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2 Evaluation of Intercropping Groundnut (*Arachis hypogaea* L.) with Maize under Different Plant Densities in Sandy Soils

Y. A. A. Hefny, S. A. Safina*# and A. M. Sheha
*Intensification Research Department, Field Crops Research Institute, Agricultural Research Center and *Agronomy Department, Faculty of Agricultrue, Cairo Univ., Giza, Egypt*

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INTERCROPPING is the practice of growing two or more crops simultaneously on the same field to maximize total production per unit area. Intercropping is traditional practice in small holders especially at developing countries. The reason for this popularity is built on high profit and maximizing agriculture resources. Therefore, the objective of the present study is to evaluate the effect of intercropping maize with different plant densities on yield and yield components of groundnut to increase the productivity of groundnut under sandy soils. Two field trials were carried out at the experimental and research station at Ismailia of the Agriculture Research Center (ARC) during 2013 and 2014 summer seasons. Maize variety SC168 and groundnut C.V. Giza.6 were sown in the two seasons. The experimental design was a split-plot design with three replications; the main plots were assigned to three maize treatments (harvesting maize for grains, defoliation maize plants at 85 days from sowing maize and harvesting maize for silage). Three maize plant densities were distributed in sub plots by 2, 3 and 4 plants/hill at distance of 70 cm apart. Groundnut plants revealed that were sown in both sides of ridges (120 cm ridge width) by growing two plants per hill at 20 cm apart under intercropping and solid2 (as intercropping) , and solid1 as recommended solid plant sowing. Results indicated that maize treatments, plant densities of maize and their interactions significantly affected groundnut characters. Removal maize plants for silage at 85 days or defoliation maize plants (at 85 days) increased light interception on groundnut plants which had a positive impact on the pod and seed yield of groundnut. Groundnut under intercropping with two maize plants per hill (50% of recommended density of maize) had the highest weight of seed per plant (13.18 and 12.78 g) and yield of pods per ha (2.16 and 2.09 ton) at 2013 and 2014 season, but four maize plants per hill (100% of recommended density of maize) caused significant reduction of seed yields per plant and pod yield per ha. According to this investigation, to gain high productivity of groundnut (2.50 and 2.32 t/ha, at 2013 and 2014 season), remove maize plants as silage (at 85 days) and / or growing two maize plants per hill (50%) under intercropping in sandy soil.

Keywords Groundnut, Intercropping, Solid, Maize treatments, Plant densities, Seed yield, Pods yield, Sandy soils.

INTRODUCTION

Although agriculture is still one of the most important activities done by man on earth, the harmony between agriculture and nature and also with achievements in innovative sciences has been disturbed and the destruction of planting lands and natural sources in the world and polluting water and soil by agricultural and increasing population shows a gloomy future to man, so, considering sustainable agriculture is vital (Marschner *et al.,* 2003). In many parts of the world, intercropping as a way of the most common in Agro-ecosystem is used, that has lots of advantages in comparison to sole crop (Banik *et al.*, 2006).

Intercropping as one of the multiple cropping systems, has been practiced by many farmers for many years in various ways and most areas. Intercropping is practiced not only for risk avoidance but also to maximize the efficiency of natural resources and monetary return. Small farmers in many countries are seriously constrained by limited land resources, intercropping has shown that possible ways for increasing the productivity on these area and increasing their return.

Groundnut (*Arachis hypogaea* L.) is one of the most important summer oil in the world. Groundnut seeds contain high oil (45%), 26-28 % protein, 20% carbohydrates and 5 % fiber (Fageria *et al.*, 1997). The seeds have high nutritive value for human consumption and for animal feed, as well as, the green

#Corresponding author email: drsayedsafina@agr.cu.edu.eg
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leaf is also used as hay for livestock (Abdalla *et al.,* 2009). The cultivated area of groundnut in Egypt during 2013-2014 season was about 56,866 hectare (FAO, 2014). Recently groundnut in Egypt has been given great attention due to its suitability for growing in the newly reclaimed sandy areas.

