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RESPONSE OF GRAIN SORGHUM AND MUNG BEAN TO SOME INTERCROPPING SYSTEMS.

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ABSTRACT

Two field experiments were carried out in randomized complete block design during 2006 and 2007 seasons at the Experimental farm of Faculty of Agriculture, Al-Azhar University, Assuit Governorate, Egypt to study the response of grain sorghum [*sorghum bicolor* (L.) Monech] c.v Dorado as main crop with mung bean [*Vigna radiate* (L) Wikzek] c.v. Kawmy-1as secondary crop to seven different intercropping systems. Intercropping mung bean at the other side of all grain sorghum ridges, grain sorghum + mung bean (planting two plants/hill of mung bean at 20, 25 and 30 cm apart), were compared with the pure stands for growth, earliness, yield and yield components, competitive relationships and the economic return. Intercropping system P_5 significantly increased plant height of grain sorghum and mung bean compared with other intercropping patterns, while the number of leaves/plant of both intercropped crops decreased by all intercropping systems, and the leaf area index (LAI) were increased at all intercropping systems compared with pure stand. Flowering of grain sorghum was significantly earlier with all intercropping systems, while, 1000–grain weight, grain yield/plant and grain yield/fed. were significantly reduced by all intercropping systems, and the maximum reduction was at P_5 system. Plant height and leaf area index at all intercropping systems increased significantly compared with pure stands while, number of leaves/plant were decreased with all intercropping systems compared with pure

stands of mung bean. Mung bean intercropped with grain sorghum significantly decreased number of pods/plant, number of seed/pod, 1000- seed weight, seeds/weight plant and seed yield/fed. compared with pure stand treatments, and the reduction reached the lowest values with P_5 intercropping system compared with other intercropping systems and pure stands.

Results indicated that P_7 system was the best for land utilization from land equivalent ratio (LER) and most efficient intercropping system from relative crowding coefficient (RCC), although, it was more aggressive on grain sorghum. All intercropping patterns of mung bean with grain sorghum achieved higher economic return than pure grain sorghum, since the most profitable system was P_7.

INTRODUCTION

Intensive cropping system to raise the production per unit of land area is a great target. Intercropping is becoming one of the most popular phenomena among small farmers in Egypt, because it results in more profit and resource maximization and efficient water and soil utilization. Among the many intercropping companions adopted successfully are those of sorghum and bean varieties. Because of the importance of legumes in human and animal nutrition, in summer, where no land to grow any of these legumes. Hitherto intercropping was the most suitable guide in mung bean cultivation with sorghum in summer season. Thakuria and Saharia (1990), Tripurari and Yadav (1990), Selim (1996) and Bhilare *et al.* (2001), found that the highest gross monetary returns (Rs 25 479/ha), sorghum grain equivalent yield 40.77 (q/ha) and land equivalent ratio 1.68 were obtained with normal planting of sorghum at 45 cm and one row of mung bean as intercrop in between the rows of sorghum. The increased benefits were 19.33 % for gross monetary returns and 19.88 % for sorghum grain equivalent yield over sole sorghum. The next best treatment was the normal planting of sorghum at 45 cm with one row of soybean as intercrop in between the rows of sorghum. Nandal and Singh (2001) and Ram and Singh (2001) showed that plant height of sorghum, and mung bean intercropping was significantly less compared with the control. The different spacing of shisham had no

significant effect on the height of oat. Lentil plants grew significantly taller under shisham than the control. El-Nagar et al. (2002), Nalatwadmath *et al.* (2002) and Zohary and Abd El-All (2003) found that the highest sorghum grain 2.073 (t/ha) was recorded in sorghum + legume intercropped into the soil followed by sorghum + legume used as mulch 1.870 (t/ha). Azraf *et al.* (2006) studied the planting geometry consisted of single rows with a 30cm. spacing, 30 x 30 cm. cross planting with intercrops, double row strips with a 45cm. spacing and four row strips with a 75cm spacing. The intercropping systems were sorghum alone, sorghum + mung bean, sorghum + cluster bean, sorghum + mung bean and sorghum + sesbania. Results showed that forage sorghum appeared to be the dominant crop, as indicated by the highest values of relative crowding coefficient and competitive ratio and positive sign of aggressiveness. These suggest that forage sorghum grown in association with forage legumes (mung bean, cluster bean, mung bean and sesbania) utilized the resources more aggressiveness.

