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Response of Two Peanut Cultivars to Row Width and Hill Spaces in Sandy Soil

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Abstract: Two field experiments were carried out at the extention field at Salheia, Fakous District, Sharkia governorate, during two summer seasons (2006 and 2007) in sandy soil. This study aimed to investigate the response of two peanut cultivars (Giza 4 and Giza 5) to three row width (40, 50 and 60 cm) and four hill spaces (10, 15, 20 and 25 cm). Asplit-split plot design with four replications was used. The results indicate that Giza 5 cultivars superior than Giza 4 in plant height, number of pods/plant, 100- pod weight, shelling % and oil seed % on the other hand Giza 4 cvs was in 100- seed weight, pod yield/plant and pod yield/fad as shown in first season and combined data. Widing row width from 40 to 60 cm tended to increase all yield attributes in the two seasons and their combined and protein and oil seed %. In general 60 cm row width gave the heighest valus followed by 50 cm. While 40 cm row width was the lowest in this respect pod yield and seed yield/fad gave the oppiste trend. Increasing the distance between hills from 10 to 25 cm caused increasing in yield attributes under this study. No significant difference between 20 and 25 cm hill spaces on most characters. The highest yields (seed and pods/fad) were recorded by 10 cm hill spaces. Interaction results between the studied factors indicate that Giza 5 gave the highest and the heaviest number and weight of pods and seeds/plant with 60 cm row width and 25 cm hill spaces. The highest pod and seed yields /faddan were recorded by the 40 cm row width and 15 cm hill space.

Key words: Peanut cultivars, row width, hill spaces sandy soil

INTRODUCTION

Peanut is considered to be one of the most important edible oil crops which due to its high nutritive value of its seeds for human and the produced cake as well as the green leaf hay for livestok, in addition to the importance seed oil for industrial purposes. Increasing of peanut production in order to cover the local consumption and exported out side could be achieved by introducing high productivity varieties and improving the cultural practces and managements as well as chosen the proper planting density- peanut crop has different groups of varieties. One group has erect type of growth and one other semi erect type. Different other groups lie in between, naturally, each of these groups has its optimum of hill spacing and row width. This may explain the wide range recommended for optimum planting spacing. The evaluation of peanut cultivars has been studied by several investigators included Ahmed and Zeidan[3] who reported that the tested cultivars differed significantly in pod and seed yield and yield attributes Abd El-Motaleb and Yousef[2] found that the peanut erect variety Giza-5 surpassed the semi erect variety Giza-4 in plant height- 100 seed weight and pod yield/fad. Similar results were reported by Yasien[21], Sarhan[19]. Rehap Abd El-Kareem[16], Maha, Abd-Alla[13] and Ash-Ashormillesy, Salwa and Abd El-Hameed[7].

Crop density is a major factor contributing to higher crop production Jadhao *et al.*[12] indicated that in rows distance of 30 cm, the optimum spacing between peanut individual plants within-row ranged from 10-15 cm aparts whereas, in rows distanced at 15 cm the optimum within row spacing was 10 cm only. Also, Roghavarah *et al.*[15] concluded that the pod yield of ground nut was higher at closer spacings i.e., 30 x 10 and 30 x 15. Similar results were reported by Chosh *et al.* and Yilamaz[22].

El-Far and Ramadan[9] found that the widest space hills of 30 cm gave the highest number of pods/plant, weight of pods/plant, while hill spaced at 20 cm recorded the heaviest 100- pod and their seed yet, plants of hills spaced at 25 cm recorded the highest shelling % followed by those in hills spaced at 20 cm. These results are in agreement with those obtained by Hussien *et al.*.

Yasein[21] found that wide spacing of 25 cm between hills produced the tollest plants, the highest number of pods/plant, weight of pods and seeds/plant and shelling %, highest seed oil % and oil yiel/fad. While the highest values of 100-seed weight and pod and seed yield /fad were achived by mid or

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low space (15 and 20 cm). These results are in agreement with those obtained by ELShahat[10], Saleh *et al*.[17], Ali *et al*.[4] Ash-Sharmillesy Salwa and Abd El-Hameed[7].

This study aims at determining the optimum row width and hill spaces for the other types erect and semi erect peanut cultivars.

