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Effect of Row Direction and Plant Arrangement on Growth, Yield and Yield Componenets of Two Maize Cultivaes

M.F. Abd El-Maksoud

Plant Production Department, Efficient Productivity Institute, Zagazig Univ., Egypt.

Abstract: Two field experiments were carried out at Sheiba village, Zagazig District, Sharkia Governorate during 2005 and 2006 summer growing seasons to study the effect of row direction (two row direction i.e. East-West (E-W) and North-South (N-S)) and plant arrangement i.e. (50 x 35, 60 x 29.1 and 70 x 25 cm) on growth, yield and yield attributes of two maize hybrids (SC 10 and SC 30 k8) single crosses. Split-split plot design with four replicates was used. Results indicated that row direction North-south (N-S) produced the highest light interception % (LIP%) at different height compared with row direction East-west. The obtained results indicated that row direction at East-west (E-W) was superior than the other row direction at North-south (N-S) on plant height, ear leaf area, LAI, ear height, ear length, ear diameter, grain number/row and/ear, 100-grain weight, ear grain weight and grain yield/faddan. Results also showed that the plant arrangement of ((70 x 25 produced the highest (LIP at 150 cm height and grain yield/faddan followed by 60 x 29 and 50 x 35 the lowest grain yield/faddan on the other plant arrangement in the most characters under this study. The obtained results revealed that the tested maize hybrids varied significantly in plant height, ear leaf area, ear height, ear length, ear diameter, number of grains/row and /ear, 100 grain weight, ear grain weight and finally grain yield/faddan. The single cross 10 (SC10) surpassed than the other one (SC 30 K8).

Key words: Row direction, plant arrangement, growth, yield componenets, maize

INTRODUCTION

Stand density and distribution of plants during planting are the important factors affecting maize growth and yield. The good distribution and orientation of maize plants during sowing permit canopy to intercept more light and hence increase vegetative growth and grain yield. Maize grain yield could be increased by raising plant population density, hill spacing or row width, inter and intera-row spacing which play a great role in maize production. At low population, grain yield is limited by the number of plants per unit area. Talentino[28], reported that row orientation significantly influenced the interception and transmission of solar radiation. He found that the daily intercepted solar radiation was higher at north- south row direction at 53 days after sowing. Robinson[22] and Seif *et al*.[25] showed that north-south row direction recorded a significant higher seed index, grain weight/head, grain yield and stover yield of grain sorghum as compared with east-west direction. El-Murshedi[6] showed no advantages in grain yield due to sowing maize on east-west or north-south rows. However, north-south direction outyielded east-west one in stover yield. Abdrabou[2] found that maize plants grown from east-west direction had an increase in number of grain/row and grain yield/ faddan than those grown from north-south. Ismail[13] found that north-south row direction recorded a significant higher in plant height, number of grains /ear, grain weight/ear, grain yield/faddan and stover yield/faddan compared with east-west row directions, but no significant difference between the two row directions in ear length, ear diameter, number of rows/ear, number of grains/row, 100- grain weight and shelling percentage. Intra spacing and competition for water as well as light and nutrients determine optimum plant densities for each environment factors[14]. Tetio-Kagho and Gardnar[27] demonstrated that planting maize plant in equidistance distribution increased the efficiency of light utilization and hence encouraged the accumulation and translocation of metabolites to the developing yield components and to the yield. Ragheb *et al*.[23] found that planting maize at rate of 2400 plants/faddan

Corresponding Author: M.F. Abd El-Maksoud, Plant Production Department, Efficient Productivity Institute, Zagazig Univ., Egypt.

(60 x 30 or 70 x 25 cm) produced the highest grain yield in this respect. Sarhan[24] under agroforstry system, found that the planting arrangement of maize planting 40 x 75 was superior than 40 x 37.5, 20 x 75 and 30 x 75 in the yield component characters i.e. ear length, grain number /ear, ear grain weight, 100- grain weight and shelling % but the highest grain yield/faddan was recorded by planting arrangement 30 x 75 cm. Abdel-Aal *et al*.[1] found that growing maize plants in 60 x 40 system gave high ear length, number of rows/ear, number of grains/ row, ear weight, 100- grain weight, shelling % and grain yield/plant. On the other contrary, the highest significant values for grain yield/faddan was obtained by sowing maize plants in quadratic distribution 40x 40 system compared the other systems, 60 x40 and 60 x 30. Ibrahim and Abd El-Maksoud[12] found that growth and productivity of the single plant were favoured with wider planting 40 cm. Also, yield components were followed the same trend while the grain yield/faddan was superior under narrow hill spacing 20 cm with 70 cm row width. El-Murshedy and Abuldahab[8] reported that increasing the hill spacing 20 to 30 cm with row width 70 cm increased yield component of maize yield but grain yield/ faddan was decreased.

