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RESPONSE OF SESAME FOR INTERCROPPING WITH SOME FORAGE CROPS.

Mahdy A.Y. and M. A. A. El-Said
Agron. Dept., Fac. Agric., El-Azhar Univ. Assiut, Egypt.

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ABSTRACT

The present study was carried out at the Agriculture Experimental Farm of Al–Azhar University at Assiut Governorate, Egypt, during summer seasons of 2014 and 2015 to study the effect of intercropping sesame {(*Sesamum indicum L.* } cv. Shandaweel-3 as main crop with cow pea {*Vigna unguiculata* (L.) Walp} cv. Carem-1, guar {*/Cyamposis tetragonoloba* } cv. Local variety and sorghum fodder {*Sorghum vulgare,* L.} cv. Giza-3 as secondary crops at five intercropping patterns. Pattern of (P_1) significantly increased plant height of sesame as compared with pure stand and other intercropping patterns. The intercropping pattern of (P_5) sesame produced the greatest values of No. of branched/plant, No. of capsules/plant, 1000–seed weight and seed yield/plant, while seed yield/fed. had the maximum reduction at (P_2) pattern. Significant increase in plant height and leaf area index at all intercropping patterns were detected as compared with the pure stands, while number of leaves/plant of forage crops decreased at all intercropping patterns as compared with pure stands. The pure stands were of the forage crops plants produced the maximum forage yield/fed. as compared with other intercropping patterns in both seasons. Meanwhile, growing forage crops under the intercropping pattern of (P_2) produced the highest values of forage yield/fed. as compared with the other intercropping patterns in both seasons. The protein ratio/plant and total ash/plant of grown cow pea and guar under intercropping pattern of (P_1) produced the maximum values as compared with all the other intercropping patterns in both seasons The intercropping patterns of (P_5) of fodder sorghum produced the best values of the protein ratio/plant and total ash/plant

as compared with other intercropping patterns in both seasons. The highest value of crude fibers for the cow pea and guar crops were recorded for (P_5) intercropping pattern, while the highest values of crude fibers from planting fodder sorghum were recorded for the intercropping pattern of (P_1) in both seasons. Intercropping pattern (P_2) was the best for land utilization from land equivalent ratio (LER) and relative crowding coefficient (RCC). Sesame (dominant) and forage crops had the lowest values for aggressivity.

INTRODUCTION

Intercropping is practically suited to develop agricultural production via increasing crop production from the available agriculture area without disturbing crop structure through growing of a secondary crop combined with the main crop on the same field using the some production factors of the main crop, like soil, water, fertilizer and tillage operation with high efficiency. It is not easy to bring more land into cultivation or increase crop productivity at the available area with the population increase so, intercropping has been recognized as a potential pattern for improving production in developing countries. Ram and Singh (2001) found that sorghum intercropped with cow pea recorded significantly higher yield and quality than forage sorghum intercropped with cluster bean. Forage and crude protein yields of sorghum were significantly increased when harvesting was done at 75 days after sowing compared at harvesting at 45 days. Ahmad *et al.* (2007) showed that legume accessions decreased the forage sorghum yield than pure stand of sorghum. However, intercropping of forage sorghum with legumes in the pattern of 45 cm. spaced double – row strips appeared to be more productive and profitable than the mono cropped sorghum. Oroka and Omoregic (2007) found an increase in number and weight of pods/plant of cow pea in sole stands. Land equivalent ratios exceeding the unity, indicating an improve resource used by the crop mixture. Relative crowding coefficient and aggressivity indices showed that cow pea was the dominant crop, while rice being dominated. Abou-Kerisha *et al* (2008) indicated that yields of all sesame varieties were decreased under intercropping condition. Sesame Giza 32 variety surpassed the other varieties (Shandaweel 3 – and Toshka 1) in plant height, number of branches/plant, number of capsules/plant, seed yield/plant and seed yield/fed. the highest plant density (100%) recorded the highest sesame seed yield/fed. where the increase were 46.93 and 13.50 % in the first season, 2.46 and 8.71 % in the second season and 25.86 and 11.19 % in the combined data over the low and medium density treatments, respectively. El - Aref *et al*. (2009) indicated that the (P_7) 100% main crop + 67% secondary crop (by growing secondary crop on four maize ridges and leaving tow maize ridge