Most studies on intercropping have focused on the legume-cereal intercropping, a productive and sustainable system, its resource utilization (water, light, nutrients), and its effect on N input from symbiotic nitrogen fixation into the cropping system and reduction of negative impacts on the environment (Willey, 1979 and Jensen, 1996). Cereal-legume intercropping plays an important design in allowance food production in both developed and developing countries, especially in situations of restricted water resources.

Maize (*Zea mays* L.) is the first summer cereal crop in Egypt "considering acreage, and total production". In cereal-legume intercropping systems the cereal benefits from the nitrogen fixed by the legume crops and from the decomposition of nutrient rich biomass from root; and nodules of the legume, therefore, the increased yield of maize may be attributed to nitrogen fixing ability of legumes (Chen *et al*., 2004 and Metwally *et al.*, 2007), helping to increase soil organic matter (Gregrich *et al.,* 2001 and Metwally *et al.*, 2007). Intercropping groundnuts with maize or sorghum is traditional practice in tropical and subtropical areas, it reached 80% of the cultivated area in many countries (Mandal *et al*., 1990). Metwally *et al.* (2005) conducted two field experiments at Ismaelia Research Station of the Agriculture Research Center (ARC) during 2003 and 2004 at summers season to study the effect of intercropping groundnut with maize at different plant densities. They reported that low density of groundnuts per ridge had higher values of pod number and yield per plant than those of high plant density in solid and intercropping cultures. But the vice versa was true with seed yield per faddan (4200 m^2). Also, mixed intercropping system gave higher yield of groundnut than alternating ridges. Dahmardeh (2013) intercropped maize with groundnut by different planting ratios. The highest biological yield of maize (57.3 t/ha) was obtained by sowing maize var KSC 604 75% + groundnut 25%. The results was shown that mixture were advantageous compared to sown both crops of sole.

Therefore, the objective of the present study is to evaluate the influences of intercropping maize with groundnut at different plant population densities on yield and yield components characters for increasing productivity of groundnut under intercropping systems in sandy soils as compared to solid planting of groundnut.

MATERIALS AND METHODS

Experimental site

Two field trials were carried out at the experimental and research station at Ismailia of the Agriculture Research Center (ARC) during 2013 and 2014 in summer seasons. The soil texture was sandy soil, as shown in Table 1.

Plant material, treatments and experimental design

Maize variety of SC168 was sown in three maize plant densities *i.e.,* two plants/hill (24,000 plants/ha, 50 % of recommended solid population of maize) , three plants/hill (36,000 plants/ha, 75 %) and four plants/hill (48,000 plants/ha, 100 %) on 70 cm between hill under intercropping and solid maize planting. Maize treatments were (M1: maize harvested for silage at 85 days from sowing, M2: defoliation of maize at 85 days from maize sowing and M3: harvesting maize for grains). Groundnut variety was C.V. Giza 6 was sown on both sides of ridges (120 cm ridge width) by growing two plants per hill distanced at 20 cm apart under intercropping and solid2 (as intercropping system) , in addition recommended solid planting (solid1) whereas groundnut plants were sown on one sides of ridges (60 cm ridge width) by growing two plants per hill distanced at 20 cm apart.

The experimental design was split-plot design in a randomized complete block arrangements with three replications. The main plots were assigned to maize treatments, whereas plant densities were distributed in sub plots. The plot size was 19.2 m^2. Each sub-plot consisted of four beds, each was 4 m in length and 1.2 m width for intercropping and solid 2, as well as, 8 ridges 60 cm width for recommended solid groundnut.