It is well known that maize varieties differ in their yielding abilities depending on the genetic make up and its interaction with the environmental conditions. Many workers found significant differences among the tested varieties. El-Metwally *et al*.[7], Oraby and Sarhan[18], Ahmed and El-Shiekh[3], Oraby *et al*.[19], Mowafy[17] and Oraby *et al*.[20].

MATERIALS AND METHODS

Two field experiments were conducted at Sheiba village, Zagazig district, Sharkia Governorate, during summer growing seasons in 2005 and 2006 to study the effect of row direction and plant arrangement of two maize hybrids.
The studied factors were:

Row directions (D):

- The rows were directed from East to West (E-W).
- The rows were directed from North to South (N-S).

Plant arrangements (P):

- The ridges were 0.5 m in width and 35 cm between hills (P_1).
- The ridges were 0.6 m in width and 29.1 cm between hills (P_2).
- The ridges were 0.7 m in width and 25 cm between hills (P_3).

Maize hybrids (H):

- Single cross 10 (SC10).
- Single cross 30K8 (SC30K8).

A split-split plot design with four replicates was used. Row directions were arranged in the main plots whereas, plants arrangements were assigned at random in the sub-plots, while maize hybrids were randomly distributed in the sub-sub plots. The sub-sub plots constituted of 6 ridges which were 4m long.

The preceding crop was Egyptian clover, the soil of experimental field was clay in texture. Super phosphate (15.5 %P_2O_5) at the rate of 100 kg /fad was applied before sowing. Nitrogen as urea (46 %N) at the rate of 100 kg/fad was added in three equal doses after 18, 30 and 42 days after sowing. Maize was sown on May 21st. After complete emergence (17 days after sowing)in the both seasons, the crop was thinned to one plant per hill. Planting density in all plant arrangements was 24000 plants/fad because all the plant arrangement treatment gave 1750 cm land area for each plant. The other agronomic practices were followed as recommended in the region.

Recorded Data: The two outer ridges (1st and 6th) were left as borders. The second two inner ridges were used for recording growth characters and to determination yield attributes.

Light Interception Percentage (LIP): After 80 days from sowing, light intensity was estimated by using a Luxmeter apparatus as according to the method of Williams *et al*.[29], between 1100 and 1330 hr according to Leach *et al*.[16]. Whereas, LIP was calculated according to the following formula used by Tetio-kagho and Gardnar[27] as follows:

- LIP = (Ia- Ig /Ia) x 100.

Where Ia and Ig are the irradiation above plants and at ground or above 50, 100 and 150 cm soil surface.

Growth Characters: After 75 days from sowing, plant height (cm), ear height (cm), ear leaf area (cm^2) and leaf area index (LAI) were measured using five guarded plants from each sub-sub plot.

Grain Yield and its Attributes: At harvest, ten guarded plants were taken from the 2nd two inner

ridges of each sub-sub plots, then ear length (cm), ear diameter (cm), number of rows/ear, number of grains per both row and ear, number of ears/plant, 100-grain weight (g), grain weight per ear (g) and shelling percentage were recorded. Plants of the central two ridges were used to determine grain yield (ardab/fad), which was the adjusted at 15.5 % moisture content.

Statistical Analysis: The obtained data were subjected to the proper statistical analysis according to Snedecor and Cochran[26]. For comparison of means, Duncan's multiple range test was used[4].

RESULTS AND DISCUSSION

Data presented in Tables (1 - 6) show the effects of row direction (D) and planting arrangement (P) on light interception % as well as growth, yield attributes and grain yield of two maize hybrids.