without intercropping) pattern was the best for land utilization from land equivalent ratio (LER) and the most efficient intercropping pattern from relative crowding coefficient (RCC). All intercropping patterns of cow pea with grain sorghum achieved higher economic return than pure maize and the most profitable pattern was (P_5) 100% main crop + 50% secondary crop (by growing secondary crop on tow maize ridges and leaving tow maize ridge without intercropping).Akbar *et al*. (2012) concluded that, to get better yield of quality fodder (crude protein – crude fibers - total ash), forage maize should be intercropped with forage legumes, preferably cow pea, under the planting pattern of 30 cm spaced lines in alternate rows. El - Aref *et al.* (2013) indicated that the pure stands of the cow pea plants produced the maximum forage yield/fed. as compared with other intercropping patterns in both seasons. Meanwhile, the cow pea grown under the intercropping pattern of (P_5) 100% main crop + 75% secondary crop (by growing secondary crop on three maize ridges and leaving one maize ridge without intercropping) produced the highest values of forage yield/fed. as compared with the other intercropping patterns in both seasons. The protein ratio/plant of cow pea was significantly decreased by intercropping as compared with pure stand treatments. Abdel-Galil and Abdel-Ghany (2014) indicated that the intercropping pattern 3 groundnut : 1 sesame recorded higher groundnut yield and its attributes than 2:2 pattern, while the highest sesame yield and its attributes were obtained by 2:2 pattern. Oyeogbe *et al.* (2015) showed that higher system productively based on system equivalent yield (SER), system profitability in terms of net realization to the growing year and land use efficiency were recorded for sesame + groundnut – castor pattern (7.9 k.g /ha/day; Rs. 298.3 /ha/day and 79.7%), sesame + green gram – castor pattern (8.0 k.g /ha/day; Rs. 297.0 /ha/day and 74.7%), sesame – castor system (7.3 k.g /ha/day; Rs. 274 /ha/day and 74%) and sesame + hybrid cotton castor pattern (5.3 k.g /ha/day; Rs. 204.5 /ha/day and 86%) , respectively.

MATERIALS AND METHODS

The present study was carried out at the Experimental Farm of Al–Azhar University at Assiut Governorate, Egypt, during the summer seasons of 2014 and 2015 to study the effect of intercropping sesame {(*Sesamum indicum L.*)} cv. Shandaweel-3 as main crop with cow pea {*Vigna unguiculata* (L.) Walp} cv. Carem-1, guar {*/Cyamposis tetragonoloba* } cv. Local variety and sorghum fodder {*Sorghum vulgare*, L.} cv. Giza-3 as secondary crops on growth, yield and yield components, chemical analysis, competitive relationships and the economic return.

The preceding crop was field bean {*Vicia faba*, (L.)} for all experiments in the two seasons.

The intercropping patterns between sesame and forage crops are shown in Table (1). Calcium super phosphate (15% P_2O_5) was added

during seed bed preparation at the rate of 150 kg/fed. The recommended rate of nitrogen fertilizer was added for both solid plots of sesame and intercropped sesame with forage crops at the rate of 100 kg. N/fed. as Urea (46.5 % N), while in pure stand forage, nitrogen was applied at the rate of 40 kg N / fed. The amount of nitrogen fertilizer was divided into two equal doses, the first was applied 20 days from planting and the second one was applied at 60 days from planting. The experimental design of each experiment was split plot design with three replicates. Area of each plot was 10.5 m^2 (3.5 m. width and 3 m. length).The plot consisted of 5 ridges spaced 60 cm apart.

Characters studied:

(1) Sesame (main crop): At harvest: Samples of 10 plants were chosen at random from sub plot and the following traits were recorded:

(1) Plant height in cm, was measured from soil surface to the top of the plant.

(2) Number of branches/plant.

(3) Number of capsules/plant.

(4) 1000-seed weight (g).

(5) Seed weight/plant (g).

(6) Seed yield (Ardab/fed): Ardab = 120 kg.

(2) Forage crops (secondary crop):

A - Growth characters:

(1) Plant height in cm, was measured from soil surface to the top of the plant.

(2) Number of leaves/plant.

(3) Leaf area index (LAI) for fodder sorghum was calculated according to Kirby and Atkins (1968).

Leaf area index (LAI) = *Total leaf area per plant (cm^2) / Area devoted for the plant (cm^2).*

Leaf area index (LAI) as recorded for cow pea and guar by disk method which recommended by Johanson (1967) = *(Total dry weight of blades/plant) (A known area of disk sample) / Dry weight of the same disk sample*

B - Yield and yield components:

(1) Forage yield (Ton/fed) cutted after 60 days from sowing.

C- Chemical analysis: secondary crops:

1- Determination of crude protein (C P): Total nitrogen content in plant was measured by using microkjeldahl method as described by A.O.A.C (1980) and percentage of protein was calculated by multiplying the nitrogen percentage by 6.25 of (cow pea + guar) and 5.75 for fodder sorghum.

2- Determination of total ash content (TAC): The total ash content was determined by heating the samples (0.5 – 2.0g) in an about 600 + 10 ^{0}C for 3 hr until they were completely ashes A.O.A.C (1975).

3- Determination of crude fibers (C F): The crude fibers content was determined according to the official method A.O.A.C (1975).Samples of 2.0 g were refluxed with 2 ml of 60 % aqueous tri chloro acetic acid, 200 ml of 80% acetic acid and 5 ml of concentrated nitric acid for30 min. the dried residue was washed consecutively with hot distilled water, ethanol and petroleum ether. Weight of the final dried product, containing fibers with some ash was determined and then aching at 600 + 10 ^{0}C in a

muffle furnace was followed by determination of ash. The crude fibers content was then calculated by difference between the last two weights.

3- Competitive relationships and yield advantages of intercropping:

A. Land equivalent ratio (LER) was measured according to Willey (1979).
B. Relative crowding coefficient (RCC) was calculated as described by Hall (1974).
C. Aggressivity (A) was determined according to Mc-Gilchrist (1965).