Agricultural practices

Groundnut seeds were sown on 10 and 15 May at 2013 and 2014 seasons, respectively, while maize was sown 15 days later. Maize grains and groundnut seeds kindly provided from Field Crop Research Institute, ARC, Giza, Egypt. Sprinkler irrigation system was used. Fertilizers *i.e.*, recommended calcium super phosphate (15.5 % P_2O_5) at a rate of 480 kg /ha was added to the experimental soil plots during

TABLE 1 . Physical and chemical analysis of the experimental sites (Average values of 2013 and 2014 seasons).

Content	Values
Physical analysis	
Coarse sand %	26.32
Fine sand %	68.37
Silt %	3.82
Clay %	1.49
Soil texture	Sandy
Chemical analysis	
pH	7.76
E.C. (dSm^{-1})	0.34
Calcium carbonate %	1.37
Organic matter %	0.19
Available -N ppm	22.17
Available - P ppm	2.83
Available - k ppm	42.76
Available - Fe ppm	1.92
Available - Zn ppm	0.63
Available - Mn ppm	1.96
Available - Cu ppm	0.84

Agriculture Research Center (ARC), Analysis Unit of Ismailia. Soil properties was determined according to Piper(1950) and Page *et al.* (1982).

soil preparation and potassium sulphate (48 % K_2O) at a rate of 240 kg/ha was added in two equal doses at sowing and after 30 days. N-fertilizer was added at rate of 480 kg/ha ammonium sulfate (20.6% N) in three equal doses at 15, 30 and 45 days after sowing. All agronomic practices were practiced according to technical recommendations of groundnut at Ismailia Governorate.

Data recorded

At harvest (150 days after sowing), ten guarded plants from central beds, and ridges in solid one were harvested to determine the following traits: plant height, number of pods/ plant, weight of pods /plant (g), Number of seeds/ plant, Number of seeds/ pod, shilling % (seed weight of 100 pods/weight of 100 pods X 100), seed index (weight of 100 seeds, g) and weight of seeds/plant (g). The middle two beds of each plot (12 m^2) were harvested for determine area yield per hectare, weight of pods/plot (kg) was converted to hectare (10000 m^2) to determine yield of pods by t/ha.

Statistical analysis

Collected data were statistically analyzed by ANOVA using MSTAT-C computer program (Freed *et al.*,1989). Means were compared by least significant differences (LSD) at 5% level of probability test according to procedures outlined by Steel *et al.* (1997).

RESULTS AND DISCUSSION

Significance of mean squares due to different sources of variation

The significance of variances of analysis at 2013 and 2014 seasons, respectively, for all studied traits are presented in Table 2. Maize treatments (M) influenced highly significant all groundnut traits except seed index and shilling % in both seasons; and number of seeds/pod in 2014 season. Maize plant densities (D) influenced highly significant of all groundnut traits except number of pods/plant on both seasons. This indicates that microclimatic changes as plant densities affected most important groundnut traits (Metwally *et al.,* 2005; Sherif *et al.*, 2005 and

Abdel-Galil *et al.*, 2014). Interaction M X D, showed varied significantly over both seasons for all traits.

Effect of maize treatments

Data presented in Table 3, revealed that weight of pods/plant and its attributes, as well as, yield of pods/ha were significantly affected by maize treatments during the two growing seasons. However, maize treatments had no significant effects on seed index and shilling % in both seasons. While, number of seeds/pod did not affect significantly in second season. Harvested maize plants for silage give rise of significant increment in number of pods/ plant, weight of pods / plant, number of seeds / plant, weight of seeds / plant and yield of pods /ha by (30.64 and 45.29 %), (57.48 and 52.03 %), (34.25 and 40.66 %), (57.42 and 48.84 %) and (54.59 and 27.80 %), during the first and second seasons, respectively, as compared with intercropped groundnut plants with harvested maize plants for grains. While, the converse was true with plant height (Tables 3). Also, defoliation of maize plants at 85 days age caused significant increase in number of pods/ plant, weight of pods / plant, No. of seeds / plant, weight of seeds / plant and yield of pods / ha by (11.29 and 22.22 %), (31.50 and 43.09 %), (20.51 and 16.91 %), (32.50 and 25.93 %) and (27.17 and 26.34 %), during the first and second seasons, respectively, in comparison with intercropped groundnut plants with harvested maize plants for grains.