Light Interception %: Light interception % measured at different depths of the canopy was affected by row direction. Ridging the land in east-west direction (E-W) caused more light to penetrate allow in the canopy than north-south (N-S). This was observed from ground level (00 cm) up to 120 cm height. Planting arrangement also exercised significant effect on light interception %. Planting maize in rectangle pattern (70 x 25 cm) allowed more light penetration at 100 cm depth than square type (50 x 35 cm). The two hybrids were similar except at 150 cm height where SC 30 K8 (H_2) intercepted less light than SC 10 (H_1). The importance of studying the agronomic factor which affect light interception % for a C4 crop like maize can not be neglected because the more light energy deep in the canopy, the more photosynthesis activities leading to more production. This results are in agreement with those obtained by Duncan[5], Goldsworthy[10], Robinson[22], Talentino[28], Leach *et al*.[16], Tetio-Kagho and Gardnar[27], Ottman and Welch[21], Fernando, *et al*.[9], Ibrahim and Abd El Maksoud[12].

Growth: AS seen the east-west direction allowed more light deep in the canopy leading to more growth of the C4 maize plants. This was reflected in plant height, ear leaf area, leaf area per plant, leaf area index and ear height. The differences were significant. Likewise, as seen the rectangle pattern in planting the crop favoured more growth than the near square type (50 x 35 cm). This effect was clear on leaf area/plant and leaf area index. In Similar way, SC 30 K8 hybrid was better than SC 10 in allowing light to penetrate which had significant effect on growth parameters presented in Tables 3 and 4. It is worth here to mention that all the treatments of row directions and planting arrangement of the two maize hybrids did not cause the leaf area index to fall below the optimum value for maize crop which ranged from 6 to 8. Similar results were reported by Seif *et al*.[25], El;-Murshedi[6], Ragheb *et al*.[23], Sarhan[24], Ismail[13], Khalil *et al*.[15], Hasssan[11], El-Mursheady and Abuldahab[8], Ahmed and El-Shiekh[3], Mowafy[17], Oraby *et al*.[20].

Yield and its Attributes: As mentioned before, the E-W row direction allowed more light to penetrate through the canopy of the C4 maize plants resulted in better growth and leading to higher grain yield and some of its components. Among these components which were affected positively by row direction ear length and diameter, number of grain per row and ear, ear grain weight, 100-grain weight and finally the grain yield was increased by 7.7 (%) although nane of the yield components was affected significantly by planting arrangement, yet the grain yield was affected significantly. The more rectangle arrangement (70 x 25 cm) caused higher grain yield than the other two arrangements. The same trend were found by the Leach *et al*.[16], Seif[25], El-Murshedi[6], Abdrobu[2], Ismail[13], Abdel Aal *et al*.[1], Ibrahim and Khalil *et al*.[15], Fernando, *et al*.[9], El-Metwally *et al*.[7] Ahmed and El-Shiekh[3]. The hybrid SC 10 outyielded the SC 30 K8. It produced longer and thicker ears, grain number/row and per ear and heavier grains. These variation may be explained on the light of different genetical make up. Many workers found significant differences among the tested maize varieties. Hassan[11], El-Metwally *et al*.[7], Oraby and Sarhan[18], Ahmed and El-Sheikh[3] Oraby *et al*.[19] and Mowafy[17] and Oraby *et al*.[20].

Effect of Interaction: Data in Table (7) show a significant effect of the interaction between row direction and plant arrangement on ear leaf area, ear grain weight, 100-grain weight and grain yield/faddan. And ear leaf area was significantly inreased by widing the row space and narrowing plant space (rectangle shape) when the rows oriented east-west. While, this trait took the oppsite trend under row orientation north- south. Under plant arrangement of 50 x 35 cm ear leaf area was larger by north-south orientation than that by east-west direction. Whereas, under the two other row orientations this trait took the opposite trend. The heaviest ear grains was recorded by plant arrangement of 70 x 25 cm, but the lighest ear grains was observed by 60 x 29.1 cm under east-west orientation. However, heavier ear grains was founded by 50 x 35 and 60 x 29.1 cm plant arrangement under

Table 1: Effect of row direction, plant arrangement and maize hybrid on light interception (%) at different heights 00.00, 50, 100 and 150 cm in the two season and their combined.