4 - The Economic return:

Net income in Egyptian pounds/fed. for pure stands of sesame and forage crops as well as intercropping patterns forage crops with sesame were estimated. Price of the yield and the cost of agricultural practices were considered according to the Ministry of Agriculture, Agricultural Research Center, Central Admen of Agric. (2014)and (2015).

5 - Statistical analysis:

The data were statistically analyzed according to procedures outlined by Steel and Torrie (1980). Least significant difference (L.S.D) at 5 % level of probability was used to compare among treatment means.

RESULTS AND DISCUSSION

1. The effect of intercropping on sesame crop:

The effect of applied intercropping patterns on yield and yield components of sesame as combined with forage crops during 2014 and 2015 seasons is presented in Table(2).

Sesame grown under the intercropping system of (P_1) resulted in the tallest plant as compared to the pure stand or the other intercropping patterns during the two experimental seasons. On the other hand, the shortest sesame plants were produced from cultivating of pure stand during the two seasons.

Results in Table(2)showed that the intercropping pattern of (P_5) which contained the plant population density of sesame66666.6 plants/fed. combined with 43999.98 plants/fed. of cow pea or 29629.62 plants/fed. of guar or 22222.22 plants/fed. of fodder sorghum produced the greatest values of No. of branched/plant, No. of capsules/plant, 1000–seed weight and seed yield/plant as compared to the intercropping patterns during 2014 and 2015 seasons, while pure stand surpassed the (P_5) pattern for all these traits. The competition between forage crops and sesame was high because of close distances between forage crops. As the number of increased forage crops sides, the competition was not too much to reduce No. of branched/plant, No. of capsules/plant, 1000–seed weight and seed yield/plant of sesame.

Table (1) : Number of plants per row and feddan and percentage of the pure stand in the intercropping patterns.

No. of system	Intercr-opping Systems Secondary crop	Sesame			Cow pea			Guar			Fodder sorghum		
		No. of plants/ row	No. of plants/ fed.	% of the pure Stand	No. of plants/ row	No. of plants/ fed.	% of the pure Stand	No. of plants/ / row	No. of plants/ fed.	% of the pure Stand	No. of plants/ / row	No. of plants/ fed.	% of the pure Stand
P_1	100 %	30	66666.6	100 %	60	133333.3	100 %	40	88888.88	100 %	30	66666.6	100 %
P_2	3 - 1	30	66666.6	100 %	60	99999.97	75 %	40	66666.66	75 %	30	49999.99	75 %
P_3	2 - 1	30	66666.6	100 %	60	89333.31	67 %	40	59555.54	67 %	30	44666.66	67 %
P_4	1 - 1	30	66666.6	100 %	60	66666.65	50 %	40	44444.44	50 %	30	33333.33	50 %
P_5	1 - 2	30	66666.6	100 %	60	43999.98	33 %	40	29629.62	33 %	30	22222.22	33 %
Pure stand		30	66666.6	100 %	60	133333.3	100 %	40	88888.88	100 %	30	66666.6	100 %

Table (2) : Effect of forage crops – sesame intercropping patterns on growth characters of sesame crop during 2014 and 2015 seasons.

Treatments		Plant height (cm)		No. of branched / plant		No. of capsules/ plant		1000-seed weight (g)		Seed yield / plant (g)		Seed yield Fad. (ardab)	
		2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
Cowpea	P_1	137.19	138.66	3.14	3.02	155.33	152.93	25.70	24.28	14.10	14.19	4.08	4.00
	P_2	136.78	135.20	3.78	3.50	162.10	159.03	29.19	28.73	14.53	15.38	4.33	4.16
	P_3	134.99	134.07	4.00	4.15	166.79	168.59	30.56	31.59	14.73	14.90	4.41	4.30
	P_4	133.54	132.14	4.52.	4.44	173.22	175.10	32.16	32.99	15.36	15.06	4.82	4.97
	P_5	131.14	129.82	4.94	4.70	179.11	177.64	33.22	34.00	15.60	16.92	5.11	5.03
Guar	P_1	143.19	144.98	2.90	2.77	140.00	142.66	25.17	24.64	11.40	11.29	3.70	3.65
	P_2	140.93	142.00	3.11	3.16	144.22	150.44	26.44	26.89	11.93	11.58	3.91	3.79
	P_3	138.20	137.85	3.31	3.19	157.00	152.39	27.39	28.11	12.25	11.90	4.15	4.22
	P_4	135.79	134.33	3.64	3.55	164.18	160.77	29.17	30.33	13.78	13.50	4.27	4.35
	P_5	130.65	133.55	3.88	3.93	170.33	178.23	32.45	33.46	14.68	13.86	4.50	4.64
Fodder sorghum	P_1	148.70	147.66	1.98	2.00	131.93	133.86	22.18	20.35	8.14	8.44	3.11	3.19
	P_2	145.17	142.63	2.28	2.64	135.13	136.57	24.30	25.77	9.80	9.35	3.17	3.23
	P_3	141.16	139.41	2.66	2.90	140.22	143.14	26.21	25.17	10.11	10.29	3.33	3.40
	P_4	137.35	137.89	3.18	3.10	143.22	145.88	27.22	27.22	10.67	10.91	3.52	3.41
	P_5	133.91	135.04	3.32	3.38	149.33	147.22	28.77	29.91	11.46	11.00	3.70	3.88
Pure stand		125.19	128.64	5.13	5.44	185.11	188.55	38.87	39.67	18.87	19.33	5.55	5.29
L .S.D		2.11	2.27	0.72	0.58	2.80	2.64	1.24	1.45	0.36	0.44	0.70	0.64