MATERIALS AND METHODS

Two field experiments were conducted out extention field out at Salheia Fakous District, Sharkia Governorate during the two successive seasons 2006 and 2007 in a sandy soil. The study aimed to investigate the resopnse of peanut ciultivars to row width and hill spaces.

Two peanut cultivars were tested i.e. Giza 4 semispreading cvs and Giza 5 erect cvs. Three row widths were investigated 40, 50 and 60 cm between rows.Also, four hill spaces were choeson: 10, 15, 20 and 25 cm between hills.

Asplit-split plot design with four replicates was used, the main plots were devoyed to peanut cultivars, while the subplots were assigned to row width and hill spaces were located in the sub-sub plots.

Peanut cultivars were planted in rows, with one plant per hill on May 15th and 20th in the first and second seasons, respectively. Irrigation was practiced according soil tescuval class and climatic conditions. The soil of the experimentas was sandy textured with 7.6 ph, having mg kg-1 0.36, 2.57 and 2.57 and 0.19.6 available N, P and K, respectively

NPK fertilizers were applied as recommended i.e. at a rate of 30, 45 and 48 kg /fad. Gypsum was applied at rate of 500 kg /fad during soil preparation. The proceding crop was wheat in the two seasons. All recommended agricultural practices were adopted throughout both growing seasons.

Data Recorded: At harvest, the following characters were recorded on ten graded plants taken randomly from the third row of each plot in both seasons.

- Plant height cm.
- Number of branches/plant.
- Number of pods/plant.
- 100- Pods weight (gm).
- 100- Seed weight (gm)
- Pod yield gm /plant.
- Shelling %

In addition, the middle two rows were harvested from each plot and the following characters were recorded:Pod yield (kg/fad). 2-Seed yield (kg/fad) 3-Biological yield (ton/fad).

Dried mature seeds were ground into very fine powered to determine oil percentage using Soxhelt method with dietheyl ether as a solvent, while crude protein percentage was determined by the micro-Kjeldahl method. Chemical analysis procedures used were followed as described by A.O.A.C.[5].

Analysis of variance for the two seasons and combined analysis were carried out as described by Snedecor and Cochran[20]. The differences among treatments were compared using Duncan's Multiple Range Test Duncan[8]. In the interaction tables, capital and small letters were used to compare between means in row and colums, respectively. The combine analysis of variance of the two seasons was used to calculate the simple correlation coefficient as described by Svab.

RESULTS AND DISCUSSION

Effects of row width and hill spacing on growth, yield attributes and seed yield of two peanut cultivars were presented in Tables (1- 4).

Cultivars Varital Differences: The two cultivars showed significant variation in most of the studied characters. The combined analysis showed that Giza 5 cv. plant was taller than Giza 4 cv., had more pod number/plant, heavier pod weight, lighter seeds and less pod yield/plant than Giza 4 cultivar. Giza 5 cv was superior in shelling %. The superiority of Giza 4 in its pod and seed weight caused its superiority in its pod yield /plant. Shelling % of Giza 5 cultivar was better and caused no significant difference from Giza 4 cultivar in seed yield/plant. The same picture was seen in pod yield and seed yield/fad , also, both cultivars did not differ in foliage yield and protein % but Giza 5 cultivar had higher oil % than Giza 4 cultivar. The same results were obtained by Abd El Motaleb and Yousef[2], Sarhan[19], Rehap Abd El-Kareem[16], Maha Abd-Alla[13], Ash –shormillesy, Salwa and Abd El-Hameed[7].

Effect of Row Width: Plant height was affected by variation in row width. Increasing row width from 40 to 50 than to 60 cm caused increases in number of pods /plant, 100- pod weight, 100-seed weight consequently reflrcted on both pod and seeds yields per plant. These increases in yield attributes could not compensate for the reduction in number of plants per unit area resulted in increases in both pod and seed yields/fad. Increasing row width caused significant reduction in both yields. These results are harmony with those reported by Abdel-Aal *et al*.[1], Jadhao *et al*.[12], Chosh *et al*., Yilmaz[22] and Sarhan[19].

On the other hand increasing row width caused the shelling % to go up. Also, both protein % and oil %

Table 1: Plant height, number of branches /plant and number of pods/plant of two peanut cultivars as influenced by row width and hill spacing in the two seasons and combined.

