.1	8.5	810.5	26.2
Solo	32	12.5	381.6	29.9	15.6	5.8	370.3	14.1
Sig.	***	***	***	***	***	**	***	**
Plant spacing(m)								
1.5x2	18c	10.0c	496.3c	27.5b	10.9c	4.4c	446.2c	14.5b
2x2	22b	13.3b	723.9b	30.7b	11.8b	6.9b	644.0b	17.2b
2x2.5	35a	26.7a	881.9a	53.5a	15.9a	10.3a	681.1a	28.6a
Sig.	***	***	***	***	***	***	***	**
Method of planting								
Flat	23	15.1	681.5	35.2	11.9	6.3	542.5	18.6
Bed	27	16.9	719.9	39.3	13.8	8.0	638.3	21.7
Sig.	*	NS	*	NS	*	*	*	*
CV (%)	26.62	26.62	25.78	27.04	19.09	38.04	20.52	48.27

Means within columns followed by the same letter(s) are not significantly different at P≤0.05 level according to Duncan's Multiple Range Test.

*,**,*** and NS indicate significance at P≤0.05, 0.01 and 0.001 and not significant, respectively.

Table 6. Interaction effects of papaya cultivar and plant spacing on number of fruits/tree, fruit yield tree, fruit weight and total yield.

Treatment		First season(July 2008)				Second season(Nov. 2008)			
Cultivar	Spacing(m)	Number of fruits/ tree	Fruit yield/tree(kg)	Fruit weight(g)	Yield (ton/ha)	Number of fruits/tree	Fruit yield/ tree(kg)	Fruit weight (g)	Yield (ton/ha)
Baladi	1.5x2	15.7e	10.4d	690.0c	34.5c	8.8d	5.4c	383.5f	17.9c
	2x2	14. 7e	16.2c	1090.8 b	35.6c	8.3d	8.3b	641.3c	20.8b
	2x2.5	24.2c	31.8a	1278.7 a	63.6a	13.2c	11.8a	890.2a	39.9a
Solo	1.5x2	20.5d	5.7e	302.7f	20.5e	13.0c	3.3d	397.8e	11.1d
	2x2	29.5b	10.3d	357.0e	25.8d	15.2b	5.5c	508.8d	13.7d
	2x2.5	46.2a	21.6b	485.2d	43.4b	18.7a	8.4b	720.8b	17.5c
Sig.		*	*	*	*	*	*	*	*
CV (%)		26.62	26.62	25.78	27.04	19.09	38.04	20.52	48.27

Means within columns followed by the same letter(s) are not significantly different at P<0.05 level according to Duncan's Multiple Range Test.
* indicate significance at P≤0.05.

Table 7. Interaction effects of papaya cultivar and method of planting on number of fruits/tree, fruit yield per tree, fruit weight and total yield.

Treatment		First season(July 2008)				Second season(Nov. 2008)			
Cultivar	Method of planting	Number of fruits/ tree	Fruit yield/ tree (kg)	Fruit weight (g)	Yield (ton/ha)	Number of fruits/ tree	Fruit yield/ tree(kg)	Fruit weight (g)	Yield (ton/ha)
Baladi	Flat	14.8d	16.6d	933.3b	38.1b	8.1c	6.2b	415.3	24.9
	Bed	21.6c	22.3a	1106.3a	50.9a	12.1b	10.8a	861.3	27.5
Solo	Flat	24.9b	11.5b	333.6d	27.6d	11.7b	5.3b	325.3	12.2
	Bed	39.2a	13.6c	429.7c	32.2c	19.1a	6.3b	759.7	15.9
Sig.		***	**	*	*	***	**	NS	NS
CV (%)		26.62	26.62	25.78	27.04	19.09	38.04	20.50	48.27

Means within columns followed by the same letter(s) are not significantly different at P≤0.05 level according to Duncan's Multiple Range Test.
*,**,*** and NS indicate significance at P≤0.05, 0.01 and 0.001 and not significant, respectively.

Table 8. The main effects of papaya cultivar, plant spacing and planting method on first fruit height, fruit length, fruit width, cavity diameter and TSS.

	First season(July 2008)					Second season(Nov. 2008)				
Cultivar	First fruit height(cm)	Fruit length (cm)	Fruit width (cm)	Fruit cavity (cm)	TSS (%)	First fruit height(cm)	Fruit length (cm)	Fruit width (cm)	Fruit cavity (cm)	TSS (%)
Baladi	117.7	16.3	9.4	5.3	11.3	222.9	11.5	7.7	3.69a	10.3
Solo	135.3	9.4	9.1	4.0	11.9	274.2	8.6	7.3	2.76b	10.6
Sig.	**	***	NS	***	NS	**	***	NS	***	NS
Plant spacing(m)										
1.5x2	127.8	11.8	9.5	5.1	11.4	249.6	10.9	8.3a	4.1a	10.6
2x2	125.9	12.4	9.1	4.4	11.9	243.8	9.3	6.6c	3.1b	10.7
2x2.5	125.8	14.3	10.2	4.5	11.4	252.3	9.8	7.7b	2. 5b	10.1
Sig.	NS	*	NS	NS	NS	NS	NS	*	**	NS
Method of planting										
Flat	126.6	12.8	9.4	5.2	11.5	251.8	10.6	7.9	3.3	10.5
Bed	126.4	12.9	9.1	4.2	11.7	245.3	9.4	7.1	3.1	10.4
Sig.	NS	NS	NS	**	NS	NS	NS	NS	NS	NS
CV (%)	13.34	17.55	19.92	22.30	19.38	9.89	20.14	18.69	21.22	11.02

Means within columns followed by the same letter(s) are not significantly different at P<0.05 level according to Duncan's Multiple Range Test.