Concerning the seed yield/fed. of sesame, results in Table (2)showed that there was significant effect of intercropping patterns on seed yield/fed. of sesame as combined with forage crops during 2014 and 2015 seasons. The pure stand of sesame had the greatest seed yield/fed. in both seasons, while the treatment (P_2) which contained the plant population density of 66666.6 sesame plants/fed. combined with 99999.9 plants/fed. of cow pea or 66666.66plants/fed. of guar or 49999.99 plants/fed. of fodder sorghum plants/fed. produced the maximum seed yield/fed. as compared with the other intercropping patterns in both seasons.

Generally, the results in Table(2) clarified that the sesame planting under the intercropping pattern (P_1) which contain the plant population density of 66666.6 sesame plants/fed. combined with 133333.3 plants/fed. of cow pea or 88888.88 plants/fed. of guar or 66666.6 plants/fed. of fodder sorghum led to decrease the values of No. of branched/plant, No. of capsules/plant, 1000–seed weight, seed yield/plant and grain yield/fed. as compared with the pure stand or all the other intercropping patterns during in both seasons. These results are in agreement with Bhatti *et al.* (2005), Ali *et al.* (2007), Kamal – Eldin (2010), Haruna *et al.* (2013), Abdel – Galil and Abdel – Chany (2014), Puste *et al.* (2014) and Oyeogbe *et al.* (2015).

II. The effect on forage crops:

A - Growth characters:

Results in Table (3) show the effect of applied intercropping patterns on average plant height, number of leaves/plant and leaf area index of forage crops during 2014 and 2015 seasons.

Results in Table(3) showed that the intercropping patterns had a significant effect on forage crops plant height during 2014 and 2015 seasons. The forage crops grown under intercropping pattern of (P_1) that contains the population density of 66666.6 sesame plants/fed. combined with 133333.3 plants/fed. of cow pea or 88888.88 plants/fed. of guar or 66666.6 plants/fed. of fodder sorghum gave the tallest plants as compared with the pure stands or all the other intercropping systems during both seasons.

Regarding the number of leaves/plant, results in Table(3) indicate that intercropping patterns had significant effect on number of leaves per plant of forage crops in both seasons. Generally, it was clear that number of leaves/plant of forage crops tended to decrease when grown under the different intercropping patterns as compared with the pure stands. The forage crops sowing under the intercropping system (P_5) which contain the population density of 66666.6 sesame plants/fed. combined with 43999.98 plants/fed. of cow pea or 29629.62 plants/fed. of guar or 22222.22 plants/fed. of fodder sorghum resulted in the highest number of leaves/plant as compared with the other intercropping patterns during 2014 and 2015 seasons. On the

other hand, the intercropping pattern of (P_1) resulted in the lowest number of leaves/plant as compared with the other intercropping patterns.

Concerning the effect of the applied intercropping systems on LAI, results in Table(3)showed a significant effect on the leaf area index (LAI) for forage crops plants during 2014 and 2015 seasons.

The intercropping pattern (P_5) of forage crops produced the greatest values of LAI as compared with the pure stands or the other intercropping systems in both seasons, while the intercropping pattern of (P_1) of forage crops led to reduction in the LAI of forage crops as compared with other intercropping patterns during 2014 and 2015 seasons. The lowest values of LAI were recorded for pure stand of forage crops in both seasons. The intercropping pattern (P_5) produced the highest values of LAI because of more land area that was occupied by each plant. These results are in agreement with those obtained by Hakan *et al* (2008), El -Aref *et al* (2009), Adeniyan *et al* (2011) and Akbar *et al* (2012).

B- Yield, yield components and chemical analysis:

The effect of applied intercropping patterns on yield, yield components and chemical analysis of forage crops that were grown with sesame during 2014 and 2015 seasons is presented in Tables(3)and (4).

The pure stands of the forage crops plants produced the maximum forage yield (Ton/fed.) as compared with the other intercropping patterns in both seasons. Meanwhile, the forage crops grown under the intercropping pattern of (P_2) when plant population density of 66666.6 sesame plants/fed. combined with 99999.9 plants/fed. of cow pea or 66666.66 plants/fed. of guar or 49999.99 plants/fed. of fodder sorghum produced the highest values of forage yield (Ton/fed.) as compared with the other intercropping patterns in both seasons. On the other hand, the forage crops plant grown under the intercropping pattern of (P_1) which had plant population density of 66666.6 sesame plants/fed. combined with 133333.3 plants/fed. of cow pea or 88888.88 plants/fed. of guar or 66666.6 plants/fed. of fodder sorghum produced the lowest forage yield (Ton/fed.) as compared with the pure stands and the other intercropping systems in both seasons. Similar results were obtained by El -Aref *et al* (2009), Eskandari and Ghanbar (2009), Dahmardeh *et al (*2010), Adeniyan *et al.* (2011) and Akbar *et al* (2012).