The present work aimed to find out the most effective system of intercropping grain sorghum (as the main cereal crop in Upper Egypt) with mung bean (as legume crop) for increasing total productivity per unit area in the same unit time. The materials included grain sorghum as the main crop and mung bean as companion crop.

MATERIALS AND METHODS

The present study was carried out at the Agriculture Experimental Farm of Al–Azhar University at Assiut Governorate, Egypt during 2006 and 2007 summer seasons to study the effect of intercropping of grain sorghum {*Sorghum bicolor* (L.) Monech} cv. Dorado as main crop with mung bean *Vigna radiate* (L) Wikzek c.v. Kawmy-1 as secondary crop on growth, earliness, yield, yield components, competitive relationships and the economic return. The soil texture of experimental farm was clay loam. Physical and mechanical analysis of the experimental sites are shown in Table 1. The preceding crop was field bean {*Vicia faba*, (L.)} for all experiments during the two seasons. Two experiments during each season were conducted each one contained seven treatments as shown

in Table 2. Intercropping mung bean was at the other side of all grain sorghum ridges. Intercropping experimental design of grain sorghum and mung bean (planting two plants/hill of mung bean at 20, 25 and 30 cm apart).

Table 1: Physical and chemical analysis of soil field experiments.

Season		2006	2007
Physical analysis	Sand%	28.31	28.85
	Silt%	38.05	37.58
	Clay%	33.64	33.57
	Soil texture	Clay loam	Clay loam
Chemical analysis	Organic matter %	0.99	1.07
	Available N (ppm)	67.20	73.60
	Available P (ppm)	10.14	10.20
	Available K (ppm)	341.31	354.00
	pH (sp 68.7)	7.87	8.02
	E.C (dsm-1)	1.14	1.16
	Total Ca CO3%	2.66	2.50

Intercropping patterns:

1 .pure stand grain sorghum20 cm between hills (P_1).
2. pure stand mung bean at 20 cm between hills (P_2).
3. pure stand mung bean at 25 cm between hills (P_3).
4. pure stand mung bean at 30 cm between hills (P_4).
5. intercropping mung bean at 20 cm on ridge sorghum at 20 cm between hills (P_5).
6. intercropping mung bean at 25 cm on ridge sorghum at 20 cm between hills (P_6).
7. intercropping mung bean at 30 cm on ridge sorghum at 20 cm between hills (P_7)

Calcium super phosphate (15% P_2O_5) was added during seed bed preparation at the rate of 150 kg/fed. The recommended does of nitrogen fertilizer was added for both solid plot of grain sorghum and intercropped grain sorghum and mung bean at the rate of 100 kg N/fed. as Urea (46.5% N), while in case of other solid crops, nitrogen

was applied at the rate of 40 kg N/fed. mung bean as a recommended does for nitrogen fertilizer for each crop. The amount of nitrogen fertilizer was divided into two equal doses. The first dose was applied at 20 days from planting and the second one was applied at 60 day from planting.

The experimental design for each experiment was randomized complete blocks design with four replicates. Area of each plot was 10.5 m^2 (3.5 lengths and 0.6 m. width). The plot consisted of 5 rows spaced 60 cm apart.

A. Growth traits:

During the growing season, growth characters were estimated at two ages; 45 and 90 days after planting. Samples of five plants in marked plot were taken to determine the following characters in each crop:

1. Grain sorghum:

(1) Plant height (cm), was measured from soil surface to the top of the plant.
(2) Number of leaves/plant.
(3) Leaf area index (LAI) was calculated according to Kirby and Atkins (1968).
(4) Days to 50 % flowering were recorded as a number of days form planting to 50 % flowering on the plant basis.