Treatments	Plant height (cm)			Number of branches/ plant			Number of pods/ plant		
	First season	Second season	Comb.	First season	Second season	Comb.	First season	Second season	Comb.
Peanut cultivars (cvs):									
Giza 4 cv_1	35.54[b]	36.16[b]	35.85[b]	16.95[b]	18.80[a]	17.88	17.33[b]	18.52[b]	18.02[b]
Giza 5 cv_2	37.36[a]	37.34[a]	37.35[a]	18.29[a]	18.13[b]	18.21	18.51[a]	19.31[a]	18.90[a]
F –Test	**	0	**	**	0	NS	0	**	**
Row width (Rw, cm):									
40 cm (Rw_1)	35.32[c]	36.29	35.80[c]	17.18[c]	18.26	17.72	16.45[c]	17.55[b]	17.00[c]
50 cm (Rw_2)	36.85[b]	36.61	36.73[b]	17.64[b]	18.68	18.16	18.06[b]	19.60[a]	18.83[b]
60 cm (Rw_3)	37.19[a]	37.39	37.29[a]	18.06[a]	18.48	18.27	19.53[a]	19.75[a]	19.64[a]
F-Test	**	NS	**	**	NS	NS	**	**	**
Hill spaces (Hs, cm):									
10 cm (Hs_1)	31.50[c]	32.92[c]	32.21[c]	16.03[d]	15.84[c]	15.94[c]	13.82[c]	15.37[c]	14.59[c]
15 cm (Hs_2)	35.15[b]	36.11[b]	35.63[b]	17.44[c]	17.97[b]	17.70[b]	17.93[b]	19.51[b]	18.22[b]
20 cm (Hs_3)	39.26[a]	38.90[a]	39.08[a]	19.26[b]	19.78[a]	19.02[a]	19.89[a]	20.52[a]	20.21[a]
25 cm (Hs_4)	39.89[a]	39.12[a]	39.51[a]	39.51[a]	20.29[a]	19.52[a]	20.41[a]	21.47[a]	20.94[a]
F –Test	**	**	**	**	**	**	**	**	**
Interactions:									
Cv x Rw	0	NS	NS	0	NS	NS	NS	**	NS
Cv x Hs	NS	NS	NS	NS	NS	NS	**	0	0
RWx Hs	NS	NS	NS	NS	NS	NS	**	0	0

Table 2: 100-pods weight "gm", 100 seed weight "gm" and pod yield gm/plant of two peanut cultivars as influenced by row width and hill spacing in the two seasons and combined.

Treatments	100- pods weight "gm"			100 seed weight "gm"			Pod yield gm /plant		
	First season	Second season	Comb.	First season	Second season	Comb.	First season	Second season	Comb.
Peanut cultivars (cvs):									
Giza 4 cv_1	161.17	146.27[b]	153.72[b]	99.12[a]	85.64[b]	92.38[a]	18.06[a]	17.23	17.64[a]
Giza 5 cv2	163.12	149.60[a]	156.45[a]	93.61[b]	87.51[a]	90.61[b]	13.57[b]	17.62	15.57[b]
F –Test	NS	**	**	**	**	0	**	NS	**
Row width(Rw, cm):									
40 cm (Rw_1)	159.30[c]	147.49	153.40[b]	94.37[c]	83.46[b]	88.92[b]	14.82[c]	16.19[c]	15.50[c]
50 cm (Rw_2)	161.90[b]	149.26	155.58[a]	96.68[b]	88.06[a]	92.37[a]	15.99[b]	17.80[c]	16.90[b]
60 cm (Rw_3)	165.33[a]	147.56	156.39[a]	98.04[a]	88.43[a]	93.23[a]	16.62[a]	18.41[a]	17.51[a]
F-Test	**	NS	0	**	0	**	**	**	**
Hill spaces (Hs, cm):									
10 cm (Hs_1)	154.02[c]	138.49c	146.26[c]	89.12[c]	81.95[c]	85.53[c]	13.27[c]	14.00[d]	13.63[c]
15 cm (Hs_2)	161.43[b]	146.32[b]	153.87[b]	95.91[b]	85.77[b]	90.84[b]	15.63[b]	17.03[c]	16.34[b]
20 cm (Hs_3)	166.36[a]	152.53[a]	159.44[a]	100.32[a]	89.31[a]	94.81[a]	17.08[a]	18.93[b]	18.58[a]
25 cm (Hs_4)	166.77[a]	155.06[a]	160.92[a]	100.12[a]	89.57[a]	94.84[a]	17.26[a]	19.91[a]	18.58[a]
F –Test	**	**	**	**	**	**	**	**	**
Interactions:									
Cv x Rw	NS	**	NS	NS	NS	NS	NS	NS	NS
Cv x Hs	NS	NS	NS	**	NS	0	NS	**	NS
RWx Hs	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 3: Shelling Percentage, pod yield "kg/faddan and seed yield kg /fadden of two peanut cultivars as influenced by row width and hill spacing in the two seasons and combined.