Concerning the protein ratio/plant, total ash /plant of forage crops, results in Table (4) reveal that the above mentioned characters were significantly decreased by intercropping as compared with the pure stand treatments during the two seasons. The forage crops grown under intercropping pattern of (P_1) which contains the population density of 66666.6 sesame plants/fed. combined with 133333.3 plants/fed. of cow pea or 88888.88 plants/fed. of guar results produced the maximum value of protein ratio/plant and total ash/plant

as compared with all the other intercropping patterns during both seasons. On the other hand, the intercropping pattern of (P_5) which contain the population density of 66666.6 sesame plants/fed. combined with 43999.98 plants/fed. of cow pea or 29629.62 plants/fed. of guar produced the lowest values for these traits as compared with the other intercropping patterns in both seasons. The intercropping patterns of (P_5) of fodder sorghum produced the greatest values of the protein ratio/plant and total ash/plant as compared with other intercropping patterns in both seasons. The highest values of crude fibers for the cow pea and guar crops were obtained at (P_5) intercropping patterns at sesame population density of 66666.6 plants/fed. combined with 43999.98 plants/fed. of cow pea or 29629.62 plants/fed. of guar while the lowest values of crude fibers from planting cow pea and guar at the intercropping pattern of (P_1) in both seasons. the highest values of crude fibers from planting fodder sorghum were obtained at the intercropping pattern of (P_1) in both seasons. Similar results were obtained by El - Aref *et al* (2009), Eskandari and Ghanbar (2009), Elena and Roman (2010), Dahmardeh *et al (*2010) and Akbar *et al* (2012).

Table (3) : Effect of forage crops – sesame intercropping patterns on growthcharacters of forage crops during 2014 and 2015 seasons.

Treatments		Plant height (cm)		Number of leaves / plant		Leaf area index (LAI)		Forage yield (Ton/fad.)	
		2014	2015	2014	2015	2014	2015	2014	2015
Cowpea	P_1	90.77	88.16	32.40	31.84	2.95	2.90	10.395	10.111
	P_2	86.10	86.89	34.18	36.16	3.04	3.11	12.644	12.900
	P_3	83.17	82.11	38.79	39.09	3.21	3.29	9.333	9.614
	P_4	80.93	78.58	41.53	42.15	3.65	3.61	7.100	7.536
	P_5	77.34	76.66	45.62	46.70	3.90	3.86	5.211	5.472
	Pure	75.11	72.00	49.12	50.22	1.79	1.77	16.240	16.395
Guar	P_1	79.12	80.75	27.13	26.98	1.97	1.90	9.256	9.666
	P_2	77.33	76.43	31.42	33.11	2.06	2.11	11.773	11.249
	P_3	74.85	73.16	34.21	35.63	2.18	2.25	7.322	7.859
	P_4	70.63	71.90	36.76	38.00	2.41	2.53	5.934	5.764
	P_5	68.19	69.48	40.35	41.57	2.65	2.70	3.610	3.930
	Pure	65.22	66.19	43.16	45.18	1.39	1.50	13.110	13.520
Fodder sorghum	P_1	149.18	151.64	8.79	8.60	8.76	8.69	14.194	14.412
	P_2	142.73	140.58	9.38	9.44	9.11	9.22	15.836	15.610
	P_3	137.60	138.92	9.87	9.77	9.40	9.37	12.847	12.263
	P_4	134.41	136.17	10.25	10.18	10.18	10.06	9.633	9.909
	P_5	127.12	130.44	10.91	10.81	10.94	10.88	6.795	6.527
	Pure	120.33	117.00	12.00	12.11	6.20	6.32	18.044	18.444
L .S.D		2.14	2.22	1.91	1.70	0.21	0.33	1.82	1.66

Table (4) : Effect of forage crops – sesame intercropping systems on Protein ratio / plant, Total ash ratio / plant and Crude fibers ratio / plant of forage crops at different ages during 2014 and 2015 seasons.

Treatments		Protein ratio / plant		Total ash ratio / plant		Crude fibers ratio / plant	
		2014	2015	2014	2015	2014	2015
Cowpea	P_1	29.18	28.77	26.17	26.80	11.85	11.15
	P_2	27.97	27.33	25.73	24.97	12.70	12.94
	P_3	25.65	25.89	24.50	24.14	12.66	12.40
	P_4	24.73	23.92	23.33	23.90	13.94	13.24
	P_5	21.48	22.10	21.92	22.38	14.46	14.78
	Pure	33.37	32.00	29.55	28.75	10.79	10.33
Guar	P_1	24.50	25.16	22.45	22.22	11.30	11.91
	P_2	23.71	23.11	21.34	21.69	13.40	13.16
	P_3	22.00	21.58	20.87	20.00	13.96	13.62
	P_4	19.94	20.34	19.94	19.52	14.58	14.23
	P_5	17.42	16.86	17.26	18.44	14.77	14.85
	Pure	30.22	31.02	24.63	23.17	12.21	12.55
Fodder sorghum	P_1	5.27	5.77	13.80	12.88	17.42	17.00
	P_2	5.74	6.12	14.64	15.36	16.44	16.23
	P_3	6.53	6.80	16.77	16.09	15.61	15.11
	P_4	7.11	6.94	17.19	17.91	14.59	14.70
	P_5	7.85	7.25	18.37	20.50	14.00	14.37
	Pure	9.36	10.22	22.15	23.42	13.80	13.24
L .S.D		0.41	0.35	0.54	0.75	0.19	0.28