2. Mung bean:

(1) Plant height (cm) was measured form soil surface to the top of the plant.
(2) Number of leaves/plant.
(3) Leaf area per plant (cm^2) was determined by disk method recommended by Johanson (1967).
(4) Number of days forms planting to 50 % flowering.

B- Yield and yield components:

1. Grain Sorghum:

At harvesting, the panicles were harvested form the middle row of each plot in the two seasons and the following data recorded:

(1) 1000-grain weight, in (g.).
(2) Grain weight/plant in (g.).
(3) Grain yields in Ardab/fed. (Ardab = 140 kg).

2. Mung bean:
(1) Number of capsules/plant.
(2) 1000-seed weight (g.).
(3) Weight of seeds/plant (g.).
(4) Seed yield in (kg/fed.).

Competitive relationships and yield advantages of intercropping:
1. Land Equivalent Ratio (LER) was determining according to Willey (1979).
2. Relative crowding coefficient (RCC) was calculated as described by Hali (1974).
3. Aggressiveness (Ag) was determined according to Mc-Gilchrist (1965).
4. Economic return by L.E. was calculated according to the yield prices and practices cost fixed by the Ministry of Agriculture during 2007/2008.

Data of the studies characters (except for competition parameters) during both seasons were statistically analyzed according to the methods given by Steel and Torrie (1980).

RESULTS AND DESICCATION

Effect of intercropping patterns on grain sorghum.

Results in Table 2 clearly show a significant effect of intercropping systems on plant height at ages of 45 and 90 day during 2006 and 2007 seasons. Grain sorghum plants grown under P_5intercropping system gave the tallest plants compared with pure stand or other intercropping systems. On the other hand, the shortest grain sorghum plants were produced from cultivating under P_6 or P_7intercropping system at the two ages during the two seasons. This means that, the competition among the same crop plants or among the plants of the two crops was minimum under those two intercropping systems.

Regarding to the number of leaves/plant, results in Table 2 indicate that all intercropping systems significantly affected the number of leaves/plant of grain sorghum during all plant ages with the exception of 45 and 90 days plant ages during the two seasons.

Generally it is clear that number of leaves per grain sorghum plant tended to decrease starting from 45 and 90 day plant ages when grown under the different intercropping systems compared with the pure stand.

Table 2 also indictes that intercropping systems had a significant effect on LAI of grain sorghum plants at all growth ages in the two seasons. While LAI significantly increased when grain sorghum plants were intercropped with mung bean under various intercropping systems compared with pure stand treatment. of P_7 intercropping system resulted in the greatest values of LAI during all plant ages while, P_5 produced the lowest value of LAI. On the other hand, the LAI papered increase by intercropping systems as compared with pure stand and in contrast effect happened on grain sorghum plant height. Similar results were also reported by Harb (1994), Nandal and Singh (2001), El-Nager *et al.* (2002), Azraf *et al.* (2006) and Toaima (2006).

Yield and yield components:

Results in Table 3 show that intercropping systems had significant effect on number of days from sowing to 50% flowering, 1000-grain weight, grain yield/ plant and yield/ fed. during the two seasons. For flowering dates, P_7intercropping system of had significant effect on flowering dates as compared with pure stand of grain sorghum. On the other hand, grain sorghum plants intercropped with mung bean under P_5 and P_6 systems encouraged the grain sorghum plants to flowering earlier by 2.83 and 2.67 day, respectively. These results may be due to the competition from the high plant population densities per unit area in these intercropping systems.

As for grain weight (1000-grain weight), grain yield/plant and yield/fed., revealed a significantly decreased by intercropping systems compared with pure stand treatment during the two seasons.