Treatments	Seed yield "gm"/plant			Pod yield "kg"/faddan			Seed yield" kg" /fadden		
	First season	Second season	Comb.	First season	Second season	Comb.	First season	Second season	Comb.
Peanut cultivars (cvs):									
Giza 4 cv_1	48.93^{b}	49.56^{b}	49.25^{b}	1114.91^{a}	1092.36	1103.63^{a}	543.40a	540.16^{b}	541.78
Giza 5 cv2	50.25^{a}	50.96^{a}	50.60^{a}	1048.56^{b}	1105.92	1076.78^{b}	526.29^{b}	562.34^{a}	544.21
F –Test	**	**	**	**	NS	0	**	**	NS
Row width(Rw, cm):									
40 cm (Rw_1)	47.11^{b}	49.75^{c}	49.43^{c}	1149.31^{a}	1195.20^{a}	1172.26^{a}	564.32^{a}	593.50^{a}	578.91^{a}
50 cm (Rw_2)	49.57^{a}	50.29^{b}	49.93^{b}	1080.61^{a}	1097.45^{b}	1089.03^{b}	533.55^{b}	550.80^{b}	542.17^{b}
60 cm (Rw_3)	50.10^{a}	50.75^{a}	50.43^{a}	1015.28^{c}	999.40^{c}	1007.34^{c}	507.14^{c}	507.01^{c}	507.07^{c}
F-Test	**	**	**	**	**	0	**	**	**
Hill spaces (Hs, cm):									
10 cm (Hs_1)	46.63^{d}	47.69^{d}	47.16^{d}	1178.02^{a}	1173.89^{a}	1175.96^{a}	549.00^{a}	559.49^{a}	554.24^{a}
15 cm (Hs_2)	48.93^{c}	50.00^{c}	49.47^{c}	1137.46^{b}	1115.41^{b}	1126.44^{b}	558.15^{a}	557.15^{a}	557.65^{a}
20 cm (Hs_3)	50.95^{b}	51.52^{b}	51.23^{b}	1026.96^{d}	1067.76^{c}	1047.36^{c}	522.61^{b}	549.88^{ab}	536.24^{b}
25 cm (Hs_4)	51.87^{a}	51.86^{a}	51.86^{a}	984.49^{d}	1032.33^{d}	1008.41^{d}	510.24^{b}	535.23^{b}	522.73^{c}
F –Test	**	**	**	**	**	**	**	0	**
Interactions:									
Cv x Rw	NS	NS	NS	**	NS	0	**	NS	**
Cv x Hs	0	**	**	NS	NS	NS	NS	NS	NS
RWx Hs	NS	**	**	**	NS	0	**	NS	**

Table 4: Foliage yield ton/faddan, protein % in seeds and oil % in seeds of two peanut cultivars as influenced by row width and hill spacing in the two seasons and combined.