COMPETITIVE RELAIONSHIPS OF INTERCROPPING FORAGE CROPS WITH SESAME:

1. Land Equivalent Ratio (LER):

Results in Table(5) showed a considerable yield advantage as results of intercropping forage crops with sesame during 2014 and 2015 seasons

Results in Table (5) showed that land equivalent ratio (LER) was increased over one by intercropping forage crops with sesame in different patterns during 2014 and 2015 seasons. The highest LER values were obtained by intercropping pattern of (P_2) at which sesame population density of 66666.6 plants/fed. combined with 99999.9 plants/fed. of cow pea or 66666.66 plants/fed. of guar or 49999.99 plants/fed. of fodder sorghum plants/fed. in both seasons. These results are in agreement with those obtained by El -Aref *et al* (2009), Ahmad *et al* (2010), Dahmardeh *et al (*2010), Chivas *et al* (2011), Addo – Quaye *et al* (2011) and Quainoo1 *et al* (2012).

2. Relative Crowding Coefficient (RCC):

Results in Table (5) showed that the relative crowding coefficient (RCC) was also influenced by different intercropping this measurement took treatments imposed

in a similar trend as land equivalent ratio (LER) behavior during 2014 and 2015 seasons. The RCC values exceeding the unity indicating that net seed in yield was more than accepted from both components. The results also evidenced that increasing the plant density of sesame and forage crops led to increase the total (RCC), i. e. , the highest total (RCC) was resulted from growing 66666.6 plants/fed. of sesame combined with 99999.9 plants/fed. of cow pea or 66666.66plants/fed. of guar or 49999.99 plants/fed. of fodder sorghum at (P_2) intercropping pattern. The same trend was reported by Nofal and Attalla (2006), Oroka and Omoregic (2007) , Yilmaz et *al.* (2008), El -Aref *et al* (2009) and Quainoo1 *et al* (2012)

3. Aggressivity (A):

Results in Table(5) showed that in both growing seasons of this study, sesame was dominant at all intercropping patterns

Aggressivity values were the highest when forage crops was intercropped with sesame at (P_2) intercropping pattern. It was also indicated that sesame was dominant and forage crops dominated. However, it could be concluded that the inter specific competition between sesame and forage crops were pronounced in all intercropping patterns because of the differences in morphology of both crops. These results were also supported by Nofal and Attalla (2006), Oroka and Omoregic (2007), Yilmaz *et al* (2008), El -Aref *et al* (2009), Chivas *et al* (2011) and Quainoo1 *et al* (2012).

ECONOMIC RETURN PER FED (L.E.)

The economic return evaluation for either intercropping sesame + forage crops at different intercropping patterns compared with pure stand of sesame were recorded in Table (6) during 2014 and 2015 seasons. It was clearly that all intercropping patterns for both forage crops as companion crop with sesame, although they were expensive but they achieved higher relative net profit than the pure stand of sesame during the experimental seasons.

Results of the economic return per fed. for intercropping forage crops with sesame revealed that all intercropping patterns under testing realized more net income and relative net income than the pure stands of forage crops or pure stand of sesame during the two experimental seasons, reaching their maximum with (P_2) cropping system in both seasons.

In general the comparison between, the intercropping pattern which realized the greatest seed yield of sesame under intercropping forage crops with sesame (P_2) also, realized the highest net income per fed. during the two experimental seasons. The results are in agreement with those obtained by Nandel and Singh (2001), Obedoni *et al*. (2005), Langat *et al.* (2006), El -Aref *et al* (2009) and Egbe and Idoko (2012).

Table (5) : Competitive relationships and yield advantage of sesame and forage crops during 2014and 2015 seasons.