*,**,*** and NS indicate significance at P≤0.05, 0.01 and 0.001 and not significant, respectively.

Table 9. Interaction effects of papaya cultivar and plant spacing on first fruit height, fruit length, fruit width, cavity diameter and TSS.

Treatment		First season(July 2008)					Second season(Nov. 2008)				
Cultivar	Spacing (m)	First fruit height(cm)	Fruit length (cm)	fruit width (cm)	Fruit cavity (cm)	TSS (%)	First fruit height(cm)	Fruit length (cm)	Fruit width (cm)	Fruit cavity (cm)	TSS (%)
Baladi	1.5x2	113.8	14.3b	8.8	5.5	12.5a	223.3	13.1	8.06	3.9a	10.6
	2x2	121.2	15.4b	10.8	5.3	10.6c	209.2	10.6	7.15	3.0b	11.5
	2x2.5	118.2	19.3a	8.8	5.2	10.8bc	236.3	10.7	7.90	4.2a	9.3
Solo	1.5x2	141. 7	9.4c	9.4	4.7	10.3c	275.8	8.9	8.50	4.3a	10. 7
	2x2	130.7	9.4c	9.7	3.5	13.3a	278.3	7.9	6.02	1.9c	9.8
	2x2.5	133.5	9.5c	8.2	3.9	12.18ab	268.3	8.9	7.42	2.1c	10.8
Sig.		NS	*	NS	NS	*	NS	NS	NS	**	NS
CV (%)		13.34	17.55	19.92	22.30	19.38	9.89	20.14	18.69	21.22	11.02

Means within columns followed by the same letter(s) are not significantly different at P<0.05 level according to Duncan's Multiple Range Test.

*,** and NS indicate significance at P≤0.05,0.01 and not significant, respectively.

Table 10. Interaction effects of papaya cultivar and method of planting on first fruit height, fruit length, fruit width, cavity diameter and TSS.

Treatment		First season(July 2008)					Second season(Nov. 2008)				
Cultivar	Method of planting	First fruit height (cm)	Fruit length (cm)	Fruit width (cm)	Fruit cavity (cm)	TSS (%)	First fruit height (cm)	Fruit length (cm)	Fruit width (cm)	Fruit cavity (cm)	TSS (%)
Baladi	Flat	114.4b	15.8a	8.7b	5.1a	11.6	217.2b	10.2b	7.3b	3.5a	10.2
	Bed	121.0b	16.8a	10.2a	5.6a	10.9	228.7b	12.7a	8.5a	3.9a	10.3
Solo	Flat	131.9a	9.8b	10.0a	5.2a	11.3	275.0a	8.5b	8.1ab	3.2a	10.7
	Bed	138.7a	9.0b	8.1b	2.8b	12.4	273.3a	8.7b	6.2c	2.4b	10.6
Sig.		*	*	*	**	NS	*	*	**	*	NS
CV (%)		13.34	17.55	19.92	22.30	19.38	9.89	20.14	18.69	21.22	11.02

Means within columns followed by the same letter(s) are not significantly different at $P<0.05$ level according to Duncan's Multiple Range Test.

*,** and NS indicate significance at $P\leq0.05$, 0.01 and not significant, respectively.

تأثير مسافات الزراعة وطرق الزراعة على الانتاجية وجودة الثمار لصنفين من الباباى (*Carica papaya* L.)

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الخلاصة

أجريت التجارب الحقلية بالمزرعة التجريبية لكلية العلوم الزراعية، جامعة الجزيرة، ودمدنى، السودان، خلال موسمى 2007-2009م، بهدف دراسة تاثير مسافات الزراعة وطرق الزراعة على النمو الخضرى والازهار و الانتاجية والجودة لصنفين من الباباى . الاصناف المستخدمة هى الصنف "بلدى" والصنف "سولو" والمسافات هى 1.5 X 2م، 2x2م، 2 X 2.5م وطرق الزراعة هى المساطب120 سم والاحواض. نظمت المعاملات بأستخدام تصميم القطاعات الكاملة العشوائية بثلاثة مكررات. أوضحت النتائج أن الأصناف ومسافات الزراعة وطرق الزراعة لها تاثير معنوى على النمو الخضرى و الانتاج وصفات الجودة فى الباباى. اظهر الصنف"سولو"نمواً خضرياً اعلى واكبر عدد من الايام للازهار واقل عدد من الايام من الازهار حتى الحصاد واقل انتاجية للهكتار وعدداً اكبراً من الثمار للشجرة مقارنة بالصنف"بلدى" الذى انتج ثماراً اكبر حجما واعلى انتاجية للهكتار. مسافة الزراعة2 X 2.5م والزراعة فى مساطب انتجت افضل نمواً خضرياً واعلى انتاجية للهكتار مقارنة بالمعاملات الاخرى للموسمين.