Accumulation of dry matter by a crop is directly dependent upon the amount of radiation intercepted by the crop canopy. These results may be due to removal maize plants for silage by about 30 days before harvesting maize plants for grains, defoliation maize plants by four weeks before harvesting maize plants for grains.

TABLE 2 . Significance of variances for groundnut traits due to different sources of variation at 2013 and 2014 years .

S.V.	Seasons (S)	Plant height (cm)	No. of pods/ plant	Weight of pods / plant (g)	No. of seeds / pod	No. of seeds / plant	Seed index (g)	Shilling %	Weight of seeds / plant, g	Yield of pods / ha, ton
Maize treatments (M)	S1	**	**	**	**	**	NS	NS	**	**
	S2	**	**	**	NS	**	NS	NS	**	**
Maize plant densities(D)	S1	**	NS	**	**	**	**	*	**	**
	S2	**	NS	**	**	**	**	**	**	**
M x D	S1	NS	NS	NS	NS	**	*	NS	*	*
	S2	NS	**	**	NS	**	**	**	**	**

*Significant at P < 0.05; **Significant at P < 0.01; NS = non-significant. M: Maize treatments. D: Maize plant densities.

TABLE 3 . Groundnut yield and yield components traits as affected by maize treatments during 2013 and 2014 seasons.

Maize treatments	Plant height (cm)	No. of pods/ plant	Weight of pods / plant (g)	No. of seeds / pod	No. of seeds / plant	Seed index (g)	Shilling %	Weight of seeds / plant, g	Yield of pods / ha, ton
2013									
M1	35.6	16.2	20.0	1.32	21.40	66.37	69.38	13.90	2.12
M2	45.70	13.8	16.7	1.41	19.21	61.72	70.53	11.70	1.74
M3	50.0	12.4	12.7	1.35	15.94	55.80	70.29	8.83	1.37
Mean	43.8	14.1	16.5	1.36	18.85	61.30	70.07	11.48	1.75
LSD 0.05	0.84	2.6	1.6	0.13	0.88	NS	NS	0.55	0.12
Solid1	29.63	22.0	23.0	1.32	29.11	54.96	69.57	16.00	2.97
Solid 2	30.22	21.0	24.0	1.35	28.39	54.97	65.00	15.60	2.69
2014									
M1	38.35	17.0	18.7	1.21	20.79	63.00	68.91	12.80	1.89
M2	50.81	14.3	17.6	1.23	17.28	63.15	61.19	10.83	1.87
M3	55.81	11.7	12.3	1.27	14.78	58.97	69.33	8.60	1.48
Mean	48.3	14.3	16.2	1.24	17.62	61.71	66.48	10.74	1.74
LSD 0.05	1.548	0.8	0.7	NS	0.40	NS	NS	0.87	0.03
Solid1	30.5	20.0	22.0	1.43	28.58	52.48	70.45	15.50	2.82
Solid 2	32.7	19.0	23.0	1.47	27.90	53.76	65.22	15.00	2.55

NS = non-significant. M1: Harvested maize plants for silage. M2: Defoliation of maize plants. M3: Harvested maize plants for grains. Solid1 : As the recommended. Solid2: As intercropping system.

These treatments caused favorable environmental conditions especially light intensity to groundnut plants during pod formation and maturation. Reduced light decreased photosynthesis and carbohydrate concentrations in leaves and pods and continuant for effected in source-sink relationships which are affected in decreasing (Metwally *et al.,* 2005; Sherif *et al.*, 2005; Abdel-Galil *et al.,* 2014 and Kubota *et al.,*2015). These results are in line with those obtained by Safina *et al.* (2014) who reported that the early time of harvesting and removal maize plants (about 50 days) before harvesting cotton plants led to subject cotton plants to environmental conditions which were available during boll formation and maturation.