Treatments	00.00			50.00			100.00			150.00		
	First	Second	Comb.	First	Second	Comb.	First	Second	Comb.	First	Second	Comb.
						Row direction (D):						
East-west(E-W)	92.57b	93.77b	93.17b	90.70b	90.48b	90.59b	76.74b	86.84b	81.79b	57.58b	75.24a	66.41b
North-south (N-S)	95.84a	95.27a	95.55a	93.65a	94.53a	94.09a	83.29a	90.20a	86.75a	68.96a	74.07b	71.52a
F-test	**	*		**	**	**	**	**	**	**	*	*
						Plant arrangement (P):						
50 x 35 cm (P_1)	93.94	94.40ab	94.17ab	92.39a	92.17	92.28	81.41a	89.13a	85.27a	58.33	73.56b	65.99b
60 x 29 cm (P_2)	93.74	92.96b	93.35b	91.34b	92.70	92.02	81.68a	89.52a	85.60a	66.19	73.45b	69.82a
70 x 25 cm (P_3)	94.94	96.19a	95.56a	92.78a	92.66	92.72	76.95b	86.92b	81.94b	65.18	76.96a	71.07a
F-test	N.S.	*	*	*	N.S.	N.S.	**	**	*	N.S.	*	*
						Maize hybrid (H):						
SC10 (H_1)	93.86	93.86	93.86	91.94	92.87	92.40	79.71	88.84	84.28	65.43a	74.71	70.07a
SC30 K8(h_2)	94.55	95.18	94.86	92.41	92.15	92.28	80.32	88.21	84.26	61.10	74.60	67.85b
F-test	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	*	N.S.	*
						Interactions:						
D x P	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	**	N.S.	N.S.	*
D x H	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
P x H	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	0	N.S.	0	0	N.S.	N. S.

Table 2: Effect of row direction, plant arrangement and maize hybrid on plant height (cm), ear leaf area (cm^2) and leaf area (dc^2) in the two season and their combined.

Treatments	Plant height cm			Ear leaf area (cm^2)			Leaf area /plant (dc^2)		
	First	Second	Comb.	First	Second	Comb.	First	Second	Comb.
					Row direction (D):				
East-west(E-W)	370.3a	369.4a	369.85a	851.7a	830.887a	841.28a	121.74	112.56	117.15a
North-south (N-S)	365.8b	356.69b	361.26b	829.5b	788.46b	808.79b	119.33	109.13	114.23b
F-test	*	*	**	**	**	**	N.S.	N.S.	*
					Plant arrangement (P):				
50 x 35 cm (P_1)	369.30	373.35b	371.33a	796.40b	836.61a	816.49	118.53b	110.51ab	114.52b
60 x 29 cm (P_2)	366.70	352.37c	354.52c	862.70a	799.14b	830.94	123.17a	114.41a	118.79a
70 x 25 cm (P_3)	368.20	362.42a	365.81b	862.10a	793.27b	827.69	119.93b	107.63b	113.78b
F-test	N.S.	*	**	**	**	N.S.	*	*	*
					Maize hybrid (H):				
SC10 (H_1)	374.70a	369.98a	372.35a	815.80b	814.11	814.94	120.46	112.32	116.39
SC30 K8(h_2)	361.40b	356.11b	358.76b	865.00a	805.24	835.14	120.60	109.38	114.99
F-test	**	*	*	*	N.S.	N.S.	N.S.	N.S.	N.S.
					Interactions:				
D x P	*	**	**	*	**	*	N.S.	N.S.	**
D x H	**	**	**	N.S.	**	N.S.	N.S.	N.S.	N.S.
P x H	*	N.S.	**	N.S.	**	N.S.	N.S.	N.S.	N.S.

Table 3: Effect of row direction, plant arrangement and maize hybrid on leaf area index plant height (cm), ear height (cm) and ear leaf area (cm^2) in the two season and their combined.

Treatments	Leaf area index (LAI)			Ear height cm			Ear length (cm)		
	First	Second	Comb.	First	Second	Comb.	First	Second	Comb.
Row direction (D):									
East-west(E-W)	6.956a	6.437	6.696a	188.10a	186.8a	187.44a	19.82a	20.75a	20.28a
North-south (N-S)	6.819b	6.236	6.527b	180.50b	179.78b	180.14b	19.04b	18.79b	18.92b
F-test	*	N.S.	*	**	**	**	**	**	**
Plant arrangement (P):									
50 x 35 cm (P_1)	6.772b	6.310ab	6.543b	180.50b	180.26b	180.40b	19.25	19.70	19.48
60 x 29 cm (P_2)	7.038a	6.530a	6.786a	186.00a	181.58b	183.79ab	19.58	19.59	19.59
70 x 25 cm (P_3)	6.852b	6.160b	6.507b	186.30a	188.03a	187.18a	19.46	20.01	19.74
F-test	*	*	**	*	**	**	N.S.	N.S.	N.S.
Maize hybrid (H):									
SC10 (H_1)	6.884	6.420	6.649	189.30a	187.49a	188.41a	19.96a	20.46a	20.21a
SC30 K8(h_2)	6.891	6.260	6.574	179.30b	179.09b	179.17b	18.90b	19.80b	18.99b
F-test	N.S.	N.S.	N.S.	**	**	**	*	*	**
Interactions:									
D x P	**	N.S.	**	*	*	**	*	*	**
D x H	**	N.S.	N.S.	**	N.S.	**	**	*	**
P x H	**	N.S.	*	N.S.	N.S.	N.S.	*	*	**