Table 2: Effect of mung bean–grain sorghum intercropping systems on growth characters of grain sorghum at different ages during 2006 and 2007seasons.

Intercropping systems	Plant height (cm)				Number of leaves/plant				Leaf area index (LAI)			
	45 day		90 day		45 day		90 day		45 day		90 day	
	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
Pure stand	108.86	108.66	153.13	152.13	8.650	8.77	12.60	12.20	5.76	5.66	7.85	8.11
P5	117.60	117.53	106.80	162.36	7.17	6.76	10.87	10.40	9.01	9.22	13.03	13.33
P6	113.16	113.40	158.06	157.16	7.48	7.66	11.23	11.50	9.58	9.72	14.00	13.73
P7	110.96	111.76	156.76	155.06	7.85	7.44	12.55	11.73	9.81	9.97	14.60	14.30
LSD. at 5%	1.32	1.91	1.52	2.49	0.19	0.21	0.55	0.86	0.16	0.17	0.17	0.12

Table 3: Effect of mung bean–grain sorghum intercropping systems on yield and yield components of grain sorghum during 2006 and 2007 seasons.

Intercropping systems	50% flowering (day)		1000-grain Weight (g)		Grains Weight /plant (g)		Grain yield (ardab/fed.)	
	2006	2007	2006	2007	2006	2007	2006	2007
P1	69.33	67.33	46.30	46.68	79.99	82.09	22.63	22.53
P5	66.5	66.83	44.47	43.80	55.73	54.26	19.81	18.65
P6	66.66	67.33	45.37	44.58	62.31	66.85	20.47	20.68
P7	67.83	66.66	45.37	45.26	71.93	74.19	21.40	21.31
LSD. at 5%	1.89	0.98	0.53	0.92	4.71	5.81	0.49	0.26

Sorghum and mung bean intercropping system

Grain sorghum plants grown combined with mung bean plants under P_7intercropping systems led to produce the greatest values of number leaves/plant and LAI of grain sorghum plants compared with the other intercropping systems. Also, it produced the greatest grain weight 45.87 and 45.26 (g), grain yield/plant 74.19 and 71.93 (g) and grain yield/fed. 22.15 and 21.40 (ardab) during 2006 and 2007 seasons, respectively, compared with the other intercropping. These results are in agreement with those Harb (1994), EL-Aref (1995), Nandal and Singh (2001), Ram and Singh (2001), El-Nager *et al.* (2002), Nalatwadmath *et al.* (2002), Azraf *et al.* (2006), Ghosh *et al* (2006) and Toaima (2006).

Effect of mung bean crop on growth traits:

Results in Table 4 indicate that intercropping systems had a pronounced significant effect on mung bean plant height at the two ages during both seasons. Mung bean plants grown in pure stands always had the shortest plants during all plant ages in comparison with mung bean plants grown in the intercrop during both seasons. On the other hand, growing mung bean in association with grain sorghum plants was favorites to increase mung bean plant height especially the intercropping system which increased plant height by 17.88 and 9.26 % after 45 and 90 (day) from sowing during both seasons, respectively. Also, results showed that number of leaves/plant decreased significantly by intercropping with grain sorghum compared with pure stands of mung bean plants at all plant ages during both seasons. The sharpest reduction was caused by P_5 intercropping systems 29.92 and 42.15 % after 45 and 90 day, respectively, in two seasons as compared with pure stands. The lowest reduction in number of leaves/plant resulted from P_7 intercropping system being 21.02 and 35.66 % after 45 and 90 days from sowing, respectively.

Generally results in Table 4 indicate that intercropping systems had a significant effect on LAI of mung bean plants at all growth ages during both seasons. LAI increased significantly when mung bean plants were intercropped with grain sorghum under various intercropping systems compared with pure stands treatment.