Treatments	Foliage yield ton/fadden			Protein % in seeds			Oil % in seeds		
	First season	Second season	Comb.	First season	Second season	Comb.	First season	Second season	Comb.
Peanut cultivars (cvs):									
Giza 4 cv_1	6.887^{a}	6.657	6.772	24.39	24.27	24.34	27.21^{b}	47.54^{b}	47.37^{b}
Giza 5 cv_2	6.565^{b}	6.691	6.627	24.27	24.52	24.39	49.99^{a}	50.34^{a}	50.16^{a}
F –Test	**	NS	NS	NS	NS	NS	**	**	**
Row width(Rw, cm):									
40 cm (Rw_1)	7.003^{a}	6.415^{b}	6.710	23.95^{b}	24.03^{b}	23.98^{b}	48.25^{c}	48.25^{c}	48.26^{c}
50 cm (Rw_2)	6.697^{b}	6.803^{a}	6.750	24.45^{a}	24.66^{a}	24.55^{a}	48.22^{b}	49.05^{b}	48.64^{b}
60 cm (Rw_3)	6.478^{c}	6.847^{a}	6.663	24.58^{a}	24.56^{a}	24.57^{a}	49.33^{a}	49.53^{a}	49.43^{a}
F-Test	0	0	NS	0	0	0	0	0	**
Hill spaces (Hs, cm):									
10 cm (Hs_1)	6.026^{c}	5.943^{c}	5.985^{c}	23.79^{b}	23.82^{b}	23.80^{b}	47.78^{c}	47.75^{c}	47.76^{c}
15 cm (Hs_2)	6.464^{b}	6.619^{b}	6.541^{b}	24.28^{a}	24.39^{b}	24.33^{a}	48.25^{b}	48.69^{b}	48.47^{b}
20 cm (Hs_3)	7.163^{a}	7.067^{a}	7.115^{a}	24.62^{a}	24.66^{ab}	24.69^{a}	49.17^{a}	49.60^{a}	49.38^{a}
25 cm (Hs_4)	7.252^{a}	7.089^{a}	7.188^{a}	24.61^{a}	24.70^{a}	24.66^{a}	49.22^{a}	49.74^{a}	49.48^{a}
F –Test	**	**	**	0	0	0	**	**	**
Interactions:									
Cv x Rw	0	**	**	0	NS	NS	0	NS	0
Cv x Hs	NS	NS	NS	NS	NS	NS	NS	NS	NS
RWx Hs	NS	NS	NS	NS	NS	NS	NS	NS	NS

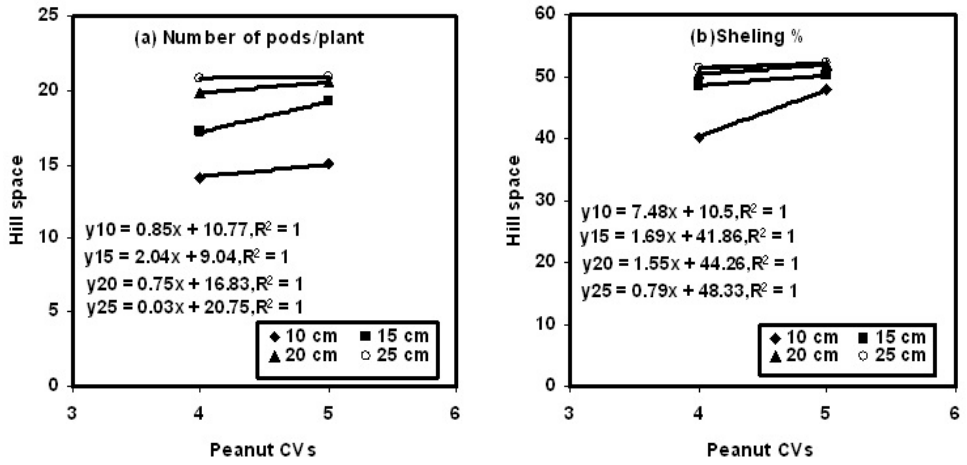

Fig. 1: Effect of interaction between peanut cultivars and hill spaces on number of pods/plant and shelling %.