Table 4: Effect of row direction, plant arrangement and maize hybrid on ear diameter (cm), number of ears/plant and number of rows/ear) in the two season and their combined.

Treatments	Ear diameter (cm)			Number of ears/plant			Number of rows/ear		
	First	Second	Comb.	First	Second	Comb.	First	Second	Comb.
Row direction (D):									
East-west(E-W)	3.966a	3.944a	3.955a	1.583	1.597	1.590	13.31	13.25	13.28
North-south (N-S)	3.837b	3.767b	3.802b	1.500	1.528	1.514	13.17	13.31	13.24
F-test	**	**	**	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
Plant arrangement (P):									
50 x 35 cm (P_1)	3.889	3.850	3.870	1.563	1.604	1.583	13.35	13.21	13.28
60 x 29 cm (P_2)	3.898	3..650	3.869	1.458	1.542	1.500	13.33	13.39	13.36
70 x 25 cm (P_3)	3.917	3.876	3.897	1.604	1.542	1.573	13.02	13.23	13.13
F-test	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
Maize hybrid (H):									
SC10 (H_1)	3.846b	3.822	3.834b	1.569a	1.625	1.597	13.07b	13.23	13.15
SC30 K8(h_2)	3.957a	3.889	3.923a	1.514b	1.500	1.507	13.40a	13.32	13.61
F-test	*	N.S.	*	*	N.S.	N.S.	0	N.S.	N.S.
Interactions:									
D x P	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
D x H	*	N.S.	*	N.S.	**	N.S.	**	**	**
P x H	N.S.	N.S.	N.S.	*	*	**	*	**	**

Table 5: Effect of row direction, plant arrangement and maize hybrid on number of grains/row, number of grains/ear and shelling (%) in the two season and their combined.

Treatments	Number of grains/row			Number of grains/ear			Shelling %		
	First	Second	Comb.	First	Second	Comb.	First	Second	Comb.
Row direction (D):									
East-west(E-W)	46.32a	48.79a	47.55a	614.00a	664.78a	639.40a	86.38	86.79	86.57
North-south (N-S)	44.27b	43.44b	43.86b	582.60b	578.20b	580.35b	86.33	86.49	86.41
F-test	**	**	**	**	**	**	N.S.	N.S.	N.S.
Plant arrangement (P):									
50 x 35 cm (P_1)	44.80	46.83	45.83	597.10	648.52	622.80	85.96	86.55	86.25
60 x 29 cm (P_2)	45.26	45.55	45.41	600.80	607.95	604.38	86.3.9	86.46	86.42
70 x 25 cm (P_3)	45.82	45.92	45.88	597.00	607.87	602.44	86.72	86.86	86.79
F-test	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
Maize hybrid (H):									
SC10 (H_1)	46.41a	47.93a	47.17a	605.50	637.27	621.38a	86.23	86.61	86.42
SC30 K8(h_2)	44.18b	44.31b	44.25b	591.10	605.63	598.36b	86.47	86.64	86.58
F-test	**	**	**	N.S.	N.S.	0	N.S.	N.S.	N.S.
Interactions:									
D x P	0	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
D x H	**	0	0	N.S.	N.S.	N.S.	**	N.S.	**
P x H	**	N.S.	N.S.	**	N.S.	*	*	N.S.	*

Table 6: Effect of row direction, plant arrangement and maize hybrid on 100-grain weight, ear grain weight and grain yield (ardab/ faddan) in the two season and their combined.