Table 4: Effect of mung bean–grain sorghum intercropping systems on growth characters of mung bean at different ages during 2006 and 2007season

Intercropping systems	Plant height (cm)				Number of leaves / plant				Leaf area index (LAI)			
	45 day		90 day		45 day		90 day		45 day		90 day	
	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
P_2	56.86	58.20	105.93	107.83	17.93	18.30	50.95	50.49	1.30	1.32	5.27	5.31
P_3	54.40	56.00	101.05	104.75	19.63	20.20	56.23	55.48	1.64	1.65	6.42	6.38
P_4	51.33	52.50	96.361	97.617	21.40	22.13	64.28	63.65	1.65	1.68	7.28	7.20
P_5	67.03	68.76	115.74	119.09	13.80	12.30	35.84	35.59	2.24	2.28	6.68	6.64
P_6	62.50	65.23	111.94	113.84	15.30	14.83	41.50	41.15	2.48	2.55	7.36	7.29
P_7	60.83	61.43	107.83	110.45	16.90	16.20	47.38	47.15	2.75	2.79	8.06	7.99
L.S.D. at 5%	1.47	1.83	2.06	1.70	1.33	0.98	2.07	1.66	0.19	0.17	0.19	0.11

P_7 resulted in the greatest values of LAI while P_5 produced the lowest LAI value at all plant ages during both seasons. These results are in agreement with those obtained by Trung and Yoshida (1985), Singh and Singh (1988), Yadva and Warsi (1988), Selim (1996), Nandal and Singh (2001), El-Nager *et al.* (2002), Zohary and Abd El-all (2003) and Ibrahim *et al.* (2006).

Yield and yield components:

Results in Table 5 reveal that intercropping encouraged mung bean plants to flower early compared with the pure stands in two seasons. Plants of P_5, P_6 and P_7 intercropping systems flowered earlier by 3.0 and 3.0, 3.3 and 3.0 and 3.7 and 4.0 (day), respectively. As for other characters results in Table 5 show that intercropping led to significant decrease in number of pods/plant, number of seeds/pod, 1000-seed weight (g.), seeds weight/plant (g.) and seed yield/fed. (kg) compared with pure stand treatments. Results showed that the reduction in all above mentioned characters reached to the lowest value under the intercropping systems of P_5 compared with pure stands. On the other hand, the highest value of these characters resulted from P_7 intercropping systems of all characters number of pods/plant, number of seed/pod, 1000-seed weight (g.), seeds weight /plant (g.) and P_6 of seed yield/fed. (kg) as compared with intercropping systems. These results agree with those of Rai *et al.* (1982), Rao *et al.* (1983), Rao *et al.* (1987), Jain *et al.* (1988), Thakuria and P. Saharia (1990), Tripurari and Yadav (1990), Selim (1996), Nandal and Singh (2001), El-Nagar *et al.* (2002) Zohary and Abd El-all (2003), Azraf *et al.* (2006) and Toaima (2006).

Competitive relationships of intercropping:

Land Equivalent Ratio (LER):

Results in Table 6 indicate that land equivalent ratio (LER) for all intercropping systems had more yield advantage than growing both crops alone. Results also indicated that growing both crops under plant population density of grain sorghum 70000 plants/fed. combined with density of mung bean 46666 plants/fed. and 55999 plants/fed. through the P_7 and P_6 respectively, resulted in the

maximum value of LER 1.70 - 1.73 and 1.71 - 1.67 respectively, during both seasons. On the other hand, the intercropping system of P_5 possessed the lowest LER values 1.54 and 1.49 during both seasons, respectively. Similar results were reported by Harb (1994), Al-Araf (1995), Bhilare *et al.* (2001), Azraf *et al.* (2006), Ghosh *et al.* (2006) and Toaima (2006).

Relative Crowding Coefficient (RCC):

Results in Table 6 indicate that P_7 system achieved the highest RCC, 50.73 and 71.77 during the first and second seasons, respectively. This indicates that this system had the best yield advantage over solid planting of both crops. On the other hand, the lowest system of intercropping with mung bean was P_5 since the RCC was 15.49 and 9.80 during the first and second seasons, respectively. Similar results were reported by Harb (1994), Al-Araf (1995), Azraf *et al.* (2006), Ghosh *et al.* (2006) and Toaima (2006).