The highest significant values of each of number of pods/ plant (22.0 and 20.0), number of seeds / plant (29.11 and 28.58 g), weight of seeds / plant (16.00 and 15.50 g) and yield of pods / ha (2.97 and 2.82 ton) were recorded when groundnut was grown as a sole crop by (solid1) during the first and second seasons, respectively. The lowest values of seed yield and its attributes as well as pod yield were recorded when groundnut was intercropped with maize for producing grains (M3), However, this may be due to the long time competition between groundnut and maize on water, solar radiation and fertilization. The reduction in yield of pods/ha was 35.03% and 31.73% when intercropped with maize, during the first and second seasons, respectively (Table 3). Similar results were reported by Metwally *et al.* (2005), Sherif *et al.* (2005) and Safina *et al.* (2014).

Effect of maize plant population densities

Plant height, weight of pods/plant, number of seeds/plant, seed index, shilling %, weight of seeds/plant and yield of pods/ha were affected significantly by sowing maize by different plant densities during the first and second seasons, except number of pods/ plant and number of seeds/pod were not affected significantly (Table 4). Sowing maize by low plant density (24000 plants/ha) resulted in higher values of each pods weight/plant (18.7 and 18.3 g), number of seeds/ plant (23.17 and 21.93), seed index (56.76 and 58.17 g), shilling % (70.94 and 70.68), weight of seeds/plant (13.18 and 12.78 g) and yield of pods/ ha (2.16 and 2.09 ton) during the first and second seasons, respectively; this may be attributed to more light penetration than those of heavy maize densities. This results are in accordance with those obtained by Abd-El Motaleb & Yousef, (1998) Metwally *et al.* (2005) and Mas-uda *et al.*(2016). Contrary a gradual reduction in groundnut traits as plant densities increased up to 48000 plants/ha were recorded. These reductions were occurred with weight of pods / plant, Number of seeds / plant, weight of seeds / plant and yield of pods / ha by (25.13 and 23.50 %), (36.86 and 39.40 %), (23.89 and 30.91 %) and (37.96 and 35.41 %), during the first and second seasons, respectively (Table 4).

The data in the same table, also revealed an improvement of groundnut yield was obtained due to more light penetration on groundnut leaves by decreasing maize plant densities. The present results are in agreement with those obtained by Jana & Saren (1998), Ghosh (2002) and Hussein *et al.* (2002). Hussein *et al.* (2002) revealed that minimum groundnut yield was obtained when intercropped with full density of maize (48000 plants/ha).

Plant height of groundnut was increased when increased plant densities from 24000 (2 plants/ hill) to 48000 (4 plants/hill) plants/ha, because increasing shading between plants with heavy density. These results are in accordance with those obtained earlier by Metwally *et al.*(2005), Sherif *et al.* (2005), Abdel-Galil *et al.*(2014), Safina *et al.*(2014) and Mas-uda *et al*. (2016).

In general, solid 2, planting gave higher yield than intercropping during the two seasons, this attributed to increasing weight of pods/plant, number of seeds per plant, shilling % and weight of seeds per plant during the first and second seasons. This results were in the same line with those reported by Hussein *et al.* (2002), Metwally *et al*. (2005) and Safina *et al.* (2014).

The interaction between treatments of maize and plant population densities

Results in Table 5 indicated that mean number of seeds/plant, seed index, weight of seeds/plant and yield of pods/ha were affected significantly by the interaction between maize treatments and maize plants/ha in first and second season, whereas, number of pods/plant, weight of pods/ plant, number of seeds/pod and shilling % were not significantly affected by the interaction in first season. While, plant height and number of seeds/pod were not affected by the interaction. The highest values of mean number of pods/ plant (18.0) and weight of pods/plant (21.0 g) resulted from harvested maize plants for silage with low densities of intercropped maize plants (two plants/hill; 24000 plants/ha) in the 2^{nd} season. Also, the highest values of mean shilling % (78.97%) resulted from harvested maize plants for grains with low densities of intercropped maize plants (two plants/hill; 24000 plants/ha) in the 2^{nd} season (Table 5).