Treatments	100-grain weight			Ear grain weight (g)			Grain yield (ardab/ faddan)		
	First	Second	Comb.	First	Second	Comb.	First	Second	Comb.
Row direction (D):									
East-west(E-W)	31.05	31.69a	31.36a	190.81a	202.85a	196.83a	28.19a	28.32a	28.26a
North-south (N-S)	30.76	30.63b	30.69b	179.38b	177.82b	178.60b	26.21b	26.28b	26.24b
F-test	N.S.	*	*	**	**	**	**	**	**
Plant arrangement (P):									
50 x 35 cm (P_1)	30.70	30.62b	30.66b	183.43	194.09	188.76	26.22c	26.19b	26.20c
60 x 29 cm (P_2)	30.73	31.31a	31.02a	185.15	187.81	186.48	27.34b	27.45ab	27.39b
70 x 25 cm (P_3)	31.27	31.51a	31.40a	186.71	189.11	187.91	28.04a	28.28a	28.16a
F-test	N.S.	*	*	N.S.	N.S.	N.S.	**	**	**
Maize hybrid (H):									
SC10 (H_1)	31.28	31.42a	31.35a	189.16a	197.52a	193.34a	27.76a	27.92a	27.84a
SC30 K8(h_2)	30.52	30.89b	30.70b	181.05b	183.15b	182.10b	26.64b	26.69b	26.66b
F-test	N.S.	*	*	*	**	**	**	*	**
Interactions:									
D x P	N.S.	*	*	*	*	*	**	**	**
D x H	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
P x H	N.S.	0	0	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

Table 7: Interaction effect between row direction and plant arrangement on ear leaf area, ear grain weight, 100- grain weight and grain yield ardab/faddan (combined data).

Plant arragement	Ear leaf area (cm2)			Ear grain weight (g)			100grai weight (g)			Grain yield (ardab/fad)		
	P1	P2	P3	P1	P2	P3	P1	P2	P3	P1	P2	P3
East-west	C	B	A	B	C	A	B	C	A	B	C	A
	840.38b	851.9a	868.38a	197.72a	190.40a	202.38a	31.49a	30.42b	32.16a	28.506a	27.225b	29.038a
North-south	A	B	C	A	A	B	C	A	B	C	A	B
	828.60a	810.78b	786.99b	179.81b	182.57a	173.44b	29.84b	31.61a	30.63b	23.903b	27.555a	27.273b

Table 8: Interaction effect between row direction and maize hybrids on LAI, number of grains /row, shelling percentage and grain yield (ardab/faddan) (combined data).

Maize hybrid	LAI		Number of grains /row		Shelling percentage		Grain yield (ardab/fad)	
	H_1	H_2	H_1	H_2	H_1	H_2	H_1	H_2
East-west	A	B	A	B	B	A	A	B
	6.82a	6.57a	50.37a	44.73a	85.76b	87.38a	28.604a	27.909a
North-south	B	A	A	B	A	B	A	B
	6.48b	6.58a	43.96b	43.76b	87.08a	85.74b	27.068b	25.420b

Table 9: Interaction effect between plant arrangement and maize hybrids on number of grains /ear, 100grain weight, shelling percentage and grain yield (ardab/faddan) (combined data).

Maize hybrid	Number of grains /ear		100 Gain weight (g)		Shelling percentage		Grain yield (ardab/fad)	
	H_1	H_2	H_1	H_2	H_1	H_2	H_1	H_2
P1	A	B	A	B	B	A	A	B
	629.18a	616.41a	31.024b	30.302b	85.91b	86.59b	26.758c	25.651c
P2	A	A	A	B	B	A	A	B
	602.63b	606.14a	32.048a	29.987c	85.90b	86.95a	27.628b	27.152b
P3	A	B	B	A	A	B	A	B
	632.35a	572.53b	30.969c	31.823a	87.46a	86.13v	29.122a	27.190a

north-south row direction. Under 50 x 35 and 70 x 25 cm plant arrangement ear grains weight was heavier by east-west orientation of rows. While, the opposite case under north-south row direction. For east-west row direction, both 100-grain weight and greain yield/faddan were the greatest by 70 x 25 cm plant arrangement. Whereas, with north-south one, the greatest 100-grain weight and grain yield /faddan were recorded by 60 x 28.1 cm arrangement. Concerning the orientation of east-west was superior in 100-grain and grain yield/faddan by 50 x 35 and 70 x 25 cm plant arrangements. However, the opposite trend was observed with north-south row direction.