Aggressiveness (A):

The obtained results in Table 6 clearly indicate that during both seasons, grain sorghum was the dominant component during all intercropping systems. The highest aggressiveness value for the grain sorghum crop was obtained at P_5 intercropping system at which population density of grain sorghum was 70000 plants accompanied with 70000 plants mung bean, while the lowest values of aggressiveness for grain sorghum plants was produced from planting grain sorghum with mung bean at the intercropping system of P_6 during both seasons. The results are in agreement with those obtained by Harb (1994), Al-Araf (1995), Azraf *et al.* (2006), Ghosh *et al.* (2006) and Toaima (2006).

Economic Return Per (L.E)

Results in Table 7 show the effect of applied intercropping system on economic return of mung bean plants with grain sorghum during 2006 and 2007 seasons. The economic return of different intercropping system compared with solid grain sorghum indicated that all intercropping systems of mung bean with grain sorghum achieved higher economic return than solid grain sorghum.

Table 5: Effect of mung bean – grain sorghum intercropping systems on yield and yield components of mung bean during 2006 and 2007 seasons.

Intercropping systems	50 % flowering (day)		No . of seeds / pod		No . of pods / plant		1000-seed weight(gm)		Seeds weight / plant (gm)		Seed yield fed/ kg	
	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
P_2	46.0	47.0	12.17	11.97	33.56	34.64	45.80	45.16	20.67	20.36	1098.4	1073.0
P_3	47.3	48.5	12.78	12.81	37.8	38.70	46.30	45.29	22.63	23.35	1247..5	1273..9
P_4	49.5	49.8	13.41	13.14	44.40	44.79	46.70	46.89	25.25	25.12	1145..3	1135..5
P_5	43.6	44.3	10.24	10.95	23.02	22.13	43.13	43.50	10.15	10.3	744.6	724..9
P_6	44.0	45.5	11.70	11.21	25.47	25.24	43.30	44.07	12.90	12.47	1018.6	999.4
P_7	45.6	45.8	12.82	13.39	28.88	28.79	44.50	44.85	16.47	17.12	881..3	898.8
L.S.D at 5 % level	1.07	1.04	1.71	1.71	1..23	1.24	0.70	1.25	1.46	1.72	29.08	34.77

Table 6: Competitive relative ships and yield advantage of sorghum and mung bean during 2006 and 2007Seasons.

Intercropping system	Land equivalent ratio (LER)						Relative crowding coefficient (RCC)						Aggressiveness (A)			
	2006			2007			2006			2007			2006		2007	
	Sorghum	Mung bean	L. E. R	Sorghum	Mung bean	L. E. R	K Sorghum	K Mung bean	R. C. C	K Sorghum	K Mung bean	R. C. C	Agg Sorghum	Agg Mng bean	Agg Sorghum	Agg Mung bean
P_5	0.87	0.67	1.54	0.82	0.67	1.49	7.28	2.10	15.49	4.80	2.12	9.80	1.84	1.84	1.85	1.85
P_6	0.90	0.81	1.71	0.90	0.77	1.67	9.69	4.51	43.91	9.49	3.69	34.91	0.93	0.93	1.36	1.36
P_7	0.94	0.76	1.70	0.94	0.78	1.73	15.14	3.35	50.73	18.31	3.73	71.77	1.56	1.56	1.35	1.35

Table 7: Effect of intercropping systems of mung bean with grain sorghum on the economic return/fed (Egyptian pounds) during 2006 and 2007 seasons .