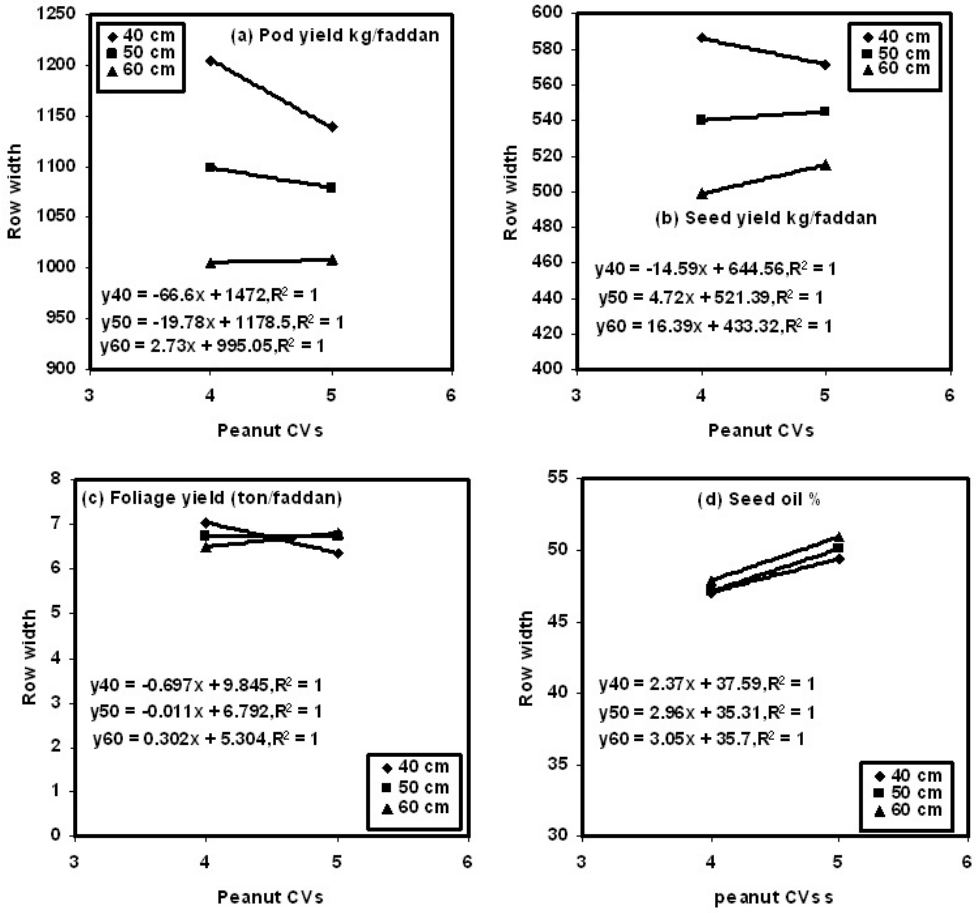

Fig. 2: Effect of interaction between peanut cultivars and row width on pod yield and seed yield/fad., foliage yield and seed oil%.

were higher under wider rows. This is expected since the individual plant grow better under wider rows. This may be due to crowding within rows of peanut caused severe competition for, soler radiation, nutrients and space for pegging mutual shadding also, reduced net photosynthetic activity which ultimately led to low kernel yield[14]. These results are in agreement with those obtained by Yalmaz[22] and Sarhan[19].