Data in Table (8) show a significant effect of the interactoion between row direction and maize hybrids (ombined data) on leaf area index (LAI), number of grains/row, shelling % and grain yield/faddan. Leaf area index of SC 10 was significantly decreased by north-south was direction. Single cross 10 gave higher LAI under east-west row direction, but SC30 K8 hybrid was superior under north-south one. Single cross 10 surpassed 30 K8 hybrid on number of grains/row under east-west row direction. Row direction of east-west produced more grains/ row than that of north-south orientation for both maize hybrids (SC 10 and SC 30K8). Maize hybrid 30 K8 was superior in shelling percentage under eastwest orientation, while SC 10 superrior under north-south orieintation. Single cross 10 produced greater than that of SC30 K 8 grain yield/faddan under east-west row direction. While, 30 K8 hybrid gave little grain yield /faddan under north south direction.

Data in Table (9) show a significant effect of the interaction between plant arrangement and maize hybrids (combined data) on number of grains/ear, 100-grain weight, shelling percentage and grain yield/faddan. Single cross 10 produced mor grains per ear than that SC30 K 8 hybrid under both 50 x 35 and 70 x 25 cm arrangement. Both 50 x 35 and 70 x 25 cm arrangements gave more grains /ear for SC 10. However, 70 x 25 cm arrangement of SC30 K 8 produced little grains/ear. Single cross 10 gave heavier grains than that of SC 30 K8 hybrid on 100-grain weight under 50 x 35 cm hybrid surpassed SC 10 in this trait under 60 x 29.1 cm arrangement. Hundred-grain weight of SC 10 was the heaviest with 60 x 29.1 cm arrangement while, grains of SC 30 K 8 hybrid was the heaviest by 70 x 25 cm arrangement. Shelling

pecentage of SC 30 K8 hybrid was higher than that of SC 10 under both 50 x 35 and 60 x 29.1 cm arrangement and the opposite trend was observed under 70 x 25 cm one. The highest shelling % of SC 10 hybrid was recorded under 70 x 25 cm plant arrangement. While, this highest of SC 30 kg 8 hybrid was appeared by 60 x 29.1 cm. Single cross 10 surpassed on grain yield/faddan than SC 30 K8 hybrid under any plant arrangement. Grain yield/faddan was sigificantly increased by any increment in row width from 50 to 60 and 70 cm.