While, the lowest values of mean number of pods/plant (8.0), weight of pods/plant (21.0 g) and shilling % (54.70 %) resulted from harvested maize plants for grains with heavy densities of intercropped maize plants (four plants/hill; 48000 plants/ha) in the 2^{nd} season. This result was in the same line with that reported by Abdel-Galil *et al.* (2014) and Safina *et al*. (2014). Groundnut plants which grown with harvested maize for silage and low densities of adjacent two maize plants/hill (24000 plants/ha) recorded the highest values of number of seeds/plant (25.87 and 24.80), weight of seeds/plant (15.1 and 14.7 g) and yield of pods/ ha (2.50 and 2.32 ton) but it gave the lowest seed index.

Whereas, groundnut plants which grown with harvested maize plants for grains with heavy densities of intercropped maize plants (four plants/hill; 48000 plants/ha) had the lowest values of number of seeds/plant (12.23 and 10.43), weight of seeds/plant (7.30 and 6.0g) and yield of pods/ha (0.94 and 1.05 ton) during the first and second seasons, respectively. This result was in the same line with that reported by Abdel-Galil *et al.* (2014) and Safina **et al.** (2014).

TBLE 4 . Groundnut yield and yield components as affected by intercropping with maize plant by different densities during 2013 and 2014 seasons.

Maize plant densities (plants/ ha)	Plant height (cm)	Number of pods/ plant	Weight of pods / plant (g)	Number of seeds /pod	Number of seeds / plant	Seed index (g)	Shilling %	Weight of seeds / plant, g	Yield of pods / ha, ton
2013									
24000	39.93	16.1	18.7	1.47	23.17	56.76	70.94	13.18	2.16
36000	44.07	13.0	16.7	1.46	18.76	59.29	67.27	11.22	1.73
48000	47.33	13.4	14.0	1.17	14.63	67.84	71.99	10.03	1.34
Mean	**43.78**	**14.2**	**16.5**	**1.37**	**18.85**	**61.30**	**70.07**	**11.48**	**1.74**
LSD 0.05	1.22	NS	0.9	NS	0.49	3.68	1.00	0.69	0.15
Solid1	29.63	22.0	23.0	1.32	29.11	54.96	69.57	16.00	2.97
Solid 2	30.22	21.0	24.0	1.35	28.39	54.97	65.00	15.60	2.69
2014									
24000	43.42	16.3	18.3	1.36	21.93	58.19	70.68	12.78	2.09
36000	48.94	15.3	16.3	1.14	17.62	61.47	66.50	10.70	1.85
48000	52.60	11.3	14.0	1.21	13.29	65.47	62.25	8.83	1.35
Mean	**48.32**	**14.3**	**16.2**	**1.24**	**17.61**	**61.71**	**66.48**	**10.77**	**1.76**
LSD 0.05	1.96	NS	0.6	NS	0.68	3.77	2.77	0.33	0.07
Solid1	30.5	20.0	22.0	1.43	28.58	52.48	70.45	15.50	2.82
Solid 2	32.7	19.0	23.0	1.47	27.90	53.76	65.22	15.00	2.55

NS = non-significant. Solid1 : As the recommended. Solid2: As intercropping system.

CONCLUSIONS

The productivity of groundnut was decreased by 41.31 and 37.46 percent for pod yield/ha, during the first and second seasons, respectively, in the comparison with solid groundnut planting as intercropping (solid2). Defoliation maize plants or harvesting maize for silage contributed positively the adverse effects of maize shading on adjacent groundnut plants. Also; Intercropping maize with groundnut by 24,000 plants/ha has not adverse effects on pod yield of groundnut.