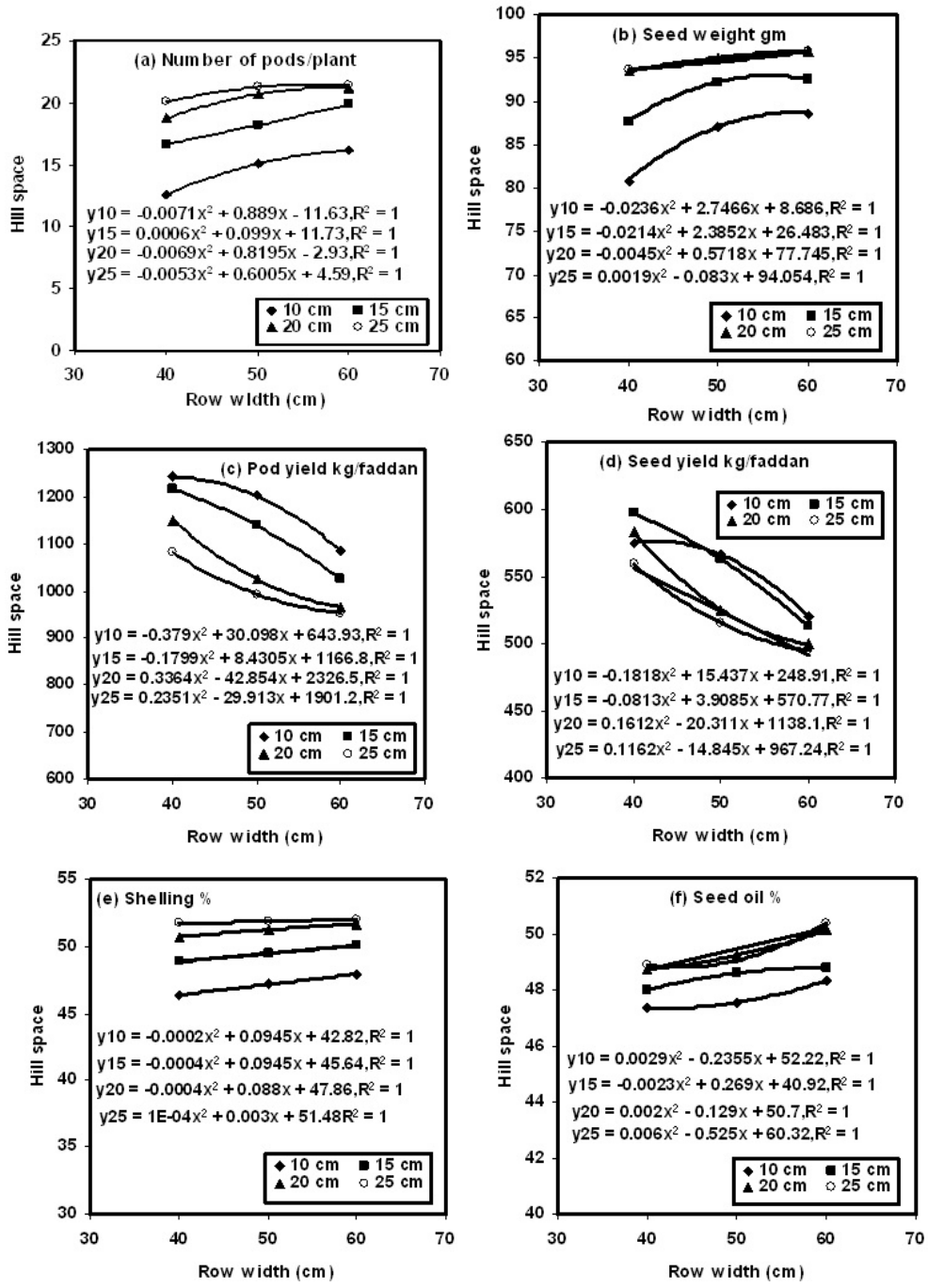

Fig. 3: Effect of interaction between hill space and row width on number of pods/plant, seed weight, pod yield and seed yield/fad., shelling% and seed oil %.

Effect of Hill Spacings: Giving the individual plant more space within the rows (from 10 to 20 cm) caused the superiority in most of the yield components. These superiorities could not conpensate for the reduction in number of plants in the single row. Pod and seed yields of the narrowest spacing (10 cm) went to decreasing as a result of increasing hill spacing from 10 to 15, to 20 and then to 25 cm between hills. Last, the individual plant under the wider spacing gave more shelling %, protein and oil percentages. Growing peanut plants at a narrow distance implies a uniform ramification of roots in the soil and consequently plants

Table 5: Number of pods/plant, seed yield kg/fadden and foliage yield ton/fadden as affected by the interaction between peanut cultivars and row width "combined data".

Row width	40 cm	50cm	60cm
Cultivars			
Giza4 cv_1		Number of pods/plant	
	A	B	C
	1205.55a	1099.37a	1005.97a
Giza5 cv_1	A	B	C
	1138.95b	1079.59b	1008.70a
Giza4 cv_1		Seed yield kg/fadden	
	A	B	C
	586.20a	540.27a	498.88b
Giza5 cv_1	A	B	C
	571.61b	544.99a	515.27a
Giza4 cv_1		foliage yield (ton/fadden)	
	A	B	B
	7.057a	6.748a	6.512b
Giza5 cv_1	B	A	A
	6.360b	6.737a	6.814a

Table 6: Number of pods/plant and shelling % as affected by the interaction between peanut cultivars and row width "combined data".

Hill spaces	10 cm	15cm	20cm	25cm
Cultivars				
Giza4 cv_1		Number of pods/plant		
	D	C	B	A
	14.17b	17.20b	19.83b	20.87a
Giza5 cv_1	C	B	A	A
	15.02a	19.24a	20.58a	20.90a
Giza4 cv_1		Shelling %		
	D	C	B	A
	40.42b	48.62b	50.46b	51.49b
Giza5 cv_1	C	B	A	A
	47.90a	50.31a	52.01a	52.28a

are more efficient in utilizing environmental inputs. This explains the superiority of growing singular plants at wide distance between hills and rows than growing singular plants at narrow distance between hills and rows.