Intercropping	Mung bean with grain sorghum							
	2006			2007			Relative net income	
	Price of the yield	cost	Net income	Price of the yield	Cost	Net income	2006	2007
P_1	4073.4	2851.4	1222	4045.4	2828.8	1206.6	100	100
P_2	3295.2	2306.6	988.6	3219.0	2253.3	965.7	80.9	80.0
P_3	3742.5	2619.7	1122.7	3821.7	2675.2	1146.5	91.9	95.0
P_4	3435.9	2405.1	1030.7	3406.5	2384.5	1021.9	84.3	84.7
P_5	5799.6	2942.8	2856.8	5531.7	2784.8	2746.9	233.8	227.6
P_6	6740.4	3190.4	3550	6666.6	3167.5	3499.1	290.5	290.0
P_7	6495.9	3225.2	3270.7	6532.2	3224.3	3307.9	267.6	274.1

The most profitable system was when grain sorghum intercropped with mung bean of intercropping system P_7 compared with other intercropping systems and pure stands during 2006 and 2007 seasons. These results are in total agreement with those of Harb (1994), El–Aref (1995) and Bhilar *et al* (2001). Nandal and Singh (2001), and Zohry and Abd El-all (2003)

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إستجابة الذرة الرفيعة وفول المانج لبعض نظم التحميل

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أقيمت تجربتان حقليتان فى تصميم القطاعات العشوائية الكاملة بمزرعة كلية الزراعة جامعة الأزهر بأسيوط خلال موسمي الزراعة ٢٠٠٦ / ٢٠٠٧ م وذلك لدراسة إستجابة تحميل محصول فول المانج على محصول الذرة الرفيعة بسبع نظم مختلفة من التحميل وعلاقة ذلك بصفات النمو والمحصول ومكوناته والعائد الإقتصادي لنظم التحميل المختلفة مقارنه بالزراعة المنفردة لكل محصول وإستخدم الصنف (دورادو) من الذرة الرفيعة و(قومى-١) من فول المانج.

وتتلخص أهم النتائج فيما يلى:

١- ادى تحميل فول المانج على جميع خطوط الذرة الرفيعة على مسافة ٢٠ سم بين الجور الى زيادة معنوية لصفة طول النبات فى الذرة الرفيعة وفول المانج مقارنة بنظم التحميل الأخرى المستخدمة بينما لوحظ نقص قى عدد الأوراق/نبات فى نظم التحميل مقارنة بالزراعة المنفردة.

٢- زاد طول النبات ودليل مساحة الأوراق معنويا تحت نظم التحميل المختلفة بينما نقص عدد الأوراق/نبات معنويا بالمقارنة بالزراعة المفردة لفول المانج.

٣- نقص وزن الألف حبة ومحصول الحبوب للنبات والفدان معنويا تحت نظم التحميل المستخدمة وكان اكبر نقص فى المحصول تحت نظام تحميل فول المانج على جميع الخطوط بمسافة ٢٠ سم.

٤- ادى تحميل فول المانج مع الذرة الرفيعة إلى نقص معنوى فى عدد القرون/نبات و عدد البذور بالقرن و وزن الألف بذرة ومحصول البذور للنبات والفدان مقارنة بالزراعة المنفردة لفول المانج تحت المسافات المختلفة حيث كانت قيم النقص عالية فى جميع الصفات تحت نظام تحميل فول المانج على مسافة ٢٠ سم مع الذرة الرفيعة بالمقارنة بنظم التحميل الأخرى والزراعة المنفردة.

٥- أوضحت النتائج ان نظام تحميل فول المانج على جميع خطوط الذرة الرفيعة على مسافة ٣٠ سم بين الجور الى الحصول على أفضل القيم لمعدل كفاءة إستغلال الأرض ومعامل الحشد النسبى والعداوانية.

٦- حققت جميع نظم التحميل المستخدمة عائد اقتصاديا أعلى من الزراعة المفردة للذرة الرفيعة وكان أعلى عا ئد إقتصادى تم الحصول علية تحت نظام تحميل فول المانج مع الذرة الرفيعة على مسافة ٣٠ سم بين الجور.