TBLE 5 . Traits of groundnut as affected by the interaction between maize treatments and plant population densities of intercropped maize during 2013 and 2014 seasons.

Maize treatments	Maize plant densities (plants/ ha)	Plant height (cm)	Number of pods/ plant	Weight of pods / plant(g)	Number of seeds /pod
2013					
M1	24000	32.7	18.2	22.0	1.43
	36000	35.2	15.6	20.0	1.43
	48000	39.0	14.9	18.0	1.10
M2	24000	41.77	16.3	19.0	1.47
	36000	46.80	12.8	17.0	1.50
	48000	48.53	12.2	14.0	1.27
M3	24000	45.33	13.7	15.0	1.50
	36000	50.20	10.6	13.0	1.43
	48000	54.47	13.0	10.0	1.13
$LSD_{0.05}$		NS	NS	NS	NS
Solid 1		29.63	22	23.0	1.32
Solid 2		30.22	21	24	1.35
2014					
M1	24000	34.57	18.0	21.0	1.43
	36000	38.30	17.0	19.0	1.23
	48000	42.17	16.0	16.0	0.97
M2	24000	45.30	18.0	20.0	1.20
	36000	52.13	15.0	18.0	1.13
	48000	55.00	10.0	15.0	1.37
M3	24000	50.40	14.0	14.0	1.43
	36000	56.40	13.0	12.0	1.07
	48000	60.63	8.0	11.0	1.30
$LSD_{0.05}$		NS	1.0	1.0	NS
Solid 1		30.49	20	22	1.43
Solid 2		32.71	19	23	1.47

NS = non-significant. M1: Harvested maize plants for silage. M2: Defoliation of maize plants. M3: Harvested maize plants for grains. Solid1 .: As the recommended. Solid2: As intercropping system

TBLE 5 . Cont.

Maize treatments	Maize plant densities (plants/ha)	Number of seeds / plant	Seed index (g)	Shilling %	Weight of seeds / plant, g	Yield of pods/ ha , ton
2013						
M1	24000	25.87	58.40	68.63	15.1	2.50
	36000	22.10	63.03	69.51	13.9	2.12
	48000	16.23	77.67	69.99	12.6	1.74
M2	24000	23.37	56.93	69.98	13.3	2.13
	36000	18.83	62.13	68.76	11.7	1.76
	48000	15.43	66.10	72.86	10.2	1.34
M3	24000	20.27	54.93	74.20	11.13	1.86
	36000	15.33	52.70	63.55	8.07	1.32
	48000	12.23	59.77	73.11	7.30	0.94
$LSD_{0.05}$		0.85	6.37	NS	0.75	0.26
Solid 1		29.11	54.96	69.57	16.0	2.97
Solid 2		28.39	54.97	65.00	15.6	2.69
2014						
M1	24000	24.80	59.30	70.04	14.7	2.32
	36000	21.93	56.10	64.78	12.3	1.99
	48000	15.63	73.60	71.91	11.5	1.55
M2	24000	20.93	60.23	63.03	12.6	2.26
	36000	17.10	63.90	60.49	10.9	1.87
	48000	13.80	65.33	60.06	9.0	1.46
M3	24000	20.07	55.03	78.97	11.0	1.70
	36000	13.83	64.40	74.24	8.9	1.68
	48000	10.43	57.47	54.79	6.0	1.05
$LSD_{0.0}5$		1.18	6.53	3.79	0.57	0.13
Solid 1		28.58	52.48	70.45	15.5	2.82
Solid 2		27.90	53.76	65.22	15.0	2.55

NS = non-significant. M1: Harvested maize plants for silage. M2: Defoliation of maize plants. M3: Harvested maize plants for .grains. Solid1 : As the recommended. Solid2: As intercropping system

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أداء الفول السوداني تحت الزراعة المحملة مع الذرة الشامية في الاراضي الرملية