This results are in harmony with these results were reported by El-Far and Ramadan[9], El-Shahat[10], Saleh *et al.*[17], Ali *et al.*[4] and Yasein[21].

Effect of Interactions: Both cultivars differently reacted to changing row width. Pod and seed yield per fed were decreased when row width increased from 40 to 50 and then to 60 cm. Giza4 autyielded Giza5 under 40 and 50 cm row width only in pod yield and seed yield showed different trend. Under 40 cm Giza 4 cultivars was better than Giza5 and the letter performed better under the widest row width 60 cm indicating differential response of both cultivars to row width change. The interaction of peanut cultivars and row width on foliage yield. Can be shown in Tables (5 - 6) and figure (1-2). Giza4 cultivars outyielded Giza 5 in foliage yield under 40 or 50 cm row width. When the row width increased to 60 cm, both cultivars gave statistically similar foliage yields.

Table 7: Number of pods/plant, 100- seed weight (gm) and pods yield (kg)d/fad Seed yield kg/fad Shelling % Seed oil % as affected by the interaction between row width and hill spaces "combined data".

Hill spaces	10cm	15cm	20cm	25cm
Row width				
		Number of pods/plant		
40 cm	D	C	B	A
	12.57c	16.65c	18.73c	20.05b
50 cm	D	C	B	A
	15.07b	18.18b	20.67b	21.24a
60 cm	C	B	A	A
	16.15a	19.83a	21.22a	21.36a
		100- seed weight (gm)		
40 cm	C	B	A	A
	80.484c	87.667b	93.433c	93.726c
50 cm	D	C	A	B
	87.106b	92.268a	95.110b	94.579b
60 cm	C	B	A	A
	88.651a	92.591a	95.889a	95.806a
		Pods yiel (kg)d/fad		
40 cm	A	B	C	D
	1241.39a	1216.08a	1150.67a	1080.88a
50 cm	A	B	C	D
	1201.23b	1138.43b	1024.93b	993.34b
60 cm	A	B	C	C
	1085.26c	1024.79c	966.48c	952.82c
		Seed yield kg /fad		
40 cm	B	A	C	D
	575.57a	597.11a	583.53a	559.42a
50 cm	A	A	B	C
	566.36b	563.07b	525.50b	515.59b
60 cm	A	B	C	C
	520.80c	512.78c	499.71c	495.01c
		Shelling %		
40 cm	D	C	B	A
	46.36c	48.86b	50.74b	51.76a
50 cm	D	C	B	A
	47.17b	49.49a	51.26a	51.88a
60 cm	C	B	A	A
	47.95a	50.05a	51.70a	52.02a
		Seed oil %		
40 cm	C	B	A	A
	47.636b	48.00b	48.74c	48.92b
50 cm	C	B	A	A
	47.58b	48.62a	49.25b	49.07b
	48.35a			
60 cm		C	B	A
		48.78a	50.16a	50.42a

Both cultivars showed different variation to varing hill spacings in number of pods/plant. Giza 4 was affected positively to each change in hill spacing up to 25 cm but Giza 5 was affected positively too to only 20 cm. The supriority of Giza 5 was observed under different hill spacingd except with 25 cm; both cultivars gave similar pod numbers/plant. This was shown in Table (6).

The significant interaction effects of row width and hill spacings Data in Table (7) and figure (3) showed that the hill spaces 25 cm was superior than the hill spaces (10, 15 and 20 cm) under different row width on number of pods plant, 100-seed weight, shelling % and seed oil%, but nosignificant difference between 25

and 20 cm hill spaces under 60 cm row width on 100-seed weight. On the other hand, row width 60 cm was superior to the other row width under the different hill spaces on number of pods/ plant, 100-seed weight, shelling % and seed oil%. Pod and seed yields/faddan were highest under 10cm hill spaces and different row width compared with any hill spaces. On the other direction 40cm row width was superior to the other row width under any hill spaces on seed and pod yields/faddan.

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