Treatments		Land equivalent ratio (LER)						Relative crowding coefficient (RCC)						Aggressivity (A)			
		2014			2015			2014			2015			2014		2015	
Cowpea	P_1	0.73	0.64	1.37	0.75	0.61	1.36	1.38	3.55	4.89	1.55	3.21	4.97	0.91	0.91	0.79	0.79
	P_2	0.78	0.77	1.55	0.78	0.78	1.56	1.79	7.03	12.58	1.84	7.83	14.17	1.29	1.29	1.31	1.31
	P_3	0.79	0.57	1.36	0.81	0.58	1.39	1.93	2.70	5.21	2.17	2.83	6.14	0.59	0.59	0.60	0.60
	P_4	0.86	0.43	1.29	0.93	0.45	1.38	3.30	1.55	5.11	7.76	1.70	13.19	0.26	0.26	0.30	0.30
	P_5	0.92	0.32	1.24	0.95	0.33	1.28	5.80	0.94	5.45	9.67	1.00	9.67	0.46	0.46	0.47	0.47
Guar	P_1	0.66	0.70	1.36	0.68	0.71	1.39	1.50	3.20	4.80	1.66	3.34	5.54	0.46	0.46	0.43	0.43
	P_2	0.70	0.89	1.59	0.71	0.83	1.54	1.78	11.74	20.89	1.89	6.60	12.47	0.82	0.82	0.80	0.80
	P_3	0.74	0.55	1.29	0.79	0.58	1.37	2.22	1.68	3.72	2.95	1.85	5.45	0.35	0.35	0.40	0.40
	P_4	0.76	0.45	1.21	0.82	0.42	1.24	1.66	1.10	1.82	3.46	0.99	3.42	0.28	0.28	0.43	0.43
	P_5	0.81	0.27	1.08	0.87	0.29	1.16	2.97	0.50	1.48	5.35	0.54	2.88	0.75	0.75	0.66	0.66
Fodder sorghum	P_1	0.56	0.78	1.34	0.60	0.78	1.38	1.27	3.68	4.67	1.51	3.57	5.39	0.38	0.38	0.24	0.24
	P_2	0.57	0.87	1.44	0.61	0.84	1.45	1.33	7.17	9.53	1.56	5.50	8.58	0.51	0.51	0.63	0.63
	P_3	0.60	0.71	1.31	0.64	0.66	1.30	1.50	2.45	3.67	1.79	1.98	3.54	0.18	0.18	030	030
	P_4	0.63	0.53	1.16	0.64	0.53	1.17	1.73	1.14	1.97	1.81	1.16	2.09	0.16	0.16	0.18	0.18
	P_5	0.66	0.37	1.03	0.73	0.35	1.08	2.00	0.60	1.20	2.75	0.54	1.48	0.49	0.49	0.40	0.40

Table (6) : Effect of intercropping systems of forage crops with maize on the economic return/fed. (Egyptian pounds) during 2014 and 2015 seasons.

Treatments		2014			2015			Relative net income	
		Price of the yield	Cost	Net income	Price of the yield	Cost	Net income	2014	2015
Cowpea	P_1	16191.50	7000.88	9190.62	16557.00	7190.76	9366.24	192.43	192.46
	P_2	16847.00	6887.94	9959.06	16950.33	6958.88	9991.45	208.53	205.30
	P_3	15600.00	6677.61	8922.39	15893.17	6748.32	9144.85	186.82	187.91
	P_4	15380.50	6500.00	8880.50	15611.64	6565.22	9046.42	185.94	185.88
	P_5	15055.50	6338.22	8717.28	15155.50	6338.74	8816.76	182.52	181.17
Guar	P_1	13952.40	7100.32	6852.08	14391.40	7214.00	7177.40	143.47	147.48
	P_2	14484.20	6960.11	7524.09	14574.60	7110.56	7464.04	157.54	153.37
	P_3	13303.80	6736.00	6567.80	13793.60	6870.43	7123.17	137.52	146.36
	P_4	13048.60	6659.52	6389.08	13580.60	6794.67	6785.93	133.77	139.43
	P_5	12694.00	6499.74	6194.26	13172.00	6630.12	6541.88	129.69	134.42
Fodder sorghum	P_1	12933.20	7050.67	5882.53	13298.60	7288.64	6009.96	123.17	123.49
	P_2	12975.80	6920.38	6055.42	13558.00	7060.33	6497.67	126.79	133.51
	P_3	12279.10	6642.11	5636.99	12678.90	6799.48	5879.42	118.03	120.81
	P_4	11989.90	6590.35	5399.55	12097.70	6620.00	5477.70	113.05	112.55
	P_5	11688.50	6450.25	5238.25	11958.10	6584.55	5373.55	109.68	110.41
Pure stand (sesame)		11175.84	6400.00	4775.84	11411.55	6544.99	4866.56	100.00	100.00