REFERENCES

1. Abdel-Aal, S.M., M.E. Ibrahim, A.A. Ali and Kh.S. Sarha, 1997. Studied on some maize varieties sown at different plant distribution systems. II. Flowering, grain filling and yield and its components. Monofya J. Agric. Res., 22(3): 755-780.
2. Abdrabou, R. Th., 1996. Response of maize yield to etheophon treatment and nitrogen fetilizer rates under two directions. Annals Agric. Sci., Ain. Shams Univ. Cairo, Egypt., 41(2): 683-695.
3. Ahmed, M.A. and M.H. El-Shiekh, 2002. Response of maize cultivars to different management regimes. Journal of Agric. Sci., Mansoura Univ., 29(8): 4821-4833.
4. Duncan, D.B., 1955. Multiple range and multiple F-test. *Biometrics*, 11: 1-42.
5. Duncan, D.B., 1972. Plant spacing, density, oriantaton and light relationships as related to different corn genotype. Proc. 27th Annual Corn and Sorghum Research Conf. Am. Seed Trad Assoc., Washington, USA.
6. El-Murshedi, W.A., 1991. Crop canopy and crop distribution pattern in the field and its influence on biological and economical yields in Maize. M.Sc. Thesis, Fac. Agric., Cairo Univ., Egypt.
7. El-Metwally, I.M., S.A. Ahmed and Samia A. Saad El-Din, 2001. Nitrogen fertilizer levels and some weed control treatments effects on maize and its associated weeds. J. Agric. Sci. Mansoura Univ., 26(2): 585-601.
8. El-Murshedy, W.A. and A.A. Abuldahab, 2002. Response of some maize hybrids and a synthetic cultivars to planting density. Egyptian J. Appl. Sci., 17(7): 546-562.
9. Fernando, H. Andrade, Maria E. Otegui and Claudia vega, 2000. Intercepted radiation at flowering and kernel in maize. Agron. J., 92: 92-97.
10. Goldsworthy, P.R. 1974. Maize physiology. In: Proc. World Wide Maize Improvement in the 7th and role for CIMMYT, CMMYT, Mexico.
11. Hassan, A.A., 2000. Effect of plant population density on yield and yield components of eight Egyptian maize hybrids. Bull. Fac. Agric. Cairo Univ., 51: 1-16.
12. Ibrahim, A.A. and M.F. Abd El-Maksoud, 2001. Leaf defoliation and hill spacing effects on maize productivity. Zagazig Agric. Res., 28(2): 261-274.
13. Ismail, M.A., 1997. Effect of some agronomic practices on maize. M.Sc. Thesis Zagazig University, Zagazig, Egypt.
14. Karlen, D.L. and C.R. Camp, 1985. Row spacing, plant population and water management effects on corn in the Atlantic costal proin. Agron. J., 77: 393-398.
15. Khalil, A.N.M., Sh. A. El-Shamarka, M.E. Ibrahim and E.A. El-Absawy, 1999. Effect of plant densities on growth yield of sixteen maize genotypes differed in their leaves angles. Minufiya J. Agric. Res., 24(1): 85-106.
16. Leach, M.C., M.C. Ress and D.A. Chorles, Dewards, 1986. Relation between summer crops and ground cover legumes in subtropical environment. 1. Effect of avignal trilobgata ground cover on growth and yield of sorghum and sunflower. Field crops. Res., 15: 17-37.
17. Mowafy, S.A.E., 2003. Response of some maize hybrids to nitrogen fertilizer splitting under drip irrigation system in sandy soils. Zagazig J. Agric. Res., 30(1): 17-34.
18. Oraby, F.T. and A.A. Sarhan, 2002. Proper agronmic practices required to maximize productivity of some maize varieties in old and reclaimed soils: II- Response of some maize varieties to NPK fertilization in the reclaimed sandy soil. Egyptian J. Appl. Sci., 17(11): 520-542.
19. Oraby, F.T., A.A. Sarhan, M.F. Abd El-Maksoud and A.H. Bassiouny, 2003a. Proper agronmic practices required to maximize productivity of some maize varieties in old and reclaimed soils: III. Effect of sowing dates on response of two maize hybrids to nitrogen fertilization. Egyptian J. Appl. Sci., 18(5B): 597-618.
20. Oraby, F.T., M.F. Abd El-Maksoud and A.A. Sarhan, 2005b. Proper agronmic practices required to maximize productivity of some maize varieties in old and reclaimed soils: v- Response of ten maize hybrids to N fertilization under two locations., J. Prodct. & Dev., 10(1): 55-73.

21. Ottman, M.J. and L.F. Welch, 1989. Planting pattern and radiation interception, plant nutrient concentration and yield in corn. Agron. J., 81: 167-174.
22. Robinson, R.G., 1975. Effect of row direction on sunflower. Agron. J., 67: 93-94.
23. Ragheb, M.M.A., A.A. Bedeer and A. Sh.A. Gouda, 1993. Effect of row spacing and plant population density on grain yield of some maize hybrids. Zagazig J. Agric. Res., 20(2): 581-594.
24. Sarhan, A.A., 1994. Agrofrestry system and plant arrangement effects on yield and its components of some maize hybrids. Egypt. J. Appl. Sci., 12: 728-746.
25. Seif, S.A., M.I. Bashir and M.H. El-Bakry, 1988. Effect of sowing directions, inter and intra row spacing on growth and yield of two grain sorghum cultivars. (*Sorghum bioclor L.*). Egyptian J. Appl. Sci., 3: 181-191.
26. Snedecor, G.W. and W.G. Cochran, 1980. Statistical Methods. 6th ed Iowa State Univ. Press Ames Iwoa, USA.
27. Tetio, F. Kagho and F.P. Gardnar, 1988. Response of maize to plant population density. 1. Canopy development, light relationship and vegetative growth. Agron. J., 80: 430-435.
28. Talentino, N.M., 1982. Solar radiation interception on sorghum (*Sorghum bioclar L.*) grown at different plant densities. Sorghum and Millets information enter (SMIC) Newsletter, 19, April, 1986)
29. Williams, W.A., R.S. Loomis and C.R. Lpley, 1965. Vegetative growth of corn as affected by population density. 1. productivity in relation to interception of solar radiation. Crop Sci., 5: 211-215.