ياسر احمد عبد الحليم حفني، سيد احمد سفينة* و أحمد محمد شيحة
قسم بحوث التكثيف- معهد بحوث المحاصيل الحقلية - مركز البحوث الزراعية و * قسم المحاصيل - كلية الزراعة - جامعة القاهرة - جيزة - مصر

التحميل أحد نظم الزراعة التي يتم فيها زراعة محصولين او اكثر في وقت واحد في نفس قطعة الارض لتحقيق أقصي إنتاج من وحدة المساحة. يعتبر التحميل من افضل نظم الزراعة في المساحات الصغيرة في الدول النامية وتعظيم العائد والاستفادة من الموارد المتاحة وكفاءة المياة. الهدف من هذه الدراسة هو دراسة العلاقة المتبادلة بين تحميل الذرة مع الفول السوداني ، ومعاملات الذرة والكثافة النباتية للذرة في التربة الرملية مقارنة بالزراعة المنفردة للفول السوداني. أجريت تجربتان بمحطة التجارب الزراعية بالاسماعيلية لمركز البحوث الزراعية، بمحافظة الاسماعيلية ، مصر خلال الموسم الصيفي 2013 و 2014. استخدم في التجربة هجين الذرة الفردي 168(أصفر) وصنف الفول السوداني جيزة 6. وكان التصميم التجريبي المستخدم تصميم القطاعات المنشقة مرتين في تصميم القطاعات الكاملة العشوائية و في ثلاثة مكررات. أستخدمت ثلاث معاملات للذرة الشامية (حصاد نباتات الذرة الشامية بغرض الحبوب، توريق نباتات الذرة الشامية بعد 85 يوم من زراعته، حصاد نباتات الذرة الشامية بغرض السيلاج بعد 85 يوم من الزراعة) تحت التحميل و تم توزيع المعاملات داخل القطع الرئيسية. وتم توزيع الكثافة النباتية للذرة (2 و 3 و 4 نباتات/الجورة) علي مسافة 70 سم بين الجور في منتصف المصطبة في القطعة المنشقة مرة واحدة. تم زراعة الفول السوداني علي جانبي المصطبة (عرضها 120 سم) ونباتين في الجورة علي 20 سم بين الجور في الزراعة المحملة والمنفردة (مثل التحميل) بالاضافة للزراعة المنفردة الموصي بها. ويمكن تلخيص اهم النتائج المتحصل عليها كما يلي: معاملات الذرة والكثافة النباتية للذرة تحت نظام التحميل اثرت معنويا علي صفات الفول السوداني تحت الدراسة بالمقارنة بالزراعة المنفردة. نباتات الذرة التي حصدت بغرض السيلاج عند عمر 85 يوما من الزراعة أو ازالة الأوراق للذرة (في عمر 85 يوما من الزراعة) ادت الي زيادة الضوء على نباتات الفول السوداني والتي كان لها تأثير إيجابي على محصول الفول السوداني. أعطت الكثافة النباتية نباتين في الجورة (50٪ من الكثافة الموصى بها للذرة) للذرة المحملة مع الفول السوداني أعلى وزن لبذور نبات الفول السوداني (13.18 و 12.78 جرام) ومحصول القرون للهكتار (2.164 و 2.093 طن) خلال موسمي 2013 و 2014 ولكن زراعة اربع نباتات في الجورة (100٪ من الكثافة الموصى بها للذرة) تسببت في انخفاض كبير في محصول البذور للنبات، ومحصول القرون للهكتار. ووفقا لهذة الدراسة، للحصول على إنتاجية عالية من الفول السوداني لمحصول قرون الهكتار تحت نظام التحميل (2.502 و 2.322 طن) خلال موسمي 2013 و 2014 يتضح من استخدام معاملةحصاد نباتات الذرة بغرض السيلاج (عند 85 يوما من الزراعة) وزراعة نباتين في الجورة الذرة (50٪ من الكثافة الموصى بها للذرة) في الاراضي الرملية.