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الملخص العربى

إستجابة السمسم للتحميل مع بعض محاصيل الأعلاف

أحمد يوسف مهدى – محمد عبدالعزيز أحمد السيد

قسم المحاصيل – كلية الزراعة – جامعة الأزهر بأسيوط

نفذت تجربتان حقليتان خلال موسمي صيف 2014 ، 2015 بالمزرعة البحثية لكلية الزراعة جامعة الأزهر فرع أسيوط لدراسة إستجابة السمسم للتحميل مع بعض محاصيل الأعلاف وعلاقة ذلك بصفات النمو والمحصول ومكوناته والتحليل الكيميائي لكل هذه المحاصيل وكذلك العلاقات التنافسية والعائد الإقتصادي لنظم التحميل المختلفة تحت الدراسة مقارنة بالزراعة المنفردة لكل محصول وكانت أصناف السمسم كل من ، لوبيا العلف ، الجوار و سورجم العلف المستخدمة في الدراسة هي شندويل – 3 ،كريم – 1، الصنف المحلى و جيزة – 3 على الترتيب. وقد إشتملت الدراسة خلال كل موسم زراعة المحصول الرئيسى (السمسم) على جميع الخطوط فى الفدان بالمعدلات الموصى بها والمسافة بين الجور (20سم) وزراعة نباتين بالجورة وزراعة المحصول الثانوى (لوبيا العلف ،الجوار و سورجم العلف) على الريشة الأخرى للسمسم بمسافات مختلفة بين الجور (10 سم) للوبيا العلف، (15 سم) للجوار، (20 سم) لسورجم العلف وزراعة نباتين فى الجورة لمحاصيل العلف الثلاثة بنظم تحميل مختلفة 100% ، 75% ، 67% ،50% و 33% على التوالى. وأستخدم تصميم القطع المنشقة مرة واحدة فى ثلاث مكررات . ووزعت محاصيل العلف الثلاثة فى القطع الرئيسية بينما وزعت نظم التحميل المختلفة فى القطع المنشقة.

1- تفوقت الزراعة تحت نظم التحميل المختلفة لمحصول السمسم معنويا على الزراعة المنفردة في طول النبات خلال موسمي 2014 ، 2015.

2- أظهرت النتائج أن الزراعة المنفردة لمحصول السمسم قد أدت إلى إعطاء أعلى القيم لعدد الأفرع/ نبات وعدد كبسولات/نبات ووزن الألف بذرة ومحصول النبات من البذور ومحصول الفدان من البذور مقارنة بنظم التحميل المختلفة خلالموسمى 2014 ، 2015.

3- أدى تطبيق نظام التحميل (P_1) لمحصول السمسم إلى نقص في عدد الأفرع/ نبات وعدد كبسولات/نبات ووزن الألف بذرة ومحصول النبات من البذور ومحصول الفدان من البذور خلال الموسمين مقارنة بنظم التحميل المختلفة وعلى النقيض أدى النظام (P_5) إلى إعطاء أعلى القيم للسمسم خلال الموسمين لصفات عدد الأفرع/ نبات وعدد كبسولات/نبات ووزن الألف بذرة ومحصول النبات من البذور بينما صفة محصول الفدان من البذور كانت أعلى القيم عند نظام التحميل(P_2) مقارنة بنظم التحميل المختلفة.

4- أعطى نظام التحميل (P_1) لمحاصيل العلف أعلى قيمة لطول النبات خلال الموسمين مقارنة بالزراعة المنفردة ونظم التحميل المختلفة.

5- تفوقت الزراعة المنفردة لمحاصيل العلف معنويا في عدد الأوراق / نبات في نظم التحميل المختلفة خلال الموسمين بينما أعطى نظام التحميل(P_5) أعلى قيمة لدليل مساحة الأوراق خلال الموسمين مقارنة بالزراعة المنفردة ونظم التحميل المختلفة.

6- أدت الزراعة تحت نظام التحميل (P_2) الحصول على أعلى محصول للفدان من وزن النباتات لمحاصيل العلف مقارنة بنظم التحميل المختلفة خلال الموسمين.

7- تفوقت الزراعة المنفردة لمحاصيل العلف معنويا لنسبة البروتين والرماد /نبات بينما كانت أقل القيم لنسبة الألياف الخام / نبات مقارنة بنظم التحميل المختلفة بينما أعطى النظام (P_1) خلال موسمى 2014 ، 2015 أعلى قيمة لنسبة البروتين للوبيا العلف والجوار بينما أعطى نظام التحميل(P_5) أعلى القيم لنسبة الرماد والألياف الخام/نبات لمحصول لوبيا العلف والجوار مقارنة بنظم التحميل المختلفة خلال الموسيمين.

8- أعطى نظام التحميل(P_5) أعلى قيمة لنسبة البروتين والرماد /نبات بينما كانت أعلى القيم للألياف الخام/نبات لنظام التحميل (P_1) لمحصول سورجم العلف خلال الموسمين.

9- أثبتت النتائج أن التحميل لمحاصيل العلف على السمسم أدى إلى زيادة مقياس كفاءة إستغلال وحدة المساحة ومقياس معامل الحشد النسبي في كل نظم التحميل المختلفة و حقق نظام التحميل(P_2) أعلى القيم للمقياسيين وقد أعطى محصول السمسم أكبر قيم للعدوانية (سائد) بينما أعطت محاصيل العلف أقل قيم للعدوانية (مسود).

العائد الاقتصادى للفدان (بالجنية المصرى).

1- أظهرت النتائج أن الزراعة المحملة لكل من السمسم + محاصيل العلف تحت نظم التحميل المختلفة كانت أكثر تكلفة إلا إنها قد حققت أعلى عائد إقتصادي مقارنة بالزراعة المنفردة لمحصول السمسم.

2- حققت الزراعة المحملة للسمسم + محاصيل العلف تحت نظام التحميل (P_2) أعلى عائد إقتصادي خلال الموسمين 2014 ، 2015 مقارنة بنظم التحميل الأخرى.